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АНГЛИЙСКИЙ ЯЗЫК ДЛЯ ИТ-СПЕЦИАЛЬНОСТЕЙ

УЧЕБНОЕ ПОСОБИЕ ДЛЯ СПО

Рекомендовано Учебно–методическим отделом среднего профессионального образования в качестве учебного пособия для студентов образовательных учреждений среднего профессионального образования

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Учебное пособие предназначено для развития навыков аудирования и говорения в процессе углубленного изучения английского языка для специальных целей в сфере информационных технологий. Состоит из десяти уроков, разработанных на основе аутентичных видеоматериалов, охватывающих различные сферы использования современных информационных технологий. Может быть использовано как для аудиторных занятий, так и для самостоятельной работы.

Соответствует актуальным требованиям Федерального государственного образовательного стандарта среднего профессионального образования и профессиональным требованиям.

Для студентов образовательных учреждений среднего профессионального образования обучающихся по ИТ-специальностям.

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Предисловие (Preface)

Данное учебное пособие предназначено для развития навыков аудирования и говорения у студентов образовательных учреждений среднего профессионального образования, изучающих английский язык для специальных целей и имеющих уровень владения английским языком *Intermediate – Advanced (B1/C1)*.

Пособие состоит из трех частей. В первой части представлены уроки, разработанные на основе аутентичных видеоматериалов (лекций *TED Talks* и эпизодов видео хостинга *YouTube*), охватывающих различные сферы использования современных информационных технологий. Содержание учебного материала соответствует профессиональным интересам студентов и направлено на вызов познавательной активности и повышение мотивации к изучению иностранного языка.

Использование видеоматериалов при изучении английского языка для ИТ-специальностей дидактически оправдано, так как это способствует более детальному пониманию принципов действия сложных механизмов и процессов, которые невозможно непосредственно наблюдать, обучению алгоритмам выполнения различных видов деятельности и организации проведения исследований, расширению кругозора, укреплению связи обучения с жизнью за счет использования иностранного языка в профессиональном контексте.

Пособие состоит из десяти уроков. Каждый урок основан на материале видеолекции (просмотр которой осуществляется в классе или дома) и организации дальнейшей работы по развитию навыков аудирования, чтения, а также лексических и грамматических навыков говорения.

Каждый урок имеет единую структуру, состоящую из таких компонентов, как *Introduction* (представление темы урока, экспозиция), *Comprehension* (контроль понимания общего и детального содержания услышанного), *Vocabulary* (упражнения, нацеленные на овладение новыми лексическими единицами, при этом часть упражнений возможно выполнять онлайн), *Grammar & Grammar Practice* (презентация грамматического явления и развитие грамматического навыка), *Discussion* (задания на развитие рече-

вого умения, которые могут выполняться как в мини-группах, так и в парах). В целом упражнения каждого урока направлены на расширение словарного запаса учащихся, обучение общему и детальному пониманию иноязычной речи, развитие навыков говорения.

Во второй части пособия представлены ключи к заданиям, которые целесообразно использовать в процессе самоконтроля, если учебное пособие используется для самостоятельной работы студентов. Отметим, что для заданий по поиску слов ответы приведены к тому набору букв, который дается в учебнике, так как при выполнении задания онлайн буквы каждый раз генерируются случайным образом.

В целях более детального понимания содержания видеолекций в третью часть пособия включены их полные тексты.

В результате изучения представленного в пособии учебного материала студент должен освоить:

трудовые действия

- владеть лингвистическими навыками в объеме, необходимом для получения информации из аутентичных источников;
- навыками выражения своих мыслей и мнения в межличностном и деловом общении на иностранном языке;
- приемами эффективной работы в парах и группах;
- приемами самостоятельной работы с аутентичными лекционными материалами с целью собственного интеллектуального развития, повышения культурного уровня, профессиональной компетенции;

необходимые умения

- в области аудирования: воспринимать на слух аутентичные научные и научно-популярные лекции, относящиеся к теме информационных технологий (длительность звучания 5–15 минут); извлекать общую и детальную информацию из услышанного;
- в области чтения: понимать содержание аутентичных научных и научно-популярных текстов (объемом до 2600 слов); извлекать общую и детальную информацию из прочитанного;
- в области говорения: вести/поддерживать диалог-расспрос о содержании лекции, соблюдая нормы речевого этикета, при необходимости использовать стратегии преодоления трудностей в процессе коммуникации (переспрос, перефразирование и др.); расспрашивать собеседника, задавать вопросы и отвечать на них, высказывать свое мнение; принимать участие в обсуждении проблемы;

необходимые знания

- общую и профессиональную лексику в рамках обозначенных тем;

- грамматические явления, соответствующие современным нормам английского языка, в рамках обозначенных тем;
- факты иноязычной культуры, упоминающиеся в лекциях учебного пособия;
- основные ресурсы, с помощью которых можно эффективно компенсировать недостающие умения в английском языке (словари, справочники, компьютерные программы, обучающие сайты).

Пособие предназначено как для аудиторных занятий, так и для самостоятельной работы студентов.

I. LESSONS



Lesson 1

CAN WE BUILD AI WITHOUT LOSING CONTROL OVER IT?

(by Sam Harris)

Scared of superintelligent AI? Sam Harris neuroscientist and philosopher says that you should be, and not just in some theoretical way. We are going to build superhuman machines, says Harris, but we haven't yet grappled with the problems associated with creating something that may treat us the way we treat ants.

TED Talk for this lesson is available at: https://www.ted.com/talks/sam_harris_can_we_build_ai_without_losing_control_over_it

Intro

- Can Artificial Intelligence exist?
- Can Artificial Intelligence become self-aware?
- Can Artificial Intelligence learn?
- Can Artificial Intelligence replace humans?
- How close can we get to Artificial Intelligence being a replica of the human brain? What is the best way to design it to get there?

Comprehension

Watch the video and answer the questions.

1. What is Sam Harris's professional background?
2. What are the two possible options in the development of AI?
3. What is Sam Harris's concern about building machines that are much more clever than people?
4. What example did Harris give to illustrate how machines can treat people?
5. At what level of intelligence can machines perform now?
6. Why according to Sam Harris is AI inevitable?
7. What are the possible benefits and risks of superintelligent AI?

8. We are told not to worry about AI. What are the reasons for that?
9. What problem may cause building superintelligent AI integrated with human mind?
10. What solution to this problem does Harris offer?

Vocabulary

1. Match the words with their definitions.

1. intelligence	A. the ability to think flexibly and transfer learning from one domain to other domains
2. general intelligence	B. an intellect that is much smarter than the best human brains in practically every field, including scientific creativity, general wisdom and social skills
3. Artificial Intelligence	C. the ability to perceive information and to retain it as knowledge to be applied towards adaptive behaviors within an environment or context
4. superintelligence	D. the science and engineering of making intelligent machines, especially intelligent computer programs that perform tasks that can normally only be done by human intelligence such as “learning” and “problem solving”
5. far-fetched	E. out of control with anger or excitement
6. exponential progress	F. an uneasy feeling of doubt, worry, or fear, especially about one’s own conduct
7. oracle	G. a large spacecraft or ship from which smaller craft are launched or maintained
8. mothership	H. a complex system of nerves and networks in the brain, it controls the basic emotions (fear, pleasure, anger) and drives (hunger, sex, dominance, care of offspring)
9. prudent	I. hard menial or dull work
10. limbic system	J. increase in number or size, at a constantly growing rate
11. breakthrough	K. certain to happen; unavoidable

12. berserk	L. very unlikely to be true
13. qualm	M. someone who knows a lot about a subject and can give good advice
14. inevitable	N. sudden, dramatic, and important discovery or development
15. drudgery	O. acting with or showing care and thought for the future

2. Practice the words online:

<https://quizlet.com/215445232/can-we-build-ai-without-losing-control-over-it-flash-cards/>

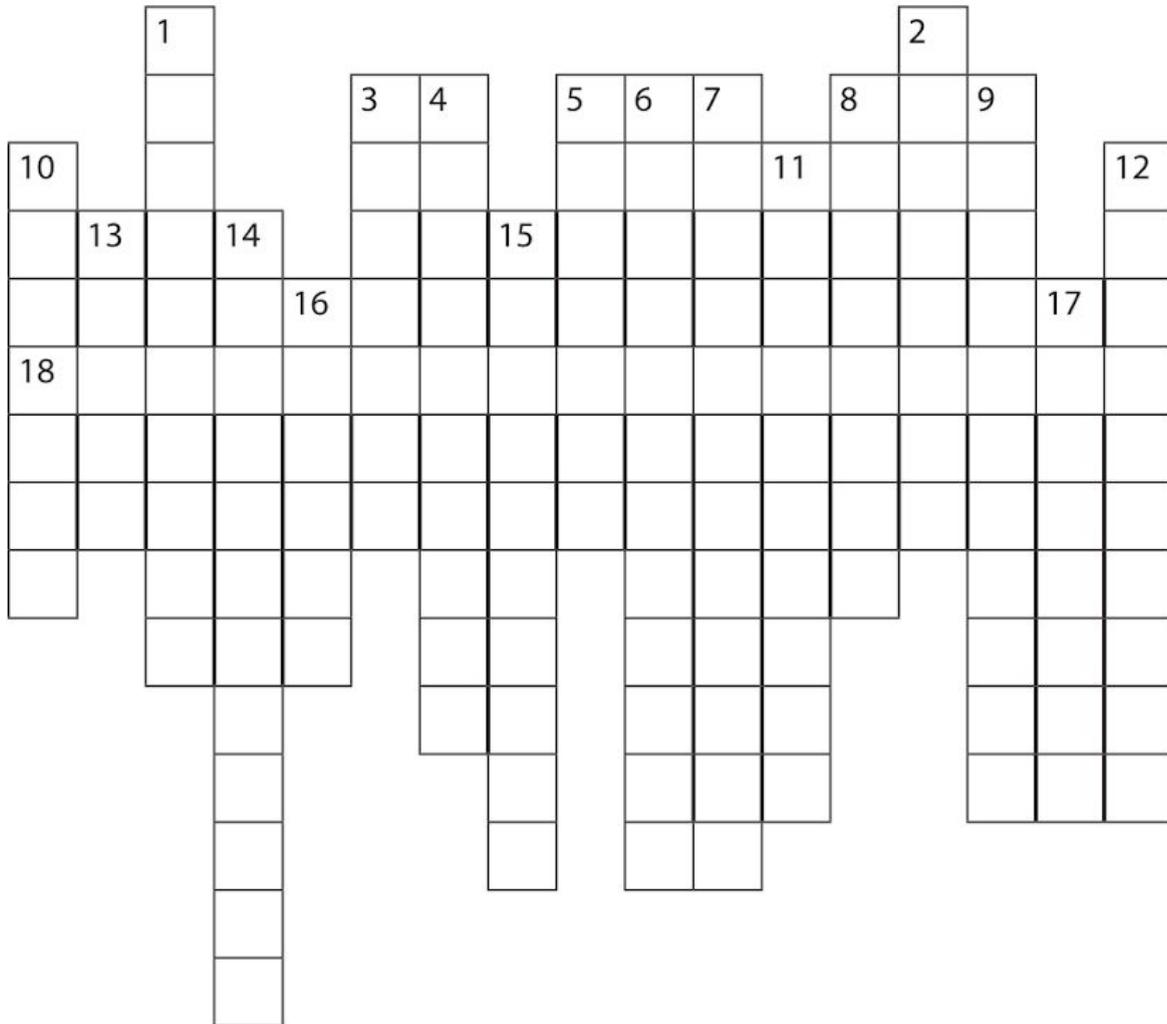
3. Fill in the gaps with the words from Ex.1.

- Whenever their (ants') presence seriously conflicts with one of our goals, let's say when constructing a building like this one, we annihilate them without a _____.
- Now, I suspect this seems _____ to many of you.
- I bet there are those of you who doubt that _____ is possible, much less _____.
- We know that mere matter can give rise to what is called _____, an ability to think flexibly across multiple domains, because our brains have managed it.
- _____ is a matter of information processing in physical systems.
- It can design the machine that can build the machine that can do any physical work, so we are talking about the end of human _____.
- Stuart Russell is regarded as the _____ on Artificial Intelligence.
- So it seems that even mere rumors of this kind of _____ could cause our species to go _____.
- Now we are just counting down the months until the _____ lands.
- The safest and only _____ path forward is to implant this technology directly into our brains.

3. Solve the clues and the puzzle.

1. A thing that is accepted as true or as certain to happen, without proof. **2.** Development towards an improved or more advanced condition. **3.** Any device that transmits a force or directs its application. **4.** The application of scientific knowledge for practical purposes, especially in industry. **5.** Acting with or showing care and thought for the future. **6.** The ability to perceive information, and to retain it as knowledge to be applied towards adaptive behaviors within an environment or context. **7.** The society, culture, and way of life of a par-

tical area. **8.** Hard menial or dull work. **9.** Increase in number or size, at a constantly growing rate. **10.** Out of control with anger or excitement. **11.** Made or produced by human beings rather than occurring naturally. **12.** A person who carries out academic or scientific research. **13.** An uneasy feeling of doubt, worry, or fear, especially about one's own conduct. **14.** Sudden, dramatic, and important discovery or development. **15.** A large spacecraft or ship from which smaller craft are launched or maintained. **16.** Someone who knows a lot about a subject and can give good advice. **17.** A postulated sequence or development of events.



Grammar

Predictions: Future Perfect and *it* in subject position

The Future Perfect is used to predict actions, which will be completed before a particular time in the future. It is often used with time expressions such as *by 2020*, *before the end of the century*. For example:

By 2050, scientists will have designed AI.

The strength of predictions can be varied by using the certainty verbs like *may/might/could* instead of *will*. For example:

*By 2070 the researchers **may/might/could** have implanted AI chips directly into human brain.*

The predictions can also be made by using *it* in subject position when the true subject of the prediction is *that* clause. For example:

***It's likely that** AI will share our values because it is literally extension of ourselves.*

***It's possible that** AI will destroy human civilization.*

Grammar practice

1. **Make predictions for 2050 about AI for each of the following items using the rules given above. You may wish to use these verbs: *use, become, design, build, replace, wage, disappear, implant, and perform.***

- Computers software
- Superintelligence
- Artificial Intelligence
- General intelligence
- Human intelligence
- Superintelligent AI/computers/machines
- AI technology

2. **Put the verbs in brackets into the Future Perfect.**

1. By 2018 AI _____ (be) your physician able to prescribe medication through machine-learning algorithms.
2. By 2019 AI _____ (resolve) 90 % disagreements among eBay traders using “online dispute resolution.”
3. By 2020 AI _____ (do) virtual drug screening using machine-learning algorithms called neural networks.
4. By 2021 AI _____ (provide) personalized tutoring and real-time feedback for the schoolchildren.
5. By 2022 AI _____ (become) a high-tech personal chef with a database of 2,000 recipes.
6. By 2025 AI _____ (create) a human-like character who can think, act, react, and interact in a natural way, using both verbal and nonverbal communication.

Discussion

Read the opinions of different people about AI:

“AI is being developed in numerous fields, such as driverless transport, finance, fraud detection, as well as robotics and text and speech

recognition for numerous other applications. Supporters of AI suggest that it is a massive opportunity for humanity, not a threat, and argue that machines which can learn to do tasks currently requiring humans could speed up processes, allowing humans more leisure time in the future. However, critics worry that if we develop machines that can learn very rapidly, drive our cars and do our jobs, we may reach a situation where they become more intelligent than humans.”¹

In pairs or in small groups discuss the following question:

Should humanity fear advances in Artificial Intelligence?

Where do you stand? Choose one side only – for or against the statement. Note down the points in support of your side. Using your notes try to persuade your partner to accept your views on the statement.

For the statement	Against the statement
1.	1.
2.	2.
3.	3.
4.	4.

¹ Lyons R. Artificial Intelligence // Debating Matters. 2016. May. URL: http://www.debatingmatters.com/documents/DM_Topic_Guides_Artificial_Intelligence_pdf1.pdf

Lesson 2

FIVE COOL USES FOR A USB FLASH DRIVE

(by CNET)

Flash memory is a type of non-volatile memory that can be electronically erased and reprogrammed. Its name was invented by *Toshiba* to express how much faster it could be erased – “in a flash”, which means “very quickly.”

The video for this lesson is available at: <https://youtu.be/wGcn3RnnqTc>

Intro

- What is flash memory?
- Is it volatile or non-volatile?
- In what portable devices is it used?
- Do you often use a USB flash drive? What for?

Comprehension

Watch the video and fill in the table with the five possible applications of a USB flash drive and software required.

An applications of a USB flash drive	Required software

Vocabulary

1. Match the words with their definitions.

1. virus	A. general term for the various kinds of programs used to operate computers and related devices
2. USB flash drive	B. able to be transferred from one machine or system to another
3. password	C. a piece of software that attaches itself to a file. Once you run an infected program, it quickly spreads to the system files and other software and destroy the content of hard disks
4. software	D. software which is specifically designed to disrupt, damage, or gain authorized access to a computer system a piece of software that attaches itself to a file
5. malware	E. a sequence of characters (letters, numbers, symbols) used as a secret key for accessing a computer system or network
6. portable	F. to place or fix software in position ready for use
7. to install	G. to copy data from one computer system to another, typically over the Internet
8. to download	H. the process of saving and transmitting data in encoded form
9. encryption	I. a small, portable flash memory card that plugs into a computer's USB port and functions as a portable hard drive

2. Practice the words online:

<https://quizlet.com/215501729/five-cool-uses-for-a-usb-flash-drive-flash-cards/>

3. Complete the word search task online following the link <http://www.proprofs.com/games/word-search/five-cool-uses-for-a-usb-flash-drive/> or in your course book.

J	R	W	D	R	O	W	S	S	A	P	C	PORTABLE ACCESS UNLOCK PASSWORD USB PREDATOR MALWARE SOFTWARE FLASH INSTALL
R	A	Q	F	P	F	Y	O	B	E	P	H	
O	A	Y	C	L	Y	F	H	R	F	Z	U	
T	B	L	K	H	T	S	A	M	S	N	X	
A	E	M	E	W	I	W	R	S	L	S	L	
D	F	L	A	N	L	X	E	O	H	M	L	
E	H	R	B	A	C	C	C	B	S	U	A	
R	E	Q	M	A	C	K	J	B	A	M	T	
P	G	H	Z	A	T	P	V	Z	L	P	S	
Q	T	Q	X	I	J	R	D	L	F	B	N	
R	J	Y	P	J	Y	O	O	D	N	F	I	
Q	U	W	D	X	N	V	X	P	H	R	H	

2. Complete the sentences with the missed words from the word search task.

- If you have a _____ drive, it is probably because you need a way to carry your files and documents around with you.
- The secret agent in all of us will love this first trick, which lets you use your USB drive to lock and _____ your computer.
- Once you get the _____ on your drive, you will be able to choose which apps you want to _____ on it.
- Truecrypt* is a free program that will encrypt or scramble the data of your USB drive and protect it with a secure _____ only you know.
- AVG* will scan your computer for _____ and hopefully get you back to work in no time.
- Your computer will deny _____ to anyone who doesn't have the USB drive or your unique _____.
- More _____ than your tablet or smartphone your USB drive can run applications too. You can carry around programs like *Firefox*, *Chrome* and *Open Office* and use your drive to run them on any computer.

Grammar

Zero and First conditionals

Sentences with *if* where one event depends on another event are called conditionals. The *if...* clause is the condition and the other part of the sentence is the result.

Zero conditional:

if + Present Simple, ... Present Simple.

Zero conditional is used to describe things that are always or generally true. We can use *when* or *if* to introduce the sentence:

If you lose a USB flash drive, your data may be stolen.

An imperative structure may be used in the result clause:

If your USB device is not detected, try to reconnect the device.

First conditional:

if + Present Simple, ... will/won't ...

First conditional is used to describe future events that will happen or likely to happen. The event is real possibility in the speaker's mind, not imaginary.

If you use a unique password, your computer will be locked for unauthorized usage.

Grammar practice

1. **Make sentences with *if*. Start a new sentence with the ending of the previous one.**

- carry documents, photos and music around

Example: If I have a flash drive, I will carry my documents, photos and music around with me.

- encrypt the information

Example: If I carry my documents, photos and music around with me, I will encrypt the information on a flash drive.

- sensitive information is safe in case of loss or theft
- nobody uses information for harmful purposes
- information remains secure
- I am happy and confident

2. **Read the examples of *if* clauses and tell if it is Zero or First conditional.**

1. If you have a USB flash drive, you will probably need a way to carry your files and documents around with you.

2. If you are like me, you have a drawer full of drives from marketers at conventions and events.
3. If you are hit with the virus that renders your system, scan your computer for malware.
4. If all you want to do is use this thing for storing data, don't forget to encrypt it, especially if you have top secret information on your drive.
5. If you lose this flash drive, your information will remain secure.
6. If you have any ideas we missed, tweet me.

Discussion

In pairs or in small groups discuss the following questions.

- What are the pros and cons of USB flash drives vs cloud storage according to their cost, security, service life, reliability, etc.?
- Which application of a USB flash drive do you find the most demanded?
- Choose a flash-based device that you own and describe it.

Lesson 3

HOW DOES A HARD DISK WORK?

(by Computer Tutorials)

“A hard disk drive (sometimes abbreviated as Hard drive, HD, or HDD) is a non-volatile memory hardware device that permanently stores and retrieves data on a computer. A hard drive consists of one or more platters to which data is written using a magnetic head, all inside of an air-sealed casing. The desktop hard drive consists of the head actuator, read/write actuator arm, read/write head, spindle, and platter coated with magnetic material. On the back of a hard drive is a circuit board called the disk controller or interface board and is what allows the hard drive to communicate with the computer.”¹

The video lecture for this lesson is available at: <https://youtu.be/4iaxOUYa1JU>

Intro

- What is the internal hard drive?
- What is it used for?
- What is the largest storage capacity of a hard disk at present?
- Can lost data from a hard drive be recovered?
- Why should you format your hard drive?

Comprehension

Watch the video and answer the questions.

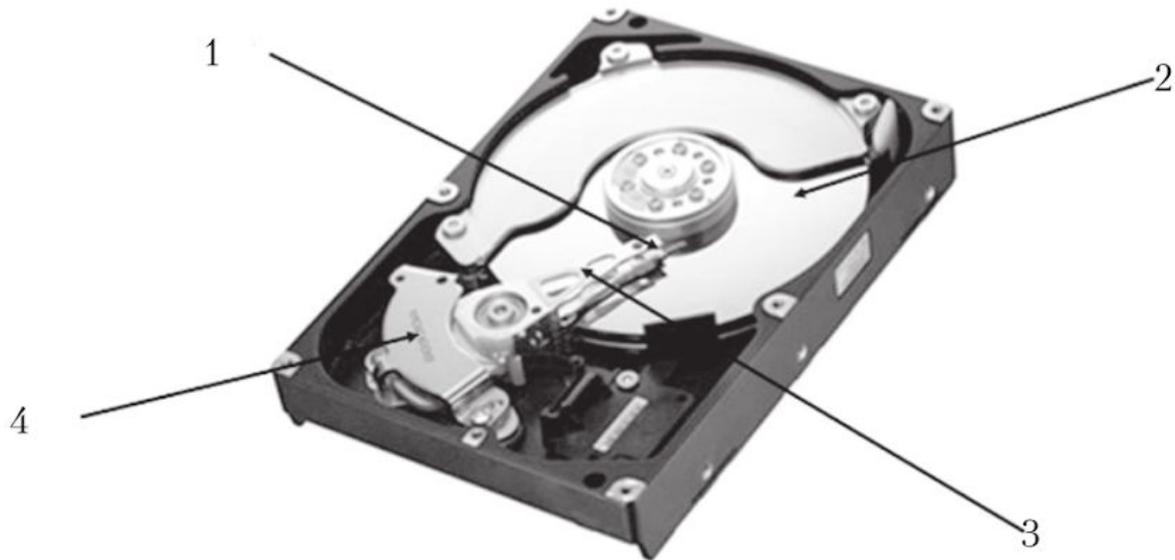
1. How is data written and read on the platter?
2. What makes the arm move?
3. How does Faraday’s law work in the hard drive?
4. What is the gap between the head and the disk surface?
5. What is the function of a recirculating filter?

¹ Hard drive // Computer Hope. 26.04.2017. URL: <https://www.computerhope.com/jargon/h/harddriv.htm>

6. What is the key element of the platter?
7. What is coercivity?
8. How can the information on the disk be squeezed up to 40%?

Vocabulary

1. Label the parts of the hard drive mentioned in the video



2. Match the words with their definitions.

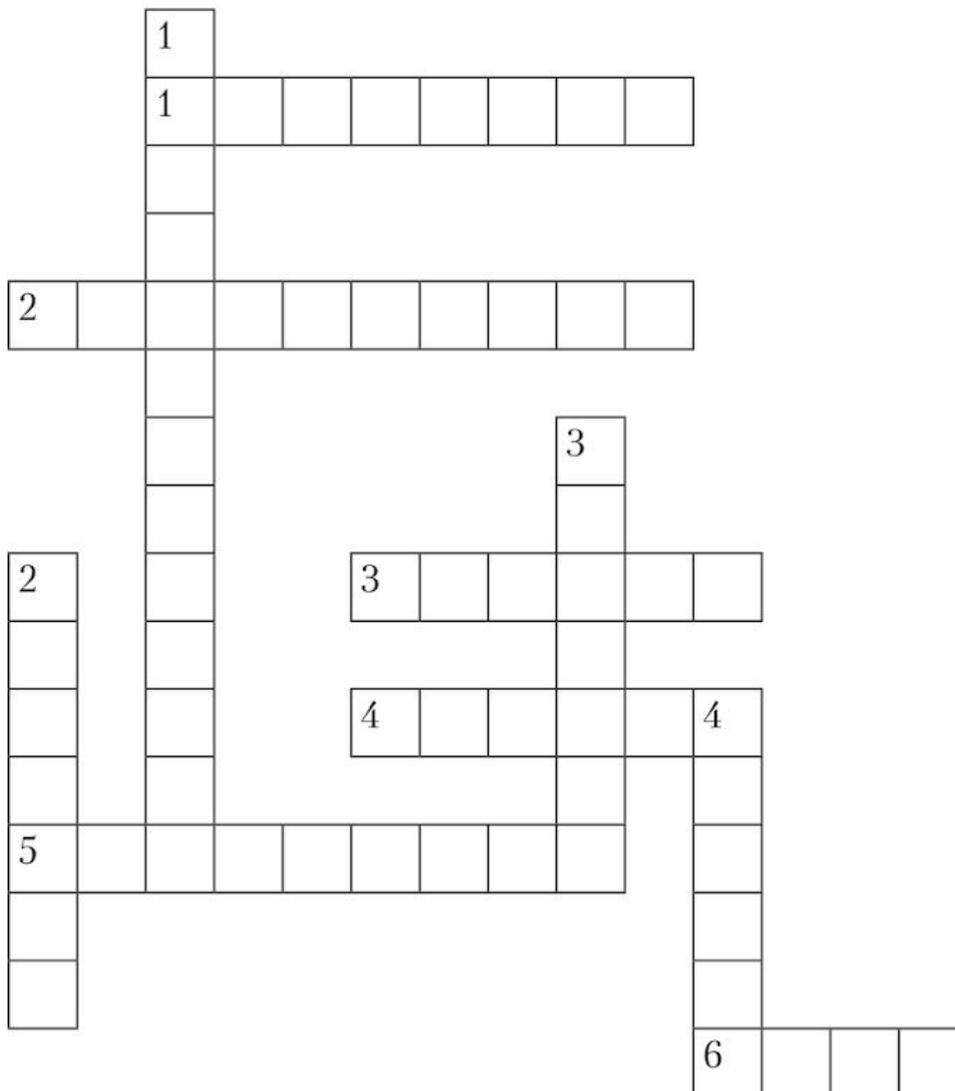
1. coercivity	A. the force exerted on a charged particle q moving with velocity v through an electric E and magnetic field B
2. filter	B. a magnetic plate, or disk, that constitutes part of a hard drive
3. nanometer	C. writing information on a disk or storage area
4. binary	D. information in electronic form that can be stored and processed by a computer
5. actuator	E. a mechanical device for moving or controlling something
6. magnetization	F. the resistance of a magnetic material to changes in magnetization, equivalent to the field intensity necessary to demagnetize the fully magnetized material

7. Lorentz force	G. the process of making a substance magnetic by insertion in a magnetic field
8. data	H. relating to a system of encoding data using 0's and 1's
9. platter	I. a device that is used to remove something unwanted from a liquid, gas or surface
10. record	J. one billionth of a meter

3. Practice the words online:

<https://quizlet.com/215541118/how-does-a-hard-disk-work-flash-cards/>

4. Solve the crossword online following the link: <https://www.proprofs.com/games/crossword/a-hard-disk-drive-hdd/> or in your course book



Across

1. A mechanical device for moving or controlling something.
2. The resistance of a magnetic material to changes in magnetization, equivalent to the field intensity necessary to demagnetize the fully magnetized material.

