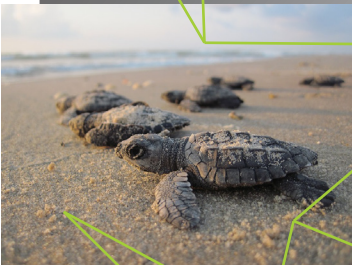


# Artificial Intelligence

## Alternate Curriculum Unit



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For more information, visit [www.exploringcs.org](http://www.exploringcs.org).



## — Alternate Curriculum Unit — **ARTIFICIAL INTELLIGENCE**

### Introduction

Artificial Intelligence (AI) is a term that we hear on a daily basis. Yet the topic is not taught explicitly to our learners, while they and we are operating in a world that is using AI with promises of further AI usage to come. The aim of this unit is to demystify the topic of AI, with students gaining an understanding of terminology such as machine learning, deep learning, and other AI-associated terminology. Students will gain knowledge and skills while considering the social, moral, and ethical impacts of AI systems and usage. The unit has students explore practical daily applications of AI that are likely to have an impact upon their lives. Throughout the unit students are encouraged to come up with their own designs for areas such as smart cities, homes, and schools and to share them with the group.

Students also learn to build, train, and test an AI system through a NVIDIA platform. Students are also encouraged to look at how “the message of AI” is communicated to each of us through images and narratives.

### Topics to be addressed

- Background of Artificial Intelligence
- Everyday usage of AI systems
- Building and applying AI systems
- Societal impacts of computing

### Objectives

The student will be able to:

- Explain key terminology associated with the field of AI.
- Identify the AI being used, such as image recognition, speech recognition, translation.
- Gain an understanding of how a neural network functions.
- Build, train, and test an AI system—gaining an understanding of datasets.
- Gain an understanding of how AI is changing different sectors such as medicine, agriculture, etc.



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- Consider algorithmic bias and the effect of bias on individuals and society.
  - Consider issues around privacy and collection of data.
  - Appreciate that the future of work is changing.
  - Develop an understanding of AI images and narratives.
  - Explore and explain the impact of AI in/on our society.

Specific topics for each instructional day are listed in the overview chart on the next page.

# — Artificial Intelligence — Daily Overview Chart

INSTRUCTIONAL DAY	TOPIC
1	What is Artificial Intelligence?
2	Smart cities, homes, and schools
3-4	Smart city, home, and school design
5-7	What is a neural network? Forward propagation and backward propagation
8-10	Image Recognition Activity ( <i>on NVIDIA platform</i> )
11	Areas that AI is changing
12	Algorithmic bias
13	Accessible AI
14-15	AI and the world of work; moral and ethical dilemmas
16-17	Future News! AI images and narratives design and presentations
18-19	Final project: "AI for Everyone"
20	Final project presentations



# — DAILY LESSON PLANS —

*Instructional Day: 1*

## Topic Description

In this lesson students are introduced to the world of Artificial Intelligence (AI) along with some of the applications and implications of AI.

## Objectives

The student will be able to:

- Explain the term AI and key terminology such as machine learning and deep learning.

## Outline of the Lesson

- Journal Entry (10 minutes)
- What is AI? (20 minutes)
- Evolution of AI (5 minutes)
- Machine learning video (20 minutes)

## Student Activities

- Complete journal entry.
- Groups participate in discussion on what AI is.
- Groups participate in discussion on evolution of AI.
- Groups participate in discussion on future applications of AI.

## Resources

- Teacher Lesson PowerPoint Day 1 (*for teacher reference and background knowledge only*)
- <http://www.bbc.co.uk/news/av/technology-34224406/what-is-artificial-intelligence>
- <https://www.youtube.com/watch?v=GiZ7kyrwZGQ>
- <https://www.youtube.com/watch?v=F1wlCerC40E>

## Teaching/Learning Strategies

**Journal Entry:** Fill in the missing vowels to guess some of the key terms that will be used in this unit of work and then share the response with your elbow partner.

- Ask a few students to share their responses.
- Ask students to think back to Unit 1 (days 17–19) and what they learned and understood about the term intelligence. Then, have students write two lines to explain what they understand *Artificial Intelligence* to mean.
- Ask a few students to share their responses. During the discussion ensure that students understand that Artificial Intelligence is a term used to describe intelligence displayed by machines as opposed to *natural intelligence* which is that displayed by humans and some animals.

