

Lesson 5

Lesson 5: AI and Robotics



LESSON SKILLS

After completing this lesson, you will be able to:

- Define the word "robot".
- Provide examples of different types of robots.
- Explain how AI and robots work together.
- Explain how robots use sensors to work.
- List some ways robots benefit people and society today.
- Understand how robotics started and developed until the present day.

KEY TERMS

- Augmenting Robots
- Autonomous Robots
- Computer Vision Technology
- Dependent Robots
- Humanoid Robots
- Human-Robot Systems
- Independent Robots
- Industrial Robots
- Pre-programmed Robots
- Teleoperated Robots

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.

- What is a robot?
- What is the difference between independent and dependent robots?
- How are robots categorized?
- What are some examples of different types of robots?
- How do AI and robots work together?
- How does computer vision work?
- What are some applications of robots in today's world?
- What are some companies that use AI robot technology?
- What are the main components (parts) of a robot?
- How are robots being used to benefit people in society and the world at large?

Overview

This lesson covers how AI and robots work together. It overviews how robots first started and how they developed and progressed with the incorporation of AI. The lesson provides descriptions and examples of different types of AI robots and what they are used for. It explains how they use AI to complete their "work" and their use of sensors. In this lesson, you will see some examples of advanced robotics using AI and how they benefit people and society.



AI Robots Development

Objectives

6.1.1: Explain how AI and robots work together
6.1.2: Identify examples of robots that use AI
6.1.5: Identify different types of robots
6.1.6: Define what a robot is

Think About This

Robots are an automated type of machine. How does AI bring them to "life"?

How did robots begin? Where did the word "robot" come from? The word robot comes from the Czech word "robota" which means "forced work or labor". The first person to use the word "robot" was Karel Čapek, a writer, in the early 1900's. He wrote a play called Rossum's Universal Robots where the phrase was coined. It was a fantasy, science-fiction play about robots taking over the world! This topic, genre, trope or category of science fiction started with this play. We still see books and movies with this theme today.

Soon after at the 1939 World's Fair, the first physical robot appeared. Its name was ELEKTRO, and with human commands, it could move its head and arms, blow up balloons and walk. It was built by Westinghouse Electric Corporation. It was seven feet tall and

weighed close to 300 pounds. The following year he was joined at the fair by "Sparko", a robot dog that could bark, sit and beg on command. Robots, by definition, must have a physical form. That is why a software robot like a chatbot is a type of computer program but is not considered an actual "robot".



Figure 5-1: Elektro and Sparko robots

The first robots to use a form of AI were created in 1948 by William Grey Walter. These robots were in the shape of tortoises, and their names were Elmer and Else. They could navigate around obstacles because they were equipped with the ability to follow light, which is called phototaxis, and they had a bump sensor. This helped them get around objects in their path. They were the first robots in history that were programmed to think the way biological brains do. Our modern-day autonomous vacuum cleaners like the Roomba function similarly. These robots were also used to make comparisons to our own nervous system because they responded to the sensory inputs of light and touch as we do.

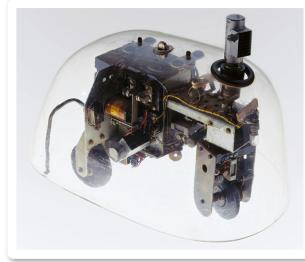


Figure 5-2: Tortoise shaped robots with AI

Early robots without AI were developed for performing specific repetitive tasks. The field of robotics continued to grow using AI and many developments took place. In the 1960's the Robotics Institute was established by Carnegie Mellon and AI research laboratories opened at MIT, Stanford Research Institute and the University of Edinburgh. The Table 5-1 shows a few of the many robots created through time and what their purposes were.