3. Relating to a system of encoding data using 0's and 1's.
4. A device that is used to remove something unwanted from a liquid, gas or surface.
5. One billionth of a meter.
6. Information in electronic form that can be stored and processed by a computer.

Down

1. The process of making a substance magnetic by insertion in a magnetic field.
2. The force exerted on a charged particle q moving with velocity v through an electric E and magnetic field B .
3. A magnetic plate, or disk, that constitutes part of a hard drive.
4. Writing information on a disk or storage area.
5. **Watch the video again. While watching fill in the gaps with the missing words.**

As a whole computer is a powerful tool but it must (1) _____ reliably to work well. Otherwise, it's kind of pointless, isn't it? Let's look inside and see how it stores data. It's an ordinary hard drive but its details, of course, are (2) _____. Now I am sure you know the (3) _____ of hard drive. We store data on it in (4) _____ form, ones and zeros. Now this (5) _____ supports a (6) _____, which is an electromagnet that scans over the disc and either writes data by changing the magnetization of specific sections on the (7) _____ or it just (8) _____ the data by measuring the magnetic polarization. In (9) _____ pretty simple but in (10) _____ a lot of hardcore engineering. The key focus lies in being sure that the head can precisely, (11) _____ read and write to the disk. The first order of business is to move it with great control. To position the arm engineers use a voice coil actuator. The base of the arm sits between two (12) _____ _____. They are so strong they're actually kind of hard to pull apart. There. The arm moves because of the Lorentz (13) _____: pass a current through wire that's in a the geomagnetic field, and the wire experiences a force. (14) _____ the current, and the force also reverses. As current flows in one direction in the coil, the force created by the (15) _____ magnet makes the arm move this way. Reverse the current, and it moves back. The force of the arm is directly proportional to the (16) _____ through the coil, which allows the arm's position to be (17) _____. Unlike a mechanical system of linkages, there is minimal wear and it isn't sensitive to temperature. At the end of the arm lies the most (18) _____ _____, the head. At it's simplest it's a piece of ferromagnetic material wrapped with wire. As it passes over the magnetized sections

of the platter, it measures changes in the direction of the magnetic (19) _____. We call it Faraday's law. A change in (20) _____ produces a voltage in a nearby coil. So as the head passes a section where the polarity has changed, it records a voltage spike. The spike's both negative and positive represent a one, and where there is no voltage spike corresponds to a zero. The head gets astonishingly close to the disk surface. A hundred nanometers in older drives, but today under (21) _____ in the newest ones. As the head gets closer to the disc, its magnetic field covers less area allowing for more (22) _____ of information to be packed onto the disk surface. To keep that critical height engineers use an ingenious method. They float the head over the disk. You see, as the disk spins, it forms a boundary layer of air that gets dragged past the stationary head at (23) _____ at the outer edge. The head rides on a slider aerodynamically designed to float above the platter and the (24) _____ of this air bearing technology is its self-induced adjustment. If any disturbance causes the slider to rise too high, it floats back to where it should be. Now because the head is so close to the disk (25) _____, any stray particles could damage the disc, resulting in (26) _____. So engineers place this recirculating filter in the airflow. It removes small (27) _____ scraped off the platter. To keep the head flying at the right height the platter is made incredibly (28) _____. Typically, this platter is so smooth that it has a surface roughness of about (29) _____. To give you an idea of how smooth that is, let's imagine that this section is enlarged until it is as long as a football field American or International. The average bump on the surface would be about three hundredths of an inch. The key element of the platter is (30) _____, which is cobalt with perhaps (31) _____ and (32) _____ mixed in. Now this mixture of metals has high coercivity, which means that it will maintain that magnetization and thus data until it's exposed to another powerful magnetic field. One last thing that I find enormously clever using a bit of math to squeeze up to (33) _____ percent more information on the disk. Consider this sequence of magnetic poles on the disk surface 0 1 0 1 1 1. A scan by the head would (34) _____ these distinct voltage spikes both (35) _____ or _____ for the ones. We would be easily able to distinguish it from, say, this similar sequence. If we compare them, they clearly differ. Engineers, though, always work to get more and more data onto a hard drive. One way to do this is (36) _____ the magnetic domains, but look what happens to the voltage spikes when we do this. For each sequence, the spikes of the ones now overlap and superimpose giving fuzzy signals. In fact the two sequences now look very (37) _____. Using a technique called "partial (38) _____ maxi-

mum likelihood” engineers have developed (39) _____ codes that can take a murky signal like this, (40) _____ the possible sequences that could make it up and then choose the most probable. As with any successful technology, these hard drives remain unnoticed in our daily lives unless something goes wrong.

Grammar

The Subordinate Clause

Subordination is used to combine two ideas in a single sentence. For example:

Most PC's have an internal hard drive. It is used to store the operating system, the programs and the user's files. => Most PC's have an internal hard drive that is used to store the operating system, the programs and the user's files.

A subordinate (or dependent) clause begins with a subordinate conjunction or a relative pronoun and contains a subject and a verb. Still, it's not a complete sentence, it doesn't contain a complete thought.

Subordinate Conjunctions	Relative Pronouns
After, although, as, because, before, even, even though, if, in order that, once, provided that, rather than, since, so that, that, than, though, unless, unlike, until, when, whenever, where, whereas, whether, while, why	That, which, whichever, who, whoever, whom, whose, whom-ever

Grammar practice

Fill in the gaps with subordinate conjunctions and relative pronouns: *as, unlike, because, until, unless, which* (each word can be used more than once).

1. _____ current flows in one direction in the coil, the force created by the permanent magnet makes the arm move this way.
2. The force of the arm is directly proportional to the current through the coil, _____ allows the arm's position to be finely tuned.
3. _____ a mechanical system of linkages, there is minimal wear and it isn't sensitive to temperature.
4. _____ it passes over the magnetized sections of the platter, it measures changes in the direction of the magnetic poles.

5. _____ the head gets closer to the disc, its magnetic field covers less area allowing for more sectors of information to be packed onto the disk surface.
6. _____ the head is so close to the disk surface, any stray particles could damage the disc, resulting in data loss
7. This mixture of metals has high coercivity, _____ means that it will maintain that magnetization and thus data _____ it's exposed to another powerful magnetic field.
8. _____ with any successful technology, these hard drives remain unnoticed in our daily lives _____ something goes wrong.

Discussion

In pairs or in small groups discuss the following questions:

- As Bill Hammack mentions in the video, the hard drive remains unnoticed in our daily life unless something goes wrong. It is a sophisticated but fragile device. How can you protect your hard drive? Make a poster with some useful tips and share it with other students in your class.
- What should you consider when thinking about upgrading or buying a new computer hard drive?
- What should be done to minimize the risk of data loss or corruption?

Lesson 4

HOW THE INTERNET WORKS IN FIVE MINUTES

(by Aaron Titus)

We are still at the very beginnings of the Internet. Let's use it wisely. (Jimmy Wales, the co-founder of *Wikipedia*).

The video lecture for this lesson is available at: https://www.youtube.com/watch?v=7_LPdttKXPc

Intro

- How old is the Internet? When was it created?
- Who created the Internet?
- Did the Internet become popular quickly?
- How do you get online?

Comprehension

Watch the video. Mark the statements true (T) or false (F). Correct the false sentences.

1. Normally about 20% of people understand how the Internet actually works.
2. The Internet is a cloud buried in the ground.
3. A server is a special computer connected directly to the Internet.
4. Every server has a unique Internet protocol address, or IP address.
5. Your computer at home is a server because it is connected directly to the Internet.
6. Computers we use every day are called clients because they are connected indirectly to the Internet through an Internet service provider.
7. aol.com is ISP only.
8. Whenever an email, picture or webpage travels across the Internet, computers break the information into smaller pieces called packets.
9. When information reaches its destination, the packets are reassembled in their original order to make a picture, email, webpage or tweet.
10. Anywhere two or more parts of the Internet intersect, there's an IP address.

Vocabulary

1. What do the acronyms stand for?

IP, DSL, ISP, AOL.

2. Match the words with their definitions.

1. server	A. an organization that provides services for accessing and using the Internet, which include Internet access, Internet transit, domain name registration etc.
2. client	B. a technology used to create high-bandwidth network connections over standard telephone lines, often in providing Internet service to homes
3. IP address	C. an American multinational mass media corporation, originally provided a dial-up service to millions of Americans, as well as providing a web portal, e-mail, instant messaging
4. digital subscriber line	D. an individual document on the Web, identified by its own unique URL. It contains different elements, such as text, picture, video, links, etc.
5. Internet service provider	E. a networking device that forwards data packets between computer networks. It performs the traffic directing functions on the Internet
6. America Online	F. a computer program or a device that accepts and responds to requests made by another program, known as a client
7. coincidentally	G. a segment of data sent from one computer or device to another over a network. It contains the source, destination, size, type, data, and other useful information that helps packet get to its destination
8. webpage	H. a number which identifies a computer and distinguishes it from other computers on the Internet
9. router	I. happening by chance

10. packet	J. an application that runs on a personal computer or workstation and relies on a server to perform some operations
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3. Practice the words online:

<https://quizlet.com/215772408/how-the-internet-works-in-five-minutes-flash-cards/>

4. Complete the word search task online following the link <http://www.proprofs.com/games/word-search/the-Internet-3/> or in your course book.

M	J	T	G	P	S	L	U	D	G	X	E	IP AOL ROUTER ISP DSL SERVER WEBPAGE CLIENT PACKET
I	S	A	T	G	H	E	N	T	N	H	R	
Y	O	O	P	S	I	I	R	R	Y	G	A	
E	P	Z	L	M	A	O	Z	V	C	I	W	
J	X	E	O	T	U	B	E	N	E	E	F	
T	Q	V	A	T	D	Y	W	Q	B	R	Q	
R	T	N	E	I	L	C	P	P	Q	I	O	
W	Y	R	Z	X	I	A	A	W	Z	C	A	
B	Z	W	G	E	B	G	E	P	V	Z	L	
B	P	E	L	F	E	U	U	X	U	N	C	
P	Z	I	S	V	I	N	I	Z	V	Y	B	
E	M	V	D	P	A	C	K	E	T	I	P	

5. Watch the video again and fill in the gaps with the missing words from Ex.1.

- Just like a postal address, _____ help computers find each other.
- Your computer at home is not a _____ because it is not connected directly to the Internet.
- Computers you and I use every day are called _____ because they are connected indirectly to the Internet through _____.
- Now let's pretend that I want to visit aol.com which is _____ both a server and an ISP.
- I hop onto my laptop with _____, go through my ISP onto the Internet and look at aol.com.

6. The next day Aunt Ruth dials into _____ servers and retrieves the email.
7. Whenever an email picture or _____ travels across the Internet, computers break the information into smaller pieces called packets.
8. You are both sending _____ back and forth over the Internet, but what's to keep your _____ from accidentally ending up on your boss's screen?
9. _____ direct your packets around the Internet helping each packet get one step closer to its destination.

Grammar

Questions

In questions, the auxiliary verb is placed before the subject.

Are you part of any social networks like Facebook or Google+?

If there is no other auxiliary, *do* or *does* (Present Simple) or *did* (Past Simple) is used.

Did the Internet become popular quickly?

To find out more or different information, question words can be added: *who* (for people), *what/which* (for things), *when, how often* (for time), *how much* (for quantity), *where* (for places), *why* (for reasons) and *how* (for manner).

What are some of the benefits of the Internet?

How much time do you spend on the Internet?

Why is it important to follow the Internet safety rules?

If *who, what* or *which* is the subject of the question, it comes before the verb, and *do* as an auxiliary verb is not used.

Who created the Internet? (Subject – *who*)

What happened to the Internet connection? (Subject – *what*)

Object questions follow the normal structure.

What sort of Internet connection do they have? (Subject – *they*; object – *what*)

Grammar practice

1. Make questions using these prompts, then practice asking and answering the questions with your partner.
 1. How much time / spend / the Internet / every day?
 2. What / you / use / the Internet?

3. What / favorite website?
4. When / get / first email address?
5. / you / answer/ a spam e-mail?
6. What sort / Internet connection / you have?
7. How reliable / it?
8. / you / use / *Google Maps* to plan a route?
9. ... / you / ever / catch / a virus / the Internet?
10. What / the Internet / be / in 10 years?

2. **Ask as many questions to the following statements from the lecture as you can.**

1. The Internet is a wire actually buried in the ground that might be fiber optics, copper or occasionally being transmitted due satellites or through cellphone networks but the Internet is simply a wire.
2. A server is a special computer connected directly to the Internet, which has a unique IP address.
3. Your home computer is not a server because it's not connected directly to the Internet, it is called a client because it's connected indirectly to the Internet through an Internet service provider.
4. If you want to visit aol.com, which is coincidentally both a server and an ISP, you should hop onto my laptop with DSL, go through your ISP onto the Internet and look at aol.com, so your computer connects with aol.com, and you can look at these webpages.
5. Whenever an email, picture or webpage travels across the Internet, computers break the information into smaller pieces called packets, which when reaching its destination, are reassembled in their original order to make a picture, email, webpage or tweet.

Discussion

In pairs or in small groups discuss the following questions:

- What makes the Internet so popular in the modern world?
- Does the Internet bring people of the world together? Why or why not?
- What websites do you browse most often and why?
- Is it dangerous to meet a person you met online in real life?
- What Internet safety rules do you know?¹

¹ For more ideas about online safety, refer to Appendix 2.

Lesson 5

HOW TO LIVE BEFORE YOU DIE

(by Steve Jobs)¹

Jobs' famous persuasive power was equalled by his creativity and business brilliance — apparent in legendary hardware and software achievements across three decades of work. The *Macintosh* computer (which brought the mouse-driven, graphical user interface to prominence), *Pixar Animation Studios* (which produced *Toy Story*, the first fully 3D animated feature film), the *iPod*, the *iPhone*, the *iPad* all owe credit to Jobs' leadership and invention.

TED Talk for this lesson is available at: https://www.ted.com/talks/steve_jobs_how_to_live_before_you_die

Intro

- What do you know about Steve Jobs?
- What companies did he found?
- What products that have cultural ramification did he develop?
- What is a commencement speech?
- Who is a commencement speaker?

Comprehension

Watch the video and answer the questions.

1. What level of education did Steve Jobs' biological mother and his adoptive mother and father reach?
2. Did Jobs graduate from college? Why or why not?
3. When Steve Jobs dropped out of the college, his life wasn't romantic. What did he do to survive?
4. Jobs studied calligraphy while at Reed College. What is calligraphy? How did that later help Jobs as he started *Apple*?

¹ Commonly known as Steve Jobs' Stanford University Commencement Speech (delivered on June 12, 2005).

5. In Jobs' second story, he talks about his experience at *Apple*. What happened to him at *Apple*?
6. Why does Jobs claim that "getting fired from Apple was the best thing that could have ever happened to him"?
7. What does Jobs mean when he says, "Sometimes life's gonna hit you in the head with a brick"? He then tells his audience two things not to do, beginning his sentences with *don't*. What are they?
8. In Jobs' third story, he tells about his cancer diagnosis. What was discovered that gave him a new hope?
9. What does he tell the Stanford graduates at the end of his speech?

Vocabulary

1. Match the words with their definitions.

1. commencement	A. a revival of or renewed interest in something
2. to drop out	B. to separate from another route and go in a different direction
3. to relent	C. to find or encounter by chance
4. hitchhiking	D. (in Hinduism and Buddhism) the sum of a person's actions in this and previous states of existence, viewed as deciding their fate in future existences
5. to stumble into	E. to change one's mind/decision, and soften in attitude or temper
6. calligraphy	F. a journey made by getting free lifts in passing vehicles
7. karma	G. a ceremony in which degrees or diplomas are conferred on university or high-school students (North American)
8. to diverge	H. to abandon a course of study
9. devastating	I. the art of producing decorative handwriting or lettering with a pen or brush
10. destination	J. a principle or set of principles laid down by an authority as incontrovertibly true

11. renaissance	K. to break into pieces; become smaller or lower in amount, level, value etc.
12. to fall away	L. an intended ending point of a journey
13. dogma	M. causing severe shock, distress, or grief

2. Practice the words online:

<https://quizlet.com/196595560/steve-jobs-stanford-university-commencement-address-flash-cards/>

3. Fill in the gaps with the words from Ex.1.

- I am honored to be with you today at your _____ from one of the finest universities in the world.
- I _____ of Reed College after the first 6 months.
- And yet death is the _____ we all share.
- She only _____ a few months later when my parents promised that I would someday go to college.
- And much of what I _____ by following my curiosity and intuition turned out to be priceless later on.
- Reed College at that time offered perhaps the best _____ instruction in the country.
- You have to trust in something – your gut, destiny, life, _____, whatever.
- But then our visions of the future began to _____, and eventually we had a falling out.
- What had been the focus of my entire adult life was gone, and it was _____.
- Apple* bought *NeXT*, I returned to *Apple*, and the technology we developed at *NeXT* is at the heart of *Apple*'s current _____.
- Don't be trapped by _____ – which is living with the results of other people's thinking.
- On the back cover of their final issue was a photograph of an early morning country road, the kind you might find yourself _____ on if you were so adventurous.

4. What do the following idioms mean:

- to connect the dots;
- to drop the baton;
- to dawn on?

In the transcript of the speech, find how these idioms are used. Make your own examples using the idioms.

Grammar

Phrasal verbs

Phrasal verbs are two-part verbs that consist of a verb and a particle. The most common adverb particles used to form phrasal verbs are *around, at, away, down, in, off, on, out, over, round, up*, e.g. *bring in, go around, look up, put away, take off* etc.

Phrasal verbs often have two meanings. One we can easily guess from their individual parts.

*Don't waste your life, you won't be able **to turn** the time **around!*** (Phrasal verb meaning "to reverse the direction of something or someone")

Adding particle changes the meaning of the verb. A special meaning is not easily related to the separate meanings of the words.

*I hope the new IT Director will **turn around** our failing network security.* (Phrasal verb meaning "to change a plan, business, or system that is unsuccessful and make it successful")

When you see a new phrasal verb for the first time, you should study the context of use, and check the meaning in a dictionary. Phrasal verbs are commonly used in both writing and speech. Some are informal, but others are generally used.

Grammar practice

1. Match the verb to the preposition to make phrasal verbs from the Steve Job's speech. The same verb can be used with different prepositions.

<i>Verbs</i>	<i>Prepositions</i>
drop	
pop	
find	out
look	back
come	in
look	forward
let	backwards
be	over
start	on
turn	away
go	down
roll	
clear	

2. Now complete each blank with the appropriate phrasal verb from the box in the correct form.

look forward / look backwards / let down / come back /
clear out / look back / pop in / pop out / find out / drop
in / drop out

1. When I _____, they decided at the last minute that they really wanted a girl.
2. My biological mother later _____ that my mother had never graduated from college and that my father had never graduated from high school.
3. It was pretty scary at the time, but _____ it was one of the best decisions I ever made.
4. The minute I _____, I could stop taking the required classes that didn't interest me, and begin _____ on the ones that looked interesting.
5. But 10 years later, when we were designing the first *Macintosh* computer, it all _____ to me.
6. Of course, it was impossible to connect the dots _____ when I was in college.
7. Again, you can't connect the dots looking forward; you can only connect them _____.
8. It _____ the old to make way for the new.
9. I felt that I had _____ the previous generation of entrepreneurs _____ – that I had dropped the baton as it was being passed to me.

3. Replace the verb in bold with the phrasal verb of similar meaning.

1. So at 30 I **was fired**.
2. And so I decided **to begin again**.
3. It **happened** that getting fired from Apple was the best thing that could have ever happened to me.
4. Pixar **continued** to create the world's first computer animated feature film, *Toy Story*, and is now the most successful animation studio in the world.
5. Like any great relationship, it just gets better and better as the years **pass**.
6. All external expectations all pride, all fear of embarrassment or failure – these things **break into pieces** in the face of death, leaving only what is truly important.
7. Right now, the new is you, but someday not too long from now, you will gradually become the old and **depart**.

Discussion

In pairs or in small groups discuss the following questions:

1. What are the lessons learned from these stories?
2. Jobs experienced great success and great failure. What were his successes, and how did his failure occur?
3. Do you agree that the primary difference between successful people and unsuccessful people is that the successful people fail more?
4. How do you understand the following statement: “You can’t connect the dots looking forward; you can only connect them looking backwards”?
5. “If today were the last day of my life, would I want to do what I am about to do today?”
6. In your opinion, what does Steve Jobs mean by quoting the statement, “Stay hungry. Stay foolish”?

Lesson 6

THE GAME THAT CAN GIVE YOU TEN EXTRA YEARS OF LIFE

(by Jane McGonigal)

Jane McGonigal, a game designer, claims that when we play a game we tackle tough challenges with more creativity, more determination, more optimism, and we are more likely to reach out to others for help. She wanted to bring these gamer traits to her real life.

TED Talk for this lesson is available at: http://www.ted.com/talks/jane_mcgonigal_the_game_that_can_give_you_10_extra_years_of_life#t-264799

Intro

- Do you like video/online games?
- What's your favourite game?
- How often do you play video games?
- Do you enjoy playing with others online or in person? Neither/both?
- Have you learned anything from gaming?
- How much gaming do you consider to be too much? Why?
- What do your parents think of video games?

Comprehension

Watch the video and answer the questions.

1. According to Jane McGonigal, how much time a week people (as the planet) should spend on playing computer games?
2. What are the most frequently expressed regrets that people say when they are on their deathbeds?
3. Some people say that playing video games is a waste of time. Is it true according to recent studies?

4. What life event prompted Jane to create a role-playing recovery game called *Jane the Concussion Slayer*, which was later renamed *SuperBetter*?
5. What is the order of playing a *SuperBetter* game?
 - ___ Recruit your allies
 - ___ Activate the power-ups
 - ___ Adopt a secret identity
 - ___ Battle the bad guys
6. What happened to Jane as the result of playing a *SuperBetter* game?
7. What is the impact of the game on the human condition after a traumatic event?
8. How do you get from trauma to growth?
9. What are the four types of resilience? What tasks did she ask people to complete as a part of a *SuperBetter* quest?
10. What is the bonus for boosting these four types of resilience?

Vocabulary

1. Match the words with their definitions.

1. reasonable	A. something that is accepted as true or as certain to happen, without proof
2. to outperform	B. to remain undamaged or unaffected by
3. assumption	C. the capacity to recover quickly from difficulties
4. to trigger	D. to perform better than others
5. to contribute to	E. to use the good things in a situation
6. resilience	F. temporary damage to the brain caused by a fall or hit on the head or by violent shaking
7. to withstand	G. to suddenly release a violent force that cannot be controlled
8. to take advantage of	H. to help to cause an event or situation
9. to tackle	I. to cause something to start

10. concussion	J. something that provides you with the encouragement that is needed to make your plan successful
11. nausea	K. based on or using good judgment and therefore fair and practical
12. to unleash	L. to try to deal with something or someone
13. springboard	M. a feeling of spinning around and being unable to balance, often caused by looking down from a height
14. vertigo	N. a feeling of sickness with an inclination to vomit

2. Fill in the gaps with the words from Ex.1.

- Recent clinical trials conducted at East Carolina University showed that online games can _____ pharmaceuticals for treating clinical anxiety and depression.
- Now, because I am a game designer, you might be thinking to yourself, "I know what she wants us to do with those minutes, she wants us to spend them playing games." Now this is a totally _____, given that I have made quite a habit of encouraging people to spend more time playing games.
- I had to avoid everything that _____ my symptoms.
- There are four kinds of strength, or resilience, that _____ to post-traumatic growth.
- Your body can _____ more stress and heal itself faster.
- Oxytocin will linger during the break, so _____ of the networking opportunities.
- Even just _____ a tiny challenge, you are going to boost your resilience, so you are going to earn more minutes.
- The number one thing you can do to boost your physical _____ is to not sit still.
- Instead, we can use a traumatic event as a _____ to unleash our best qualities and lead happier lives.
- Two years ago I hit my head and got a _____.
- The concussion didn't heal properly, and after 30 days, I was left with symptoms like nonstop headaches, _____, _____, memory loss, mental fog.

3. Complete the word search task online following the link <http://www.pro-profs.com/games/word-search/the-game-that-can-give-you-10-extra-years-of-life/> or in your course book

R	E	A	S	O	N	A	B	L	E	W	L	NAUSEA TACKLE WITHSTAND RESILIENCE CONCUSSION TRIGGER REASONABLE ASSUMPTION CONTRIBUTE SPRINGBOARD
N	Y	D	N	J	J	J	B	K	U	I	E	
O	F	R	B	A	M	U	K	M	R	T	T	
I	N	A	R	S	T	W	Q	P	E	H	U	
S	A	O	R	S	F	V	P	S	S	S	B	
S	U	B	E	U	C	A	K	U	I	T	I	
U	S	G	G	M	S	I	M	E	L	A	R	
C	E	N	G	P	D	U	Z	S	I	N	T	
N	A	I	I	T	A	C	K	L	E	D	N	
O	W	R	R	I	U	M	Q	U	N	K	O	
C	Q	P	T	O	X	H	D	T	C	U	C	
B	L	S	U	N	F	Z	Z	P	E	Q	B	

4. Practice the words online:

<https://quizlet.com/215980828/the-game-that-can-give-you-ten-extra-years-of-life-flash-cards/>

Grammar

Wishes and regrets about the past

We use *wish* and *if only* to talk about regrets – things that we would like to change either about the past or the present.