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## What is AI?

- Show students the following video to set the scene for understanding what AI is: <http://www.bbc.co.uk/news/av/technology-34224406/what-is-artificial-intelligence>.
- Place students into groups and ask them to discuss some of the points raised in the video clip such as:
  - Do you think AI will “rule the world by 2050”? Why/Why not? How do you feel about this?
  - What experiences have you had to date with AI?
- Then show students the following video and further develop the discussion: <https://www.youtube.com/watch?v=GiZ7kyrwZGQ>. Ask students to consider:
  - Can computers be more intelligent than humans? How?
  - Would you trust a computer to make all decisions? Why/Why not?
  - Could AI potentially stifle creativity? How?
  - Who would program the computer/robot to make the decisions?
  - What about the morals and ethics of the person/people/organizations programming the computer?
- Students are to record their answers on post-it notes and add them to a flipchart. Ask each group to share their ideas with the whole class.

## Evolution of AI

- Show students the slide on the Evolution of AI and explain that AI is an umbrella term to describe intelligence displayed by machines.
  - Machine learning is a field of computer science that gives computers the ability to learn without being explicitly programmed.
  - Deep learning is a subset of machine learning involving neural networks. (Neural networks will be discussed in later lessons.)
  - Ask students to recap to you the meaning of the word algorithm as discussed in previous units. Explain that algorithms will be referred to within this unit.

## Machine Learning Video

- Show the students the following video, which explains how machine learning works: <https://www.youtube.com/watch?v=F1wlCerC40E>. Ask students to note down any terms that they hear and are unfamiliar with as these will be used in coming lessons.
- In small groups ask students to consider possible future applications for AI. Let them know that this will be developed in future lessons.
- Ask each group to share a few ideas on possible future applications for AI.
- In the same small groups ask students to consider what would happen if a machine learning algorithm was biased in some way. What possible impacts could there be on people who relied on the predictions made by the algorithm?
- Ask each group to share a few ideas on possible issues with biased algorithms. Explain to the class that this will be developed in future lessons.

## Instructional Day: 2

### Topic Description

In this lesson students will learn about “smart” cities/homes/schools and will consider benefits and issues that can arise in smart cities/homes/schools. They will also discuss the possible need for changing legislation to manage smart cities, homes, and schools.

### Objectives

The student will be able to:

- Explain and discuss the term “smart” and how this is applied to cities, homes and schools.

### Outline of the Lesson

- Journal Entry (10 minutes)
- Smart cities/homes/schools (45 minutes)

### Student Activities

- Complete journal entry.
- Participate in and complete group work and discussion activities on smart cities/homes/schools.

### Resources

- Teachers PowerPoint Day 2 (*for teacher reference and background knowledge only*)
- <https://www.youtube.com/watch?v=Br5aja6MkBc>
- <https://www.youtube.com/watch?v=bANfnYDTzxE>
- <https://www.youtube.com/watch?v=JZlgYiXzu58>

### Teaching/Learning Strategies

**Journal Entry:** List 2–4 ways in which your city is automated.

- Ask students to share their lists with their elbow partners.
- Explain that the term “smart” is used to signify computational automation and with a show of hands ask how many students have heard the term “smart” in this context.

#### Smart cities/homes/schools

- In small groups have students use flipchart paper and divide the paper into three columns: “Smart Cities”, “Smart Homes”, and “Smart Schools”. Give students two different colors of post it notes; for example, yellow and green. Across all columns the first color post it notes are to have examples of where students have seen/heard things related to the column heading. Then across all columns the second color post it notes are to have examples of what the students predict can be added under that column heading in the future.