Robot Name	Year and Creator	Purpose
Sputnik I	1957 Soviet Union	First autonomous artificial satellite
Phoney Pony	1968 McGee and Frank, University of South Carolina	First controlled walking machine
Stanford Arm	1969 Victor Scheinman	First computer-controlled robot arm
WABOT I	1973 Ichiro Kato	First humanistic robot
RB5X	1985 General Robotics Corp	Programmable robot with many sensors and software that enabled it to learn about its environment
Aquarobot	1989 Japan's Ministry of Transport	Walking robot for undersea use
RoboTuna	1996 David Barrett at MIT	Robot study of how fish swim
PathFinder	1997 NASA	Sent back images and data from its landing on Mars
iRobot Packbots	2001 Endeavor Robotics	Carry out dangerous search missions used by military and first responders
HUBO	2005 Korean Institute of Science and Technology	Smartest mobile robot in the world at that time
Sophie Surgical System	2010 Eindhoven University	First surgical robot
RoboChef Restaurant	2017 Tehran, Iran	First entirely robotic restaurant
Nanobots	2019 University of Pennsylvania	Microrobot that could be used in the human body

Table 5-1: Robot timeline



Figure 5-3: BEMONI humanoid robot

▷ 📚 AI and Robots Work Together

Objectives

- 1.1.1: Define Artificial Intelligence and how it relates to problem solving
- 5.1.2: Describe how artificial intelligence applies machine learning
- 6.1.1: Explain how AI and robots work together
- 6.1.3: Describe how robots use AI to accomplish tasks
- 6.1.6: Define what a robot is

A robot is defined as a machine that is capable of sensing and interacting with its environment. It is an automatically operated machine that replaces human effort. It can do the work of a person automatically or while being controlled by a computer. AI gives robots a [computer vision](#) to navigate, sense and calculate their reactions to input. Robots learn to complete their tasks through machine learning. A machine using AI can perceive its environment and change its behavior accordingly to reach its programmed goals. It does this through problem solving. Chess playing robots are a good example of how an AI robot problem solves by gathering facts about a situation, compares the information to stored data, predicts which action will be most successful and then makes a move.



Figure 5-4: Chess playing robot

Computer vision is the process of gaining high level understanding by perceiving images and videos as they are available in digital format. It is used to train the model to recognize patterns and store data. This allows robots to recognize various objects and carry out their actions correctly. Robots also use many different types of sensors. Sensors make robots automated. Without them they would be essentially deaf and blind. Through their sensors robots collect information from their environment to interact with it.

These are some sensors robots use

- proximity sensors
- sound sensors, microphones
- temperature sensors
- acceleration sensors
- vibration sensors
- optical sensors, cameras
- “bump switch” sensor (allows robot to “feel” when touched by an object)

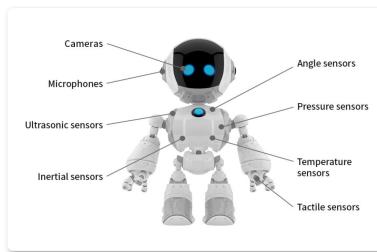


Figure 5-5: Robotic sensors

▷ 📚 Parts and Types of Robots

Objectives

- 6.1.3 Describe how robots use AI to accomplish tasks
- 6.1.4 Explain how robots help people in different areas of life

6.1.5 Identify different types of robots

There are many different types of robots that accomplish lots of different tasks in a variety of ways. **Industrial robots** are used in manufacturing and complete tasks faster and more accurately than humans. Robots are either **independent** or **dependent**. Robots that are dependent are non-autonomous and interact with humans to enhance their actions. Independent robots are capable of functioning completely independent of human operator control. **Aerial robots** are referred to as unmanned aerial vehicles (UAVs). Underwater robots are called **autonomous** underwater vehicles (AUVs). Robots have a wide variety of uses and help people in many areas of life. Generally speaking, there are five different categories of robots as shown in Table 5-2.