Present regrets. In this case *wish* and *if only* are followed by the Past Simple tense (emphasising that the wish we express is “unreal”).

If only he knew the rules of the game, he could win with better score.

I wish I knew what to do.

Past regrets. In this case, *wish* and *if only* are followed by the Past Perfect tense.

I wish I'd known that when I was a teenager.

If only we'd known you were in town.

If the situation is negative, we make a positive wish clause.

I haven't played that game. I wish I had played that game.

If the situation is positive, we make a negative wish clause.

I lost the game. I wish I hadn't lost.

Grammar practice

1. Make a wish clause according to the situation as in the examples.

Situations	Wishes/regrets
She failed the test.	She wishes she hadn't failed the test.
He didn't call me yesterday.	I wish he had called me yesterday.
1. She spent three hours playing computer games.	
2. I am afraid to do what makes me happy.	
3. I didn't have the courage to express my true self.	
4. My priorities have not changed.	
5. I am not able to focus on my goals and dreams.	
6. He doesn't stay in touch with his friends.	
7. I didn't let myself be happier.	
8. I work so hard.	

2. Complete each sentence with a suitable form of the verb in brackets.

1. I played *Counter-Strike* yesterday, that is why I didn't write an essay. I wish I _____ (not wasted) my time playing computer game.
2. I was ill last night and I didn't go out with my friends. I wish I _____ (go out) with my friends to the cybercafé last night.
3. My computer was infected with malware. I wish I _____ (install) antivirus software before surfing the Net.

4. I play fast-paced games. I wish it _____ (help) me to make quicker decisions in real life.
5. This processor is really slow! I wish we _____ (have) a faster one to play computer games.
6. I am disappointed in this web camera. I wish I _____ (not buy) it.
7. John spent a lot of money on video games. He wishes he _____ (not wasted) so much money!
8. Thirty minutes of online game play a day increase people's happiness. I wish I _____ (play) online games instead of taking antidepressants.
9. He couldn't fix his computer. He wishes his tech knowledge _____ (be) better.
10. You promised not to tell anyone my password but you did. I wish I _____ (not tell) you.
11. I give up quickly when dealing with difficulties. I wish I _____ (tackle) tough challenges with more creativity.

Discussion

In pairs or in small groups discuss the following questions.

- What are the pros and cons of computer gaming?
- What is your biggest regret in life? Why?
- Do you agree with the following sayings?

“I would rather have a life full of mistakes than a heart full of regrets.”

“Our biggest regrets are about chances we did not take.”

“Life is too short to live with regrets.”

Lesson 7.

THIS COMPUTER WILL GROW YOUR FOOD IN THE FUTURE

(by Caleb Harper)

What do we know about the food we eat? What if there was climate democracy? Caleb Harper and his colleagues explore the future of food systems. Caleb Harper is the principal investigator and director of the Open Agriculture Initiative (OpenAG) at the MIT Media Lab. Under his guidance, a diverse group of engineers, architects, urbanists, economists and plant scientists is developing an open-source agricultural hardware, software and data common aiming to create a more agile, transparent and collaborative food system.

TED Talk for this lesson is available at: https://www.ted.com/talks/caleb_harper_this_computer_will_grow_your_food_in_the_future?language=ca

Intro

- What is the global food crisis?
- What is causing the global food crisis?
- What does the term “food security” mean?
- Is there a food crisis in Russia?
- How does rising food prices influence local families and communities?

Comprehension

Watch the video and answer the questions.

1. What is the food crisis according to Caleb Harper?
2. Why being a farmer is not popular among the youth in the world?
3. So how can we build the platform that inspires the youth?
4. What is Caleb Harper’s lab known for?

5. How can Caleb Harper grow “strawberries from Mexico” in his lab?
6. What information can IP addressable broccoli provide a farmer with?
7. What is a controlled environment for plants? How can it help the plants grow?
8. What are the benefits of Caleb Harper’s lab integration in school education?
9. What happened as the result of such integration?
10. How is Caleb Harper sharing the information about his project?
11. What is the future of food production?

Vocabulary

1. Match the words with their definitions

1. genome	A. living genetic resources such as seeds or tissues that are maintained for the purpose of animal and plant breeding, preservation, and other research uses
2. phenomenon	B. the state of not having or not having enough of something that is needed
3. recipe	C. a measurement of how much water there is in the air
4. nutrition	D. a set of instructions telling you how to prepare and cook something, including a list of ingredients
5. deficiency	E. an organism’s complete set of DNA, including all of its genes
6. humidity	F. the value of food and the way that it influences your health
7. aeroponics	G. to use something or someone, especially in an effective way
8. beacon	H. something that exists and can be seen, felt, tasted, etc., especially something unusual or interesting
9. to deploy	I. the process of growing plants in an air or mist environment without the use of soil or an aggregate medium (known as geponics)

10. germplasm	J. a light or fire on the top of a hill that acts as a warning or signal
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2. Fill in the gaps with the words from Ex.1.

1. If you know about the _____ or genetics, this is the phenome, right? The _____.
2. So, if you are coding climate – this much CO₂, this much O₂ creates a _____ – you are coding the expression of that plant, the _____ of that plant, the size of that plant, the shape, the color, the texture.
3. They can tell you when you see that plant dying that it's a nitrogen _____, a calcium deficiency or it needs more _____.
4. This process, _____, was developed by NASA for *Mir* space station for reducing the amount of water they send into space.
5. We start having _____. We start sending information about food, rather than sending food. This is not just my fantasy, this is where we are already _____.
6. Do you know that we have rare and ancient seed banks? Banks of seed. It's amazing. They have _____ alive and things that you've never eaten.

3. Watch the lecture again and write down:

- a) what kind of professionals are involved in digital farming;
- b) what plants and vegetables are mentioned in the lecture.

4. Practice the words online:

<https://quizlet.com/216044857/this-computer-will-grow-your-food-in-the-future-flash-cards/>

Grammar

Imaginary situations, suggestions and possibilities

We use *what if* to talk about:

- imaginary situations. We try to guess (or learn) possible results based on future, present or past circumstances.

What if I start sending information about food, rather than sending food? [=What will happen if I start sending information about food, rather than sending food?]

What if I didn't put a bunch of sensors in the strawberries? [=What would happen if I didn't put a bunch of sensors in the strawberries?]

If we refer to imaginary situations, we use “Third” conditional.

What if we hadn't built a farm inside of the digital lab? [=What would have happened if we hadn't built a farm inside of the digital lab?];

- suggestions: **What if + present verb** form can be used to make suggestions about what may happen.
 - *What if we buy a food computer to grow our greens and vegetables?*
 - *OK. Good idea;*
- possibilities: **What if + past verb** form can be used to talk about future possibilities.

What if we hired Camille as a new mechanical engineer?

Grammar practice

Fill in the gaps from the lecture with **What if...** structure. Decide if it is an imaginary situation, suggestion or possibility.

How do you express yourself in food? If we had a platform, we might feel empowered to question: (1) _____? For me, I questioned: (2) _____ (climate / democratic)? So, this is a map of climate in the world.

(3) _____ (each country / have / productive climate)? What would that change about how we live? What would that change about quality of life and nutrition?

Welcome to your global farm. We built a huge analog farm. (4) _____ (we / build / digital farm)? A digital world farm. (5) _____ (you / can take / apple), digitize it somehow, send it through particles in the air and reconstitute it on the other side?

(6) _____ (you / create / interface) that was much like a game. So they have a 3D environment, they can log into it anywhere in the world on their smartphone, on their tablet. They have different parts of the bots – the physical, the sensors. (7) _____ (they / select / recipes) that have been created by other kids anywhere in the world. They select and activate that recipe, they plant a seedling. While it's growing, they make changes. Does a plant need CO₂? (8) _____ (CO₂ / be / bad for the plants)? Crank up CO₂, plant dies. Or crank down CO₂, plant does very well. Harvest plant, and you've created a new digital recipe.

Discussion

In pairs or in small groups discuss the following questions.

- How was the idea of computerized food production born?
- What is the Food Computer?
- What are the benefits of the Food Computer?
- What could it change in quality of life and nutrition?
- What are the main ideas of the lecture?

Lesson 8.

TXTNG IS KILLING LANGUAGE. JK!!!

(by John McWhorter)

Does texting mean the death of good writing skills? John McWhorter posits that there's much more to texting – linguistically, culturally – than it seems, and it's all good news.

John McWhorter is a linguist, Associate Professor of English and Comparative Literature at Columbia University, teaching linguistics, Western civilization and music history. He thinks about language in relation to race, politics and our shared cultural history.

He is a regular columnist on language matters and race issues for *Time* and *CNN*, writes for the *Wall Street Journal* "Taste" page, and writes a regular column on language for *The Atlantic*.

TED Talk for this lesson is available at: http://www.ted.com/talks/john_mcwhorter_txtng_is_killing_language_jk?language=en

Intro

- Do you prefer to text or to talk on the phone? Why?
- How often do you text?
- Do you consider yourself a fast texter?
- What is your favorite thing about texting?
- Who do you text the most?
- What is John McWhorter's professional background?

Comprehension

Watch the video and answer the questions.

1. Is it true that texting means the decline of literacy?
2. What are the main features of writing?
3. What are the main features of speech?
4. At what condition are we allowed to write as we speak?
5. What is texting? What are the characteristic features of texting?
6. How does the meaning of LOL change over time?

7. What is a pragmatic particle? What pragmatic particles are mentioned in the text?
8. How is slash used in texting among young people today, according to John McWhorter? What is the meaning of slash?

Vocabulary

1. Match the words with their definition.

1. bidialectal	A. a text-based method of digital communication
2. bilingual	B. a word or phrase that is used in speech to support interaction but do not generally add any specific semantic meaning to the message
3. empathy	C. a method of rapid writing by means of abbreviations and symbols, used especially for taking dictation
4. hiccup	D. the ability to read and write
5. JK	E. capable of using two dialects of the same language
6. literacy	F. speaking two languages fluently
7. medium	G. a person or thing that causes great trouble or suffering
8. pragmatic particle	H. the ability to understand and share the feelings of another
9. scourge	I. “just kidding”
10. shorthand	J. a temporary or minor problem or setback
11. slang	K. a number of objects of one kind, especially papers
12. texting	L. a type of language consisting of words and phrases that are regarded as very informal, are more common in speech than writing, and are typically restricted to a particular context or group of people.
13. sheaf	M. to laugh loudly and heartily

14. guffaw	N. a means by which something is communicated or expressed
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2. Practice the words online:

<https://quizlet.com/216145760/txtng-is-killing-language-jk-flash-cards/>

3. Fill in the gaps with the words from Ex.1.

1. A _____, that is what LOL has gradually become.
2. Slash is used in a very different way in _____ among young people today.
3. They condense complicated concepts into _____ words and phrases, saving time.
4. Innovative programs successfully encouraged adults to develop their _____ and numeracy skills.
5. Personally, I am glad I am _____, but I am much more comfortable speaking Spanish than English.
6. Increasing evidence is that being bilingual is cognitively beneficial. That's also true of being _____.
7. Texting is a _____ provoking the decline and fall of any kind of serious literacy, or at least writing ability, among young people in the United States.
8. LOL is being used in a very particular way. It's a marker of _____.
9. "LOL, thanks, gmail is being slow right now." If you think about it, that's not funny. No one's laughing. And yet, there it is, so you assume there's been some kind of _____.
10. The _____ would have changed a little bit since the era of *Love Story*, but they would understand what was on that message board.
11. You can't change the topic while you are texting, and so ways are developing of doing it within this _____.
12. Please show me a _____ of texts written by 16-year-old girls, because I would want to know where this language had developed since our times.

4. Complete the crossword online following the link <http://www.proprofs.com/games/crossword/texting-1/> or in your course book.

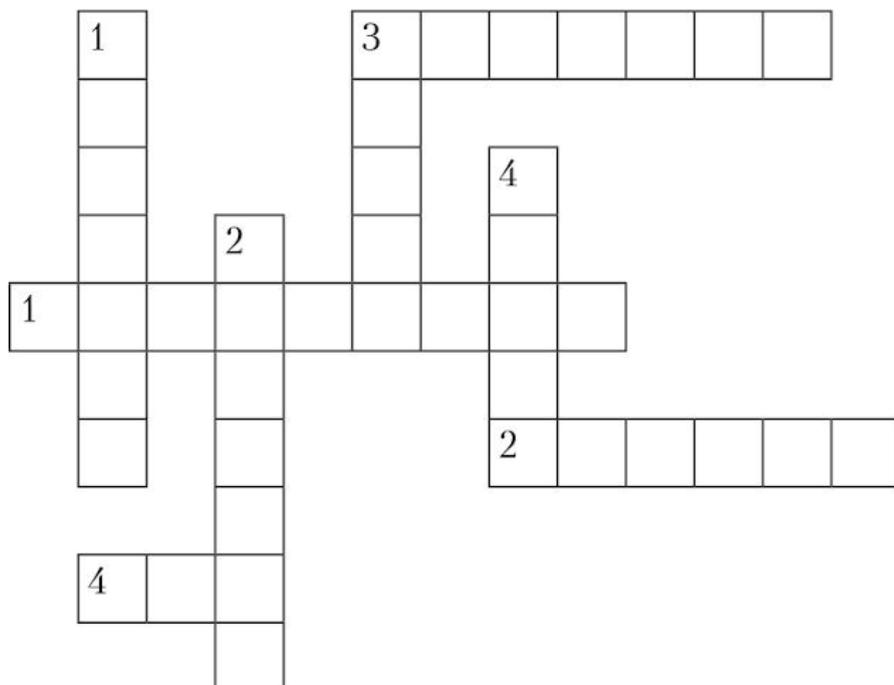
Across

1. Fluently speaking two languages.
2. A temporary or minor problem or setback.
3. A person or thing that causes great trouble or suffering.
4. A pragmatic particle, a marker of empathy.

Down

1. Fingered speech.

2. An extraordinary event that is not explicable by natural or scientific laws and is therefore attributed to a divine medium.
3. A type of language consisting of words and phrases that are regarded as very informal.
4. A new information marker.



Grammar

Adverbs

Adverbs are words that modify:

- a verb:

*That is not the way any human being speaks **casually**.* (How did he speak?);

- an adjective:

*On a manual typewriter, it was **very** difficult to type with the pace of speech.* (How difficult was it?);

- another adverb:

*She texted **quite** slowly.* (How slowly did she text?)

Adverbs describe the reason or location of something, the time or the way something happened. Generally, but not always, they end in *-ly*. It's important to note that not every word ending in *-ly* is an adverb (e.g. *lonely* and *friendly* are adjectives).

There are also cases when the word has the same form as an adjective and an adverb (e.g. *hard*, *early*, *fast*):

*New games require a **fast** processor.* (*Fast* is an adjective)

*The processor speed tells you how **fast** your PC executes instructions. (Fast is an adverb)*

Adverbs can often function as intensifiers, they can be used to:

- emphasize:

*I **really** think that texting is an expansion of the linguistic repertoire.*

*Texting **actually** is evidence of a balancing act that young people are using today;*

- amplify:

*Our freshmen can't spell **completely**.*

*I **absolutely** disagree that texting means the decline of good writing skills;*

- downtone:

*What is going on is a **kind of** emergent complexity.*

*LOL means "laughing out loud" to **some extent**.*

Grammar practice

1. Write an adverbial form for the following words:

- 1) artificial —
- 2) basic —
- 3) exact —
- 4) first —
- 5) genetic —
- 6) latter —
- 7) one —
- 8) disorder —
- 9) shameful —
- 10) casual —

2. Complete the paragraph from the lecture with the adverbs (from the previous exercise) + **most, much, always** and **little**:

(1) _____, if we think about language, language has existed for perhaps 150,000 years, at least 80,000 years, and what it arose as is speech. People (2) _____ talked. That's what we are probably (3) _____ specified for. That is how we use language (4) _____. Writing is something that came along (5) _____ later. There is a (6) _____ bit of controversy as to (7) _____ when that happened, but according to traditional estimates, if humanity had existed for 24 hours, then writing (8) _____ came along at about 11:07 p.m. That's how much of

a latterly thing writing is. So (9) _____ there is speech, and then writing comes along, kind of (10) _____.

Discussion

In pairs or in small groups discuss the following questions:

- What are the positive and negative effects of texting?
- Do you use any “textese” when you text?
- How is texting similar to writing and how is it different?
- Do you agree that texting means the decline of good writing skills?

Lesson 9

WHAT'S WRONG WITH YOUR PA\$SWORD?

(by Lorrie Faith Cranor)

Lorrie Faith Cranor is a Professor in the School of Computer Science and the Engineering and Public Policy Department at Carnegie Mellon University. She studies online privacy, usable security, phishing, spam and other research around keeping us safe online. Lorrie Faith Cranor studied thousands of real passwords to figure out the surprising, very common mistakes that users — and secured sites — make to compromise security. How, you may ask, did she study thousands of real passwords without compromising the security of any users? That's a story in itself. It's secret data worth knowing, especially if your password is 123456...

TED Talk for this lesson is available at: http://www.ted.com/talks/lorrie_faith_cranor_what_s_wrong_with_your_pa_w0rd

Intro

- What is password?
- Why is it important to choose a strong password?
- What should you do to protect your passwords?
- Do you know any tips for good passwords?

Comprehension

Watch the video and answer the questions.

1. What is Cranor's professional background?
2. What is the aim of the research?
3. What is the challenge of the research?
4. What methods of collecting password data are used in the research?
5. How can password strength be measured?
6. Do password meters actually work?
7. What is a potential disadvantage of a password meter?

8. What advice would you give to anyone who wants to create a strong password?

Vocabulary

1. Match the words with their definitions.

1. data set	A. an approximate calculation
2. password entropy	B. occurring or done without definite aim, reason, or pattern
3. rule of thumb	C. a considerable number or amount
4. reluctant	D. a descriptive name added to or replacing the actual name of a person, place, or thing
5. to be susceptible to attackers	E. a measure of the strength of a password
6. to crack	F. something demanded or imposed as an obligation
7. scrambled form	G. to hack
8. nickname	H. to be sensitive to attackers
9. a bunch of	I. unwilling
10. requirement	J. a collection of related sets of information composed of separate elements but can be manipulated as a unit by a computer
11. random	K. coded form

2. Practice the words online:

<https://quizlet.com/216189683/whats-wrong-with-your-paw0rd-flash-cards/>

3. Unscramble the words.

1. rakcc _____
2. amrdno _____
3. ucnbh _____
4. nlimhecaca _____
5. erlntautc _____
6. ypnreto _____
7. traufdefrs _____
8. emblsdca _____

4. **Fill in the gaps with the words from Ex.1. and then discuss them with your group/partner.**

1. What makes you much more _____ reusing your password or writing your password down?
 2. How could we benefit from _____ that our passwords have to have a lot of entropy?
 3. What is the reason that the National Institute of Standards and Technology has a set of guidelines, which have some _____ for measuring entropy?
 4. Why do you think system administrators are _____ to reveal password data to others?
 5. How is the size of the passwords related to the frequency of their appearance in the stolen _____?
 6. What do smarter hackers do for _____ passwords?
5. **Write down the words that have the opposite meaning, e.g. *a dumb attacker* – *a smart attacker*:**

- 1) a known rule –
- 2) a complex password –
- 3) an unusable character –
- 4) an easy policy –
- 5) a strong password –
- 6) a frequent password –
- 7) an effective password meter –
- 8) a positive feedback –
- 9) a random word –
- 10) a memorable phrase –

Grammar

Modal verbs: *have to, can, could, may, might*

- We use ***have to*** to show that we are forced or obliged to do something, to recommend something, to say that something must be true or must happen.

*One of the other policies we tried was called Basic 16, and the only requirement here was that your password **had to have** at least 16 characters.*

- We use *can/could* and *can't/couldn't* to express ability or possibility, to offer to do something, to ask for or give permission, to request something, to offer politely.

*We are doing some research to see if we **can** make that approach work even better.*

Could you check the strength of your password with a password meter?

- We use *may* when we aren't sure about something and to make polite requests.

*Password meters **may** help to make effective passwords.*

- We use *might* when we aren't sure about something, as the past tense of *may* for requests, and for very polite requests.

*He asked if password meters **might** be used to make effective passwords.*

Grammar practice

1. Fill in the gaps with *have to*, *can*, *could*, *may*, and *might* in an appropriate form.

1. One of the requirements of membership was that we _____ have stronger passwords that complied with some new requirements.
2. Why not to have a really good password that you _____ remember but nobody else is able to guess!
3. If password meters would just wait a little bit before giving you a positive feedback, you _____ probably have better passwords.
4. A number of symbols that people are actually using in their passwords _____ measure the password strength.
5. You can make long passwords that are still the sort of thing that an attacker _____ easily guess.
6. When people use a *Basic8* policy, their passwords _____ to consist of at least eight characters.
7. Now we had data from 470 people, but that was really not very much password data, and so we looked around to see where _____ we find additional password data.
8. You _____ get a pass phrase which is more memorable than so called pronounceable passwords.

2. Match a sentence with its purpose.

polite request / not sure about something / something that must be true / past request / possibility / obligation (2) / ability / polite request / advice

1. One of the requirements of membership was that our passwords **had** to have a lot of entropy.
2. *Amazon Mechanical Turk* is a service where you **can** post a small job online and pay people to do a task for you through *Amazon.com*.

3. **Could** I use the same character more than three times?
4. To protect your computer you simply **have** to change your password every two weeks.
5. There **has** to be a reason for the information security office at Carnegie Mellon to be reluctant to share the passwords with the researchers.
6. Instead of telling people that they need to put all these symbols and numbers into their passwords, we **might** be better just telling people to have long passwords.
7. She wondered if she **might** use a dictionary word as her password.
8. May I use a pass phrase instead of a password?
9. In the Carnegie Mellon University, they **have to have** eight characters including uppercase, lowercase, digit, symbol in their password.
10. We **can** collect some good password data if we study 5 000 passwords.

Discussion

In pairs or in small groups discuss the following questions:

- Do you know how to create strong passwords?
- What rules mentioned in the lecture do you follow when creating your own passwords?
- Do you believe that password meters work?
- Do you use passphrases instead of passwords?
- Do you educate your friends, parents or grandparents on using secure passwords?

Lesson 10

WHY MASSIVE OPEN ONLINE COURSES (STILL) MATTER

(by Anant Agarwal)

2013 was a year of hype for MOOCs (massive open online courses). MOOCs still matter — as a way to share high-level learning widely and supplement (but perhaps not replace) traditional classrooms. Anant Agarwal shares his vision of blended learning, where teachers create the ideal learning experience for 21st century students.

TED Talk for this lesson is available at: http://www.ted.com/talks/anant_agarwal_why_massively_open_online_courses_still_matter?language=en

Intro

- What is MOOC?
- When and where did MOOCs first appear?
- What are the advantages and disadvantages of MOOCs?
- Have you ever taken a MOOC?
- What is your opinion about eLearning?

Comprehension

Watch the video and answer the questions.

1. What was the last big innovation in education according to Agarwal?
2. What does, in terms of education, “going from ox carts to the airplane” mean?
3. What was the name of the first course MIT (The Massachusetts Institute of Technology) launched? How many students enrolled in the course? How many of them passed the course?
4. How is a flipped classroom organized?
5. How did the failure rate change in blended learning classroom?

6. What key principles ensure the efficiency of MOOCs?
7. What does it mean to reimagine and revolutionize education?

Vocabulary

1. Match the words with their definitions.

1. Massive Open Online Course (MOOC)	A. the use of imagination or original ideas to create something; inventiveness
2. blended learning	B. an educational practice in which students interact with other students to attain educational goals
3. flipped classroom	C. a method of learning in which students are actively or experientially involved in the learning process. It is a model of instruction that focuses the responsibility of learning on learners
4. pilot	D. an online course aimed at unlimited participation and open access via the Web
5. failure rate	E. a thing that prevents someone from concentrating on something else
6. active learning	F. an instructional strategy that reverses the traditional learning environment by delivering instructional content outside of the classroom; class that explores topics in greater depth and creates meaningful learning opportunities
7. gamification	G. number of failures per academic unit
8. peer learning	H. something done as an experiment or a test
9. distraction	I. a preference or special liking for something
10. creativity	J. an education program that combines online digital media with traditional classroom methods
11. alumni	K. an educational approach to motivate students to learn by using game design and game elements in learning environments
12. predilections	L. a graduate of a specific school, college or university

2. Practice the words online:

<https://quizlet.com/192479966/moocs-flash-cards/>

3. Fill in the gaps with the words from Ex.1.

1. At *edX* and a number of other organizations, we are applying these technologies to education through _____ to really increase access to education.
2. Two high school teachers at the Sant High School in Mongolia _____ their classroom, and their students watched video lectures and completed interactive exercises at home and then they came into class to interact with each other and do some physical laboratory work.
3. We applied these _____ techniques to learning, to engage the students more in the learning process and teach them _____.
4. Discussion forums and Facebook-like interaction is not _____, but it really helps students to learn.
5. Learning from each other and learning by teaching is _____.
6. We did a _____ experimental blended courses, working with San Jose State University in California with the circuits and electronics course.
7. With this blended class last year, the _____ fell to nine percent.
8. _____ provides much better results especially when the students are interacting with material.
9. Technologies that we are developing to create a _____ of education help us to reinvent what we do in the classroom.
10. 155,000 students from 162 countries enrolled in this very first course. This number is bigger than the total number of MIT _____ in its 150-year history.
11. But what if we embraced technology, embraced the millennial generation's natural _____, and blend them into their lives.

