Lesson 2

Lesson 2: The Development of AI

LESSON SKILLS

After completing this lesson, you will be able to:

- Identify some important developments in the progress of AI.
- Identify some important people in the development of AI and their accomplishments.
- Define some AI developments/ products in the timeline of AI.
- Identify some organizations and companies that are leading the way in AI in today's world.
- Explain how the development of AI has led to ethical regulations around the world.
- Explain why laws around AI are still developing.

KEY TERMS

- Ada Lovelace
- AI Winter
- Alexa
- Deep Blue
- Eliza
- Ethics
- Gary Kasparov
- John McCarthey
- Siri
- Turing Test
- Watson

Points to Ponder

These Points to Ponder are designed to help you focus on key elements in this lesson. They are also suitable for use to spark discussions or individual research.

- Describe the Turing Test and how it is used.
- What were some important developments in AI through time?
- Describe what AI winters were and why they happened.
- After reading the information and viewing the slides, name some influential organizations in the progress of modern AI.
- What did John McCarthey do for the field of AI?
- Who was Ada Lovelace?
- What ethical considerations come with AIs development?
- Create a timeline of AI development and provide examples of the technology.

Overview

This lesson introduces how artificial intelligence (AI) began and what underlying concepts were developed through time. There were many important people along the way who helped develop AI and various AI products. In this lesson, you will learn how it started and important developments up to the present day. You will learn about pioneers including innovative women who led the way and contributed to its growth along with organizations that have been influential in its progress. Specific products and processes will be highlighted, along with how the development of AI leads to laws around privacy and security and ethical considerations.

The History of AI

Objectives
2.2.2: Identify who the word "Artificial Intelligence" was first coined by and when
2.2.3: Identify milestones in the development of AI
2.2.6: Identify some pioneers and leaders in AI including important women

Think About This

As AI developed over time, why would laws become more important to protect people's privacy and security? Why would ethics become so important in this field of computer science?

The Turing Test

The earliest work in the field of AI can be traced back to a man named Alan Turing. He was a mathematician, computer scientist and cryptographer from Britain. In 1950, he made a statement that one day in the future a machine would be able to replicate human intelligence and would prove it by passing a special test. He called this the Turing Test. The way the test worked is that a human and a computer would be asked random identical questions. If the computer was successful, it would be impossible for the tester to tell the human and computer answers apart.

Figure 2-1: The Turing Test

When Alan Turing explained the Turing Test in a famous paper he wrote, called "Computing Machinery and Intelligence," published in 1950, he approached it as a game. He called it the imitation game, and it made people question if in the future a computer could "think." It made people really consider what intelligence is and how thinking occurs. Turing's paper raised awareness of AI and started many years of work in the computer science field to create computers with the ability to reason. Today, the most common form of the Turing test are chatterbots, software applications designed to 'talk' to users through text or text-to-speech without employing a human.

The Loebner Prize

There is a special prize awarded for AI called the Loebner Prize. The Loebner Prize is an annual competition to find the chatbot considered by the judges to be the most human-like. The format of the competition is based on the Turing test. A human judge conducts conversations, via a computer keyboard, with a computer program and with a human being. Based on the responses, the judge decides which is which. Judges rank each of their conversation partners from most human-like to least human-like. The computer program with the highest average ranking wins the competition and is awarded a medal and a cash prize.

Kuki is a chatbot created by Steve Worswick using Pandorabots AIML technology. This chatbot is a five-time (2013, 2016, 2017, 2018, and 2019) Loebner Prize winner of a Turing Test competition. Kuki.ai holds a world record.

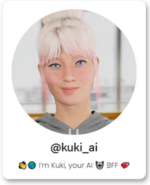


Figure 2-2: Kuki chatbot

John McCarthey

The development of AI cannot be explored without learning about John McCarthey who is considered one of the founding fathers of AI. He was an American computer and cognitive scientist and a leader in the development of AI. He is credited with coining the phrase "artificial intelligence" along with a team of computer scientists. McCarthy and his associates coined the term "artificial intelligence" in a proposal that they wrote for the famous Dartmouth AI Conference in Summer 1956. This conference started AI as a field. McCarthy defined artificial intelligence as "the science and engineering of making intelligent machines."
He also developed the Lisp programming language, used for AI research, and invented "garbage collection" (not trash, a way of clearing unused data from computer storage).