Example	Robot Category	Description
	Pre-Programmed Robots	These operate in a controlled environment and do simple repetitive tasks like a mechanical arm on an assembly line.
	Humanoid Robots	These look like humans and mimic their behavior like Sophia or Atlas. They can run, jump, carry objects and even make facial expressions.
	Autonomous Robots	These operate independent of human operators and have no supervision. They use sensors to perceive the world around them and then make decisions. The Roomba vacuum cleaner is an example of this type.
	Teleoperated Robots	These are semi-autonomous because they use a wireless network that enables human control. They are used for environments unsafe for humans, like fixing underwater pipe leaks during an oil spill or drones to detect landmines.
	Augmenting Robots	These enhance human capabilities or replace ones that are lost. Examples of this are prosthetic limbs and exoskeletons used to carry very heavy weights.

Table 5-2: Robot categories

Robots can be made from many different materials including metals and plastics. Most robots are composed of 3 main parts:

1. **Controller** – the robot's "brain" is run by a computer program. The program is very specialized because it directs the moving parts of the robot.
2. **Mechanical parts** – motors, wheels, grips, pistons and gears that make the robot able to turn, move in different ways and to grab and lift.
3. **Sensors** – these are what tell the robot about its surroundings. Using sensors, the robot can tell sizes, shapes, space between objects, direction and other factors like temperature and distance.

The controller, mechanical parts and sensors work together to control how the robot operates. Scientists and inventors try to program robots to be as intelligent as possible using AI. They work on building the best robots with the most useful materials so they can perform complex movements using a variety of sensors in order to accomplish their tasks successfully and reach the goals they were designed for. The creation of a robot by engineers and scientists follows the steps of the design process and the scientific method.