Grammar

Present and Past Tenses

There are four present tense forms in English:

Tense	Form
Present Simple	<i>I work</i>
Present Continuous	<i>I am working</i>
Present Perfect	<i>I have worked</i>
Present Perfect Continuous	<i>I have been working</i>

We use these forms to talk about:

- the present:

*He **is** the student of the IT faculty at the Higher School of Economics. He **has been studying** here for three months.*

*University education always **aims** at delivering knowledge and skills relevant to a profession.*

*He **is writing** a code in Google. He **has been coding** for three years;*

- the future:

*The new MOOC on Linux **starts** next week.*

*We are **going to be** up monitoring the forum, answering questions.*

*I'll get a new promotion as soon as I **have finished** course.*

*You will be tired out after you **have been working** all night;*

- the past:

*So one night I am **sitting** up there, at 2 a.m. at night, and **I think** about the question from a student from Pakistan.*

There are four past tense forms in English:

Tense	Form
Past Simple	<i>I worked</i>
Past Continuous	<i>I was working</i>
Past Perfect	<i>I had worked</i>
Past Perfect Continuous	<i>I had been working</i>

We use these forms:

- to talk about the past:

*He **studied** at the IT faculty of the Higher School of Economics. He **had studied** there since September.*

*The students **were discussing** and **interacting** with each other and by 4 a.m. in the morning, they **had discovered** the right answer;*

- to refer to the present or future in conditions:

*If you **were** like me, by the fifth minute I **would lose** the professor.*

- to refer to hypotheses and wishes:

*A student **might** watch a five-, seven-minute video and **followed** that with an interactive exercise.*

*I wish it **wasn't** so time consuming to complete this online course.*

- to talk about the present in a few polite expressions:

*Excuse me, I **was wondering** if this were the computer-graded exercises.*

*I just **hoped** you **would** be able to help me with giving the students feedback.*

- to talk about the action happened before another action in the past:

*Before the teacher **could** finish typing his answer to the question, a student from the U.S. **had popped** in with a different answer.*

Grammar practice

Complete this paragraph (on peer learning) from the lecture with the verbs given. Use these tenses – Present Simple, Present Continuous, Past Simple, Present Perfect, Past Perfect – giving alternatives where possible.

So here, we (1) _____ (use) discussion forums and discussions and *Facebook*-like interaction not as a distraction, but to really help students learn. Let me tell you a story. When we (2) _____ (do) our circuits course for the 155,000 students, I (3) _____ (sleep) for three nights leading up to the launch of the course. I (4) _____ (tell) my TAs, OK, 24/7, we (5) _____ (be) going to be up monitoring the forum, answering questions. They (6) _____ (answer) questions for 100 students. How (7) _____ you _____ (do) that for 150,000?

So one night I (8) _____ (sit) up there, at 2 a.m. at night, and I (9) _____ (think) there (10) _____ (be) this question from a student from Pakistan, and he (11) _____ (ask) a question, and I said, OK, let me go and type up an answer. I (12) _____ (type) all that fast, and I (13) _____ (begin) typing up the answer. Before I (14) _____ (finish), another student from Egypt (15) _____ (pop) in with an answer, not quite right, so I (16) _____ (fix) the answer. Before I (17) _____ (finish), a student from the U.S. (18) _____ (pop) in with a different answer. Then I (19) _____ (sit) back, fascinated. Boom, boom, boom, boom, the students (20) _____ (discuss) and interacting with each other, and by 4 a.m. that night, I (21) totally _____ (fascinate), having this epiphany. By 4 a.m. in the morning, they (22) _____ (discover) the right answer. All I had to do was go and

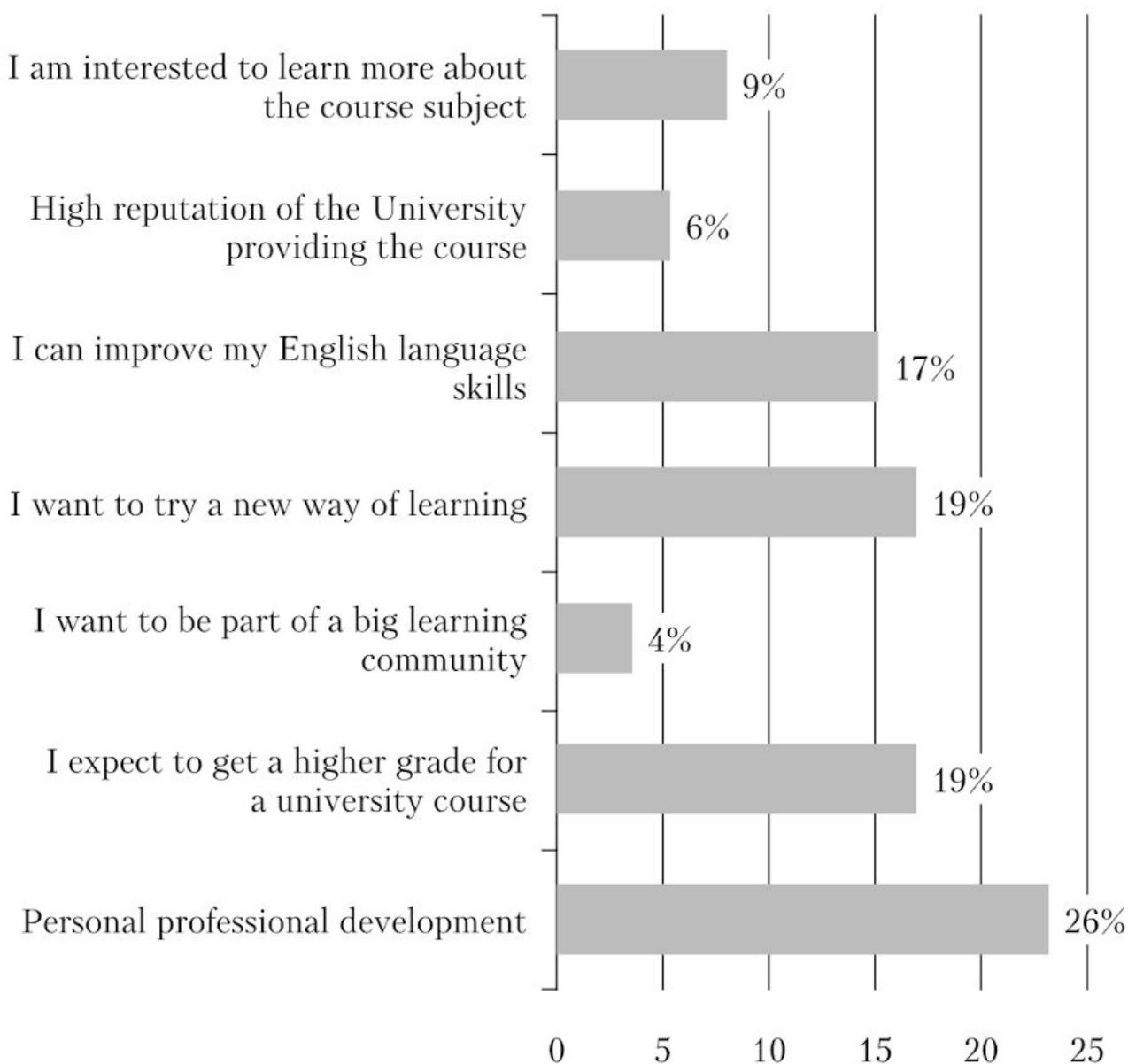
bless it, “Good answer.” So this is absolutely amazing, where students (23) _____ (learn) from each other, and they (24) _____ (tell) us that they (25) _____ (learn) by teaching.

Discussion

In pairs or in small groups discuss the following.

The students who have taken a MOOC as a part of their university course were asked to rate various scenarios from strongly disagree to strongly agree¹. Describe the information given in the graphs to your partner².

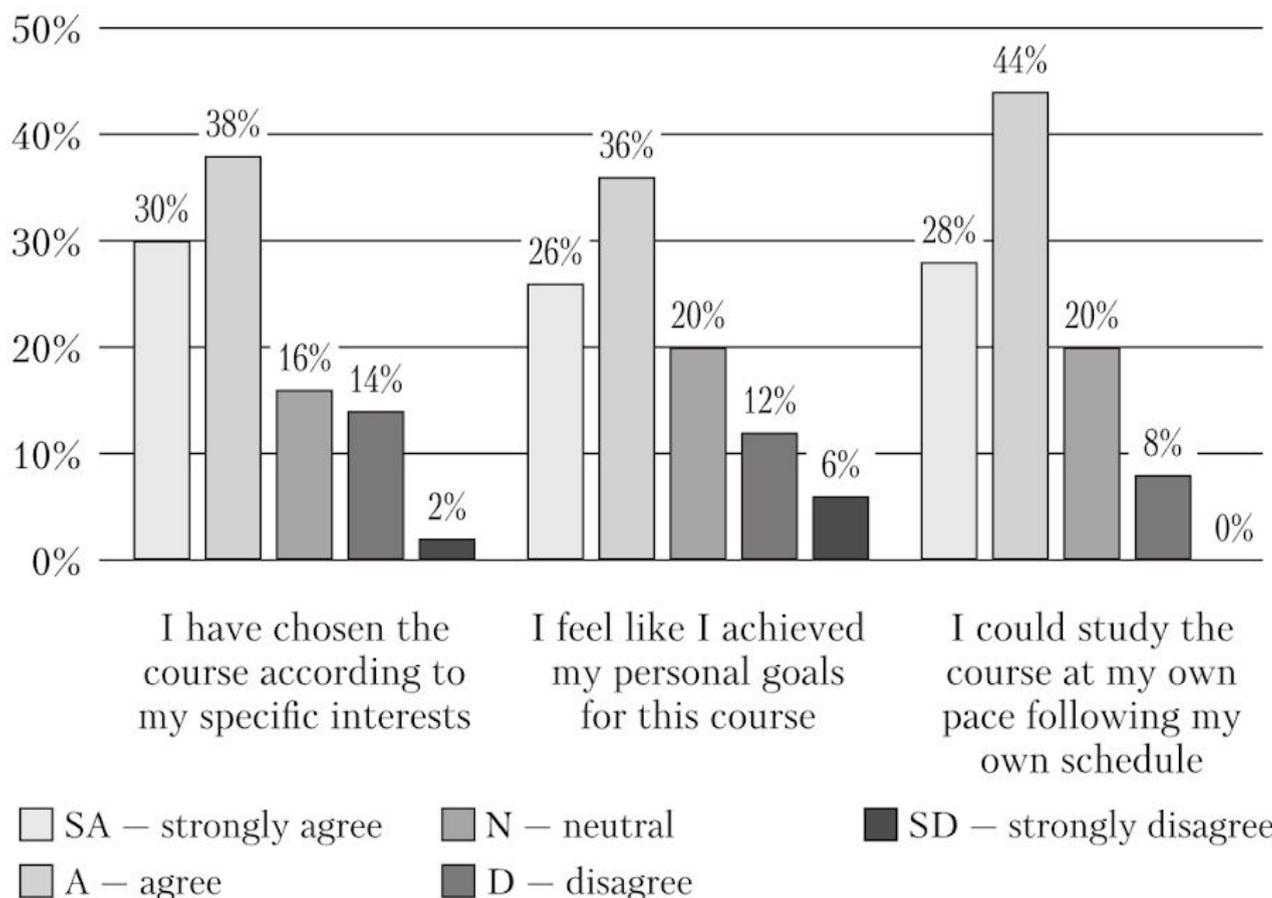
1. The reasons for taking a MOOC.



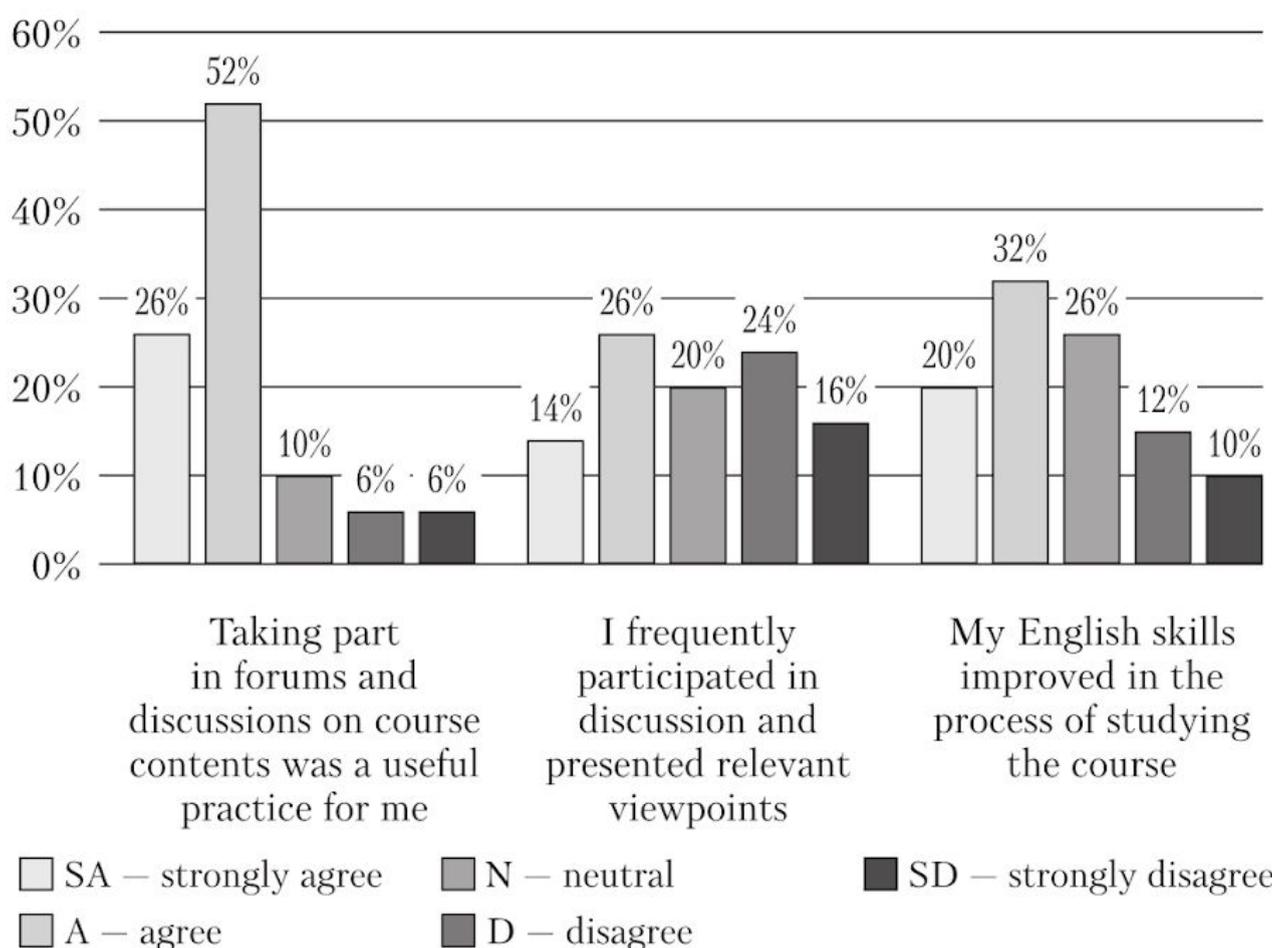
¹ Stognieva O. The integration of MOOCs into the University ESP course curriculum: Beliefs and Practices // Professional and Academic English. 2016. No. 48. P. 25–33.

² For some useful vocabulary and grammar see Appendix 3 “Tips for describing bar charts.”

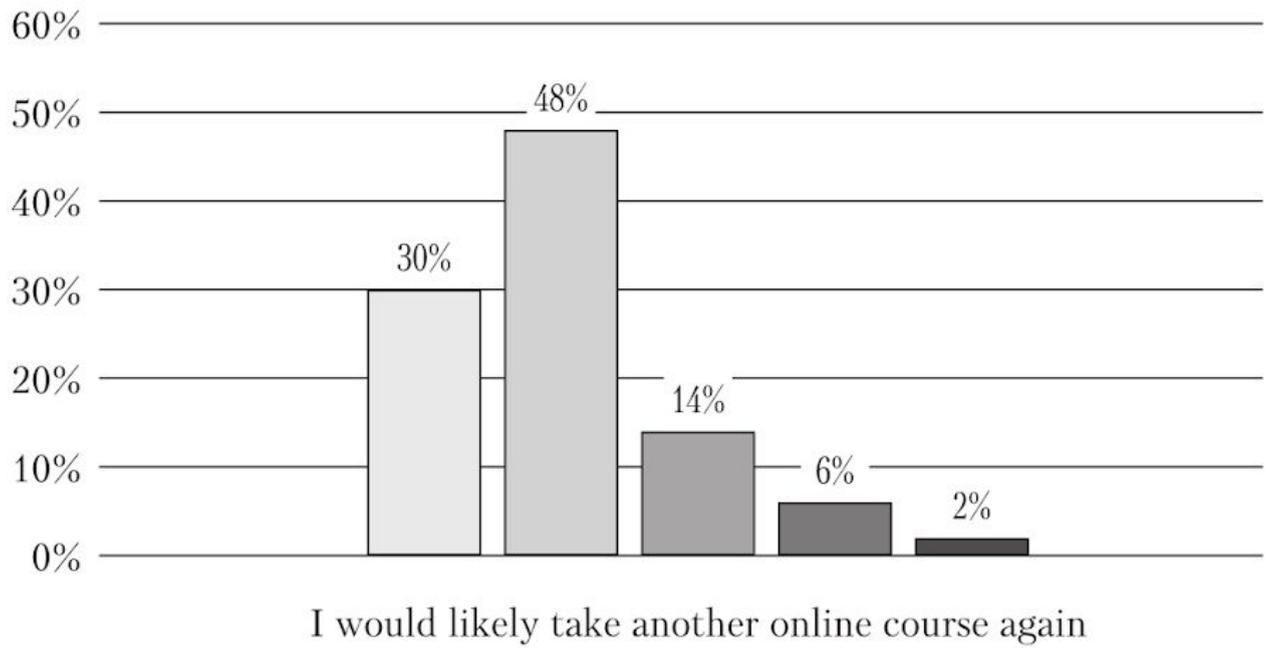
2. Personalization of online learning.



3. How students participating in MOOCs can contribute to the learning community.



4. Motivation to continue online education.



Very likely Likely Neutral Unlikely Very unlikely

II. TRANSCRIPTS



1. Can we build AI without losing control over it?¹

I am going to talk about a failure of intuition that many of us suffer from. It's really a failure to detect a certain kind of danger. I am going to describe a scenario that I think is both terrifying and likely to occur, and that's not a good combination, as it turns out. And yet rather than be scared, most of you will feel that what I am talking about is kind of cool.

I am going to describe how the gains we make in Artificial Intelligence could ultimately destroy us. And in fact, I think it's very difficult to see how they won't destroy us or inspire us to destroy ourselves. And yet if you are anything like me, you'll find that it's fun to think about these things. And that response is part of the problem. OK? That response should worry you. And if I were to convince you in this talk that we were likely to suffer a global famine, either because of climate change or some other catastrophe, and that your grandchildren, or their grandchildren, are very likely to live like this, you wouldn't think, "Interesting. I like this *TED Talk*."

Famine isn't fun. Death by science fiction, on the other hand, is fun, and one of the things that worries me most about the development of AI at this point is that we seem unable to marshal an appropriate emotional response to the dangers that lie ahead. I am unable to marshal this response, and I am giving this talk.

It's as though we stand before two doors. Behind door number one, we stop making progress in building intelligent machines. Our computer hardware and software just stops getting better for some reason. Now take a moment to consider why this might happen. I mean, given how valuable intelligence and automation are, we will continue to improve our technology if we are at all able to. What could stop us from doing this? A full-scale nuclear war? A global pandemic? An asteroid impact? Justin Bieber becoming president of the United States?

The point is, something would have to destroy civilization as we know it. You have to imagine how bad it would have to be to prevent us from making improvements in our technology permanently, gen-

¹ *Harris S.* Can we build AI without losing control over it? : transcript // TED. 2016. June. URL: https://www.ted.com/talks/sam_harris_can_we_build_ai_without_losing_control_over_it/transcript?language=en

eration after generation. Almost by definition, this is the worst thing that's ever happened in human history.

So the only alternative, and this is what lies behind door number two, is that we continue to improve our intelligent machines year after year after year. At a certain point, we will build machines that are smarter than we are, and once we have machines that are smarter than we are, they will begin to improve themselves. And then we risk what the mathematician I. J. Good¹ called an “intelligence explosion,”² that the process could get away from us.

Now, this is often caricatured, as I have here, as a fear that armies of malicious robots will attack us. But that isn't the most likely scenario. It's not that our machines will become spontaneously malevolent. The concern is really that we will build machines that are so much more competent than we are that the slightest divergence between their goals and our own could destroy us.

Just think about how we relate to ants. We don't hate them. We don't go out of our way to harm them. In fact, sometimes we take pains not to harm them. We step over them on the sidewalk. But whenever their presence seriously conflicts with one of our goals, let's say when constructing a building like this one, we annihilate them without a qualm. The concern is that we will one day build machines that, whether they're conscious or not, could treat us with similar disregard.

Now, I suspect this seems far-fetched to many of you. I bet there are those of you who doubt that superintelligent AI is possible, much less inevitable. But then you must find something wrong with one of the following assumptions. And there are only three of them.

Intelligence is a matter of information processing in physical systems. Actually, this is a little bit more than an assumption. We have already built narrow intelligence into our machines, and many of these machines perform at a level of superhuman intelligence already. And we know that mere matter can give rise to what is called “general intelligence”, an ability to think flexibly across multiple domains, because our brains have managed it. Right? I mean, there's just atoms in here, and as long as we continue to build systems of atoms that display more and more intelligent behavior, we will eventually, unless we are interrupted, we will eventually build general intelligence into our machines.

¹ Irving John Good (9 December 1916 – 5 April 2009) was a British mathematician who worked as a cryptologist at Bletchley Park with Alan Turing. An originator of the concept now known as “intelligence explosion.”

² The intelligence explosion is the expected outcome of the hypothetically forthcoming technological singularity, that is, the result of humanity building artificial general intelligence (AGI). AGI would be capable of recursive self-improvement leading to the emergence of ASI (artificial superintelligence), the limits of which are unknown.

It's crucial to realize that the rate of progress doesn't matter, because any progress is enough to get us into the end zone. We don't need Moore's law¹ to continue. We don't need exponential progress. We just need to keep going.

The second assumption is that we will keep going. We will continue to improve our intelligent machines. And given the value of intelligence — I mean, intelligence is either the source of everything we value or we need it to safeguard everything we value. It is our most valuable resource. So we want to do this. We have problems that we desperately need to solve. We want to cure diseases like Alzheimer's and cancer. We want to understand economic systems. We want to improve our climate science. So we will do this, if we can. The train is already out of the station, and there's no brake to pull.

Finally, we don't stand on a peak of intelligence, or anywhere near it, likely. And this really is the crucial insight. This is what makes our situation so precarious, and this is what makes our intuitions about risk so unreliable.

Now, just consider the smartest person who has ever lived. On almost everyone's shortlist here is John von Neumann². I mean, the impression that von Neumann made on the people around him, and this included the greatest mathematicians and physicists of his time, is fairly well-documented. If only half the stories about him are half-true, there's no question he's one of the smartest people who has ever lived. So consider the spectrum of intelligence. Here we have John von Neumann. And then we have you and me. And then we have a chicken. Sorry, a chicken. There's no reason for me to make this talk more depressing than it needs to be.

It seems overwhelmingly likely, however, that the spectrum of intelligence extends much further than we currently conceive, and if we build machines that are more intelligent than we are, they will very likely explore this spectrum in ways that we can't imagine, and exceed us in ways that we can't imagine.

And it's important to recognize that this is true by virtue of speed alone. Right? So imagine if we just built a superintelligent AI that was no smarter than your average team of researchers at Stanford or MIT. Well, electronic circuits function about a million times faster than

¹ Moore's law is the observation that the number of transistors in a dense integrated circuit doubles approximately every two years.

² John von Neumann (1903–1957) was a Hungarian-born American mathematician. His gift for applied mathematics contributed to the development of quantum theory, automata theory, economics, and defense planning. Von Neumann pioneered game theory and, along with Alan Turing and Claude Shannon, was one of the conceptual inventors of the stored-program digital computer. (*Encyclopedia Britannica*)

biochemical ones, so this machine should think about a million times faster than the minds that built it. So you set it running for a week, and it will perform 20,000 years of human-level intellectual work, week after week after week. How could we even understand, much less constrain, a mind making this sort of progress?

The other thing that's worrying, frankly, is that, imagine the best-case scenario. So imagine we hit upon a design of superintelligent AI that has no safety concerns. We have the perfect design the first time around. It's as though we've been handed an oracle that behaves exactly as intended. Well, this machine would be the perfect labor-saving device. It can design the machine that can build the machine that can do any physical work, powered by sunlight, more or less for the cost of raw materials. So we are talking about the end of human drudgery. We are also talking about the end of most intellectual work.

So what would apes like ourselves do in this circumstance? Well, we'd be free to play Frisbee and give each other massages. Add some LSD and some questionable wardrobe choices, and the whole world could be like *Burning Man*.

Now, that might sound pretty good, but ask yourself: what would happen under our current economic and political order? It seems likely that we would witness a level of wealth inequality and unemployment that we have never seen before. Absent a willingness to immediately put this new wealth to the service of all humanity, a few trillionaires could grace the covers of our business magazines while the rest of the world would be free to starve.

And what would the Russians or the Chinese do if they heard that some company in Silicon Valley was about to deploy a superintelligent AI? This machine would be capable of waging war, whether terrestrial or cyber-, with unprecedented power. This is a winner-take-all scenario. To be six months ahead of the competition here is to be 500,000 years ahead, at a minimum. So it seems that even mere rumors of this kind of breakthrough could cause our species to go berserk.

Now, one of the most frightening things, in my view, at this moment, are the kinds of things that AI researchers say when they want to be reassuring. And the most common reason we are told not to worry is time. This is all a long way off, don't you know. This is probably 50 or 100 years away. One researcher has said, "Worrying about AI safety is like worrying about overpopulation on Mars." This is the Silicon Valley version of "don't worry your pretty little head about it."

No one seems to notice that referencing the time horizon is a total non sequitur. If intelligence is just a matter of information processing, and we continue to improve our machines, we will produce some form of superintelligence. And we have no idea how long it will take us to

create the conditions to do that safely. Let me say that again. We have no idea how long it will take us to create the conditions to do that safely.

And if you haven't noticed, 50 years is not what it used to be. This is 50 years in months. This is how long we've had the *iPhone*. This is how long *The Simpsons* has been on television. Fifty years is not that much time to meet one of the greatest challenges our species will ever face. Once again, we seem to be failing to have an appropriate emotional response to what we have every reason to believe is coming.

The computer scientist Stuart Russell¹ has a nice analogy here. He said, imagine that we received a message from an alien civilization, which read: "People of Earth, we will arrive on your planet in 50 years. Get ready." And now we are just counting down the months until the mothership lands? We would feel a little more urgency than we do.

Another reason we are told not to worry is that these machines can't help but share our values because they will be literally extensions of ourselves. They'll be grafted onto our brains, and we'll essentially become their limbic systems. Now take a moment to consider that the safest and only prudent path forward, recommended, is to implant this technology directly into our brains. Now, this may in fact be the safest and only prudent path forward, but usually one's safety concerns about a technology have to be pretty much worked out before you stick it inside your head.

The deeper problem is that building superintelligent AI on its own seems likely to be easier than building superintelligent AI and having the completed neuroscience that allows us to seamlessly integrate our minds with it. And given that the companies and governments doing this work are likely to perceive themselves as being in a race against all others, given that to win this race is to win the world, provided you don't destroy it in the next moment, then it seems likely that whatever is easier to do will get done first.