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- Have students share their examples with the whole class. As each successive group presents, they should only add new items. Encourage students to query each other on how the smart technology either currently present or predicted works/will work.
  - Let students know that when all the devices in each of these columns are connected to the internet, we use the term *Internet of Things* (IoT). Explain that the IoT relies on inputs via sensors in each of these devices.
  - In small groups students are to then go back to their lists and identify how each of the smart technologies uses sensors. This can be written on another color of post-it notes.
  - Have one person from each group share a few examples and develop the class discussion by pointing out that image and speech recognition sensors are used in real time to give accurate results.
  - Explain to students that there are a few smart cities in the US; show the relevant slide of the teacher PowerPoint.
  - Further re-enforce the point of smart cities/homes by showing students the following videos: <https://www.youtube.com/watch?v=Br5aja6MkBc>, <https://www.youtube.com/watch?v=bANfnYDTzxE>, and <https://www.youtube.com/watch?v=JZlgYiXzu58>.
  - In small groups ask students to consider the following questions related to the concept of a smart city/home/school:
    - Are there advantages or disadvantages?
    - How will we ensure that smart devices are kept safe and secure?
    - Will there be a need for new or updated legislation with so much data being generated and used for a variety of purposes? Give reasons why or why not.
    - Should we be concerned about where and how devices are recycled? If so, where would they go?
    - What considerations would need to be made for the smart city to be sustainable?
  - Have groups note this down on a large sheet of paper.
  - Have one student from each group share at least one advantage and disadvantage from a couple of the question points raised above.

### Topic Description

Students will learn about smart cities/homes/schools and complete a design project on smart technologies affecting cities homes and schools.

### Objectives

The student will be able to:

- Apply the knowledge from the previous lesson either to build a new smart city with homes/schools or to develop an existing city/home/school to be “smarter.”

### Outline of the Lesson

- Planning and design of a smart city/home/school (55 minutes)
- Group presentations (55 minutes)

### Student Activities

- Design a new smart city/home/school OR develop and modernize an existing city/home/school to be smarter.
- Student teams present their smart cities/homes/schools.
- Reflect on presentations.

### Resources

- Smart City/Home/School Sample Rubric

### Teaching/Learning Strategies

#### Planning and design of smart city/home/school

- Make the resources such as post-it notes, videos, and definitions from the last lesson available to students at different points around the classroom.
- Put students into new groups and have them decide if they would like to create a new smart city/home/school or to develop their existing city/home/school.
- Groups work to design or develop their cities/homes/schools on flipchart paper.
- Walk around and check on the design and ask students to consider safety, legality, benefits, and whether the technology in use ensures all groups, such as persons with disabilities, are benefitting.

#### Group presentations

- Each group is to present their idea to the class and invite feedback from the class on their design. Use the Smart City/Home/School Sample Rubric.
- After the presentations, have each student write a short reflection in their journal about their group's presentation, including their role, their contributions, and what they learned from the activity.

## Smart City/Home/School Sample Rubric

Group Members' Names:

_____	_____
_____	_____
_____	_____
_____	_____

In this presentation you are to choose one of the following to complete. Indicate your choice with a checkmark.

Create a new smart city	<input type="checkbox"/>
Develop an existing non-smart city	<input type="checkbox"/>
Create a new smart home/school	<input type="checkbox"/>
Develop an existing non-smart home/school	<input type="checkbox"/>

DO YOU HAVE?	POINTS POSSIBLE	YES	NO	POINTS EARNED
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### PRODUCT

Group members introduced	5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
An explanation for your choice of product to be presented	5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5–10 Smart technologies included	20	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Smart technologies that support people with disabilities—at least 2 technologies	10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Potential safety issues addressed—at least 1 safety issue	5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Potential legal issues addressed—at least 1 legal issue	5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Potential privacy issues around the collection of data addressed—at least 2 issues around data/privacy	10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Key terminology—at least 5 terms	10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### PRESENTATION

All parts of the product section covered	10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
All group members have participated in the presentation	10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Able to answer at least 2 questions from the audience	10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>TOTAL:</b>	<b>100</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### Topic Description

In this lesson, students learn the theory behind image recognition in a neural network.

### Objectives

The student will be able to:

- Explain how a computer recognizes an image and consider issues that arise with reliance on systems that detect images.

### Outline of the Lesson

- Seeing computers (30 minutes)
- Image recognition and forward propagation part I (45 minutes)
- Forward propagation part II (20 minutes)
- Back Propagation (20 minutes)
- Data Classification and training data (35 minutes)

### Student Activities

- Consider where they have encountered image recognition technology.
- Reflect on a world that utilizes and could be reliant on image recognition technology.
- Participate in a whole class activity to simulate the workings of a neural network.
- Consider issues that arise with data classification and training data.