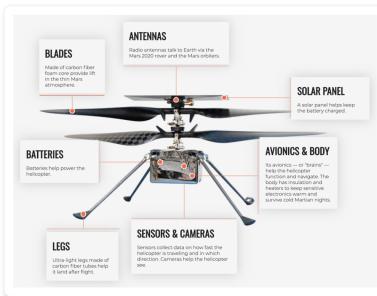


Figure 5-6: Anatomy of the Mars helicopter

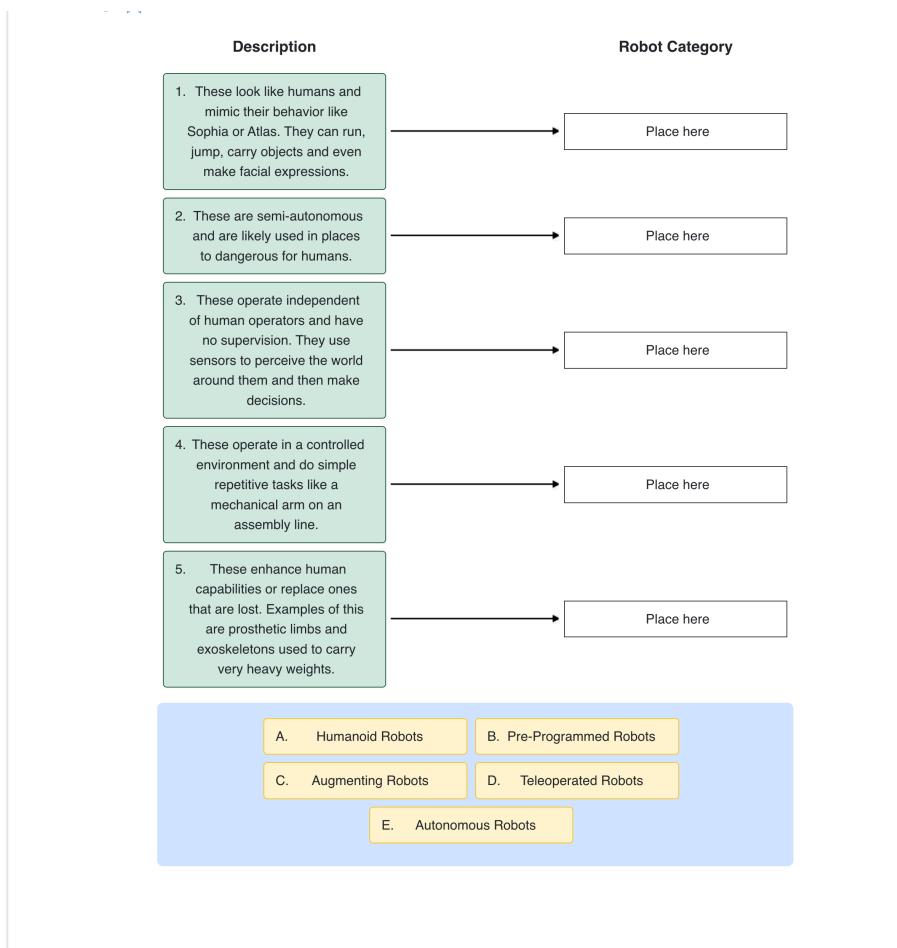
🔗 Link to Learn More

Read more about robots and their development:

- Grey Walter's tortoises, Elmer and Elsie
- Robot facts
- Inventors and the Design Process (Scroll down to find the section)
- Different Kinds of Robots (Slideshow)

Suggested activities

- Robot Categories (See below)
- Hour of Code – Robotics and Circuits (Online)
- AI in Robotics (Hands-on)
- Early Robots Research (Team)



Demonstration videos

- [5 Most Advanced Humanoid Robots](#) (YouTube 7 minutes)

⌚ AI Robot Considerations

Objectives

- 6.1.3 Describe how robots use AI to accomplish tasks
- 6.1.4 Explain how robots help people in different areas of life

The writer Isaac Asimov, who wrote many stories about robots, created the three laws of robotics to keep humans safe from them.

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey orders given to it by human beings, except where such orders would conflict with the first law.
3. A robot must protect its own existence as long as such protection does not conflict with the first or second law.

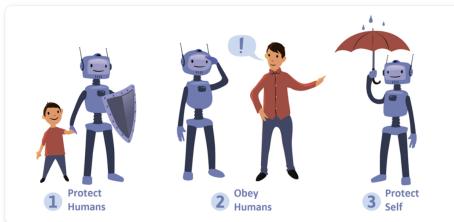


Figure 5-7: Three laws of robotics

These were not used in real life when he invented them because it was so early on; that was more than 70 years ago! In today's world AI robots are very complicated, and real laws and regulations are being discussed and considered. Their content is much like Isaac Asimov's original three laws and deal with security, privacy and ethics issues. Robots are becoming increasingly prevalent in our home, school, social and professional work life.

As AI develops in the field of robotics, so will the laws and regulations that revolve around it. Because these new technologies will advance in areas of our society like education, transportation, business, the military and in security, frameworks will be created, and many are being debated and considered today.





Figure 5-8: Laws regarding robotics

As technology continues to speed along in its development, in addition to considering laws and ethical use of AI robots, comes the very exciting topics of what they can do for humans and the world, and how they can be used in new and unique ways. AI robots are used in every field, and their advancements have made things possible that never were before. Today's application of AI in robotics has allowed robots to be developed that can diffuse bombs safely, lift elderly patients and put them into wheelchairs, explore Mars and has even enabled drones to deliver vaccines to remote parts of the world. Robots exist now that run banks, hotels and even restaurants.

There is a famous restaurant in Paris that makes pizzas and is entirely run by robots. It makes pizza in 45 seconds and Pazzi, calls itself as the "world's first autonomous restaurant," relies on cloud technology and machine learning to make pizza without human contact.



Figure 5-9: Pazzi, autonomous pizza restaurant

Robots are being seen in every walk of life, and their ability to help humans and the world is exciting! See the table below for some examples of today's helpful AI robots.