Now, unfortunately, I don't have a solution to this problem, apart from recommending that more of us think about it. I think we need something like a Manhattan Project on the topic of Artificial Intelligence. Not to build it, because I think we'll inevitably do that, but to understand how to avoid an arms race and to build it in a way that is aligned with our interests. When you are talking about superintelligent AI that can make changes to itself, it seems that we only have one chance to get the initial conditions right, and even then we will need to absorb the economic and political consequences of getting them right.

¹ Stuart Jonathan Russell (born 1962) is a Professor of Computer Science at University of California, Berkeley, known for his contributions to Artificial Intelligence.

But the moment we admit that information processing is the source of intelligence, that some appropriate computational system is what the basis of intelligence is, and we admit that we will improve these systems continuously, and we admit that the horizon of cognition very likely far exceeds what we currently know, then we have to admit that we are in the process of building some sort of god. Now would be a good time to make sure it's a god we can live with.

Thank you very much.

2. Five cool uses for a USB flash drive¹

Hey guys! I am Sharon Vaknin and if you have a USB flash drive, it's probably because at some point you need a way to carry your files and documents around with you. Or if you are like me, you have a drawer full of drives you got from marketers at conventions and events. And at the most basic level flash drives are good for storing anything from documents to photos and music. But there are actually a bunch of other cool ways you can use these little guys, and today I'll show you a few of my favorites.

The secret agent in all of us will love this first trick, which lets you use your USB drive to lock and unlock your computer. With the free program called *Predator* you can turn your drive into a key that keeps your computer unlocked when it's plugged in, but when you remove it your computer locks down and will deny access to anyone who doesn't have the USB drive or your unique password.

More portable than your tablet or smartphone, your USB drive can run apps too. You can carry around programs like *Firefox*, *Chrome* and *Open Office* and use your drive to run them on any computer. Just download the *Portableapps* platform from *Portableapps.com* to get started. Once you get the software on your drive, you'll be able to choose which apps you want to install on it. There are many to choose from like games, browsers and a bunch of useful utilities.

If you are hit with the virus that renders your system useless, you can use a USB drive to get yourself up and running again. First go to *avg.com* on another computer and load the *AVG rescue CD software* onto the USB drive. Then plug it into the crippled PC. *AVG* will scan your computer for malware and, hopefully, get you back to work in no time.

With *Windows 8* on the horizon, you might be wondering what's in store for *Microsoft's* next operating system. Well, you can check out

¹ CNET How to: Five cool uses for a USB flash drive // Youtube. 04.05.2012. URL: <https://youtu.be/wGcn3RnnqTc>

Windows 8 without overriding your current operating system by booting it from your USB flash drive. That way you can test drive *Windows 8* and go back to your current operating system whenever you want. There are some requirements and a few semi-advanced steps, so check out Seth Rosenblatt's complete instructions and this how-to video on *CNet TV*.

And of course, if all you want to do is use this thing for storing data, don't forget to encrypt it, especially if you have top secret information on your drive. *TrueCrypt* is a free program that will encrypt or scramble the data of your USB drive and protect it with a secure password only you know. So, if you lose this flash drive, your information will remain secure.

So there you have it, five cool new uses for a USB flash drive. To find more detailed instructions for all the ideas I mentioned, head on over to *How-to.cnet.com* and tweet me if you have any ideas we missed.

3. How does a hard disk work?¹

A whole computer is a powerful tool but it must store data reliably to work well. Otherwise, it's kind of pointless, isn't it? Let's look inside and see how it stores data.

Look at that. It's marvellous. It's an ordinary hard drive but its details, of course, are extraordinary.

Now, I am sure you know the essence of a hard drive. We store data on it in binary form, ones and zeros.

Now, this arm supports a head, which is an electromagnet that scans over the disc and either writes data by changing the magnetization of specific sections on the platter or it just reads the data by measuring the magnetic polarization. In principle pretty simple but in practice a lot of hardcore engineering. The key focus lies in being sure that the head can precisely, error-free read and write to the disk. The first order of business is to move it with great control. To position the arm engineers use a voice coil actuator. The base of the arm sits between two powerful magnets. They are so strong they're actually kind of hard to pull apart. There. The arm moves because of the Lorentz force: pass a current through a wire that's in a geomagnetic field, and the wire experiences a force. Reverse the current, and the force also reverses. As current flows in one direction in the coil, the force created by the permanent magnet makes the arm move this way. Reverse the current, and it moves back. The force of the arm is directly proportional to the

¹ Hard Disk Working | How does a hard disk work | Hard Drive // Youtube. 18.06.2013. URL: <https://youtu.be/4iaxOUYalJU>

current through the coil, which allows the arm's position to be finely tuned. Unlike a mechanical system of linkages, there is minimal wear and it isn't sensitive to temperature.

At the end of the arm lies the most critical component, the head. At it's simplest it's a piece of ferromagnetic material wrapped with wire. As it passes over the magnetized sections of the platter, it measures changes in the direction of the magnetic poles. We call it Faraday's law. A change in magnetization produces a voltage in a nearby coil. So, as the head passes a section where the polarity has changed, it records a voltage spike. The spike's both negative and positive represent a one, and where there is no voltage spike corresponds to a zero.

The head gets astonishingly close to the disk surface. A hundred nanometers in older drives, but today under ten nanometers in the newest ones. As the head gets closer to the disc, its magnetic field covers less area allowing for more sectors of information to be packed onto the disk surface. To keep that critical height engineers use an ingenious method. They float the head over the disk. You see, as the disk spins, it forms a boundary layer of air that gets dragged past the stationary head at 80 miles per hour at the outer edge. The head rides on a slider aerodynamically designed to float above the platter, and the genius of this air-bearing technology is its self-induced adjustment. If any disturbance causes the slider to rise too high, it floats back to where it should be.

Now, because the head is so close to the disk surface, any stray particles could damage the disc, resulting in data loss. So engineers place this recirculating filter in the airflow. It removes small particles scraped off the platter.

To keep the head flying at the right height the platter is made incredibly smooth. Typically, this platter is so smooth that it has a surface roughness of about one nanometer. To give you an idea of how smooth that is, let's imagine that this section is enlarged until it is as long as a football field, American or international. The average bump on the surface would be about three hundredths of an inch. The key element of the platter is the magnetic layer, which is cobalt with perhaps platinum and nickel mixed in. Now, this mixture of metals has high coercivity, which means that it will maintain that magnetization and thus data until it's exposed to another powerful magnetic field.

One last thing that I find enormously clever: using a bit of math to squeeze up to forty percent more information on the disk. Consider this sequence of magnetic poles on the disk surface: 0 1 0 1 1 1. A scan by the head would reveal these distinct voltage spikes, both positive or negative for the ones. We would be easily able to distinguish it from, say, this similar sequence. If we compare them, they clearly dif-

fer. Engineers, though, always work to get more and more data onto a hard drive. One way to do this is to shrink the magnetic domains, but look what happens to the voltage spikes when we do this. For each sequence, the spikes of the ones now overlap and superimpose giving fuzzy signals. In fact, the two sequences now look very similar. Using a technique called “partial response maximum likelihood” engineers have developed sophisticated codes that can take a murky signal like this, generate the possible sequences that could make it up and then choose the most probable.

As with any successful technology, these hard drives remain unnoticed in our daily lives unless something goes wrong.

4. How the Internet works in five minutes¹

So, how does the Internet work? Most of us know how to use the Internet without actually understanding how it works, sort of like electricity in your home. You use it every day but may not understand the mechanics behind it. And if the electric grid is difficult to understand, then the Internet must be impossible. Right? Wrong! In the next few minutes, I’ll put you in the top 10% of people who understand how the Internet actually works. For *security catalyst.com*, I am Aaron Titus.

Whenever most people think of the Internet, this is what comes to mind. The Internet is not a bubble cloud, even in the new age of cloud computing. The whole fuzzy cloud picture was created by people more concerned about job security than education. *This* is the Internet. The Internet is a wire actually buried in the ground. It might be fiber optics, copper or occasionally being due satellites or through cellphone networks but the Internet is simply a wire. The Internet is useful because two computers connected directly to this wire can communicate. A server is a special computer connected directly to the Internet, and webpages are files on that server’s hard drive. Every server has a unique Internet protocol address, or IP address. Just like a postal address, IP addresses help computers find each other. But since 72.14.205.100 doesn’t exactly roll off the tongue, we also give them names like *google.com*, *facebook.com* or *securitycatalyst.com*.

So, this is how it works. Your computer at home is not a server because it’s not connected directly to the Internet. Computers you and I use every day are called clients because they’re connected indirectly to the Internet through an Internet service provider. Here we’ll pre-

¹ How the Internet Works in 5 Minutes // Youtube. 18.02.2009. URL: https://www.youtube.com/watch?v=7_LPdttKXPc

tend that this is my home laptop and I am using DSL. Now let's pretend that I want to visit *aol.com* which is coincidentally both a server and an ISP. I hop onto my laptop with DSL, go through my ISP onto the Internet and look at *aol.com*. My computer connects with *aol.com*, and I can look at these webpages.

Now let's say that I want to send an e-mail to Aunt Ruth, and Ruth has AOL dial up from home, and I've got a *Gmail* account.

I log on to *gmail.com* and compose a message to Aunt Ruth's e-mail address *auntruth@aol.com*.

Once I click "Send", *gmail.com* sends the email to *aol.com*. The next day Aunt Ruth dials into AOL servers and retrieves the email. Whenever an email, picture or webpage travels across the Internet, computers break the information into smaller pieces called packets. When information reaches its destination, the packets are reassembled in their original order to make a picture, email, webpage or tweet.

OK, so imagine you are at work sitting next to your boss and you are both surfing online. Your boss is doing a market research and you are updating your *Facebook* profile. You are both sending packets back and forth over the Internet, but what's to keep your packets from accidentally ending up on your boss's screen? That could be embarrassing. The solution to that problem is IP addresses and routers. Everything is connected directly or indirectly to the Internet has an IP address, everything.

That includes your computer, servers, cell phones and all of the equipment in between. Anywhere two or more parts of the Internet intersect, there's a piece of equipment called a router. Routers direct your packets around the Internet helping each packet get one step closer to its destination. very time you visit a website, upwards of 10 to 15 riders may help your packets find their way to and from your computer.

Imagine each packet as a piece of candy wrapped in several layers. The first layer is your computer's IP address. Your computer sends the packet to the first router, which adds its own IP address. Each time the packet reaches a new router, another layer is added until it reaches the server. Then, when the server sends back information, it creates packets with an identical wrapping. As a packet makes its way over the Internet back to your computer, each router unwraps a layer to discover where to send the packet next until it reaches your computer and not your bosses.

And that's how the Internet works in five minutes or less, and you are now easily in the top 10% of people who understand the basics of the Internet. If you found this video helpful, check out *securitycatalyst.com*, for all kinds of ideas on how to protect your information.

5. How to live before you die¹

I am honored to be with you today at your commencement from one of the finest universities in the world. Truth be told, I never graduated from college, and this is the closest I've ever gotten to a college graduation. Today I want to tell you three stories from my life. That's it. No big deal. Just three stories.

The first story is about connecting the dots.

I dropped out of Reed College after the first six months, but then stayed around as a drop-in for another eighteen months or so before I really quit. So why did I drop out?

It started before I was born. My biological mother was a young, unwed college graduate student, and she decided to put me up for adoption. She felt very strongly that I should be adopted by college graduates, so everything was all set for me to be adopted at birth by a lawyer and his wife. Except that when I popped out they decided at the last minute that they really wanted a girl. So my parents, who were on a waiting list, got a call in the middle of the night asking: "We've an unexpected baby boy; do you want him?" They said: "Of course." My biological mother found out later that my mother had never graduated from college and that my father had never graduated from high school. She refused to sign the final adoption papers. She only relented a few months later when my parents promised that I would go to college. This was the start in my life.

And 17 years later I did go to college. But I naively chose a college that was almost as expensive as Stanford, and all of my working-class parents' savings were being spent on my college tuition. After six months, I couldn't see the value in it. I had no idea what I wanted to do with my life and no idea how college was going to help me figure it out. And here I was, spending all of the money my parents had saved their entire life. So I decided to drop out and trust that it would all work out OK. It was pretty scary at the time, but looking back it was one of the best decisions I ever made. The minute I dropped out I could stop taking the required classes that didn't interest me, and begin dropping in on the ones that looked far more interesting.

It wasn't all romantic. I didn't have a dorm room, so I slept on the floor in friends' rooms; I returned Coke bottles for the 5¢ deposits to buy food with; and I would walk the 7 miles across town every Sunday night to get one good meal a week at the Hare Krishna temple. I loved it. And much of what I stumbled into by following my curiosity

¹ *Jobs S.* How to live before you die // TED. 2005. June. URL: https://www.ted.com/talks/steve_jobs_how_to_live_before_you_die

and intuition turned out to be priceless later on. Let me give you one example.

Reed College at that time offered perhaps the best calligraphy instruction in the country. Throughout the campus every poster, every label on every drawer, was beautifully hand calligraphed. Because I had dropped out and didn't have to take the normal classes, I decided to take a calligraphy class to learn how to do this. I learned about serif and sans serif typefaces, about varying the amount of space between different letter combinations, about what makes great typography great. It was beautiful, historical, artistically subtle in a way that science can't capture, and I found it fascinating.

None of this had even a hope of any practical application in my life. But ten years later, when we were designing the first *Macintosh* computer, it all came back to me. And we designed it all into the *Mac*. It was the first computer with beautiful typography. If I had never dropped in on that single course in college, the *Mac* would have never had multiple typefaces or proportionally spaced fonts. And since *Windows* just copied the *Mac*, it's likely that no personal computer would have them. If I had never dropped out, I would have never dropped in on this calligraphy class, and personal computers might not have the wonderful typography that they do. Of course, it was impossible to connect the dots looking forward when I was in college. But it was very, very clear looking backwards ten years later.

Again, you can't connect the dots looking forward; you can only connect them looking backwards. So you have to trust that the dots will somehow connect in your future. You have to trust in something — your gut, destiny, life, karma, whatever. Because believing that the dots will connect down the road will give you the confidence to follow your heart, even if when it leads you off the well-worn path, and that will make all the difference.

My second story is about love and loss.

I was lucky — I found what I loved to do early in life. Woz and I started *Apple* in my parents' garage when I was twenty. We worked hard, and in ten years *Apple* had grown from just the two of us in a garage into a \$2 billion company with over 4,000 employees. We'd just released our finest creation — the *Macintosh* — a year earlier, and I had just turned thirty. And then I got fired. How can you get fired from a company you started? Well, as *Apple* grew, we hired someone who I thought was very talented to run the company with me, and for the first year or so things went well. But then our visions of the future began to diverge, and eventually we had a falling out. When we did, our Board of Directors sided with him. And so at thirty I was out, and very publicly out. What had been the focus of my entire adult life was gone, and it was devastating.

I really didn't know what to do for a few months. I felt that I had let the previous generation of entrepreneurs down — that I had dropped the baton as it was being passed to me. I met with David Packard and Bob Noyce and tried to apologize for screwing up so badly. I was a very public failure, and I even thought about running away from the Valley. But something slowly began to dawn on me — I still loved what I did. The turn of events at *Apple* had not changed that one bit. I'd been rejected, but I was still in love. And so I decided to start over.

I didn't see it then, but it turned out that getting fired from *Apple* was the best thing that could have ever happened to me. The heaviness of being successful was replaced by the lightness of being a beginner again, less sure about everything. It freed me to enter one of the most creative periods of my life.

During the next five years, I started a company named *NeXT*, another company named *Pixar*, and fell in love with an amazing woman who would become my wife. *Pixar* went on to create the world's first computer animated feature film, *Toy Story*, and is now the most successful animation studio in the world. In a remarkable turn of events, *Apple* bought *NeXT*, I returned to *Apple*, and the technology we developed at *NeXT* is at the heart of *Apple's* current renaissance. And Laurene and I have a wonderful family together.

I am pretty sure none of this would've happened if I hadn't been fired from *Apple*. It was awful-tasting medicine, but I guess the patient needed it. Sometimes life's gonna hit you in the head with a brick. Don't lose faith. I am convinced that the only thing that kept me going was that I loved what I did. You've got to find what you love. And that is as true for your work as it is for your lovers. Your work is gonna fill a large part of your life, and the only way to be truly satisfied is to do what you believe is great work. And the only way to do great work is to love what you do. If you haven't found it yet, keep looking. And don't settle. As with all matters of the heart, you'll know when you find it. And, like any great relationship, it just gets better and better as the years roll on. So keep looking. Don't settle.

My third story is about death.

When I was seventeen, I read a quote that went something like: "If you live each day as if it was your last, someday you'll most certainly be right." It made an impression on me, and since then, for the past thirty-three years, I've looked in the mirror every morning and asked myself: "If today were the last day of my life, would I wanna do what I am about to do today?" And whenever the answer has been "No" for too many days in a row, I know I need to change something.

Remembering that I'll be dead soon is the most important tool I've ever encountered to help me make the big choices in life. Because

almost everything — all external expectations, all pride, all fear of embarrassment or failure — these things just fall away in the face of death, leaving only what is truly important. Remembering that you are going to die is the best way I know to avoid the trap of thinking you have something to lose. You are already naked. There is no reason not to follow your heart.

About a year ago I was diagnosed with cancer. I had a scan at 7:30 in the morning, and it clearly showed a tumor on my pancreas. I didn't even know what a pancreas was. The doctors told me this was almost certainly a type of cancer that is incurable, and that I should expect to live no longer than three to six months. My doctor advised me to go home and get my affairs in order, which is doctor's code for "prepare to die." It means to try to tell your kids everything you thought you'd have the next ten years to tell them in just a few months. It means to make sure everything is buttoned up, so that it will be as easy as possible for your family. It means to say your goodbyes.

I lived with that diagnosis all day. Later that evening I had a biopsy, where they stuck an endoscope down my throat, through my stomach and into my intestines, put a needle into my pancreas and got a few cells from the tumor. I was sedated, but my wife, who was there, told me that when they viewed the cells under a microscope, the doctors started crying because it turned out to be a very rare form of pancreatic cancer that is curable with surgery. I had the surgery and, thankfully, I am fine now.

This was the closest I've been to facing death, and I hope it's the closest I get for a few more decades. Having lived through it, I can now say this to you with a bit more certainty than when death was a useful but purely intellectual concept.

No one wants to die. Even people who want to go to heaven don't want to die to get there. And yet death is the destination we all share. No one has ever escaped it. And that is as it should be, because Death is very likely the single best invention of Life. It is Life's change agent. It clears out the old to make way for the new. Right now the new is you, but someday not too long from now, you will gradually become the old and be cleared away. Sorry to be so dramatic, but it's quite true.

Your time is limited, so don't waste it living someone else's life. Don't be trapped by dogma — which is living with the results of other people's thinking. Don't let the noise of others' opinions drown out your own inner voice. And most important, have the courage to follow your heart and intuition. They somehow already know what you truly want to become. Everything else is secondary.

When I was young, there was an amazing publication called *The Whole Earth Catalog*, which was one of the bibles of my generation. It

was created by a fellow named Stewart Brand not far from here in Menlo Park, and he brought it to life with his poetic touch. This was in the late 1960s, before personal computers and desktop publishing, so it was all made with typewriters, scissors and Polaroid cameras. It was sort of like *Google* in paperback form, thirty-five years before *Google* came along. It was idealistic, overflowing with neat tools and great notions.

Stewart and his team put out several issues of *The Whole Earth Catalog*, and then when it had run its course, they put out a final issue. It was the mid-1970s, and I was your age. On the back cover of their final issue was a photograph of an early morning country road, the kind you might find yourself hitchhiking on if you were so adventurous. Beneath it were the words: “Stay hungry. Stay foolish.” It was their farewell message as they signed off. “Stay hungry. Stay foolish.” And I have always wished that for myself. And now, as you graduate to begin anew, I wish that for you.

Stay hungry. Stay foolish.

Thank you all very much.

6. The game that can give you ten extra years of life¹

I am a gamer, so I like to have goals. I like special missions and secret objectives. So here’s my special mission for this talk: I am going to try to increase the life span of every single person in this room by seven and a half minutes. Literally, you will live seven and a half minutes longer than you would have otherwise, just because you watched this talk.

OK, some of you are looking a little bit skeptical. That’s OK, because check it out — I have math to prove that it is possible. It won’t make a lot of sense now. I’ll explain it all later, just pay attention to the number at the bottom: +7.68245837 minutes. That will be my gift to you if I am successful in my mission.

Now, you have a secret mission too. Your mission is to figure out how you want to spend your extra seven and a half minutes. And I think you should do something unusual with them, because these are bonus minutes. You weren’t going to have them anyway.

Now, because I am a game designer, you might be thinking to yourself, “I know what she wants us to do with those minutes, she wants us to spend them playing games.” Now, this is a totally reasonable assumption, given that I have made quite a habit of encouraging people to

¹ *McGonigal J.* The game that can give you 10 extra years of life // TED. 2012. June. URL: https://www.ted.com/talks/jane_mcgonigal_the_game_that_can_give_you_10_extra_years_of_life/transcript?language=en

spend more time playing games. For example, in my first *TED Talk*, I did propose that we should spend 21 billion hours a week, as a planet, playing video games.

Now, 21 billion hours, it's a lot of time. It's so much time, in fact, that the number one unsolicited comment that I have heard from people all over the world since I gave that talk, is this: "Jane, games are great and all, but on your deathbed, are you really gonna wish you spent more time playing *Angry Birds*?"

This idea is so pervasive — that games are a waste of time that we will come to regret — that I hear it literally everywhere I go. For example, true story. Just a few weeks ago, this cab driver, upon finding out that a friend and I were in town for a game developers' conference, turned around and said — and I quote — "I hate games. Waste of life. Imagine getting to the end of your life and regretting all that time."

Now, I want to take this problem seriously. I mean, I want games to be a force for good in the world. I don't want gamers to regret the time they spent playing, time that I encouraged them to spend. So I have been thinking about this question a lot lately. When we are on our deathbeds, will we regret the time we spent playing games? Now, this may surprise you, but it turns out there is actually some scientific research on this question. It's true. Hospice workers, the people who take care of us at the end of our lives, recently issued a report on the most frequently expressed regrets that people say when they are literally on their deathbeds. And that's what I want to share with you today — the top five regrets of the dying.

Number one: "I wish I hadn't worked so hard." Number two: "I wish I had stayed in touch with my friends." Number three: "I wish I had let myself be happier." Number four: "I wish I'd had the courage to express my true self." And number five: "I wish I'd lived a life true to my dreams, instead of what others expected of me."

Now, as far as I know, no one ever told one of the hospice workers, "I wish I'd spent more time playing video games", but when I hear these top five regrets of the dying, I can't help but hear five deep human cravings that games actually help us fulfill.

For example, I wish I hadn't worked so hard. For many people, this means, "I wish I'd spent more time with my family, with my kids when they were growing up." Well, we know that playing games together has tremendous family benefits. A recent study from Brigham Young University School of Family Life reported that parents who spend more time playing video games with their kids have much stronger real-life relationships with them.

"I wish I'd stayed in touch with my friends." Well, hundreds of millions of people use social games like *FarmVille* or *Words With Friends* to

stay in daily contact with real-life friends and family. A recent study from Michigan University showed that these games are incredibly powerful relationship-management tools. They help us stay connected with people in our social network that we would otherwise grow distant from, if we weren't playing games together.

"I wish I'd let myself be happier." Well, here I can't help but think of the groundbreaking clinical trials recently conducted at East Carolina University that showed that online games can outperform pharmaceuticals for treating clinical anxiety and depression. Just thirty minutes of online game play a day was enough to create dramatic boosts in mood and long-term increases in happiness.

"I wish I'd had the courage to express my true self." Well, avatars are a way to express our true selves, our most heroic, idealized version of who we might become. You can see that in this alter ego portrait by Robbie Cooper of a gamer with his avatar. And Stanford University has been doing research for five years now to document how playing a game with an idealized avatar changes how we think and act in real life, making us more courageous, more ambitious, more committed to our goals.

"I wish I'd led a life true to my dreams, and not what others expected of me." Are games doing this yet? I am not sure, so I've left a question mark — a *Super Mario* question mark. We are going to come back to this one.

But in the meantime, perhaps you are wondering, who is this game designer to be talking to us about deathbed regrets? And it's true, I've never worked in a hospice, I've never been on my deathbed. But recently I did spend three months in bed, wanting to die. Really wanting to die. Now let me tell you that story.

It started two years ago, when I hit my head and got a concussion. The concussion didn't heal properly, and after thirty days, I was left with symptoms like nonstop headaches, nausea, vertigo, memory loss, mental fog. My doctor told me that in order to heal my brain, I had to rest it. So I had to avoid everything that triggered my symptoms. For me that meant no reading, no writing, no video games, no work or email, no running, no alcohol, no caffeine. In other words — and I think you see where this is going — no reason to live. Of course it's meant to be funny, but in all seriousness, suicidal ideation is quite common with traumatic brain injuries. It happens to one in three, and it happened to me. My brain started telling me, "Jane, you want to die." It said, "You never gonna get better." It said, "The pain will never end."

And these voices became so persistent and so persuasive that I started to legitimately fear for my life, which is the time that I said to myself after thirty-four days — and I will never forget this moment —

I said, “I am either going to kill myself or I am going to turn this into a game.”

Now, why a game? Well, I knew from researching the psychology of games for more than a decade that when we play a game — and this is in the scientific literature — we tackle tough challenges with more creativity, more determination, more optimism, and we are more likely to reach out to others for help. And I wanted to bring these gamer traits to my real-life challenge, so I created a role-playing recovery game called *Jane the Concussion Slayer*.

Now, this became my new secret identity, and the first thing I did as a slayer was call my twin sister — I have an identical twin sister named Kelly — and tell her, “I am playing a game to heal my brain, and I want you to play with me.” This was an easier way to ask for help. She became my first ally in the game, my husband Kiyash joined next, and together we identified and battled the bad guys. Now, this was anything that could trigger my symptoms and therefore slow down the healing process, things like bright lights and crowded spaces. We also collected and activated power-ups. This was anything I could do on even my worst day to feel just a little bit good, just a little bit productive. Things like cuddling my dog for ten minutes, or getting out of bed and walking around the block just once.

Now, the game was that simple: Adopt a secret identity, recruit your allies, battle the bad guys, activate the power-ups. But even with a game so simple, within just a couple days of starting to play, that fog of depression and anxiety went away. It just vanished. It felt like a miracle. Now, it wasn't a miracle cure for the headaches or the cognitive symptoms. That lasted for more than a year, and it was the hardest year of my life by far. But even when I still had the symptoms, even while I was still in pain, I stopped suffering.

Now what happened next with the game surprised me. I put up some blog posts and videos online, explaining how to play. But not everybody has a concussion, obviously, not everyone wants to be “the slayer,” so I renamed the game *SuperBetter*.

And soon I started hearing from people all over the world who were adopting their own secret identity, recruiting their own allies, and they were getting “super better,” facing challenges like cancer and chronic pain, depression and Crohn's disease. Even people were playing it for terminal diagnoses like ALS. And I could tell from their messages and their videos that the game was helping them in the same ways that it helped me. They talked about feeling stronger and braver. They talked about feeling better understood by their friends and family. And they even talked about feeling happier, even though they were in pain, even though they were tackling the toughest challenge of their lives.

