

Technical English  
Chapter 3

**Artificial Intelligence:  
Machine learning and Deep learning**

## Tuning-in

Before reading the text, match these words with their definitions.

... ...	<b>1. Machine learning</b>	a. The application of computational techniques to the analysis and synthesis of man-made linguistic text and speech
.....	<b>2. Deep learning</b>	b. The study of computer algorithms that can improve automatically through experience and by the use of data
.....	<b>3. Artificial Intelligence</b>	c. The information processing paradigms inspired by the biological brain and based on a collection of connected units or nodes called artificial neurons, which model biological neurons
.....	<b>4. Artificial Neural Networks</b>	d. The process of discerning regularities, patterns and correlations within large data sets to predict outcomes.
.....	<b>5. Data Mining</b>	e. It is a subset of machine learning, essentially a neural network with three or more layers which try to simulate the behavior of the human brain, allowing it to “learn” from large amounts of data.
.....	<b>6. Natural Language Processing</b>	f. The simulation of human intelligence processes by machines, especially computer systems

# Reading section

## Introduction

Artificial intelligence (AI) makes it possible for machines to learn from experience, adjust to new inputs and perform human-like tasks. The term artificial intelligence was coined in 1956, but AI has become more popular today thanks to increased data volumes, advanced algorithms and improvements in computing power and storage. Early AI research in the 1950s explored topics like problem solving and symbolic methods. In the 1960s, the US Department of Defense took interest in this type of work and began training computers to mimic basic human reasoning. For example, the Defense Advanced Research Projects Agency (DARPA) completed street mapping projects in the 1970s. And DARPA produced intelligent personal assistants in 2003, long before Siri, Alexa, Google Assistant or Cortana were household names. This early work paved the way for the automation and formal reasoning that we see in computers today, including decision support systems and smart search systems that can be designed to complement and augment human abilities.

# Benefits of AI

While Hollywood movies and science fiction novels depict AI as human-like robots that take over the world and though there are warnings about AI taking control over human beings, the current evolution of AI technologies is not that scary – or quite that smart. Instead, AI has evolved to provide many specific benefits in different sectors as health care, retail, manufacturing, etc. Here are some other advantages of AI:

- **AI automates repetitive learning and discovery through data.** Instead of automating manual tasks, AI performs frequent, high-volume, computerized tasks. And it does so reliably and without fatigue. Of course, humans are still essential to set up the system and ask the right questions.
- **AI adds intelligence to existing products.** Many products you already use will be improved with AI capabilities, much like Siri was added as a feature to a new generation of Apple products. Automation, conversational platforms, bots and smart machines can be combined with large amounts of data to improve many technologies. Upgrades at home and in the workplace range from security intelligence and smart cams to investment analysis.



- **AI adapts through progressive learning algorithms to let the data do the programming.** AI finds structure and regularities in data so that algorithms can **acquire** skills. Just as an algorithm can teach itself to play chess, it can teach itself what product to recommend next online and what models to adapt when given new data.
- **AI analyzes more and deeper data using neural networks that have many hidden layers.** Building a fraud detection system with five hidden layers used to be impossible. However, this has changed thanks to incredible computer power and big data. Big data is a term that describes large, hard-to-manage volumes of data – both structured and unstructured – that **inundate** businesses on a day-to-day basis. But it is not just the type or amount of data that is important, it is what organizations do with the data that matters. Big data can be analyzed for insights that improve decisions and give confidence for making strategic business moves. You need lots of data to train deep learning models because they learn directly from the data.
- **AI achieves incredible accuracy through deep neural networks.** For example, your interactions with Alexa and Google are all based on deep learning. And these products keep getting more accurate the more you use them. In the medical field, AI techniques from deep learning and object recognition can now be used to pinpoint cancer on medical images with improved accuracy.

- **AI gets the most out of data.** When algorithms are self-learning, the data itself is an asset. The answers are in the data. You just have to apply AI to find them. Since the role of the data is now more important than ever, it can create a competitive advantage. If you have the best data in a competitive industry, even if everyone is applying similar techniques, the best data will win.