Figure 2-3: John McCarthey, a founding father of AI

Ada Lovelace

Ada Lovelace has been called the world's first computer programmer. She wrote the world's first machine algorithm for an early computing machine that existed only on paper, it was called the Analytical Engine. She realized that a computer could follow a series of simple instructions, a program, to perform a complex calculation. Ada theorized ways to create computer operations in specific groups that could be repeated, called "looping". This is a computer language algorithm used to this day. You may have heard of looping using Snap!, Scratch, Code.org or other programs. She made such an impact on women in computer science that there is an award named after her that celebrates women in technology, and a day in her honor to celebrate women in STEM careers. Founded in 2009, October 12th is Ada Lovelace day! Although there has been a lot of progress in terms of gender equality in STEM, hurdles are still faced and there are challenges that still need to be overcome for women AI careers.

Figure 2-4: Ada Lovelace, the first computer programmer

AI sub-disciplines

By the mid-1960s there was a great increase in the interest of AI. The U.S. Department of Defense was leading the way and people

all around the world started to learn about AI. Many different areas of AI began to be researched and these were called sub-disciplines. The table below shows some of these sub-discipline categories.

game playing	neural networks	image understanding
robotics	machine learning	natural language processing
knowledge representation	simultaneous localization and mapping	efficient personalized searching
question answering	classification	speech to text

Table 2-1: Sub-disciplines of AI

Links to Learn More

Read more about Alan Turing and the Turing Test, John McCarthy, Ada Lovelace and their contributions to computer science

- Turing test facts
- Alan Turing facts
- The Turing Test
- Ada Lovelace
- Chat with Kuki chatbot (requires you to create an an account)

Suggested Activity

- Chat with Kuki (Teacher Led Online)

The Growth of AI

OBJECTIVES
2.2.1: Create a timeline of the development of AI
2.2.3: Identify milestones in the development of AI
2.2.4: Describe some examples of how AI has been used over time (Product Examples)

In the development timeline of AI between the decades of 1950 and 1970 lots of research was happening and then there was an where the limitations of AI led to a lack of research funding. Because AI was very complex and there were many challenges, the British and American governments ended their exploratory AI research. Due to this, AI researchers couldn't find funding for their projects until 1980 when it surged again. During the early 1980s, AI flourished again until it hit its second winter in 1987. Luckily for AI, the computational power of computers greatly increased and there was a quick end to that winter. AI started showing up in many areas of data mining, medicine, and robotics. AI soon made its way into business, grew stronger than ever, and was used in companies across the globe.

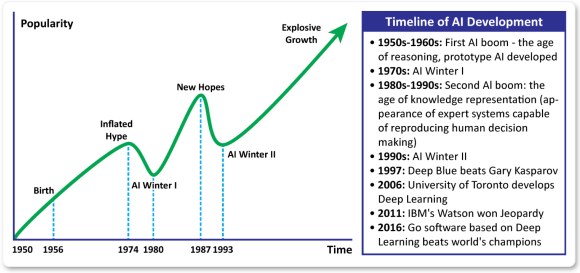


Figure 2-5: Timeline of AI Development

The following information talks about some examples of how AI developed through time and shows specific products.

1960s - Unimate, Shakey and Eliza

In 1961, Unimate, a robotic arm, became the first industrial robot as it replaced humans on the assembly line at General Motors. Shakey became the first general purpose robot that was able to reason about its own actions in 1966. In 1964, Joseph Weizenbaum developed Eliza at Massachusetts Institute of Technology (MIT). Eliza was a chatbot that held conversations with humans, acting as a therapist. Many argue that it passed the Turing Test as it was able to trick some humans into thinking it was a human therapist.

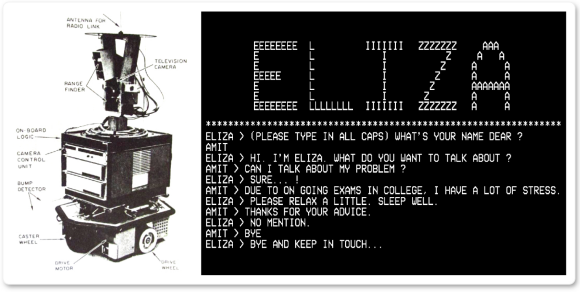


Figure 2-6: Shakey and Eliza

The A.I. Winter was a time period between the 1960s and 1990s where talks and ideas of artificial intelligence died down. However, computer scientists were able to rise out of this. This time period was followed by the era of numerous creations.