Now, at the time, I am thinking to myself, what is going on here? I mean, how could a game so trivial intervene so powerfully in such serious, and in some cases life-and-death, circumstances? I mean, if it hadn't worked for me, there's no way I would have believed it was possible. Well, it turns out there's some science here, too. Some people get stronger and happier after a traumatic event. And that's what was happening to us.

The game was helping us experience what scientists call post-traumatic growth, which is not something we usually hear about. We usually hear about post-traumatic stress disorder. But scientists now know that a traumatic event doesn't doom us to suffer indefinitely. Instead, we can use it as a springboard to unleash our best qualities and lead happier lives.

Here are the top five things that people with post-traumatic growth say: "My priorities have changed." "I am not afraid to do what makes me happy." "I feel closer to my friends and family." "I understand myself better. I know who I really am now." "I have a new sense of meaning and purpose in my life." "I am better able to focus on my goals and dreams."

Now, does this sound familiar? It should, because the top five traits of post-traumatic growth are essentially the direct opposite of the top five regrets of the dying. Now this is interesting, right? It seems that somehow a traumatic event can unlock our ability to lead a life with fewer regrets. But how does it work? How do you get from trauma to growth? Or better yet, is there a way to get all the benefits of post-traumatic growth without the trauma, without having to hit your head in the first place? That would be good, right?

I wanted to understand the phenomenon better, so I devoured the scientific literature, and here's what I learned. There are four kinds of strength, or resilience, that contribute to post-traumatic growth, and there are scientifically validated activities that you can do every day to build up these four kinds of resilience, and you don't need a trauma to do it.

Now, I could tell you what these four types of strength are, but I'd rather you experience them firsthand. I'd rather we all start building them up together right now. Here's what we are going to do. We'll play a quick game together. This is where you earn the seven and a half minutes of bonus life that I promised you earlier. All you have to do is successfully complete the first four *SuperBetter* quests. And I feel like you can do it. I have confidence in you.

So, everybody ready? This is your first quest. Here we go. Pick one: stand up and take three steps, or make your hands into fists, raise them over your head as high as you can for five seconds, go! All right, I like the people doing both, you are overachievers. Very good.

Well done, everyone. That is worth +1 physical resilience, which means that your body can withstand more stress and heal itself faster. Now, we know from the research that the number one thing you can do to boost your physical resilience is to not sit still. That's all it takes. Every single second that you are not sitting still, you are actively improving the health of your heart, and your lungs and brains.

Everybody ready for your next quest? I want you to snap your fingers exactly fifty times, or count backwards from hundred by seven, like this: one hundred, ninety-three... Go! Don't give up. Don't let the people counting down from hundred interfere with your counting to fifty.

Nice. Wow. That's the first time I've ever seen that. Bonus physical resilience. Well done, everyone. Now that's worth +1 mental resilience, which means you have more mental focus, more discipline, determination and willpower. We know from the scientific research that willpower actually works like a muscle. It gets stronger the more you exercise it. So tackling a tiny challenge without giving up, even one as absurd as snapping your fingers exactly fifty times or counting backwards from one hundred by seven is actually a scientifically validated way to boost your willpower. So good job.

Quest number three. Pick one: now, because of the room we are in, fate's really determined this for you, but here are the two options. If you are inside, find a window and look out of it. If you are outside, find a window and look in. Or do a quick *YouTube* or *Google* image search for "baby [your favorite animal.]" Now, you can do this on your phones, or you can just shout out some baby animals, I am gonna find some of them and put them on the screen for us. So, what do we want to see? Sloth, giraffe, elephant, snake. OK, let's see what we got. Baby dolphin and baby llamas. Everybody look. Got that? OK, one more. Baby elephant. We are clapping for that? That's amazing.

All right, now what we are just feeling there is plus-one emotional resilience, which means you have the ability to provoke powerful positive emotions like curiosity or love, which we feel when we look at baby animals, when you need them most.

And here's a secret from the scientific literature for you. If you can manage to experience three positive emotions for every one negative emotion over the course of an hour, a day, a week, you dramatically improve your health and your ability to successfully tackle any problem you are facing. And this is called the three-to-one positive emotion ratio. It's my favorite *SuperBetter* trick, so keep it up.

All right, pick one, last quest: shake someone's hand for six seconds, or send someone a quick "thank you" by text, email, *Facebook* or *Twit-*

ter. Go! Looking good, looking good. Nice, nice. Keep it up! I love it! All right, everybody, that is +1 social resilience, which means you actually get more strength from your friends, your neighbors, your family, your community. Now, a great way to boost social resilience is gratitude. Touch is even better.

Here's one more secret for you: shaking someone's hand for six seconds dramatically raises the level of oxytocin in your bloodstream, now that's the trust hormone. That means that all of you who just shook hands are biochemically primed to like and want to help each other. This will linger during the break, so take advantage of the networking opportunities.

OK, well, you have successfully completed your four quests, so let's see if I successfully completed my mission to give you seven and a half minutes of bonus life. And here is where I get to share one more little bit of science with you. It turns out that people who regularly boost these four types of resilience — physical, mental, emotional and social — live ten years longer than everyone else. This is true. If you are regularly achieving the three-to-one positive emotion ratio, if you are never sitting still for more than an hour at a time, if you are reaching out to one person you care about every single day, if you are tackling tiny goals to boost your willpower, you will live ten years longer than everyone else, and here's where that math I showed you earlier comes in.

So, the average life expectancy in the U.S. and the U.K. is 78.1 years, but we know from more than 1,000 peer-reviewed scientific studies that you can add 10 years of life to that by boosting your four types of resilience. So every single year that you are boosting your four types of resilience, you are actually earning 0.128 more years of life or 46 more days of life, or 67.298 more minutes of life, which means every single day, you are earning 184 minutes of life, or every single hour that you are boosting your four types of resilience, like we just did together, you are earning 7.68245837 more minutes of life.

Congratulations, those seven and a half minutes are all yours. You totally earned them.

Awesome. Wait, wait, wait. You still have your special mission, your secret mission. How are you gonna spend these minutes of bonus life?

Well, here's my suggestion. These seven and a half bonus minutes are kind of like genie's wishes. You can use your first wish to wish for a million more wishes. Pretty clever, right? So, if you spend these seven and a half minutes today doing something that makes you happy, or that gets you physically active, or puts you in touch with someone you care about, or even just tackling a tiny challenge, you are gonna boost your resilience, so you are gonna earn more minutes.

And the good news is, you can keep going like that. Every hour of the day, every day of your life, all the way to your deathbed, which will now be ten years later than it would have otherwise. And when you get there, more than likely, you will not have any of those top five regrets, because you will have built up the strength and resilience to lead a life truer to your dreams. And with ten extra years, you might even have enough time to play a few more games.

Thank you.

7. This computer will grow your food in the future¹

Food crisis. It's in the news every day. But what is it? Some places in the world it's too little food, maybe too much. Other places, GMO is saving the world. Maybe GMO is the problem? How is this apple food crisis? You've all eaten an apple in the last week, I am sure. How old do you think it was from when it was picked? Two weeks? Two months? Eleven months — the average age of an apple in a grocery store in the United States. And I don't expect it to be much different in Europe or anywhere else in the world. We pick them, we put them in cold storage, we gas the cold storage — there's actually documented proof of workers trying to go into these environments to retrieve an apple and dying, because the atmosphere that they slow down the process of the apple with is also toxic to humans.

How is it that none of you knew this? Why didn't I know this? Ninety percent of the quality of that apple — all of the antioxidants — are gone by the time we get it. It's basically a little ball of sugar. How did we get it so information poor and how can we do better?

I think what's missing is a platform. I know platforms — I know computers, they put me on the Internet when I was young. I did very weird things — on this platform. But I met people, and I could express myself.

How do you express yourself in food? If we had a platform, we might feel empowered to question: "What if?" For me, I questioned: "What if climate was democratic?" So, this is a map of climate in the world. The most productive areas in green, the least productive in red. They shift and they change, and Californian farmers now become Mexican farmers. China picks up land in Brazil to grow better food, and we are slave to climate. What if each country had its own productive climate? What would that change about how we live? What would that change about quality of life and nutrition?

¹ *Harper C.* This computer will grow your food in the future // TED. 2015. Dec. URL: https://www.ted.com/talks/caleb_harper_this_computer_will_grow_your_food_in_the_future/transcript?language=en

Last generation's problem was, we need more food and we need it cheap. Welcome to your global farm. We built a huge analog farm. All these traces — these are cars, planes, trains and automobiles. It's a miracle that we feed seven billion people with just a few of us involved in the production of food. What if... we built a digital farm? A digital world farm. What if you could take this apple, digitize it somehow, send it through particles in the air and reconstitute it on the other side? What if?

Going through some of these quotes, you know, they inspire me to do what I do.

First one: "Japanese farming has no youth, no water, no land and no future." That's what I landed to the day that I went to Minamisanriku, one stop south of Fukushima, after the disaster. The kids have headed to Sendai and Tokyo, the land is contaminated, they already import seventy percent of their own food. But it's not unique to Japan. Two percent of the American population is involved in farming. What good answer comes from two percent of any population? As we go around the world, fifty percent of the African population is under eighteen. Eighty percent don't want to be farmers. Farming is hard. The life of a small-shareholder farmer is miserable. They go into the city. In India: farmers' families not being able to have basic access to utilities, more farmer suicides this year and the previous ten before that. It's uncomfortable to talk about. Where are they going? Into the city. No young people, and everyone's headed in. So how do we build this platform that inspires the youth?

Welcome to the new tractor. Right? This is my combine. A number of years ago now, I went to *Bed Bath and Beyond* and *Home Depot* and I started hacking, and I built silly things and I made plants dance and I attached them to my computer and I killed them all — a lot. And I eventually got them to survive. And I created one of the most intimate relationships I've ever had in my life, because I was learning the language of plants. I wanted to make it bigger. They said, "Knock yourself out, kid! Here's an old electronics room that nobody wants. What can you do?"

With my team, we built the farm inside of the media lab, a place historically known not for anything about biology but everything about digital life. Inside of these sixty square feet, we produced enough food to feed about three hundred people once a month — not a lot of food. And there's a lot of interesting technology in there. But the most interesting thing? Beautiful white roots, deep green colors and a monthly harvest. Is this a new cafeteria? Is this a new retail experience? Is this a new grocery store? I can tell you one thing for sure: this is the first time anybody in the media lab ripped the roots off of anything.

We get our salad in bags; there's nothing wrong with that. But what happens when you have an image-based processing expert, a data scientist, a roboticist, ripping roots off and thinking, "Huh. I know something about — I could make this happen, I want to try."

In that process we would bring the plants out and we would take some back to the lab, because if you grew it, you don't throw it away; it's kind of precious to you. And I have this weird tongue now, because I am afraid to let anybody eat anything until I've eaten it first, because I want it to be good. So I eat lettuce every day and I can tell the pH of a lettuce within .1. I am like, "No, that's 6.1 — no, no, you can't eat it today."

This lettuce that day was hyper sweet. It was hyper sweet because the plant had been stressed and it created a chemical reaction in the plant to protect itself: "I am not going to die!" And the plants "not-going-to-die" taste sweet to me. Technologists falling backwards into plant physiology.

So we thought other people needed to be able to try this. We wanted to see what people can create, so we conceived of a lab that could be shipped anywhere. And then we built it.

So on the facade of the media lab is my lab, that has about thirty points of sensing per plant. So, if you know about the genome or genetics, this is the phenome, right? The phenomena. When you say, "I like the strawberries from Mexico," you really like the strawberries from the climate that produced the expression that you like. So if you are coding climate — this much CO₂, this much O₂ creates a recipe — you are coding the expression of that plant, the nutrition of that plant, the size of that plant, the shape, the color, the texture. We need data, so we put a bunch of sensors in there to tell us what's going on.

If you think of your houseplants, and you look at your houseplant and you are super sad, because you are like, "Why are you dying? Won't you talk to me?" Farmers develop the most beautiful fortune-telling eyes by the time they're in their late 60s and 70s. They can tell you when you see that plant dying that it's a nitrogen deficiency, a calcium deficiency or it needs more humidity. Those beautiful eyes are not being passed down.

These are eyes in the cloud of a farmer. We trend those data points over time. We correlate those data points to individual plants. These are all the broccoli in my lab that day, by IP address. We have IP-addressable broccoli.

So, if that's not weird enough, you can click one, and you get a plant profile. And what this tells you is downloadable progress on that plant, but not like you'd think, it's not just when it's ready. When does it achieve the nutrition that I need? When does it achieve the taste that

I desire? Is it getting too much water? Is it getting too much sun? Alerts. It can talk to me, it's conversant, we have a language.

I think of that as the first user on the plant *Facebook*, right? That's a plant profile and that plant will start making friends. And I mean it — it will make friends with other plants that use less nitrogen, more phosphorus, less potassium. We are going to learn about a complexity that we can only guess at now. And they may not friend us back — I don't know, they might friend us back, it depends on how we act.

So, this is my lab now. It's a little bit more systematized, my background is designing data centers in hospitals of all things, so I know a little bit about creating a controlled environment.

And so, inside of this environment, we are experimenting with all kinds of things, you know. This process, aeroponics, it was developed by NASA for *Mir* space station for reducing the amount of water they send into space. What it really does is give the plant exactly what it wants: water, minerals and oxygen. Roots are not that complicated, so when you give them that, you get this amazing expression. It's like the plant has two hearts. And because it has two hearts, it grows four or five times faster. Right? It's a perfect world. We've gone a long way into technology and seed for an adverse world and we are going to continue to do that, but we are going to have a new tool, too, which is perfect world.

So we've grown all kinds of things. These tomatoes hadn't been in commercial production for one hundred and fifty years. Do you know that we have rare and ancient seed banks? Banks of seed. It's amazing. They have germplasm alive and things that you've never eaten. I am the only person in this room that's eaten that kind of tomato. Problem is it was a sauce tomato and we don't know how to cook, so we ate a sauce tomato, which is not that great. But we've done things with protein — we've grown all kinds of things. We've grown humans... Well maybe you could, but we didn't.

But what we realized is, the tool was too big, it was too expensive. I was starting to put them around the world and they were about 100,000 dollars. Finding somebody with 100 grand in their back pocket isn't so easy, so we wanted to make a small one.

So this project was actually one of my student's, mechanical engineering undergraduates, Camille. So Camille and I and my team, we iterated all summer, how to make it cheaper, how to make it work better, how to make it so other people can make it. And then we dropped them off in schools, seventh through eleventh grade. And if you want to be humbled, try to teach a kid something.

So I went into this school and I said, "Set it to sixty-five percent humidity."

The seventh grader said, “What’s humidity?”

And I said, “Oh, it’s water in air.”

He said, “There’s no water in air, you are an idiot.”

And I was like, “Alright, alright don’t trust me. Actually — don’t trust me, right? Set it to one hundred.” He sets it to 100 and what happens? It starts to condense, make a fog and eventually drip.

And he says, “Oh. Humidity is rain. Why didn’t you just tell me that?”

We’ve created an interface for this that’s much like a game. So they have a 3D environment, they can log into it anywhere in the world on their smartphone, on their tablet. They have different parts of the bots — the physical, the sensors. They select recipes that have been created by other kids anywhere in the world. They select and activate that recipe, they plant a seedling. While it’s growing, they make changes. They’re like, “Why does a plant need CO₂ anyway? Isn’t CO₂ bad? It kills people.” Crank up CO₂, plant dies. Or crank down CO₂, plant does very well. Harvest plant, and you’ve created a new digital recipe.

It’s an iterative design and development and exploration process. They can download, then, all of the data about that new plant that they developed or the new digital recipe and what did it do — was it better or was it worse? Imagine these as little cores of processing. We are gonna learn so much.

So here’s one of the food computers, as we call them, in a school in three weeks’ time. Right? This is three weeks of growth. But more importantly, it was the first time that this kid ever thought he could be a farmer — or that he would want to be a farmer. So, we’ve open-sourced all of this. It’s all online; go home, try to build your first food computer. It’s going to be difficult — I am just telling you. We are in the beginning, but it’s all there. It’s very important to me that this is easily accessible. We are going to keep making it more so.

These are farmers, electrical engineer, mechanical engineer, environmental engineer, computer scientist, plant scientist, economist, urban planners. On one platform, doing what they’re good at. But we got a little too big.

And I am proud to announce this is my new facility that I am just starting. This warehouse could be anywhere. That’s why I chose it. And inside of this warehouse we are going to build something kind of like this. These exist right now. Take a look at it. These exist, too. One grows greens, one grows Ebola vaccine. Pretty amazing that plants and this DARPA Grand Challenge winner is one of the reasons we are getting ahead of Ebola. The plants are producing the protein that’s Ebola-resistant. So pharmaceuticals, nutraceuticals, all they way down to lettuce.

But these two things look nothing alike, and that's where I am with my field. Everything is different. We are in that weird "We are alright" stage and it's like, "Here's my black box —" "No, buy mine." "No, no, no — I've got intellectual property that's totally valuable. Don't buy his, buy mine."

And the reality is, we are just at the beginning, in a time when society is shifting, too. When we ask for more, cheaper food, we are now asking for better, environmentally friendly food. And when you have *McDonald's* advertising what's in the *Chicken McNugget*, the most mysterious food item of all time — they are now basing their marketing plan on that — everything is changing.

So into the world now. Personal food computers, food servers and food data centers run on the open phenome. Think open genome, but we are going to put little climate recipes, like *Wikipedia*, that you can pull down, actuate and grow.

What does this look like in a world? You remember the world connected by strings? We start having beacons. We start sending information about food, rather than sending food. This is not just my fantasy, this is where we are already deploying. Food computers, food servers, soon-to-be food data centers, connecting people together to share information.

The future of food is not about fighting over what's wrong with this. We know what's wrong with this. The future of food is about networking the next one billion farmers and empowering them with a platform to ask and answer the question, "What if?"

Thank you.

8. Txtng is killing language. JK!!!¹

We always hear that texting is a scourge. The idea is that texting spells the decline and fall of any kind of serious literacy, or at least writing ability, among young people in the United States and now the whole world today. The fact of the matter is that it just isn't true, and it's easy to think that it *is* true, but in order to see it in another way, in order to see that actually texting is a miraculous thing, not just energetic, but a miraculous thing, a kind of emergent complexity that we are seeing happening right now, we have to pull the camera back for a bit and look at what language really is, in which case, one thing that we see is that texting is not writing at all. What do I mean by that?

¹ *McWhorter J.* Txtng is killing language. JK!!! // TED. 2013. Feb. URL: https://www.ted.com/talks/john_mcwhorter_txtng_is_killing_language_jk/transcript?language=en

Basically, if we think about language, language has existed for perhaps 150,000 years, at least 80,000 years, and what it arose as is speech. People talked. That's what we are probably genetically specified for. That's how we use language most. Writing is something that came along much later, and as we saw in the last talk, there's a little bit of controversy as to exactly when that happened, but according to traditional estimates, if humanity had existed for 24 hours, then writing only came along at about 11:07 p.m. That's how much of a latterly thing writing is. So, first there's speech, and then writing comes along as a kind of artifice.

Now, don't get me wrong, writing has certain advantages. When you write, because it's a conscious process, because you can look backwards, you can do things with language that are much less likely if you are just talking. For example, imagine a passage from Edward Gibbon's¹ "The Decline and Fall of the Roman Empire": "The whole engagement lasted above twelve hours, till the graduate retreat of the Persians was changed into a disorderly flight, of which the shameful example was given by the principal leaders and the Surenas himself."

That's beautiful, but let's face it, nobody talks that way. Or at least, they shouldn't if they're interested in reproducing. That is not the way any human being speaks casually.

Casual speech is something quite different. Linguists have actually shown that when we are speaking casually in an unmonitored way, we tend to speak in word packets of maybe seven to ten words. You'll notice this if you ever have occasion to record yourself or a group of people talking. That's what speech is like. Speech is much looser. It's much more telegraphic. It's much less reflective — very different from writing. So we naturally tend to think, because we see language written so often, that that's what language is, but actually what language is, is speech. They are two things.

Now, of course, as history has gone by, it's been natural for there to be a certain amount of bleed between speech and writing. So, for example, in a distant era now, it was common when one gave a speech to basically talk like writing. So I mean the kind of speech that you see someone giving in an old movie where they clear their throat, and they go, "Ahem, ladies and gentlemen," and then they speak in a certain way which has nothing to do with casual speech. It's formal. It uses long sentences like this Gibbon one. It's basically talking like you write, and so, for example, we are thinking so much these days about

¹ Edward Gibbon (1737–1794) is regarded as the greatest historian of the Enlightenment. His multi-volume history of Rome was both scholarly and full of humane skepticism. (*Online Library of Liberty*)

Lincoln because of the movie. The Gettysburg Address was not the main meal of that event. For two hours before that, Edward Everett¹ spoke on a topic that, frankly, cannot engage us today and barely did then. The point of it was to listen to him speaking like writing. Ordinary people stood and listened to that for two hours. It was perfectly natural. That's what people did then, speaking like writing.

Well, if you can speak like writing, then logically it follows that you might want to also sometimes write like you speak. The problem was just that in the material, mechanical sense, that was harder back in the day for the simple reason that materials don't lend themselves to it. It's almost impossible to do that with your hand except in shorthand, and then communication is limited. On a manual typewriter it was very difficult, and even when we had electric typewriters, or then computer keyboards, the fact is that even if you can type easily enough to keep up with the pace of speech, more or less, you'd have to have somebody who can receive your message quickly.

Once you have things in your pocket that can receive that message, then you have the conditions that allow that we can write like we speak. And that's where texting comes in. And so, texting is very loose in its structure. No one thinks about capital letters or punctuation when one texts, but then again, do you think about those things when you talk? No, and so therefore why would you when you were texting?

What texting is, despite the fact that it involves the brute mechanics of something that we call writing, is fingered speech. That's what texting is. Now we can write the way we talk. And it's a very interesting thing, but nevertheless easy to think that still it represents some sort of decline. We see this general bagginess of the structure, the lack of concern with rules and the way that we are used to learning on the blackboard, and so we think that something has gone wrong. It's a very natural sense.

But the fact of the matter is that what *is* going on is a kind of emergent complexity. That's what we are seeing in this fingered speech. And in order to understand it, what we wanna see is the way, in this new kind of language, there *is* new structure coming up.

And so, for example, there is in texting a convention, which is LOL. Now LOL, we generally think of as meaning "laughing out loud." And of course, theoretically, it does, and if you look at older texts, then people used it to actually indicate laughing out loud. But if you text now, or if you are someone who is aware of the substrate of texting the

¹ Edward Everett (April 11, 1794 – January 15, 1865) was an American politician, pastor, educator, diplomat, and public speaker.

way it's become, you'll notice that LOL does not mean laughing out loud anymore. It's evolved into something that is much subtler.

This is an actual text that was done by a non-male person of about 20 years old not too long ago.

Susan: "I love the font you are using, btw."

Julie: "lol thanks gmail is being slow right now"

Now, if you think about it, that's not funny. No one's laughing. And yet, there it is, so you assume there's been some kind of hiccup.

Then Susan says "lol, I know," again more guffawing than we are used to when you are talking about these inconveniences.

So Julie says, "I just sent you an email."

Susan: "lol, I see it."

Very funny people, if that's what LOL means.

This Julie says, "So what's up?"

Susan: "lol, I have to write a 10 page paper."

She's not amused. Let's think about it. LOL is being used in a very particular way. It's a marker of empathy. It's a marker of accommodation. We linguists call things like that pragmatic particles. Any spoken language that's used by real people has them. If you happen to speak Japanese, think about that little word *ne* that you use at the end of a lot of sentences. If you listen to the way black youth today speak, think about the use of the word *yo*. Whole dissertations could be written about it, and probably are being written about it. A pragmatic particle, that's what LOL has gradually become. It's a way of using the language between actual people.

Another example is "slash." Now, we can use slash in the way that we are used to, along the lines of, "We are going to have a party-slash-networking session." That's kind of like what we are at. Slash is used in a very different way in texting among young people today. It's used to change the scene.

So for example, this Sally person says, "So I need to find people to chill with" and Jake says, "Haha" — you could write a dissertation about "haha" too, but we don't have time for that — "Haha so you are going by yourself? Why?"

Sally: "For this summer program at NYU."

Jake: "Haha. Slash I am watching this video with suns players trying to shoot with one eye."

The slash is interesting. I don't really even know what Jake is talking about after that, but you notice that he's changing the topic. Now that seems kind of mundane, but think about how in real life, if we are having a conversation and we want to change the topic, there're ways of doing it gracefully. You don't just zip right into it. You'll pat your thighs and look wistfully off into the distance, or you'll say something

like, “Hmm, makes you think—” when it really didn’t, but what you are really — what you are really trying to do is change the topic. You can’t do that while you are texting, and so ways are developing of doing it within this medium. All spoken languages have what a linguist calls a new information marker — or two, or three. Texting has developed one from this slash.

So, we have a whole battery of new constructions that are developing, and yet it’s easy to think, well, something is still wrong. There’s a lack of structure of some sort. It’s not as sophisticated as the language of *The Wall Street Journal*. Well, the fact of the matter is, look at this person in 1956, and this is when texting doesn’t exist, *I Love Lucy* is still on the air.

“Many do not know the alphabet or multiplication table, cannot write grammatically.”

We’ve heard that sort of thing before, not just in 1956. 1917, Connecticut schoolteacher. 1917. This is the time when we all assume that everything somehow in terms of writing was perfect because the people on *Downton Abbey*¹ are articulate, or something like that.

So, “From every college in the country goes up the cry, ‘Our freshmen can’t spell, can’t punctuate.’”

And so on. You can go even further back than this. It’s the President of Harvard. It’s 1871. There’s no electricity. People have three names.

“Bad spelling, incorrectness as well as inelegance of expression in writing.”

And he’s talking about people who are otherwise well-prepared for college studies.

You can go even further back. 1841, some long-lost superintendent of schools is upset because of what he has for a long time “noted with regret the almost entire neglect of the original” blah blah blah blah.

Or you can go all the way back to 63 A.D. — and there’s this poor man who doesn’t like the way people are speaking Latin. As it happens, he was writing about what had become French. And so, there are always — there are always people worrying about these things and the planet somehow seems to keep spinning.

And so, the way I am thinking of texting these days is that what we are seeing is a whole new way of writing that young people are developing, which they’re using alongside their ordinary writing skills, and that means that they’re able to do two things. Increasing evidence is that being bilingual is cognitively beneficial. That’s also true of being

¹ *Downton Abbey* is a historical drama television series, a chronicle of the lives of the British aristocratic Crawley family and their servants in the early 20th century.

bidialectal. That's certainly true of being bidialectal in terms of your writing. And so texting actually is evidence of a balancing act that young people are using today, not consciously, of course, but it's an expansion of their linguistic repertoire. It's very simple. If somebody from 1973 looked at what was on a dormitory message board in 1993, the slang would have changed a little bit since the era of *Love Story*¹, but they would understand what was on that message board. Take that person from 1993 — not that long ago, this is, you know, *Bill and Ted's Excellent Adventure*² — those people. Take those people, and they read a very typical text written by a 20-year-old today. Often they would have no idea what half of it meant because a whole new language has developed among our young people doing something as mundane as what it looks like to us when they're batting around on their little devices.