Most AI examples that you hear about today –from chess-playing computers to self-driving cars– rely heavily on machine learning, deep learning, data mining and natural language processing. Using these technologies, computers can be trained to accomplish specific tasks by processing large amounts of data and recognizing patterns in the data. In what follows we will study machine learning and deep learning.

# Comprehension Check

Decide whether the following sentences are True, False or Not Mentioned.

1. According to the text, DARPA was as powerful as Siri or Cortana.	.....
2. Decision support systems and smart search systems were among the first applications of AI.	.....
3. In the health care sector, AI is used to recognize cancerous cells.	.....

**B. Answer the following questions based on the text.**

**1. According to the text, building a fraud detection system with five hidden layers .....**

- is impossible as a result of the huge amount of such data
- has been performed by high-tech companies since 2010
- has become possible due to powerful computers and big data
- is not possible as computers are not that powerful enough

**2. Which one is NOT mentioned in this text as a benefit of AI?**

- a. AI can gradually take control over human beings.
- b. AI will perform jobs which are tiresome and repetitive for human beings.
- c. Many products will be value-added with AI competences.
- d. By its progressive algorithms, AI is able to let data learn for themselves.

**3. The incredible accuracy with which AI performs its tasks depends on .....**

•

- a. the way they are trained to self-learn
- b. the more times you use them
- c. the algorithm used in performing the task
- d. the number of layers involved



# Machine learning

Machine learning is a method of data analysis that automates analytical model building. It is a branch of AI based on the idea that systems can learn from data, identify patterns and make decisions with minimal human **intervention**. Because of new computing technologies, machine learning today is not like machine learning of the past. It was born from pattern recognition and the theory that computers can learn without being programmed to perform specific tasks; researchers interested in AI wanted to see if computers could learn from data. The iterative aspect of machine learning is important because as models are exposed to new data, they are able to independently adapt. They learn from previous computations to produce reliable and repeatable decisions and results. It is a science that is not new – but one that has gained fresh momentum.

**Resurging** interest in machine learning is due to the same factors that have made data mining and Bayesian analysis more popular than ever, i.e. factors like growing volumes and varieties of available data, computational processing that is cheaper and more powerful and affordable data storage. All these factors mean it is possible to quickly and automatically produce models that can analyze bigger, more complex data and deliver faster, more accurate results – even on a very large scale. And by building precise models, an organization has a better chance of identifying profitable opportunities and avoiding unknown risks.

While many machine learning algorithms have been around for a long time, the ability to automatically apply complex mathematical calculations to big data – over and over, faster and faster – is a recent development. Here are a few widely publicized examples of machine learning applications you may be familiar with:

- The heavily hyped, self-driving Google car: The essence of machine learning;
- Online recommendation offers such as those from Amazon and Netflix: Machine learning applications for everyday life;

- Knowing what customers are saying about you on Twitter: Machine learning combined with linguistic rule creation;
- Fraud detection: One of the more obvious, important uses in our world today (as in plagiarism)

### Comprehension check

**A. Decide whether the following sentences are True, False or Not Mentioned.**

<b>1. The idea of machine learning is new.</b>	.....
<b>2. The reason behind a revival in interest in machine learning is related to similar factors as those of data mining.</b>	.....
<b>3. Bayesian analysis is a statistical paradigm that answers research questions about unknown parameters using probability statements.</b>	.....

**B. Answer the following questions based on the text.**

**1. Which one is NOT true about machine learning.**

- a. Machine learning is a branch of AI.
- b. Machine learning has had great changes over time.
- c. It originates from pattern recognition
- d. They are not dependent on previous computations

**2. Two benefits of developing exact models by machine learning for organizations are .....**

- a. identifying profitable opportunities and avoiding unknown risks
- b. applying complex mathematical calculations and having a better understanding of variable relationship
- c. pattern recognition and the having computers learn without being
- d. iteratively being exposed to new data and being able to independently adapt.