### Resources

- Teachers PowerPoint (*for teacher reference and background knowledge only*)
- <https://www.youtube.com/watch?v=Dy0hJWltsyE>
- <https://www.youtube.com/watch?v=q8GwXSQ-QWQ>
- [https://www.youtube.com/watch?v=cNxadbrN\\_al](https://www.youtube.com/watch?v=cNxadbrN_al)
- <https://www.independent.co.uk/life-style/gadgets-and-tech/news/artificial-intelligence-dangers-machine-learning-training-neural-networks-badnets-a7916721.html>
- Folder Day 5–7
  - Forward Propagation Script
  - Forward Propagation Cards
  - Back Propagation

### Teaching/Learning Strategies

#### Seeing computers

- In groups ask students to consider occasions when they have encountered any technology that is able to see and recognize an image. Some examples might be face recognition, pedestrian detection, or recognizing traffic lights. Ask students to record on flipchart paper the type of image and the level of detection accuracy. Be prepared to discuss: How important is it to have technology capable of recognizing images? Are there any problems that can occur with technology recognizing images?

- Lead a class discussion in which each group shares their image recognition technology examples with the class.
- Show students the following video: <https://www.youtube.com/watch?v=Dy0hJWltsyE>.
- After viewing the video have students share with their elbow partners their thoughts about a world that is making increasing use of image recognition and artificial intelligence. Have some student pairs share their responses with the whole class.

### Image recognition and forward propagation part I

- Show the students the following video: <https://youtu.be/GCV5-TOHpqQ>.
- Explain to students that they will now participate in a whole-class activity to simulate the image recognition activity they have just learned about and that the name given to the process they have just seen is “forward propagation”. Forward propagation is used to identify images in a neural network.
- Arrange the class as per the instructions in the Forward Propagation Script. Have students identify each of the layers as they are standing and explain what their purpose is in the neural network.
- After the first full completion of the activity, stop and ask each layer what happened.
- Have each student record in their journal the input, process, and output that takes place in the neural network and ask if they can draw parallels with inputs/processes/ outputs with any other system that they have encountered; remind students that they have encountered these terms in previous ECS units.

### Forward propagation part II

- Show students the slide on neural networks from the Teachers PowerPoint. Explain that the left image shows a human head and brain and the right image shows a neural network, which is a computer representation of the human brain, and that each circle within the neural network is called a “neuron”/“node”.
- Point out that there are lines between the neurons/nodes in the neural network. Each line is called an “edge” and there is a weight to each edge that shows if there is a strong connection between the neurons/nodes. (This is shown by some of the edges being thicker.) The neural network learns to recognize the strong connections to positively identify an image. This is called “training” a neural network. The neural network is the core of the area of AI called “deep learning”. Remind students that this was mentioned when they discussed the evolution of AI. The Evolution of AI slide on the Teachers PowerPoint recaps this point.
- Then have students repeat the activity and swap layers so that students get to be in different parts of the neural network. Do this a couple of times.
- Have students respond to the following questions:
  - What role did each node play in the activity?
  - What happened at each node if the correct determination was made?
  - What is likely to happen as a neural network gets larger?
  - Where might neural networks be used?
- Ask a few students to share their answers with the class and lead a whole class discussion. Conclude the whole class discussion by showing the class the slide from the Teachers PowerPoint: Where Are Neural Nets Used?



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## Back Propagation

- Arrange the class as per the instructions in Back Propagation Day 5-7 folder. During the activity ask students to think about and observe what is happening. After the activity explain to students that the activity is called “Back Propagation” and is used to fine-tune a neural network and correct errors/correct identification of an object.
- Show students the following video to emphasize the point of back propagation, in which the process goes back and forth, back and forth until the concept is learned and the neural network can accurately identify the image: <https://www.youtube.com/watch?v=ADaAtGdJ3YY>.
- Have students answer the following questions:
  - What happens if the target is overshoot in the neural network?
  - Why are the steps adjusted within the neural network?
  - As we get closer to the target in the neural network what adjustments are made to the steps? Larger or smaller adjustments? Why?
  - Record 2-4 keywords from the back propagation activity and explain what they mean.