So, in closing, if I could go into the future, if I could go into 2033, the first thing I would ask is whether David Simon had done a sequel to *The Wire*³. I would want to know. And — I really would ask that — and then I'd want to know actually what was going on on *Downton Abbey*. That'd be the second thing. And then the third thing would be, please show me a sheaf of texts written by 16-year-old girls, because I would want to know where this language had developed since our times, and ideally I would then send them back to you and me now so we could examine this linguistic miracle happening right under our noses.

Thank you very much.

9. What's wrong with your pa\$\$w0rd?⁴

I am a computer science and engineering professor here at Carnegie Mellon, and my research focuses on usable privacy and security, and so my friends would like to give me examples of their frustrations with computing systems, especially frustrations related to unusable privacy and security. Excuse me.

¹ *Love Story* is a 1970 romance novel by American writer Erich Segal.

² *Bill & Ted's Excellent Adventure* (1989) is an American science fiction comedy about two teens struggling to prepare a historical presentation with the help of a time machine.

³ *The Wire* is an American television drama series that takes place in Baltimore and the surroundings.

⁴ Cranor L. F. What's wrong with your pa\$\$w0rd? // TED. 2014. Mar. URL: https://www.ted.com/talks/lorrie_faith_cranor_what_s_wrong_with_your_pa_w0rd/transcript

So passwords are something that I hear a lot about. A lot of people are frustrated with passwords, and, you know, it's bad enough when you have to have one really good password that you can remember but nobody else is going to be able to guess. But what do you do when you have accounts on a hundred different systems and you are supposed to have a unique password for each of these systems? It's tough.

At Carnegie Mellon, they used to make it actually pretty easy for us to remember our passwords. The password requirement up through 2009 was just that you had to have a password with at least one character. Pretty easy. But then they changed things. And at the end of 2009, they announced that we were going to have a new policy, and this new policy required passwords that were at least eight characters long, with an uppercase letter, lowercase letter, a digit, a symbol, you couldn't use the same character more than three times, and it wasn't allowed to be in a dictionary.

Now, when they implemented this new policy, a lot of people, my colleagues and friends, came up to me and they said, "Wow, now that's really unusable. Why are they doing this to us, and why didn't you stop them?" And I said, "Well, you know what? They didn't ask me."

But I got curious, and I decided to go talk to the people in charge of our computer systems and find out what led them to introduce this new policy, and they said that the university had joined a consortium of universities, and one of the requirements of membership was that we had to have stronger passwords that complied with some new requirements, and these requirements were that our passwords had to have a lot of entropy. Now, entropy is a complicated term, but basically it measures the strength of passwords. But the thing is, there isn't actually a standard measure of entropy. Now, the National Institute of Standards and Technology has a set of guidelines which have some rules of thumb for measuring entropy, but they don't have anything too specific, and the reason that they only have rules of thumb is, it turns out, they don't actually have any good data on passwords. In fact, their report states, "Unfortunately, we do not have much data on the passwords users choose under particular rules. NIST would like to obtain more data on the passwords users actually choose, but system administrators are understandably reluctant to reveal password data to others."

So, this is a problem, but our research group looked at it as an opportunity. We said, "Well, there's a need for good password data. Maybe we can collect some good password data and actually advance the state of the art here."

So, the first thing we did is, we got a bag of candy bars and we walked around campus, and talked to students, faculty and staff, and asked them for information about their passwords. Now we didn't say,

“Give us your password.” No, we just asked them about their password. How long is it? Does it have a digit? Does it have a symbol? And were you annoyed at having to create a new one last week? So, we got results from 470 students, faculty and staff, and indeed we confirmed that the new policy was very annoying, but we also found that people said they felt more secure with these new passwords. We found that most people knew they were not supposed to write their password down, and only 13 percent of them did, but disturbingly, 80 percent of people said they were reusing their password. Now, this is actually more dangerous than writing your password down, because it makes you much more susceptible to attackers. So, if you have to, write your passwords down, but don’t reuse them. We also found some interesting things about the symbols people use in passwords. So, CMU allows 32 possible symbols, but as you can see, there’s only a small number that most people are using, so we are not actually getting very much strength from the symbols in our passwords.

All right, so this was a really interesting study, and now we had data from 470 people, but in the scheme of things, that’s really not very much password data, and so we looked around to see where could we find additional password data. So, it turns out there are a lot of people going around stealing passwords, and they often go and post these passwords on the Internet. So, we were able to get access to some of these stolen password sets. This is still not really ideal for research, though, because it’s not entirely clear where all of these passwords came from, or exactly what policies were in effect when people created these passwords.

So we wanted to find some better source of data. So we decided that one thing we could do is we could do a study and have people actually create passwords for our study. So, we used a service called *Amazon Mechanical Turk*¹, and this is a service where you can post a small job online that takes a minute, a few minutes, an hour, and pay people, a penny, ten cents, a few dollars, to do a task for you, and then you pay them through *Amazon.com*. So, we paid people about 50 cents to create a password following our rules and answering a survey, and then we paid them again to come back two days later and log in using their password and answering another survey. So, we did this, and we collected 5,000 passwords, and we gave people a bunch of different policies to create passwords with. So, some people had a pretty easy policy, we call it *Basic8*, and here the only rule was that your password had

¹ *Amazon Mechanical Turk* is a crowdsourcing Internet marketplace enabling individuals and businesses to coordinate the use of human intelligence to perform tasks that computers are currently unable to do.

to have at least eight characters. Then some people had a much harder policy, and this was very similar to the CMU policy, that it had to have eight characters including uppercase, lowercase, digit, symbol, and pass a dictionary check. And one of the other policies we tried, and there were a whole bunch more, but one of those we tried was called Basic 16, and the only requirement here was that your password had to have at least 16 characters.

All right, so now we had 5,000 passwords, and so we had much more detailed information. Again, we see that there's only a small number of symbols that people are actually using in their passwords. We also wanted to get an idea of how strong the passwords were that people were creating, but as you may recall, there isn't a good measure of password strength. So, what we decided to do was to see how long it would take to crack these passwords using the best cracking tools that the bad guys are using, or that we could find information about in the research literature.

So, to give you an idea of how bad guys go about cracking passwords, they will steal a password file that will have all of the passwords in kind of a scrambled form, called a hash, and so what they'll do is they'll make a guess as to what a password is, run it through a hashing function, and see whether it matches the passwords they have on their stolen password list. So, a dumb attacker will try every password in order. They'll start with AAAAA and move on to AAAAB, and this is going to take a really long time before they get any passwords that people are really likely to actually have. A smart attacker, on the other hand, does something much more clever. They look at the passwords that are known to be popular from these stolen password sets, and they guess those first. So they're going to start by guessing "password", and then they'll guess "I love you", and "monkey", and "12345678", because these are the passwords that are most likely for people to have. In fact, some of you probably have these passwords.

So, what we found by running all of these 5,000 passwords we collected through these tests to see how strong they were, we found that the long passwords were actually pretty strong, and the complex passwords were pretty strong too. However, when we looked at the survey data, we saw that people were really frustrated by the very complex passwords, and the long passwords were a lot more usable, and in some cases, they were actually even stronger than the complex passwords. So this suggests that, instead of telling people that they need to put all these symbols and numbers and crazy things into their passwords, we might be better off just telling people to have long passwords. Now here's the problem, though: some people had long passwords that actually weren't very strong. You can make long passwords that are still

the sort of thing that an attacker could easily guess. So, we need to do more than just say “long passwords.” There has to be some additional requirements, and some of our ongoing research is looking at what additional requirements we should add to make for stronger passwords that also are going to be easy for people to remember and type.

Another approach to getting people to have stronger passwords is to use a password meter. Here are some examples. You may have seen these on the Internet when you were creating passwords. We decided to do a study to find out whether these password meters actually work. Do they actually help people have stronger passwords, and if so, which ones are better? So we tested password meters that were different sizes, shapes, colors, different words next to them, and we even tested one that was a dancing bunny. As you type a better password, the bunny dances faster and faster. This was pretty fun.

What we found was that password meters do work. Most of the password meters were actually effective. And the dancing bunny was very effective too, but the password meters that were the most effective were the ones that made you work harder before they gave you that thumbs up and said you were doing a good job, and in fact we found that most of the password meters on the Internet today are too soft. They tell you are doing a good job too early, and if they would just wait a little bit before giving you that positive feedback, you probably would have better passwords.

Now, another approach to better passwords, perhaps, is to use pass phrases instead of passwords. So, this was an *xkcd* cartoon from a couple of years ago, and the cartoonist suggests that we should all use pass phrases, and if you look at the second row of this cartoon, you can see the cartoonist is suggesting that the pass phrase “correct horse battery staple” would be a very strong pass phrase and something really easy to remember. He says, in fact, you’ve already remembered it. And so, we decided to do a research study to find out whether this was true or not. In fact, everybody who I talk to, who I mention I am doing password research, they point out this cartoon. “Oh, have you seen it? That *xkcd*. Correct horse battery staple.” All right, so we did the research study to see what would actually happen.

So in our study, we used *Mechanical Turk* again, and we had the computer pick the random words in the pass phrase. Now, the reason we did this is that humans are not very good at picking random words. If we asked a human to do it, they would pick things that were not very random. So we tried a few different conditions. In one condition, the computer picked from a dictionary of the very common words in the English language, and so you’d get pass phrases like “try there three come.” And we looked at that, and we said, “Well, that doesn’t really

seem very memorable.” So then we tried picking words that came from specific parts of speech, so how about noun-verb-adjective-noun. That comes up with something that’s sort of sentence-like. So you can get a pass phrase like “plan builds sure power” or “end determines red drug.” And these seemed a little bit more memorable, and maybe people would like those a little bit better. We wanted to compare them with passwords, and so we had the computer pick random passwords, and these were nice and short, but as you can see, they don’t really look very memorable. And then we decided to try something called a pronounceable password. So here the computer picks random syllables and puts them together so you have something sort of pronounceable, like “tufritvi” and “vadasabi.” That one kind of rolls off your tongue. So these were random passwords that were generated by our computer.

So, what we found in this study was that, surprisingly, pass phrases were not actually all that good. People were not really better at remembering the pass phrases than these random passwords, and because the pass phrases are longer, they took longer to type and people made more errors while typing them in. So, it’s not really a clear win for pass phrases. Sorry, all of you *xkcd* fans. On the other hand, we did find that pronounceable passwords worked surprisingly well, and so we actually are doing some more research to see if we can make that approach work even better. So, one of the problems with some of the studies that we’ve done is that because they’re all done using *Mechanical Turk*, these are not people’s real passwords. They’re the passwords that they created or the computer created for them for our study. And we wanted to know whether people would actually behave the same way with their real passwords.

So, we talked to the information security office at Carnegie Mellon and asked them if we could have everybody’s real passwords. Not surprisingly, they were a little bit reluctant to share them with us, but we were actually able to work out a system with them where they put all of the real passwords for 25,000 CMU students, faculty and staff, into a locked computer in a locked room, not connected to the Internet, and they ran code on it that we wrote to analyze these passwords. They audited our code. They ran the code. And so we never actually saw anybody’s password.

We got some interesting results, and those of you Tepper students in the back will be very interested in this. So, we found that the passwords created by people affiliated with the school of computer science were actually 1.8 times stronger than those affiliated with the business school. We have lots of other really interesting demographic information as well. The other interesting thing that we found is that when we compared the Carnegie Mellon passwords to the *Mechanical Turk*-

generated passwords, there was actually a lot of similarities, and so this helped validate our research method and show that actually, collecting passwords using these *Mechanical Turk* studies is actually a valid way to study passwords. So that was good news.

OK, I want to close by talking about some insights I gained while on sabbatical last year in the Carnegie Mellon art school. One of the things that I did is I made a number of quilts, and I made this quilt here. It's called "Security Blanket." And this quilt has the 1,000 most frequent passwords stolen from the *RockYou* website. And the size of the passwords is proportional to how frequently they appeared in the stolen data set. And what I did is I created this word cloud, and I went through all 1,000 words, and I categorized them into loose thematic categories. And it was, in some cases, it was kind of difficult to figure out what category they should be in, and then I color-coded them.

So, here are some examples of the difficulty. So "Justin." Is that the name of the user, their boyfriend, their son? Maybe they're a Justin Bieber fan. Or "princess." Is that a nickname? Are they *Disney* princess fans? Or maybe that's the name of their cat. "I love you" appears many times in many different languages. There's a lot of love in these passwords. If you look carefully, you'll see there's also some profanity, but it was really interesting to me to see that there's a lot more love than hate in these passwords. And there are animals, a lot of animals, and "monkey" is the most common animal and the 14th most popular password overall. And this was really curious to me, and I wondered, "Why are monkeys so popular?" And so in our last password study, any time we detected somebody creating a password with the word "monkey" in it, we asked them why they had a monkey in their password. And what we found out — we found 17 people so far, I think, who have the word "monkey" — we found out about a third of them said they have a pet named "monkey" or a friend whose nickname is "monkey", and about a third of them said that they just like monkeys and monkeys are really cute. And that guy is really cute.

All right. So it seems that at the end of the day, when we make passwords, we either make something that's really easy to type, a common pattern, or things that remind us of the word password or the account that we've created the password for, or whatever. Or we think about things that make us happy, and we create our password based on things that make us happy. And while this makes typing and remembering your password more fun, it also makes it a lot easier to guess your password. So, I know a lot of these *TED Talks* are inspirational and they make you think about nice, happy things, but when you are creating your password, try to think about something else.

Thank you.

10. Why massive open online courses (still) matter¹

I'd like to reimagine education. The last year has seen the invention of a new four-letter word. It starts with an M. MOOC: massive open online courses. Many organizations are offering these online courses to students all over the world, in the millions, for free. Anybody who has an Internet connection and the will to learn can access these great courses from excellent universities and get a credential at the end of it. Now, in this discussion today, I am going to focus on a different aspect of MOOCs. We are taking what we are learning and the technologies we are developing in the large and applying them in the small to create a blended model of education to really reinvent and reimagine what we do in the classroom.

Now, our classrooms could use change. So, here's a classroom at this little three-letter institute in the Northeast of America, MIT. And this was a classroom about 50 or 60 years ago, and this is a classroom today. What's changed? The seats are in color. Whoop-de-do. Education really hasn't changed in the past 500 years. The last big innovation in education was the printing press and the textbooks. Everything else has changed around us. You know, from healthcare to transportation, everything is different, but education hasn't changed.

It's also been a real issue in terms of access. So what you see here is not a rock concert. And the person you see at the end of the stage is not Madonna. This is a classroom at the Obafemi Awolowo University in Nigeria. Now, we've all heard of distance education, but the students way in the back, 200 feet away from the instructor, I think they are undergoing long-distance education.

Now, I really believe that we can transform education, both in quality and scale and access, through technology. For example, at *edX*, we are trying to transform education through online technologies. Given education has been calcified for 500 years, we really cannot think about reengineering it, micromanaging it. We really have to completely reimagine it. It's like going from ox carts to the airplane. Even the infrastructure has to change. Everything has to change. We need to go from lectures on the blackboard to online exercises, online videos. We have to go to interactive virtual laboratories and gamification. We have to go to completely online grading and peer interaction and discussion boards. Everything really has to change.

¹ *Agarwal A.* Why massive open online courses (still) matter // TED. 2013. June. URL: https://www.ted.com/talks/anant_agarwal_why_massively_open_online_courses_still_matter/transcript?language=en

So at *edX* and a number of other organizations, we are applying these technologies to education through MOOCs to really increase access to education. And you heard of this example, where, when we launched our very first course — and this was an MIT hard circuits and electronics course — about a year and a half ago, 155,000 students from 162 countries enrolled in this course. And we had no marketing budget. Now, 155,000 is a big number. This number is bigger than the total number of alumni of MIT in its 150-year history. 7,200 students passed the course, and this was a hard course. 7,200 is also a big number. If I were to teach at MIT two semesters every year, I would have to teach for 40 years before I could teach this many students.

Now, these large numbers are just one part of the story. So today, I want to discuss a different aspect, the other side of MOOCs, take a different perspective. We are taking what we develop and learn in the large and applying it in the small to the classroom, to create a blended model of learning.

But before I go into that, let me tell you a story. When my daughter turned 13, became a teenager, she stopped speaking English, and she began speaking this new language. I call it teen-lish. It's a digital language. It's got two sounds: a grunt and a silence.

“Honey, come over for dinner.”

“Hmm.”

“Did you hear me?”

Silence.

“Can you listen to me?”

“Hmm.”

So, we had a real issue with communicating, and we were just not communicating, until one day I had this epiphany. I texted her. I got an instant response. I said, no, that must have been by accident. She must have thought, you know, some friend of hers was calling her. So I texted her again. Boom, another response. I said, this is great. And so since then, our life has changed. I text her, she responds. It's just been absolutely great.

So, our millennial generation is built differently. Now, I am older, and my youthful looks might belie that, but I am not in the millennial generation. But our kids are really different. The millennial generation is completely comfortable with online technology. So why are we fighting it in the classroom? Let's not fight it. Let's embrace it. In fact, I believe — and I have two fat thumbs, I can't text very well — but I am willing to bet that with evolution, our kids and their grandchildren will develop really, really little, itty-bitty thumbs to text much better, that evolution will fix all of that stuff. But what if we embraced technology, embraced the millennial generation's natural predilections, and

really think about creating these online technologies, blend them into their lives. So here's what we can do.

So rather than driving our kids into a classroom, herding them out there at eight o'clock in the morning — I hated going to class at eight o'clock in the morning, so why are we forcing our kids to do that? So instead what you do is you have them watch videos and do interactive exercises in the comfort of their dorm rooms, in their bedroom, in the dining room, in the bathroom, wherever they're most creative. Then they come into the classroom for some in-person interaction. They can have discussions amongst themselves. They can solve problems together. They can work with the professor and have the professor answer their questions.

In fact, with *edX*, when we were teaching our first course on circuits and electronics around the world, this was happening unbeknownst to us. Two high school teachers at the Sant High School in Mongolia had flipped their classroom, and they were using our video lectures and interactive exercises, where the learners in the high school, 15-year-olds, mind you, would go and do these things in their own homes and they would come into class, and as you see from this image here, they would interact with each other and do some physical laboratory work. And the only way we discovered this was they wrote a blog and we happened to stumble upon that blog.

We were also doing other pilots. So we did a pilot experimental blended course, working with San Jose State University in California, again, with the circuits and electronics course. You'll hear that a lot. That course has become sort of like our Petri dish¹ of learning. So there, the students would, again, the instructors flipped the classroom, blended online and in person, and the results were staggering. Now, don't take these results to the bank just yet. Just wait a little bit longer as we experiment with this some more, but the early results are incredible. So traditionally, semester upon semester, for the past several years, this course, again, a hard course, had a failure rate of about 40 to 41 percent every semester. With this blended class late last year, the failure rate fell to nine percent. So the results can be extremely, extremely good.

Now, before we go, you know, too far into this, I'd like to spend some time discussing some key ideas. What are some key ideas that make all of this work?

One idea is active learning. The idea here is, rather than have students walk into class and watch lectures, we replace this with what we

¹ Petri dish is a small, round dish with a cover, used in scientific tests especially for growing bacteria.

call lessons. Lessons are interleaved sequences of videos and interactive exercises. So a student might watch a five-, seven-minute video and follow that with an interactive exercise. Think of this as the ultimate Socratization of education. You teach by asking questions. And this is a form of learning called active learning, and really promoted by a very early paper, in 1972, by Craik and Lockhart, where they said and discovered that learning and retention really relates strongly to the depth of mental processing. Students learn much better when they are interacting with the material.

The second idea is self-pacing. Now, when I went to a lecture hall, and if you were like me, by the fifth minute I would lose the professor. I wasn't all that smart, and I would be scrambling, taking notes, and then I would lose the lecture for the rest of the hour. Instead, wouldn't it be nice with online technologies, we offer videos and interactive engagements to students? They can hit the pause button. They can rewind the professor. Heck, they can even mute the professor. So this form of self-pacing can be very helpful to learning.

The third idea that we have is instant feedback. With instant feedback, the computer grades exercises. I mean, how else do you teach 150,000 students? Your computer is grading all the exercises. And we've all submitted homeworks, and your grades come back two weeks later, you've forgotten all about it. I don't think I've still received some of my homeworks from my undergraduate days. Some are never graded. So with instant feedback, students can try to apply answers. If they get it wrong, they can get instant feedback. They can try it again and try it again, and this really becomes much more engaging. They get the instant feedback, and this little green check mark that you see here is becoming somewhat of a cult symbol at *edX*. Learners are telling us that they go to bed at night dreaming of the green check mark. In fact, one of our learners who took the circuits course early last year, he then went on to take a software course from Berkeley at the end of the year, and this is what the learner had to say on our discussion board when he just started that course about the green check mark: "Oh god; have I missed you." When's the last time you've seen students posting comments like this about homework? My colleague Ed Bertschinger, who heads up the physics department at MIT, has this to say about instant feedback: he indicated that instant feedback turns teaching moments into learning outcomes.

The next big idea is gamification. You know, all learners engage really well with interactive videos and so on. You know, they would sit down and shoot alien spaceships all day long until they get it. So we applied these gamification techniques to learning, and we can build

these online laboratories. How do you teach creativity? How do you teach design? We can do this through online labs and use computing power to build these online labs. So, as this little video shows here, you can engage students much like they design with Legos. So here, the learners are building a circuit with Lego-like ease. And this can also be graded by the computer.

Fifth is peer learning. So here, we use discussion forums and discussions and Facebook-like interaction not as a distraction, but to really help students learn. Let me tell you a story. When we did our circuits course for the 155,000 students, I didn't sleep for three nights leading up to the launch of the course. I told my TAs, OK, 24/7, we are going to be up monitoring the forum, answering questions. They had answered questions for 100 students. How do you do that for 150,000? So one night I am sitting up there, at 2 a.m. at night, and I think there's this question from a student from Pakistan, and he asked a question, and I said, OK, let me go and type up an answer, I don't type all that fast, and I begin typing up the answer, and before I can finish, another student from Egypt popped in with an answer, not quite right, so I am fixing the answer, and before I can finish, a student from the U.S. had popped in with a different answer. And then I sat back, fascinated. Boom, boom, boom, boom, the students were discussing and interacting with each other, and by 4 a.m. that night, I am totally fascinated, having this epiphany, and by 4 a.m. in the morning, they had discovered the right answer. And all I had to do was go and bless it, "Good answer." So this is absolutely amazing, where students are learning from each other, and they're telling us that they are learning by teaching.

Now, this is all not just in the future. This is happening today. So we are applying these blended learning pilots in a number of universities and high schools around the world, from Tsinghua in China to the National University of Mongolia in Mongolia to Berkeley in California — all over the world. And these kinds of technologies really help, the blended model can really help revolutionize education. It can also solve a practical problem of MOOCs, the business aspect. We can also license these MOOC courses to other universities, and therein lies a revenue model for MOOCs, where the university that licenses it with the professor can use these online courses like the next-generation textbook. They can use as much or as little as they like, and it becomes a tool in the teacher's arsenal.

Finally, I would like to have you dream with me for a little bit. I would like us to really reimagine education. We will have to move from lecture halls to e-spaces. We have to move from books to tablets like the *Aakash* in India or the *Raspberry Pi*, 20 dollars. The *Aakash* is

40 dollars. We have to move from bricks-and-mortar school buildings to digital dormitories.

But I think at the end of the day, I think we will still need one lecture hall in our universities. Otherwise, how else do we tell our grandchildren that, “You know, your grandparents sat in that room in neat little rows like cornstalks and watched this professor at the end talk about content and, you know, you didn’t even have a rewind button.”

Thank you.

III. KEYS



Lesson 1

Comprehension

1. Sam Harris is the author of five *New York Times* bestsellers, which focuses on how our growing understanding of ourselves and the world is changing our sense of how we should live. Harris received a degree in philosophy from Stanford University and a Ph.D. in neuroscience from UCLA.
2. Behind door number one, we stop making progress in building intelligent machines. Behind door number two, we continue to improve our intelligent machines year after year and once we have machines that are smarter than we are, they will begin to improve themselves.
3. The concern is that the slightest divergence between their goals and our own could destroy us.
4. Harris compares how machines can treat people with how people treat ants. Normally people don't hate them, but whenever their presence seriously conflicts with their goals, people annihilate them without a qualm.
5. We have already built narrow intelligence into our machines, and many of these machines perform at a level of superhuman intelligence.
6. "The train is already out of the station" which means the progress keeps going. Unless people are interrupted, they will eventually build general intelligence into their machines.
7. Benefits: machines can do any physical work, which means the end of human drudgery. Risks: the end of most intellectual work; the level of wealth inequality and unemployment could raise; the society could be split into the rich and the poor; AI machine would be capable of waging war, whether terrestrial or cyber, with unprecedented power followed by a winner-take-all scenario.
8. Firstly, it will take quite a lot of time before IA will be created. Secondly, these machines will inevitably share our values because they will be literally extensions of ourselves.
9. Anyone who can build superintelligent AI integrated with human mind will get a power to win the world or destroy it.
10. He does not have a solution to this problem, apart from recommending that more people in the world should think about it.

It is likely that AI technology will be implanted into our brain.
 Superintelligent machines could have performed any physical work.
 Superintelligent machines would have waged cyber war.
 Superintelligent machines could have replaced human intelligence.

2.

1. By 2018 AI ***will have been*** your physician to prescribe medication through machine-learning algorithms.
2. By 2019 AI ***will have resolved*** 90% disagreements among *eBay* traders using “online dispute resolution.”
3. By 2020 AI ***will have done*** virtual drug screening using machine-learning algorithms called neural networks.
4. By 2021 AI ***will have provided*** personalized tutoring and real-time feedback for the schoolchildren.
5. By 2022 AI ***will have become*** a high-tech personal chef with a database of 2,000 recipes.
6. By 2025 AI ***will have created*** a human-like character who can think, act, react, and interact in a natural way, using both verbal and nonverbal communication.

Lesson 2

Comprehension

Applications of a USB flash drive	Required software
You can turn your drive into a key that keeps your computer unlocked when it’s plugged in but when you remove it your computer locks down and will deny access to anyone who doesn’t have the USB drive or your unique password	Free program called <i>Predator</i>
You can use your drive to run programs like <i>Firefox, Chrome</i> and <i>Open Office</i> on any computer	The portable platform from portableapps.com
You can scan your computer for malware and get it back to work	<i>AVG Rescue CD</i>
You can test a new operating system without overriding your current operating system	Not mentioned
You can encrypt the data of your USB drive and protect it with a secure password so if you lose this flash drive, your information will remain secure	<i>Truecrypt</i>

Vocabulary

1. 1 – C; 2 – I; 3 – E; 4 – A; 5 – D; 6 – B; 7 – F; 8 – G; 9 – H.