**3. Which one is NOT given as a popular example of machine learning applications?**

- a. Google self-driving car
- b. Netflix Offers
- c. Plagiarism checkers
- d. Amazon's App store

# Deep learning

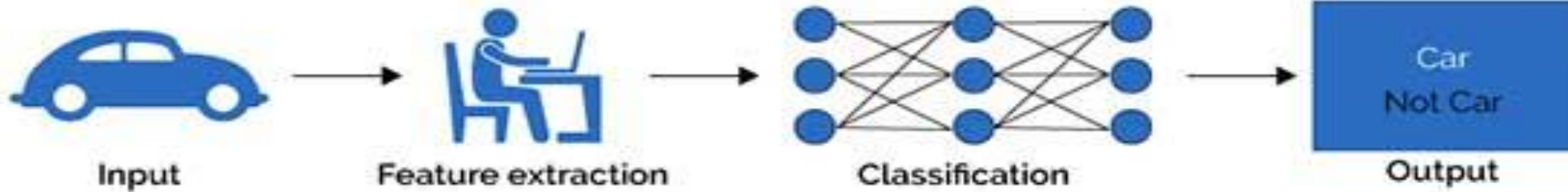
- Deep learning (DL) is a subtype of machine learning. Deep learning is a **paradigm** shift in model building that moves from feature engineering to feature representation. Instead of using known variables to predict unknowns, deep learning uses looks at layers of the data to recognize **latent** features of the data using **matrix factorization**. Such latent features can then be used for **dimensionality** reduction or as features for classification. The promise of deep learning is that it can lead to predictive systems that **generalize** and **adapt** well and improve continuously as new data arrives. You no longer fit a model. Instead, you train the task.



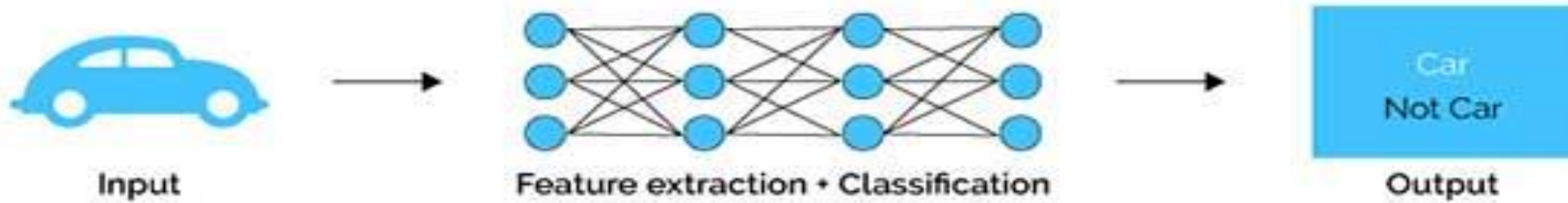
## Self-Check

Distinguish the following processes as deep learning and machine learning.

1. ....



2. ....



A traditional approach to **analytics** is using data at hand for engineering features to derive new variables, then select an analytic model and finally estimate the parameters (or the unknowns) of that model. These techniques can **yield** predictive systems that do not generalize well because completeness and correctness depend on the quality of the model and its features. Adding more data requires you to do it all over again. The new approach with deep learning is to replace the formulation and specification of the model with hierarchical characterizations (or layers) that learn to recognize latent features of the data from the regularities in the layers.

**A. Decide whether the following sentences are True, False or Not Mentioned.**

<b>1. Deep learning is a subset of machine learning.</b>	<b>.....</b>
<b>2. Latent features are discovered trough matrix factorization.</b>	<b>.....</b>
<b>3. Deep learning uses known variables to predict unknowns.</b>	<b>.....</b>

## **B. Answer the following questions based on the text.**

**1. What is the most important problem of the traditional methods of analytics?**

- a. They move from known to unknown.
- b. They select analytic models before estimating the parameters.
- c.** They yield predictive systems that do not generalize well.
- d. The model and its features are determined after deriving new variables.

## **2. The new approach to deep learning, ..... .**

- a. requires redoing the whole model when new data is added
- b. derive a model from initial variables using data transformations
- c. determines meaningful and non-meaningful variables after shaping the model
- d. recognizes latent features from the regularities in the hierarchical layers

## **3. It can be **inferred** that the main difference between machine learning and deep learning lays in .....**

- a. feature extraction
- b. feature representation
- c. hierarchical structure
- d. from known to unknown

**III. Write NO MORE THAN TWO WORDS from the passage for each answer.**

1. Models are able to adapt themselves independently as being exposed to new data due to the ..... feature of machine leaning.
2. The main objective of machine learning systems are learning from data, recognize patterns and decision making with the least .....
3. Identifying latent variables in deep learning is done by inspecting different layers through .....
4. Although AI systems are moving toward self-leaning and self-control, humans are still needed to ..... the system and raise the proper questions.
5. Fitting the model to the new data is not required in deep learning as training the ..... is the main objective.
6. Big data are called so not according to the amount of data but rather based on what ..... do with the data.

