Robotics Applications and Careers   Syllabus

» Course Overview

It seems like many elementary to high school robotics courses are focused on simply coding a Lego robot to move its mechanical arm up and down. This course, in contrast, teaches students what a robot is and how it relates to other key technologies such as artificial intelligence and machine learning. Then the course examines 10 applications of robots and how they will change and impact various aspects of our lives and the economy. Will robots simply steal our jobs, or will they be a tool that will create new opportunities and even free humans to use our creativity and curiosity to their full potential? Students will grapple with this and many other questions as they explore this vital, future-focused subject.

» Course Outline by Module

Module 1	What is a Robot?	**Module 6**	Robots that Play Games
Module 2	Robots in Factories	**Module 7**	Robots that Drive
Module 3	Robots in Healthcare	**Module 8**	Robots at School
Module 4	Robots on the Farm	**Module 9**	Robots with Global Impact
Module 5	Robots and Home	**Module 10**	Singularity

» Module Overview and Learning Objectives

| Module 1. What is a Robot?

This module is the introduction to this course on robots and artificial intelligence. You'll be introduced to concepts and definitions that you'll be able to draw upon throughout the rest of the course. The remaining modules will go through the many applications of robots today, including their pros and cons, and risks and opportunities.

Learning Objectives: In this module, students will:

- Describe what a robot is and explain the differences between robots and other machines
- Summarize the history of robot development
- Define key concepts in robotics (e.g., artificial intelligence, algorithm, machine learning, deep learning, and neural networks) and explain how robots relate to artificial intelligence
- Examine the *Three Laws of Robotics* and the Turning Test
- Identify potential risks associated with the rise of robots and AI
- Identify career opportunities in robotics and educational paths to enter those careers

| Module 2. **Robots in Factories**

This module is all about the use of robots in factories. You'll go on a tour of history to see how the industrial revolution led to automation and eventually to the rise of robots in factories starting with the first industrial robot Unimate in 1961. You'll learn about the benefits of using robots in various industries but also about the consequences on jobs for human workers. Finally, you'll be introduced to concepts and definitions that will help you understand the impact of robots on the job market in the future and our way of life.

Learning Objectives: In this module, students will:

- Describe the use and growth of robots in factories and manufacturing
- Explain the Luddite uprising in England in 1812 and describe how it demonstrates peoples' reaction to technological change
- Determine the impact of robots on jobs in manufacturing
- Compare the benefits and limitations of utilizing robots and artificial intelligence in manufacturing
- Identify potential career opportunities in manufacturing robotics

| Module 3. Robots in Healthcare

This module is all about medical robots, which are used to care for elderly people or to deliver drugs and chase bad cells in our bodies. You'll learn about how artificial intelligence is used in diagnosing diseases and you'll discuss the implications of using robots in the healthcare sector, including their pros and cons, and impact on society.

***Learning Objectives*:** In this module, students will:
- Evaluate various use cases of robotics in healthcare, including: diagnostics, robotic surgery, early disease/cancer detection, and DNA-specific drugs
- Discuss how robots could be a component of caring for elderly populations
- Compare the benefits and limitations of utilizing robots and artificial intelligence in healthcare
- Determine the impact of robots on jobs in the medical field
- Identify potential career opportunities in healthcare robotics

| Module 4. Robots on the Farm

This module will explore the many uses of robots and artificial intelligence in farming, including automated milking systems, harvest automation, and precision application of fertilizer. Prior technologies, such as plows, tractors, fertilizer and pesticides, have had a tremendous impact on farming jobs in the past. We'll examine the impact robots will have in continuing this trend. The module will also discuss the impact these technologies might have on the environment.

***Learning Objectives*:** In this module, students will:

- Describe the change in agriculture employment from 1900 to today and the causes of the change
- Evaluate various use cases of robotics and artificial intelligence in farming
- Discuss how precision application of fertilizer and other robotic innovations allow for environmental benefits
- Determine the impact of robots on jobs in the agriculture industry
- Compare the benefits and limitations of utilizing robots and artificial intelligence in agriculture

| Module 5. Robots at Home

In this module, we'll look at different kinds of robots and AI devices currently being used in homes. We'll see how they are mini-versions of much more complex AI-based systems that use the same basic robotics and AI principles such as machine and deep learning, AI algorithms, and natural language recognition to name a few. We'll also discuss ethical, security and privacy issues that come with allowing what are essentially listening, viewing and data collecting technologies in our homes.