## Data classification and training data

- Show perceptron in the 50-60s video: [https://www.youtube.com/watch?v=cNxadbrN\\_al](https://www.youtube.com/watch?v=cNxadbrN_al).
- Have students work with elbow partners and brainstorm issues that arise when attempting to classify the data, i.e., the difference between men and women, as shown in this video.
- Have pairs reflect on the following questions: How much data will be needed to accurately train systems? Who will oversee ensuring that the system is trained with the correct data? What issues could arise if errors are made at this stage?
- Ask the class to consider any issues that may arise with incorrect classification of data. Who should be responsible for addressing these? Why/Why not? Are the computers we currently have powerful enough to train all this data? What further advances in technology may we possibly see?
- Have each pair of students form with another pair and discuss their responses to the previous questions.

## AI in the news

- With elbow partners have students read the following article: <https://www.independent.co.uk/life-style/gadgets-and-tech/news/artificial-intelligence-dangers-machine-learning-training-neural-networks-badnets-a7916721.html>. How does an article like this make them feel? Does it change any of the thoughts they have just recorded in their journal?
- Have some students share with the whole group their thoughts and feelings. Let students know that in the next lesson they will complete a practical activity with image recognition.

## Reinforcement learning (optional)

- Show students the following presentation: Day 5-7 Reinforcement Learning (play in full screen mode).
- Ask students to explain what they have noticed about the movement of the people in the video. Let them know that this is simulating a process called “reinforcement learning”.

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- In this process we get the neural network to work more like how humans learn through extreme trial & error. We're told off when we do something bad, so we (hopefully) learn not to do it again, and we're praised for doing something right, e.g. being graded in school. Reinforcement learning also takes into account our environment. As we walk around a room, for example, we will affect that environment, we'll bump into things, we'll move chairs, we'll alter the environment.
  - Reinforcement learning is about being in a particular state, taking a (good) action, which alters our state and so on and so on, to achieve a goal. Think of AI in the form of either a physical robot or a virtual "agent" or player in a video game. The key for reinforcement learning is giving the agent an objective, a goal, e.g. to get from A to B. If they take a wrong step, take 1 off their score; if they get closer, add 1. The objective is for the agent to maximize its score. Just that. **It actually figures out how to do that entirely by itself.** It trains itself. At first it will do nothing, but you get no score for doing nothing, so then it will make random movements. Most won't make sense and it will lose points, but eventually it will learn the right move, getting it closer to its goal. It can do all this in microseconds—very very quickly.

### Topic Description

In this lesson, students will access remote GPUs via a cloud server (Amazon Web Services) to access DIGITS (a front-end tool of common AI frameworks) and use images from the web against those from a known dataset to accurately identify images.

### Objectives

The student will be able to:

- Train a deep neural network to recognize handwritten digits.
- Explain the hardware used in artificial intelligence.

### Outline of the Lesson

- Journal Entry (10 minutes)
- Introduction to image classification activity (5 minutes)
- Image classification with DIGITS (120 minutes)
- Thoughts on data (15 minutes)
- Deployment (15 minutes)

### Student Activities

- Complete journal entry.
- Participate in activity on image recognition.
- Participate in discussion on data and deployment.

### Resources

- <https://courses.nvidia.com/courses/course-v1:DLI+L-FX-01+V1/about>
- Teachers PowerPoint Days 8–10 (*for teacher reference and background knowledge only*)

### Teaching/Learning Strategies

**Journal Entry:** *When you look at a cat or a dog, how do you know which is which? What process did you go through to decide? Were you even aware that you went through a process? How old were you when you learned to recognize the differences? What about different types of cats and dogs?*

- Have students share their thoughts with an elbow partner.

#### Introduction to image classification activity

- Remind students that in the first lesson of this unit they discussed the term “deep learning” and that in the previous lesson they then simulated a deep learning neural network. In this lesson they will use a computer to train a neural network to recognize hand written digits.
- Explain to students that in this activity they will learn to train a neural network using clean, labeled data. They will be introduced to deep learning through the task of supervised image classification, where, given many images and their labels, they build a tool that can *predict* labels of *new* images.