## Vocabulary exercises: A. Match the words with their definitions.

1. latent	.....	a. a computer program that performs automatic repetitive tasks
2.hierarchical structure	.....	b. to cover or <b>overspread</b> with large amounts of sth
3. <b>inundate</b>	.....	c. to become interested in sth after a period of disinterest; a period of rise of a period of fall
4. iterative	.....	<b>d.</b> hidden links, patterns or attributes which are discovered in data
5. algorithm	.....	e. a set of rules or instructions given to an AI program, neural network, or machine learning to help it learn on its own
6. reasoning	.....	<b>f.</b> an upward grade or slope; a move toward an elevated change
7. bot	.....	g. The process of deriving logical and rational conclusion and making predictions from available knowledge, facts, and beliefs
8. upgrade	.....	h. the feature of a machine learning system showing the number of times the algorithm's parameters are updated
	.....	<b>i.</b> In deep learning, the fact that each layer is <b>constructed</b> based on the features of the previous layer to reflect the relations among them



Fill in the blanks with the appropriate words (extra choices).

**factorization \* momentum \* dimensionality \* mining \* adapt \* publicized**  
**\*competitive \* regularity \* augment \***

1. Text ..... uses the extraction techniques to find and dig out the cryptic knowledge automatically from text files.
2. Attitudes toward online education are changing as a result of the ..... technologies being advertised today.
3. The software trade is extremely ....., and companies need plenty of contracts in order to survive.
4. A ..... in data is a feature which occurs in a definable environment with a significant frequency.
5. Because edge detection reduces image ....., the total iterative computation pixels are only 0.88 percent compared to that of the original algorithm.
6. The ability of a service-oriented process to use the information available within its environment and ..... its execution accordingly is called data-driven revision.

# Language Focus

## Adverbial clauses

Adverbial **conjunctions** (as opposed to non-adverbials such as *but, however, nevertheless, yet, so, therefore, thus, for example, for instance, moreover, in addition, furthermore*, etc.) are used to make some kind of relationship between a dependent (subordinating) clause and an independent (main) clause. This relationship could be reason, contrast, condition, purpose, time and place. The following table presents these adverbial conjunctions and provides some examples.

Adverbial type		
reason	because, since, because, given	<p>-Because Bitcoin’s blockchain has a decentralized nature, all transactions can be transparently viewed by either having a personal node or using blockchain explorers.</p> <p>- Doing such a thing would not go unnoticed, as network members would see such drastic alterations to the blockchain.</p>
contrast	although, though, even though, while, whereas, in spite of the fact that, even if	<p>-Although blockchain can save users money on transaction fees, the technology is far from free.</p> <p>-A database usually structures its data into tables whereas a blockchain structures its data into chunks (blocks) that are strung together.</p>

condition	if, <b>unless</b> , in case, provided that	<p>-<i>If</i> one user <b>tampers</b> with Bitcoin's record of transactions, all other nodes will cross-reference each other and easily pinpoint the node with the incorrect information.</p> <p>-After a block has been added to the end of the blockchain, it is extremely difficult to go back and alter the contents of the block <i>unless</i> a majority of the network has reached a <b>consensus</b> to do so.</p>
purpose	so that, in order that	-In Bitcoin's case, blockchain is used in a decentralized way <i>so that</i> no single person or group has control.
time	when, whenever, as, while, before, after, once	<p>-<i>When</i> you receive the message to press R to repair Windows by using the Recovery Console, press the R key.</p> <p>- Submit trades in a virtual environment <i>before</i> you start risking your own money.</p>
place	where, wherever	<p>-You could track Bitcoin <i>wherever</i> it goes.</p> <p>-<i>Where</i> the economy is in its <b>infancy</b>, people are entirely dependent on cash.</p>

## Language focus Exercises

**A. Choose the correct conjunction to complete the following sentences.**

1. .... more efficient algorithms and hardware can be and are being developed, the energy intensity of blockchains may become an increasing problem in the future.