Learning Objectives: In this module, students will:

- Evaluate various use cases of robotics and artificial intelligence used in home applications
- Describe components and technologies that contribute to robots used in the home
- Describe elements of robotics or artificial intelligence that are in smartphones and personal assistants
- Compare the benefits and limitations of utilizing robots and artificial intelligence in the home
- Examine the concept of the Uncanny Valley and how engineers and roboticists approach this issue

| Module 6. Robots that Play Games

In this module, we'll look at different kinds of gaming AI used in video games, sports playing robots, robot pets and strategy games like chess and Go. We'll look at how robot competitions like RoboCup, BattleBots, and many others, determine the direction AI robotics is going in and how it helps train the next generation of robot engineers, scientists, and technicians. Finally, we'll look at the process of gamification to show how game AI has been integrated into many aspects of our daily life.

Learning Objectives: In this module, students will:

- Define key terms related to game-playing robots
- Evaluate various use cases of robotics playing board games, video games, and physical games (sports)
- Compare the benefits and limitations of utilizing robots and artificial intelligence in games
- Discuss the impact that the success of gaming robots has had on society
- Examine how the success of combining human and robot teams could translate into other fields
- Identify potential career opportunities in gaming robotics

| Module 7. Robots that Drive

Who wants a self-driving car that can take them wherever they want, whenever they want? Now that self-driving cars have become a reality, how does this technology work? In this module, students will learn how algorithms and robotic systems allow self-driving cars to operate. A contrast will be defined between the benefits and limitations of utilizing robots and artificial intelligence in transportation. Finally, students will be able to review the educational paths and identify career opportunities with self-driving cars.

Learning Objectives: In this module, students will:

- Identify key technologies that enable self-driving cars
- Define algorithm and explain how algorithms allow self-driving cars to operate
- Compare the benefits and limitations of utilizing robots and artificial intelligence in transportation
- Evaluate changes in elevator operator jobs and describe how it demonstrates peoples' reaction to change in transportation technology and automation
- Determine the impact of robots on jobs in transportation
- Identify career opportunities in self-driving cars and educational paths to enter those careers

| Module 8. **Robots at School**

In this module, we'll look at different ways robots and AI-based systems are being used in education delivery, such as assisting children with disabilities or encouraging technical creativity. A comparison will be made between the benefits and limitations of using robots and artificial intelligence in education. By the end of this module, you'll be able to identify career opportunities in education robotics and a pathway to enter this type career.

Learning Objectives: In this module, students will:

- Evaluate various uses of robotics used in education
- Describe how robots are used to assist children with disabilities
- Compare the benefits and limitations of utilizing robots and artificial intelligence in education
- Discuss the impact that robots may have on the teaching profession
- Identify career opportunities in educational robotics and describe how teachers and students can utilize robotics and AI to achieve positive educational outcomes

| Module 9. **Robots with Global Impact**

This module provides a sensitive, but balanced and realistic look at the controversial topics of robots in battle and in space. Students will discuss ethical implications of utilizing robots and artificial intelligence in combat and for the purpose of mining or claiming other planets. They'll also think about the growing debris field around the Earth that threatens people both on and off the planet.

The module will introduce students to the important debates we will have in society in the coming years as robots become more sophisticated and the nature of warfare and space exploration change. Finally, we'll talk about some important contributors to space robotics.

Learning Objectives: In this module, students will:

- Identify the current and potential near-term uses of robots and artificial intelligence in war
- Discuss the ethics of using robots and artificial intelligence in war
- Determine the impact of robots on jobs in the military

- Evaluate various use cases of robotics used in outer space
- Compare the benefits and limitations of utilizing robots and artificial intelligence in space
- Identify key contributors to development of robotics in this the military and space

| Module 10. Singularity

This final module will tie together all the applications and end-markets that have been reviewed in this course and look toward the future. Students will examine and discuss questions like: Will robots ever become self-aware? What happens if robots become a serious threat to humanity? Can someone upload their brain into a computer? Though many of these questions paint a bleak and dystopian picture, the course will end on a positive note by helping students understand the contributions they can make to the technology, policies, and societal debates on the future of robots.

Learning Objectives: In this module, students will:

- Define exponential growth and compare it to linear growth
- Describe Moore's law and how it is used to predict singularity
- Explain technological singularity
- Evaluate contributions made by key scientists and writers on the subject of singularity, including: John Von Neumann, Vernor Vinge, Ray Kurzweil, and Stephen Hawking
- Compare arguments made about singularity, including "will it happen" and "should it happen"
- Predict when (if ever) singularity will occur and support argument
- Hypothesize on the future progress of robotics