- The intent is to build the skills to start experimenting with deep learning. Students will examine:
  - What it means to *train* vs. to *program*.
  - The role of data in artificial intelligence.
  - How to load data for training a neural network.
  - The role of a *network* in deep learning.
  - How to train a model with data.
  - Images to solve a classic deep learning challenge.
- At the end of the lab, they will have trained a neural network that can successfully classify images to solve a classic deep learning challenge.

### Image classification with DIGITS

- Have students work in pairs. One student in each pair will read the instructions on one computer and the other will perform the instructions on the adjacent computer. Students need to go to this website: <https://courses.nvidia.com/courses/course-v1:DLI+L-FX-01+V1/about>.
- Click on “Enroll Now” and register.
- Having registered, students will be working in the NVIDIA environment. There will be a bit of wait time for the application to launch. While this is happening:
  - Have a discussion with the class about the connection between CPU (discussed in unit one) and GPU. Let students know that the machines they are using will be using GPUs (Graphics Processing Units), which are specialized circuits similar to CPUs, which are used due to their speed in processing images. They are used in deep learning as deep learning relies on image recognition.
  - Ask students what an image is made up of. Remind students that many computer images are comprised of pixels. Draw links with Unit 1 when they edited images. Explain that each pixel has numerical values attached and due to this we can process *anything* we can digitize i.e. convert to numbers.
- As students work through the activity offer support to pairs and ensure they are understanding the terms from the terminology slide of the Teachers PowerPoint. These are explained throughout the online activity but should also be called out in discussion.

### Thoughts on data

- In groups of 3–4, ask students to consider how much data is required to make the neural network accurate. What problems can arise if the neural network has not been trained with enough examples? What happens if the data set is labeled incorrectly? Is the neural network using supervised or unsupervised learning?
- Have students record responses on flipchart paper.
- Have students share their responses with the whole class and discuss.

### Deployment

- Have the groups discuss ways in which they think this technology can be utilized. For example, let them think of any task which requires image recognition, such as a cat flap or doggie door, being set to only recognize cats or dogs or a particular cat or dog. Also, how could this technology be used in areas such as medicine, etc.?
- Have each group share their thoughts with the whole class.

### Topic Description

This lesson will get students to delve further into areas that AI is changing: Areas to be investigated are:

- Agriculture
- Shopping (automated services)
- Cooking
- Transport including NVIDIA driverless cars (roads)
- Medical diagnosis
- Assembly line manufacturing
- Wildlife conservation
- Sport
- Or another area of their choice

### Objectives

The student will be able to:

- Explore the impact of AI in our present and future society.

### Outline of the Lesson

- Journal Entry (10 minutes)
- Areas being changed by AI (30 minutes)
- Group presentations and feedback (15 minutes)

### Student Activities

- Complete journal entry.
- Groups complete investigation of areas being changed by AI.
- Groups present findings and respond to questions.

### Resources

- Teachers PowerPoint Day 11 *(for teacher reference and background knowledge only)*
- Areas Being Changed by Artificial Intelligence
- Areas Being Changed by Artificial Intelligence Investigation
- Areas Being Changed by Artificial Intelligence Investigation Sample Rubric

### Teaching/Learning Strategies

**Journal Entry:** Sum up how you feel about a future dominated by artificial intelligence in either a single word or a short sentence.

- Choose a few students to share their thoughts with the class.

#### Areas being changed by AI

- Explain to students that they will be focusing in-depth on an area that is being changed by Artificial Intelligence.