Figure 2-6: AI Winter

Late 1990s - KISmet and AiBO

In 1998, KISmet, a robot that could detect and respond to people's emotions and feelings, was introduced by Cynthia Breazeal at MIT. In order for Kismet to properly interact with human beings, it contains input devices that give it visual, auditory, and kinesthetic abilities. Kismet simulates emotion through a variety of facial expressions, vocalizations, and movements. Facial expressions are created through movements of the head including ears, eyebrows, and lips. In 1999, AiBO became the first consumer robot pet dog. The machine was developed by Sony and could develop its skills and personality over time.

Figure 2-8: KISmet and AiBO

2000's Roomba, Siri and Watson

iRobot released Roomba in 2002. Roomba is the first mass produced autonomous (having the ability to control oneself) vacuum cleaner robot. The machine had the ability to navigate and clean homes. It is one of the most popular everyday AI items for the home in today's world. In 2011, Siri and Watson were introduced. Siri, a virtual assistant, was launched by Apple after it was integrated into the iPhone 4S. Watson, a question answering machine, was created by IBM and won first place on Jeopardy in 2011.

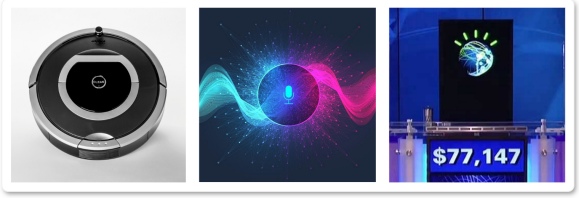


Figure 2-9: Roomba, Siri and Watson

Some of the most recent uses of AI today in our everyday lives are using Google search, Netflix recommendations, navigation maps, smart surveillance systems, online banking and drone deliveries.

Links to Learn More

Read more about the development of AI, Eliza, Deep Blue and Gary Kasparov

- Artificial intelligence facts
- Watson (computer) facts
- Garry Kasparov facts
- ELIZA facts

Suggested activities

- History of AI (Teacher Led Slideshow)
- Putting AI Events in Order (See below)

Putting AI Events in Order

FULL SCREEN RESET SUBMIT

Drag the AI events in order from oldest to most recent.

AI Events

- Eliza
- Roomba
- Shakey
- AI Winter
- Siri
- KISmet
- AiBO

TABLE OF CONTENTS

Unimate

Click to select. Drag and Drop to set sequence.

AI and Ethical Issues

OBJECTIVE
2.2.5: What are some international laws and ethics regulations regarding the use of AI
8.1.5: Identify privacy issues involved with AI

After the last AI winter, the development of this branch of computer science grew very quickly with new developments happening each year. The work of some AI neural network pioneers, like John Hopfield and David Rumelhart, revived huge interest in AI. Many new developments occurred that brought the possibilities of AI to better the world to a whole new level. Along with its advancements, many questions have arisen about its legal and appropriate use, and laws and foundations were established for these ethical purposes.

The first laws concerning AI were the "Three Laws of Robotics" devised by science fiction author Isaac Asimov: Robots may not injure a human being, must obey orders (unless they go against the First Law) and must protect themselves (unless to do so conflicts with the First or Second Law). These laws may sound basic and simple, but applied to some real-world situations, they can be tricky. Consider this,-A self-driving car might have to decide between possibly harming its passengers or a greater number of pedestrians. Should the car protect the passengers at all costs, or try to minimize the total harm to humans involved, even if that means injuring people in the car? Because AI is a newer field, there are many situations where laws are being considered but they are under "wait and see" clauses. This means they don't have enough data to decide on what is appropriate. Think about cell phone use. It took a very long time before laws came out about cell phone use and driving. Now it is common and everyone knows "don't text and drive, it's the law"

Figure 2-10: Don't text and drive

Although many states have created some laws around AI, many of them are changing with the times and constantly under discussion and editing. There are different categories of AI regulations. The most common category that laws have been created in is privacy. This is because AI depends so much on big data and this category of privacy has been impacted the longest so far.

Here are some other categories that AI regulations are being made in around the world. There are different types of laws, some prohibit specific uses of AI and some have permissible use regulations. Most categories are still in the discussion mode with possible laws and regulations coming in the future. See the table below.