2.

J	R	W	D	R	O	W	S	S	A	P	C
R	A	Q	F	P	F	Y	O	B	E	P	H
O	A	Y	C	L	Y	F	H	R	F	Z	U
T	B	L	K	H	T	S	A	M	S	N	X
A	E	M	E	W	I	W	R	S	L	S	L
D	F	L	A	N	L	X	E	O	H	M	L
E	H	R	B	A	C	C	C	B	S	U	A
R	E	Q	M	A	C	K	J	B	A	M	T
P	G	H	Z	A	T	P	V	Z	L	P	S
Q	T	Q	X	I	J	R	D	L	F	B	N
R	J	Y	P	J	Y	O	O	D	N	F	I
Q	U	W	D	X	N	V	X	P	H	R	H

3. 1 – USB flash; 2 – unlock; 3 – software, install; 4 – password; 5 – malware; 6 – access; 7 – portable.

Grammar practice

1. If I encrypt the information on a flash drive, sensitive information will be safe in case of loss or theft.

If sensitive information is safe in case of loss or theft, nobody will use it for harmful purposes.

If nobody will use it for harmful purposes, my information will remain secure.

If information remains secure, I will be happy and confident.

2. Zero conditionals: 2, 3, 4, 6. First conditionals: 1, 5.

Lesson 3

Comprehension

1. An arm supports a head, which is an electromagnet that scans over the disc and either writes data by changing the magnetization of specific sections on the platter or it just reads the data by measuring the magnetic polarization.

2. The arm moves because of the Lorentz force.

11 – error-free; 12 – powerful magnets; 13 – force; 14 – reverse; 15 – permanent; 16 – current; 17 – finely tuned; 18 – critical component; 19 – poles; 20 – magnetization; 21 – 10 nanometers; 22 – sectors; 23 – 80 miles per hour; 24 – genius; 25 – surface; 26 – data loss; 27 – particles; 28 – smooth; 29 – one nanometer; 30 – the magnetic layer; 31 – platinum; 32 – nickel; 33 – forty; 34 – reveal; 35 – positive, negative; 36 – to shrink; 37 – similar; 38 – response; 39 – sophisticated; 40 – generate.

Grammar practice

1 – as; 2 – which; 3 – unlike; 4 – as; 5 – as; 6 – because; 7 – which, until; 8 – as, unless.

Lesson 4

Comprehension

1 – F; 2 – F; 3 – T; 4 – F; 5 – F; 6 – T; 7 – F; 8 – F; 9 – T; 10 – F.

Vocabulary

1. IP – Internet protocol; DSL – digital subscriber line; ISP – Internet service provider; AOL – America Online.
2. 1 – F; 2 – J; 3 – H; 4 – B; 5 – A; 6 – C; 7 – I; 8 – D; 9 – E; 10 – G.
- 4.

M	J	T	G	P	S	L	U	D	G	X	E
I	S	A	T	G	H	E	N	T	N	H	R
Y	O	O	P	S	I	I	R	R	Y	G	A
E	P	Z	L	M	A	O	Z	V	C	I	W
J	X	E	O	T	U	B	E	N	E	E	F
T	Q	V	A	T	D	Y	W	Q	B	R	Q
R	T	N	E	I	L	C	P	P	Q	I	O
W	Y	R	Z	X	I	A	A	W	Z	C	A
B	Z	W	G	E	B	G	E	P	V	Z	L
B	P	E	L	F	E	U	U	X	U	N	C
P	Z	I	S	V	I	N	I	Z	V	Y	B
E	M	V	D	P	A	C	K	E	T	I	P

- 1 – IP addresses; 2 – server; 3 – clients, Internet service provider; 4 – coincidentally; 5 – DSL; 6 – AOL; 7 – webpage; 8 – packets, packets; 9 – routers.

Grammar practice

1.

1. How much time do you spend on the Internet every day?
2. What do you use the Internet for?
3. What is your favorite website?
4. When did you get your first e-mail address?
5. Have you ever answered a spam e-mail?
6. What sort of Internet connection do you have?
7. How reliable is it?
8. Do you use *Google Maps* to plan a route?
9. Have you ever caught a virus over the Internet?
10. What will the Internet be like in 10 years?

2.

1. What is the Internet? Where is the wire buried? What kind of wire might it be? How else is the information transmitted?
2. What is a server? What is a server connected to? What does each server have? What does IP stand for?
3. Why is your home computer not a server? How is your home computer called? Why is it called a client? How is it connected to the Internet?
4. What is aol.com? What is ISP? What is DSL? How is your computer connected with aol.com? When can you look at these webpages?
5. How does the information travel across the Internet? What is a packet? What happens to packets when they reach their destination?

Lesson 5

Comprehension

1. Jobs' biological mother was an unwed graduate student when Steve was born and she put him up for adoption. His adoptive mother never finished college and his adoptive father never finished high school.
2. Jobs dropped out of college. He did this in part because college was tremendously expensive and his family did not have much money. In fact, they had been saving money for most of their lives to afford college for him. Jobs felt guilty about "wasting" their money, as

he didn't feel like he was getting a good return on his investment. Additionally, Jobs says that "by dropping out, he could stop taking the required classes that didn't interest him, and begin dropping in on the ones that looked interesting." This shows that Jobs would more interested in learning and growing than he was in following what everyone else was doing.

3. He did not have a dorm room, he slept on the floor in friends' rooms, he returned *Coke* bottles for the 5¢ deposits to buy food with, and he walked the 7 miles across town every Sunday night to get one good meal a week at the Hare Krishna temple.
4. Calligraphy is the art of producing decorative handwriting or lettering with a pen or brush. This is made clear as Jobs discusses posters, typefaces, and spaces between letter combinations. While Jobs admits that this wasn't a very practical area of study, it later became critical to the success of Apple as it was the first computer company that placed an emphasis on style and typography. This also shows that Jobs wasn't afraid to follow his own path in life. While calligraphy wasn't a topic that most students would have followed, Jobs was able to use it to his advantage later in life.
5. Despite being a co-founder of *Apple*, Jobs was fired from the company after having a disagreement with company leadership and its board of directors. This was a significant failure for Jobs, but one that ultimately helped him react on his working style and made him a better person.
6. The heaviness of being successful was replaced by the lightness of being a beginner again, less sure about everything. It freed him to enter one of the most creative periods of his life.
7. "Sometimes life's gonna hit you in the head with a brick" means "when the worst things happen in your life". The two sentences are "Don't lose faith" and "Don't settle."
8. After Jobs was diagnosed with a largely untreatable form of pancreatic cancer, it was discovered that he had a very rare form of this cancer that actually was treatable through surgery. This was a remarkable shift as Jobs went from believing he only had a few months to live to the realization that he could live a much longer life.
9. "Stay hungry. Stay foolish."

Vocabulary

1. 1 - G; 2 - H; 3 - E; 4 - F; 5 - C; 6 - I; 7 - D; 8 - B; 9 - M; 10 - L; 11 - A; 12 - K; 13 - J.

3. 1 – commencement; 2 – dropped out; 3 – destination; 4 – relented; 5 – stumbled into; 6 – calligraphy; 7 – karma; 8 – diverge; 9 – devastating; 10 – renaissance; 11 – dogma; 12 – hitchhiking.
4. “To connect the dots” means to understand the relationship between different ideas or experiences, to find the “big picture.”

The person “dropping the baton” has not done his or her part and has let down the team.

“To dawn on” means to suddenly understand something.

Grammar practice

1. drop out; pop out; find out; be out; turn out; clear out; let down; clear away; drop in; look forward; look backward; look back; come back; go on; roll on; start over.
2. 1 – popped out; 2 – found out; 3 – looking back; 4 – dropped out, dropping in; 5 – came back; 6 – looking forward; 7 – looking backwards; 8 – clears out; 9 – let down.
3. 1 – was out; 2 – start over; 3 – turned out; 4 – went on; 5 – roll on; 6 – fall away; 7 – be cleared away.

Lesson 6

Comprehension

1. 21 billion hours a week, as a planet.
2. “I wish I hadn’t worked so hard”, “I wish I had stayed in touch with my friends”, “I wish I had let myself be happier”, “I wish I’d had the courage to express my true self”, “I wish I’d lived a life true to my dreams, instead of what others expected of me.”
3. According to modern studies:
 - parents who spend more time playing video games with their kids have much stronger real-life relationships with them;
 - these games are incredibly powerful relationship-management tools. They help us stay connected with people in our social network that we would otherwise grow distant from;
 - online games can outperform pharmaceuticals for treating clinical anxiety and depression. Just 30 minutes of online game play a day was enough to create dramatic boosts in mood and long-term increases in happiness;
 - playing a game with an idealized avatar changes how we think and act in real life, making us more courageous, more ambitious, more committed to our goals.

4. Jane hit her head and got a concussion. The concussion didn't heal properly, she had such symptoms as nonstop headaches, nausea, vertigo, memory loss, mental fog. Her doctor told her to avoid everything that triggered the symptoms (no reading, no writing, no video games, no work or email, etc.) She knew from researching the psychology of games that when people play a game they tackle tough challenges with more creativity, more determination, and more optimism. Jane wanted to bring these gamer traits to her real-life challenge, so she created a role-playing recovery game called Jane the Concussion Slayer.
5. Adopt a secret identity, recruit your allies, battle the bad guys, activate the power-ups.
6. Within just a couple days of starting to play, that fog of depression and anxiety went away. Even when she still had the symptoms, even while she was still in pain, she stopped suffering.
7. The game could help people experience what scientists call post-traumatic growth.
8. Somehow, a traumatic event can unlock our ability to lead a life with fewer regrets and build up the four kinds of resilience or strength that contribute to post-traumatic growth.
9. The four types of resilience are the physical, mental, emotional and social resilience.

First, the audience was asked to either stand up and take three steps, or make their hands into fists, raise them over the head as high as they could for five seconds. The next task was to either snap the fingers exactly fifty times or count backwards from hundred by seven. The third task was to do a quick *YouTube* or *Google* image search for baby animal. The final task was to shake someone's hand for six seconds, or send someone a quick "Thank you" by text, email, *Facebook* or *Twitter*.

10. It turns out that people who regularly boost these four types of resilience — physical, mental, emotional and social — live 10 years longer than everyone else.

Vocabulary

1. 1 — K; 2 — D; 3 — A; 4 — I; 5 — H; 6 — C; 7 — B; 8 — E; 9 — L; 10 — F; 11 — N; 12 — G; 13 — J; 14 — M.
2. 1 — outperform; 2 — reasonable assumption; 3 — triggered; 4 — contribute; 5 — withstand; 6 — take advantage; 7 — tackling; 8 — resilience; 9 — springboard; 10 — concussion; 11 — nausea, vertigo.

3.

R	E	A	S	O	N	A	B	L	E	W	L
N	Y	D	N	J	J	J	B	K	U	I	E
O	F	R	B	A	M	U	K	M	R	T	T
I	N	A	R	S	T	W	Q	P	E	H	U
S	A	O	R	S	F	V	P	S	S	S	B
S	U	B	E	U	C	A	K	U	I	T	I
U	S	G	G	M	S	I	M	E	L	A	R
C	E	N	G	P	D	U	Z	S	I	N	T
N	A	I	I	T	A	C	K	L	E	D	N
O	W	R	R	I	U	M	Q	U	N	K	O
C	Q	P	T	O	X	H	D	T	C	U	C
B	L	S	U	N	F	Z	Z	P	E	Q	B

Grammar practice

1.

Situations	Wishes/regrets
1. She spent three hours playing computer games	<i>She wishes she hadn't</i> spent three hours playing computer games
2. I am afraid to do what makes me happy	<i>If only I was not</i> afraid to do what makes me happy
3. I didn't have the courage to express my true self	<i>I wish I'd had</i> the courage to express my true self
4. My priorities have not changed	<i>I wish</i> my priorities had changed
5. I am not able to focus on my goals and dreams	<i>I wish I were</i> able to focus on my goals and dreams
6. He doesn't stay in touch with his friends	<i>He wishes</i> he stayed in touch with his friends
7. I didn't let myself be happier	<i>I wish I had</i> let myself be happier
8. I work so hard	<i>I wish I didn't</i> work so hard

2. 1 – hadn't wasted; 2 – had gone out; 3 – had installed; 4 – helped; 5 – had; 6 – hadn't; 7 – hadn't wasted; 8 – played; 9 – had been; 10 – hadn't told; 11 – tackled.

Lesson 7

Comprehension

1. Using too much of GMO makes the food toxic and attenuate nutrition.
2. Young people don't want to be farmers because farming is hard. The life of a small-shareholder farmer is miserable. In India farmers' families are not able to have basic access to utilities, more farmer suicides this year and the previous 10 before that.
3. By developing digital farms.
4. With his team, he built a farm inside of the media lab, which is about 60 square feet. They produced enough food to feed about 300 people once a month.
5. He is coding a climate like in Mexico – this much CO₂, this much O₂, creates a recipe – he is coding the expression of that plant, the nutrition of that plant, the size of that plant, the shape, the color, the texture. In the lab they put a bunch of sensors in the plant (about 30) to know what's going on.
6. You can click one button and get a plant profile, which tells downloadable progress of that plant. When will it achieve the desired nutrition and taste? Is it getting too much water? Is it getting too much sun?
7. It's a perfect world for plants. Aeroponics give the plant exactly what it wants: water, minerals and oxygen. It's like the plant has two hearts. And because it has two hearts, it grows four or five times faster.
8. An interface like a game makes the children learn so much due to exploration process. They have a 3D environment and an iterative design. They can log in from anywhere in the world on their smartphone or tablet. They select recipes that have been created by other kids anywhere in the world, activate the recipe and plant a seedling. They can download the data about that new plant that they developed or the new digital recipe and decide if it is better or worse.
9. Among else, the kids start to consider becoming a farmer.
10. He has open-sourced the food computer. Also the lab started to send information about food, rather than sending food. There are food computers, food servers, soon-to-be food data centers, connecting people together to share information.

11. The future of food is about networking the next one billion farmers and empowering them with a platform to ask and answer the question, “What if?”

Vocabulary

1. 1 – E; 2 – H; 3 – D; 4 – F; 5 – B; 6 – C; 7 – I; 8 – J; 9 – G; 10 – A.
2. 1 – genome, phenomena; 2 – recipe, nutrition; 3 – deficiency, humidity; 4 – aeroponics; 5 – beacons, deploying; 6 – germplasm.
3. a – farmers, electrical engineers, mechanical engineers, environmental engineers, computer scientists, plant scientists, economists, urban planners, software developers, image-based processing experts, data scientists, roboticists;
b – apples, strawberries, lettuce, broccoli, tomatoes, greens.

Grammar practice

1 – What if; 2 – What if climate was democratic; 3 – What if each country had its own productive climate; 4 – What if we built a digital farm; 5 – What if you could take this apple; 6 – What if you created an interface; 7 – What if they select recipes; 8 – What if CO₂ is bad for the plants.

Lesson 8

Comprehension

1. According to John McWhorter, it's not true though it's easy to think that it's true.
2. Writing is a conscious process, when you write you can look backwards and improve your piece of writing.
3. Linguists have actually shown that when we are speaking casually in an unmonitored way, we tend to speak in word packets of maybe seven to ten words. Speech is much looser. It's much more telegraphic. It's much less reflective.
4. Once you have a device in your pocket that can receive a message, then you have the conditions when we can write like we speak. That is where texting comes in.
5. Texting is fingered speech that allows us to write the way we talk. Texting is very loose in its structure. There is the lack of concern with rules. No one thinks about capital letters or punctuation when one texts. It is much less reflective.
6. In older texts LOL meant “laughing out loud.” But if you text now, you'll notice that LOL does not mean laughing out loud anymore.

burgh, Pennsylvania. She studies online privacy, security, phishing, spam and how to keep us safe online.

2. To obtain more data on the passwords users actually choose.
3. The main challenge is getting a good password data considering administrators are reluctant to reveal password data to others.
4. They walked around campus and talked to students, faculty and staff, and asked them for information about their passwords and gave them a bar of chocolate as a reward. They also had an access to some stolen password sets. They asked people to create passwords for their study, using a service called *Amazon Mechanical Turk*. They studied the real passwords for 25,000 CMU students, faculty and staff, though they never saw anybody's password.
5. Password strength can be measured by using a password meter.
6. Password meters do work. Most of the password meters are actually effective.
7. They are too soft, they tell you you are doing a good job too early, and if they would just wait a little bit before giving you that positive feedback, you probably would have better passwords.
8. A strong password should:
 - be long (at least eight characters);
 - contain both uppercase and lowercase letters;
 - use digits and symbols;
 - not contain a word or a phrase that can be found in a dictionary.Also you shouldn't:
 - write down your password;
 - use frequently used passwords like *princess, monkey, I love you* etc.;
 - reuse the password.

Vocabulary

1. 1 – J; 2 – E; 3 – A; 4 – I; 5 – H; 6 – G; 7 – K; 8 – D; 9 – C; 10 – F; 11 – B.
3. 1 – crack; 2 – random; 3 – bunch; 4 – mechanical; 5 – reluctant; 6 – entropy; 7 – frustrated; 8 – scrambled.
4. 1 – susceptible to attackers; 2 – requirements; 3 – rules of thumb; 4 – reluctant; 5 – data set ; 6 – cracking.
5. 1 – an unknown rule; 2 – a simple password; 3 – a usable character; 4 – a hard policy; 5 – a weak password; 6 – an unusual password; 7 – an ineffective password meter; 8 – a negative feedback; 9 – a specific word; 10 – an ordinary/unmemorable phrase.

Grammar practice

1. 1 – had to; 2 – can; 3 – might; 4 – may not; 5 – could; 6 – have to; 7 – could; 8 – can.

2. 1 — obligation; 2 — ability; 3 — polite request; 4 — advice; 5 — something that must be true; 6 — not sure about something; 7 — past request; 8 — polite request; 9 — obligation; 10 — possibility.

Lesson 10

Comprehension

1. The last big innovation in education was the printing press and the textbooks.
2. “Going from ox carts to the airplane” means to reinvent and reimagine what we do in the classroom. For example, to go from lectures on the blackboard to online exercises and videos; to go to interactive virtual laboratories and gamification; to go to completely online grading and peer interaction and discussion boards. Everything really has to change.
3. It was an MIT hard circuits and electronics course. About 155,000 students from 162 countries enrolled in this course. 7,200 students passed the course, though it was a hard course.
4. In a flipped classroom, the students watch videos and do interactive exercises in the comfort of their dorm rooms or wherever they’re most creative. Then they come into the classroom for some in-person interaction.
5. Traditionally, semester upon semester, for the past several years, this course had a failure rate of about 40 to 41 percent every semester. With this blended class late last year, the failure rate fell to nine percent.
6. The key principles are:
 - active learning;
 - self-pacing;
 - instant feedback;
 - gamification;
 - peer learning.
7. For Anant Agarwal it means to move from lecture halls to e-spaces, to move from bricks-and-mortar school buildings to digital dormitories.

Vocabulary

1. 1 — D; 2 — J; 3 — F; 4 — H; 5 — G; 6 — C; 7 — K; 8 — B; 9 — E; 10 — A; 11 — L; 12 — I.
3. 1 — MOOCs; 2 — had flipped; 3 — gamification, creativity; 4 — a distraction; 5 — peer learning; 6 — pilot; 7 — failure rate; 8 — active learning; 9 — blended model; 10 — alumni; 11 — predilections.

Grammar practice

1. 1 – use; 2 – did; 3 – didn't sleep; 4 – told; 5 – were going; 6 – had answered; 7 – do; 8 – was sitting / am sitting; 9 – thought / think; 10 – is / was; 11 – asked; 12 – don't / didn't; 13 – begin / began; 14 – (can) finish / finished; 15 – pops / had popped; 16 – am fixing / was fixing; 17 – (can) finish / finished; 18 – pops / had popped; 19 – sat; 20 – were discussing; 21 – am fascinated / was fascinated; 22 – had discovered; 23 – is; 24 – are learning / learn; 25 – are telling / tell; 26 – are learning / learn.

Appendices

Appendix 1

TED Talks related to Information Technology subject

Don't be left behind! Each of these talks has from 1 000 000 to 15 000 000 total views!

1. *Liukas, L.* A delightful way to teach kids about computers. — URL: https://www.ted.com/talks/linda_liukas_a_delightful_way_to_teach_kids_about_computers
2. *Rubin, A.* All your devices can be hacked. — URL: https://www.ted.com/talks/avi_rubin_all_your_devices_can_be_hacked
3. *Peleg, D.* Forget shopping. Soon you'll download your new clothes. — URL: http://www.ted.com/talks/danit_peleg_forget_shopping_soon_you_ll_download_your_new_clothes
4. *Haas, H.* Forget Wi-Fi. Meet the new Li-Fi Internet. — URL: http://www.ted.com/talks/harald_haas_a_breakthrough_new_kind_of_wireless_Internet
5. *Kurzweil, R.* Get ready for hybrid thinking. — URL: https://www.ted.com/talks/ray_kurzweil_get_ready_for_hybrid_thinking
6. *Elazari, K.* Hackers: The Internet's Immune System. — URL: https://www.ted.com/talks/keren_elazari_hackers_the_Internet_s_immune_system
7. *Urmson, Ch.* How a driverless car sees the road. — URL: https://www.ted.com/talks/chris_urmson_how_a_driverless_car_sees_the_road
8. *Li, F.-F.* How we are teaching computers to understand pictures. — URL: https://www.ted.com/talks/fei_fei_li_how_we_re_teaching_computers_to_understand_pictures
9. *Atala, A.* Printing a human kidney. — URL: https://www.ted.com/talks/anthony_atala_printing_a_human_kidney
10. *Follmer, S.* Shape-shifting tech will change work as we know it. — URL: https://www.ted.com/talks/sean_follmer_shape_shifting_tech_will_change_work_as_we_know_it

11. *Mistry, P.* The thrilling potential of SixthSense technology. — URL: https://www.ted.com/talks/pranav_mistry_the_thrilling_potential_of_sixthsense_technology
12. *El Kaliouby, R.* This app knows how you feel — from the look on your face. — URL: http://www.ted.com/talks/rana_el_kaliouby_this_app_knows_how_you_feel_from_the_look_on_your_face
13. *Case, A.* We are all cyborgs now. — URL: https://www.ted.com/talks/amber_case_we_are_all_cyborgs_now
14. *Bostrom, N.* What happens when our computers get smarter than we are? — URL: https://www.ted.com/talks/nick_bostrom_what_happens_when_our_computers_get_smarter_than_we_are
15. *Reichental, A.* What's next in 3D printing. — URL: https://www.ted.com/talks/avi_reichental_what_s_next_in_3d_printing

The Internet safety rules

1. Don't put too much personal information online. Always remember to think carefully before you post.
2. Maintain a positive online identity. Make sure you have a good on-line reputation. There are cases of people having missed out on jobs and places in college because their digital footprints didn't impress the recruiters.
3. Protect your personal information. Learn how to use privacy settings while networking.
4. Choose smart passwords! Follow basic security rules, like not using the same password for multiple accounts.
5. Watch out for phishing frauds, especially if you like to shop or manage your bank accounts online.
6. Be wary of emails promising something that sounds too good to be true and take care not to respond to spam or phishing messages.
7. Advice is available from many places and if something goes wrong online, you can get help calling a helpline or speaking to a trusted friend.
8. Balance your life! A virtual hug never matches a real one.

Tips for describing bar charts¹

1. Start by saying exactly what the chart shows.

Useful vocabulary for the introduction part

Starting	Presentation Type	Verb	Description
The given / the presented / the shown / the provided...	figure / illustration / graph / chart / picture / bar graph / column graph / data / information...	shows / represents / depicts / illustrates / presents / gives / provides / describes / outlines / compares / indicates / figures / gives data on / gives information on / presents information about / shows data about / demonstrates / outlines / summarises...	the comparison of... the differences... the changes... the number of... information on... data on... the proportion of... the amount of... information on... the percentages of...

2. Describe the given information as precisely as you can. Use data and numbers from the bar chart.

Useful vocabulary to express percentages

- 73% – nearly three quarters
- 51% – just over a half
- 49% – just under a half
- 32% – nearly a third
- 3% – a tiny fraction
- 50% – exactly a half
- 26% – roughly one quarter
- 49% – around a half
- 24% – almost a quarter
- 77% – approximately three quarters

¹ Vocabulary For Academic IELTS Writing Task 1 (part 1) // IELTS Mentor.
URL: <http://www.ielts-mentor.com/48-ielts-vocabulary/vocabulary-for-academic-ielts-writing-task-1/528-vocabulary-for-academic-ielts-writing-task-1-part-1>

3. Compare the information. Talk about differences or similarities between the groups shown.

Making comparisons

Here are three grammatical structures that can be used to make comparisons:

- *More / few / less* + noun + *than*;
- adj. of one syllable ending in *-er* + *than*
- *More / less* + adj. of more than one syllable + *than*

Examples:

Overall, more people preferred tablet devices than laptops.

A higher number for people preferred tablet devices than laptops.

Tablet devices were more popular than laptops.

4. Conclude by saying what the main trends or changes are.

Vocabulary for summarising

- To summarise ...
- Overall it is clear ...
- Overall the majority/minority ...
- In sum,

Useful phrases for discussions in pairs and in small groups

Asking for an opinion

- Could you tell me ... ?
- May I ask you ... ?
- Do you think / feel (that) ... ?
- What do you think about / of ... ?
- What's your opinion on ... ?
- How do you feel about ... ?

Giving an opinion

- In my opinion / view ...
- If you ask me ...
- Personally (speaking) I think ...
- First of all I'd like to point out ...
- It seems to me that ...
- Well, I'd say ...

Asking for an explanation

- Could you explain to me ... ?
- I don't really understand ... ?
- Are you saying that ... ?
- Just tell me the reason why ... ?
- What do you mean by that?
- Excuse me, did you say that ... ?

Giving an explanation

- What I mean is ...
- The reason for this is ...
- Just let me explain ...
- Well, the reason is ...
- Well, the thing is ...
- The main problem is ...

Agreeing with an opinion

- I (quite) agree.
- Exactly / Right / Certainly / Definitely.
- I completely agree with you on that.
- I think so, too.
- I don't think so either.
- Yes, indeed.

Polite disagreement with an opinion

- I disagree (with you), I am afraid.
- I don't think so.
- Do you really think so?
- No, I really can't agree with you.
- I don't think you are right / that's right.
- I wouldn't say so.

Suggested reading

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3. *Fitzgerald, P. English for ICT Studies in Higher Education* / P. Fitzgerald, M. McCullagh, C. Tabor, T. Phillips. — Reading : Garnet, 2011.
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5. *Hill, D. English for Information Technology: Level 2* / D. Hill. — Harlow : Pearson Education Limited, 2014.
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Новые издания по дисциплине «Английский язык» и смежным дисциплинам

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