- a. While                  b. When                  c. Whereas                  d. Because

2. .... all transactions pass through them, the creators maintain their position of power and capacity to profit from their users.

- a. Even though                      b. Wherever                      c. Unless                      **d. Since**

3. .... the block is filled with data, it is chained onto the previous block, which makes the data chained together in chronological order.

- a. Once                                      b. While                                      c. If                                      d. So that

4. Human intelligence is a quality that helps humans in learning, understanding, and solving problems with new ideas ..... artificial intelligence is something that mimics human beings by the information they receive.

a. whereas

b. when

c. as if

d. so that

5. .... an AI algorithm returns to an inaccurate prediction, then an engineer has to step in and make adjustments.

a. While

b. If

c. As though

d. Even if

6. Data mining is defined as a process used to extract usable data from a larger set of any raw data., ..... this general definition may hold true for deep learning too.

a. where

b. since

c. even if

d. in case



## Language Focus exercises

Choose the appropriate conjunction and complete the following.

**unless**- if(2)- **when**—**since**-**where**-**even though**-**so that**-**after**

- Hashing is the process of translating a given key into a code. Accordingly, a hash is a mathematical function that converts an input of **arbitrary** length into an encrypted output of a fixed length, ....., **regardless** of the original amount of data or file size involved, its unique hash will always be the same size. Moreover, hashes cannot be used to "reverse-engineer" the input from the hashed output, ..... hash functions are "one-way" (like a meat **grinder**; you can't put the ground beef back into a steak). Otherwise, hackers could easily reverse engineer the hash to convert it back to the original data and that information is completely useless to them, ..... they have a key to **decipher** it. **Still**, ..... you use such a function on the same data, its hash will be identical. Therefore, you can validate that the data is the same (i.e., **unaltered**) ..... you already know its hash. .... hashing is not **compression**, it can operate very much like file compression in that it takes a larger data set and **shrinks** it into a more manageable form.

## IV. Follow-up section

### A. Complementary Reading

**Cloze:** Read the following text and complete the blanks with the suggested words (extra choices)

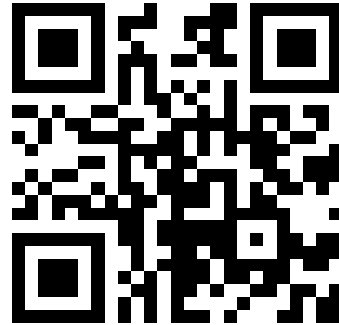
**distribution-iterative-diagnoses-pattern-dimensionality-extract-validation-statistical-neural-automation**

#### Machine learning and deep learning

Although these methods have the same goal – to .....(1) ..... **insights**, patterns and relationships that can be used to make decisions –, they have different approaches and abilities. In machine learning just like in .....(2) .....models, the goal is to understand the structure of the data: fit **theoretical** .....(3) .....to the data that are well understood. Therefore, with statistical models there is a theory behind the model that is mathematically proven, but this requires that data meets certain strong **assumptions** too. Machine learning has developed based on the ability to use computers to **probe** the data for structure, even if we do not have a theory of what that structure looks like.

The test for a machine learning model is a .....(4) .....error on new data, not a theoretical test that proves a null hypothesis. Because machine learning often uses an .....(5) .... approach to learn from data, learning can be easily automated. Passes are run through the data until a robust pattern is found. Deep learning combines advances in computing power and special types of .....(6) .... networks to learn complicated patterns in large amounts of data. Deep learning techniques are currently state of the art for identifying objects in images and words in sounds. Researchers are now looking to apply these successes in .....(7) ....recognition to more complex tasks such as automatic language translation, medical ....(8) .... and numerous other important social and business problems.

Listening: Here is a clip on the real uses of AI, deep learning and machine learning.  
Scan the following QR code and watch the clip.



Now, answer the following questions.