AI Category	Example	Laws as of 2020 in at least 200 countries of the world
Data and Privacy	The way data is shared after collection	Prohibitive Laws
Autonomous AI Devices	Drones	Prohibitive Laws
Autonomous Vehicles	Self-Driving Cars (Tesla Model S)	Permissive Laws/ In Discussion
Facial Recognition	Boarding Flights (with no boarding pass) using only Facial Recognition	Regulatory Guidance/ In Discussion
AI Enabled Decisions	InferVision (Medical AI for screening and diagnosis)	In Discussion (some limited Regulatory Guidance)
Conversational	Chatbots- Ada (customer interactions)	In Discussion
AI Ethics and Bias	Biased Algorithms that affect customers (deciding who gets a credit card)	In Discussion
Self Aware AI / Artificial Super Intelligence	AI that surpasses human abilities	NONE since it is not possible in today's world

Table 2-2: AI Law Categories and Examples

Suggested activity:

- AI Law Categories

AI Law Categories FULL SCREEN RESET SUBMIT

AI Law Categories

Drag the AI category to the correct example.

AI Category	Example
	Algorithms that affect customers
	AI that surpasses human abilities
	Self-driving cars
	The way data is shared after collection
	Chatbots
	Medical AI for screening and diagnosis
	Drones
	Boarding flights with no boarding pass

AI Ethics and Bias | Super AI | Data and Privacy | Autonomous AI Devices | AI Enabled Decisions | Autonomous Vehicles | Facial Recognition | Conversational

AI Ethics

OBJECTIVES
2.2.5: What are some international laws and ethics regulations regarding the use of AI
2.2.4: Describe some examples of how AI has been used over time (Product Examples)
2.2.3: Identify milestones in the development of AI
2.2.6: Identify some pioneers and leaders in AI including important women

In order for people around the world to make good choices when it comes to AI, there is an important area of ethics that has developed, AI ethics. AI ethics is a system of moral principles and techniques intended to inform the development and responsible use of artificial intelligence technology. The purpose of an AI code of ethics is to provide stakeholders with guidance when faced with an ethical decision regarding the use of artificial intelligence.

Figure 2-11

The advancement of AI in recent years has encouraged groups of experts to develop safeguards for protecting humans from the risks of AI. One group is the nonprofit institute founded by MIT cosmologist Max Tegmark, Skype co-founder Jaan Tallinn and DeepMind research scientist Victoria Krakovna. This institute worked with AI researchers and developers as well as scholars from many disciplines to create the 23 guidelines now referred to as the Asilomar AI Principles.

The Asilomar AI Principles are 23 guidelines for the research and development of AI. The Asilomar principles outline AI issues, ethics and guidelines for creating AI. The tenets were created at the Asilomar Conference on Beneficial AI in 2017 in Pacific Grove, California. The conference was organized by the Future of Life Institute.

Another global organization that aims to advance responsible use of AI is the Global Partnership on Artificial Intelligence. It includes many stakeholders from different fields like science, industry, and government. Their goal is to facilitate international collaboration, and to have governments work together on discussions around responsible AI use.

Many important people in the field of AI participate in organizations for the development of AI. OpenAI is an artificial intelligence research laboratory. It conducts research in the field of AI with the goal of promoting and developing friendly AI (AI that has positive effects) in a way that benefits humanity as a whole. The organization was founded by Elon Musk (SpaceX and Tesla), Sam Altman (CEO of Open AI), and others, who collectively pledged $1 billion dollars to start it.

Figure 2-12: Elon Musk, founder of OpenAI

AI and Causes in the World

OBJECTIVES
2.2.4 Describe some examples of how AI has been used over time (Product Examples)
2.2.3 Identify milestones in the development of AI
2.2.6 Identify some pioneers and leaders in AI including important women

AI in today's world has many organizations that are eager to work together in a collaborative effort to use its capabilities to help society. Many fields are using AI to make their solutions to problems more efficient and effective. Here are some examples:

Organization	Goal and Purpose
Benevolent AI	Their goal is to impact human health with better medicines, research and insights into rare diseases. They collaborate with many other pharmaceutical organizations which allows them to collect ever expanding data. Their goal is to impact human health with better medicines, research, and insights into rare diseases.
Casetext	They use AI technology to help legal researchers find relevant cases quickly. They power a legal library that more than 1 million people access monthly. It also has a neural transformer model that is trained in the law that helps people find cases even if they are in a different language!
CognitiveScale	Their focus is to pair humans and machines together for fantastic results. They work in the areas of banking, healthcare, energy, and manufacturing. The machine systems learn and adapt with the data they receive. This helps provide personalized customer service and increased productivity!
DriveAI	They work to solve transportation challenges, and they have technology that includes sensors. LiDAR (Light Detection and Ranging) is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth. Along with high-definition cameras that allow a vehicle to get a 360-degree view of its surroundings.
MyCrop Technologies	This company uses machine learning to provide real time support for farmers to help them make important decisions about their crops. They use big data, sensors, drone technology and intelligent algorithms to process data, and advise farmers on what actions they should take.