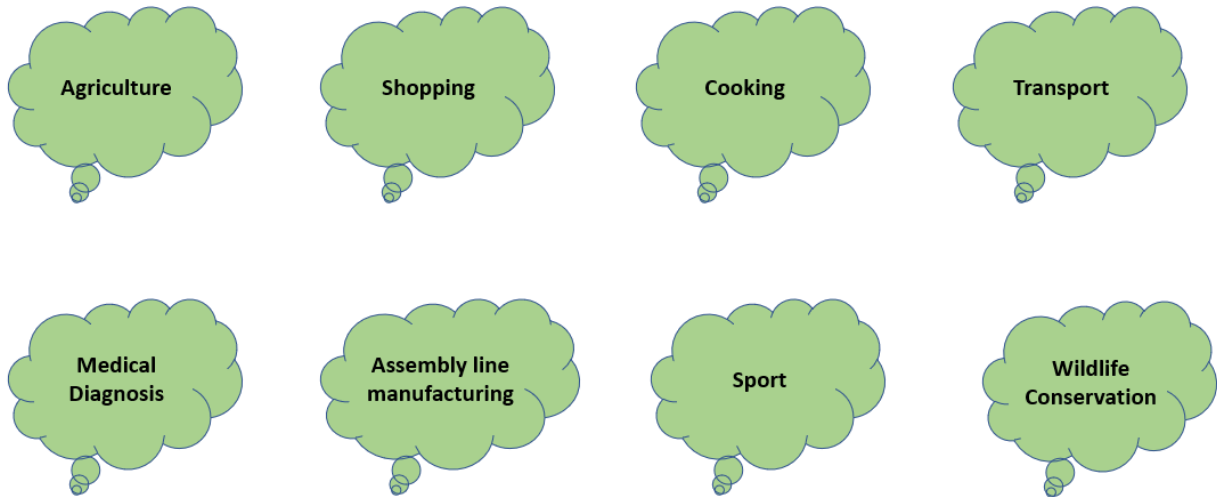
- 
- In pairs or small groups of about four ask students to choose one of the following areas to investigate: agriculture, shopping (automated services), cooking, transport including NVIDIA driverless cars (roads), medical diagnosis, sport, wildlife conservation, and assembly line manufacturing. If possible, have at least one group of students per area so as to cover a wider range of areas.
  - Have students conduct research to find out more about how AI is changing their chosen area.
  - There is a help sheet with suggested links for this research to support students.
  - Students should also be encouraged to go online and conduct independent research. Students can also choose another area not on the list.
  - Each pairing/group is to use the items in the student-facing resources to complete this activity and then present their findings to the class.

### Group presentations and feedback

- During the discussion ask students to consider how jobs are changing in the given area. Are jobs becoming obsolete? Are new types of jobs being created? What do people need to do to prepare to work in these industries? Let students know that in a few lessons' time, there will be a focus on jobs and the workforce.

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## Areas Being Changed by Artificial Intelligence



### 1. Agriculture

In the suburbs of Beijing, farmers have been growing peaches for nearly 60 years. The job is extremely labor-intensive, but two students say their artificial intelligence machine can help.

- [https://www.youtube.com/watch?v=bXQg\\_M7\\_6\\_E](https://www.youtube.com/watch?v=bXQg_M7_6_E)
- <http://www.bbc.co.uk/news/av/world-asia-china-41479282/when-artificial-intelligence-met-peaches>

### 2. Shopping

- <https://www.youtube.com/watch?v=NrmMk1Myrxc>

### 3. Cooking

- <https://www.youtube.com/watch?v=ypLD1rcjmrs>

### 4. Transport including driverless cars/trucks

- [https://www.youtube.com/watch?v=CNgi\\_E6vj34&t=10s&index=3&list=PLZHnYvH1qtObE\\_PjzaAFqS\\_CpmumGx5cW](https://www.youtube.com/watch?v=CNgi_E6vj34&t=10s&index=3&list=PLZHnYvH1qtObE_PjzaAFqS_CpmumGx5cW)
- [https://www.youtube.com/watch?v=YVjliDkLSTs&list=PLZHnYvH1qtObE\\_PjzaAFqS\\_CpmumGx5cW&index=5](https://www.youtube.com/watch?v=YVjliDkLSTs&list=PLZHnYvH1qtObE_PjzaAFqS_CpmumGx5cW&index=5)
- <https://www.nvidia.com/en-us/self-driving-cars/drive-px/>
- <http://fortune.com/2018/01/08/nvidia-self-driving-car-partners-uber-baidu-aurora/>
- <https://www.youtube.com/watch?v=fmVWLr0X1Sk>

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## 5. Medical diagnosis

- Give your opinion on systems that perform medical diagnosis without the presence of a doctor.
- [https://www.youtube.com/watch?v=Swf\\_W0vDSDo&t=140s&index=4&list=PLZHnYvH1qtObE\\_PjzaAFqS\\_CpmumGx5cW](https://www.youtube.com/watch?v=Swf_W0vDSDo&t=140s&index=4&list=PLZHnYvH1qtObE_PjzaAFqS_CpmumGx5cW)
- <https://www.youtube.com/watch?v=wHagnH3yIMY>
- <https://www.youtube.com/watch?v=cmE6GVvAk2o>