1. The new era of medicine which is in particular helped by artificial Intelligence and high performance computing is called ..... medicine.  
  - a. **precision**
  - b. precise
  - c. practice
2. Medical applications are using deep learning and machine learning to .....  
  - a. **accelerate** learning output
  - b. promote patient outcomes
  - c. develop medication procedures

3. Due to the use of ML and DL in medicine, automation, cloud technology and ..... IT have become more important than ever.

- a. strengthened
- b. scheduled
- c. streamlined

4. Write **NO MORE THAN TWO WORDS** from the clip for each answer.

- a. Machine learning diagnoses conditions through .....
- b. Advances in deep learning used in medicine are driven by NVIDIA's powerful .....
- c. With the help of deep learning, the healthcare industry is advancing towards even more **sophisticated** applications such as personalized medicine, wearable medical devices, and ..... surgery.
- d. .... is helping researchers to compare patients with a broader population, predicting medical conditions before they occur.
- e. Data scientists, innovators, big data architects and those leading ..... are using ..... to digital evolution within healthcare.

- **Discussion panel**
- **You can talk about the following topics in class or as a presentation.**
- What are some shortcomings, drawbacks or threats of AI, Machine Learning and Deep Learning?
- Some futurists have warned against a strong version of AI as it may become so powerful that it will take over human life. Is such concern real and needs to be thought of? Should we avoid a strong version of AI and stick to a weaker version?
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# Writing Paraphrasing

In academic writing, it is very common to argue based on the authority of previous studies. **Citation** of others' research can be done in two ways: either you directly quote another researcher's or scholar's text (direct quotation) or you try to paraphrase that text, i.e. express the idea using your own words. In fact, paraphrasing is practicing to convey the same meaning using different forms. It should be noted that in both cases, the name of the original author must be cited.

➤ Look at the following sentences for examples of paraphrasing.

- **Original:** Steve Jobs' life **spanned** years of incredible change in IT as it was a period of innovative advances in both hardware and software.
- **Paraphrase:** Steve Jobs lived through the exciting **era** of IT developments.

- **Original:** When a virus attaches itself to other host programs it is said that it **infects** those programs.
- **Paraphrase:** Program infection happens as a result of a virus attaching itself to a host program.
  
- **Original:** When the virus stays in the memory until the computer is powered off, it is said that it becomes memory **resident**.
- **Paraphrase:** Memory resident is the state in which a virus is active as long as the system is on.
  
- **Original:** Blu-ray is expected to replace DVD over the coming years as it offers much greater capacity.
- **Paraphrase:** DVD is expected to give way to Blu-ray in future due to its greater capacity.

- **Now try to paraphrase the following sentences.**
- HDD, as compared to SSD, has a lower read time but provides a higher storage capacity at an affordable price.
- .....
- SSHD is a combo disc which uses a small SSD as a cache for more often accessed pieces of the stored data, on top of a normal HDD.
- .....
- From the perspective of an application, both HDD and SSD are exactly identical.
- .....

## Paraphrase

- The SSD cache on SSHD drives is often smaller than the amount of space allocated by Windows for the swap file, so very few users note any significant improvement in performance by using a Hybrid drive.

.....

- An SSHD might not be spectacular compared to other HDDs but it will improve performance on gaming and read/write intensive applications which might vary from brand to brand and device to device based on the queuing mechanism.

.....

## Translation

**Translate the following paragraph into fluent Persian.**

- Promoting man/machine cooperation makes sense. But why must humans become more machine-like? Or machines more like humans? We are can never match computers for speed or raw processing power. But why devote man-years to developing AI systems that merely mimic the imaginative and instinctive potential of humans, when we could instead strive to make humans and AI systems teammates--more like horses and humans used to be than the pitiless mechanisms and frantic machine-tenders that came into being with the Industrial Revolution? When AI learns how to learn on its own, worldwide, it will learn faster and faster than humans can learn, unless humans become augmented cyborgs, which may come to unpredictable and inevitable consequences. Instead of devising robots and AI systems that are specifically intended to replace human workers, let unions, governments, and academic/business R&D focus more on developing tools that make humans better at the things they already do well. This might cost more and take longer, but the results would be sustainable, long-term and comprehensible to people everywhere.