Table 2-3: Organizations using AI

Link to Learn More

To learn more details about these organizations view the slides.

- Leading the Way Today in AI (Slideshow)

Pairing cutting edge artificial intelligence with skills only humans currently have like empathy, cultural perspective and reasoning allows us to create technology for the betterment of humanity.

AI 's capabilities empower humans to be able to create solutions more efficiently and effectively in order to solve problems for society and our world today.

Figure 2-13: AI empowering humans

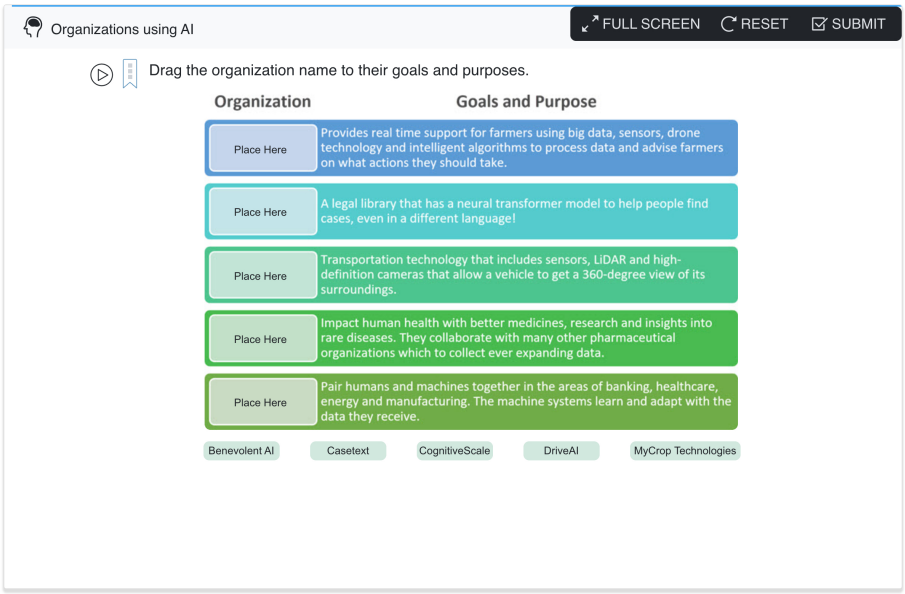
Link to Learn More

Read more about Elon Musk and the Global Partnership on Artificial Intelligence

- Elon Musk facts
- The Global Partnership on Artificial Intelligence (GPAI)
- Timeline of strategies, action plans and policy papers setting approaches to AI

Suggested activities

- Organizations using AI (See below)
- An Hour of Code Activities (Online)
  - Hello World (Code.org)
  - Code Your Hero (Google for Education)
- Defend an AI Regulation (Hands on)
- Design an AI Company for Today's World (Teacher-Led)
- AI Pioneer Project (Hands-on)



Demonstration videos

- AI FOR GOOD - Ethics in AI

Glossary

Ada Lovelace

The world's first computer programmer.

AI Winter

A period when progress and funding in artificial intelligence slowed down due to unmet expectations.

Ethics

The study of right and wrong, guiding people on how should act based on moral values and principles.

Alexa

Amazon's voice-controlled virtual assistant that can answer questions, play music, control smart devices, and more.

Deep Blue

It was IBM's chess-playing computer that became famous for defeating world champion Garry Kasparov in 1997.

Gary Kasparov

He was central to AI history because he played chess against IBM's Deep Blue, one of the earliest powerful chess-playing computers.

Siri

A virtual assistant, was launched by Apple after it was integrated into the iPhone 4S.

Turing Test

A test of a machine's ability to show human-like intelligence, where it passes if people cannot tell it apart from a human in conversation.

Watson

A question answering machine created by IBM that won first place on Jeopardy in 2011.

Eliza

A chatbot that held conversations with humans, acting as a therapist.

Next Steps

1. Study flashcards to ensure your understanding of the material. Open
2. Quiz yourself to check your understanding of fundamental facts. Open
3. Proceed to the next lesson. Open