Robot Name	Use	Results
Tug	Brings supplies around hospitals	Saves staff to care directly for patients
Da Vinci Surgical System	Uses tiny robotic arms to complete small surgeries	Precision surgery human hands couldn't do
Quince	Cleans up radioactive debris	Keeps humans from being exposed to dangerous radiation
Atlas	Completes search and rescue tasks	Keeps human first responders out of danger
Curiosity	Sends images and data back from Mars	Autonomous robot explores a planet people cannot yet
Protei	Monitor pollution in the water	Helps plan for ocean cleanup

Table 5-3: Helpful AI robots

Considering AI robots not only do they help the planet at large with global concerns, they can also help with very individualized needs of people, consider the care providing robot "FRIEND." The objective of the robot is to assist elderly and persons with disabilities in their daily and professional life activities.



Figure 5-10: "FRIEND", care providing robot

There is a whole category of personal companion robots that use AI to connect on an emotional level. One of the more popular ones is called Buddy. This robot is like a member of the family. He is an "emotional" robot and will display many different facial expressions and show happiness, sadness and surprise. He can assist with smart home controls, security, entertainment, game playing, elder care and much more.

Along with these examples, there are many ways AI robots are helping individuals from cleaning and cooking to the use of robotic prosthetics and personalized tutors.





Figure 5-11: Robotic prosthetic arm

Artificial intelligence allows robots to learn and process information. Sensors allow them to take in information about their surroundings and they can then choose actions based on the information. AI robots' capabilities are amazing, but they are still limited by the information that they are provided with, the problems they are given to solve and how they are programmed. It is important to remember that humans are the source of robots' intelligence and they work together with humans to improve people's lives. There are some important things to think about when considering robots and humans working together. When humans and robots are working together in a strategically planned way this is called a **human-robot system**. Designing a human-robot systems involves these important factors:

- The human and robot must have specific jobs or tasks to complete.
- They must have effective communication between the two.
- They must be able to give each other "back up" or help if needed.
- They must be able to rely on each other to do their part. In essence, trust each other.

With humans and robots working together, both of their strengths and capabilities pair up and make a great problem-solving team.



Figure 5-12: Humans and robots working together

🔗 Link to Learn More

Read more about inventions. personal robots

- [Best Inventions of 2020](#)
- [Meet Stevie](#)

Suggested activities

- Asimov's Three Laws of Robotics (See below)
- Helpful AI Robots (See below)
- [Hour of Code, Save the Forest](#) (Online)
- [Hour of Code, Building a Galaxy](#) (Online)
- [AI Robots and the World](#) (Hands-on)
- [Personal Robot](#) (Team)

⌚ Asimov's Three Laws of Robotics

FULL SCREEN RESET SUBMIT

Choose the correct answer from the dropdown lists.

1. A robot may not injure a .
2. A robot must given to it.
3. A robot must protect .

⌚ Helpful AI Robots

FULL SCREEN RESET SUBMIT

Drag the robot name to its use.

Robot Name	Use
<input type="text"/>	Sends images and data back from Mars
<input type="text"/>	Brings supplies around hospitals
<input type="text"/>	Completes search and rescue tasks
<input type="text"/>	Uses tiny robotic arms to complete small surgeries
<input type="text"/>	Monitor pollution in the water
<input type="text"/>	Cleans up radioactive debris

Protei Da Vinci Quince Tug Curiosity Atlas

Demonstration videos

- How AI Works, Computer Vision  
- Pizza shop run by all-robot staff  

Glossary

Augmenting Robots

Robots designed to enhance or support human abilities, such as improving strength, precision, or mobility, often through exoskeletons or assistive devices.

Autonomous Robots

A robot that can perform tasks and make decisions on its own without human control, using sensors, data, and AI to navigate and act in its environment.

Computer Vision Technology

AI that enables computers to see, interpret, and understand visual information from the world, such as images and videos.

Dependent Robots

Robots that rely on human guidance and control to operate, unable to function or make decisions entirely on their own.

Humanoid Robots