## 6. Assembly line/manufacturing

- <https://www.youtube.com/watch?v=aPTwpLlpDWE>

## 7. AI in sport

- [https://www.youtube.com/watch?v=TkqylbzQZCg&list=PLZHnYvH1qtObE\\_PjzaAFqS\\_CpmumGx5cW&index=8&t=223s](https://www.youtube.com/watch?v=TkqylbzQZCg&list=PLZHnYvH1qtObE_PjzaAFqS_CpmumGx5cW&index=8&t=223s)

## 8. AI in wildlife conservation

- [https://www.youtube.com/watch?v=TLw\\_I1ghvLM&index=6&list=PLZHnYvH1qtObE\\_PjzaAFqS\\_CpmumGx5cW](https://www.youtube.com/watch?v=TLw_I1ghvLM&index=6&list=PLZHnYvH1qtObE_PjzaAFqS_CpmumGx5cW)

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## Areas Being Changed by Artificial Intelligence Investigation

For this project you will work in groups and you will consider how AI is affecting a range of different areas. Choose 1 area to investigate. Suggested areas are: agriculture, shopping (automated services), cooking, transport including NVIDIA driverless cars (roads), medical diagnosis, sport, wildlife conservation, and assembly line manufacturing. Supporting references for each of these areas has been given to get you started. You may also choose another area not suggested to investigate.

Your presentation can be in any suitable format as designated by your school, such as using presentation software, a poster, a skit, or another suitable format.

Your presentation should include:

1. The names of your group members.
2. The reason why you chose the given area to investigate.
3. Images to support the presentation.
4. What AI is doing in the given area.
5. What benefits AI brings to the area including to the individual and to society.
6. What potential disadvantages AI brings to the area including to the individual and to society.
7. Any issues with collection of data or data misuse in this area.
8. Any safety considerations in this area.
9. Whether you trust AI in this area. Why/Why not?
10. Sources of information that have been referenced.

## Areas Being Changed by Artificial Intelligence Investigation Sample Rubric

Group Members' Names:

_____	_____
_____	_____

DO YOU HAVE?	POINTS POSSIBLE	YES	NO	POINTS EARNED
<b>ARTIFICIAL INTELLIGENCE</b>				
Group members introduced	5			
Area to be investigated	5			
Reason why you chose the given area to investigate	10			
Images to support the presentation	10			
What AI is doing in the given area	5			
What benefits AI brings to the area including to the individual and to society	5			
What potential disadvantages AI brings to the area including to the individual and to society	10			
Any issues with collection of data/data misuse in this area	5			
Any safety considerations in this area	5			
Whether you trust AI in this area—Why/Why not?	5			
Sources of information that have been referenced	5			
<b>PRESENTATION</b>				
Present all parts of the project	10			
All group members have participated in the presentation	10			
Able to answer at least 2 questions from the audience	10			
<b>TOTAL:</b>	<b>100</b>			



## Instructional Day: 12

### Topic Description

In this lesson students will delve further into the area of algorithmic bias.

### Objectives

The student will be able to:

- Explore the concept of algorithmic bias and the impact this is likely to have on society.

### Outline of the Lesson

- Journal Entry (10 minutes)
- Conscious vs unconscious bias (10 minutes)
- Deployment for good/legislation (20 minutes)
- Research on algorithmic bias (15 minutes)

### Student Activities

- Complete journal entry.
- Groups discuss conscious vs unconscious bias.
- Groups participate in activity on how AI is deployed and legislation that society may need.
- Pairs complete research on algorithmic bias.

### Resources

- Day 12 Bias Resource
- Deployment Ideas and Bias
- Teachers PowerPoint Day 12 (*for teacher reference and background knowledge only*)

### Teaching/Learning Strategies

**Journal Entry:** *How would you feel if you were discriminated against in any way? Describe a situation in which you feel you have experienced discrimination.*

- Ask a few volunteers to share their thoughts with the whole class.
- Then ask students to individually write in their journals how they would feel if the discrimination was happening due to an algorithm—meaning a non-human with which they had no recourse and were not able to even have a discussion regarding the discrimination.
- Ask a few volunteers to share their thoughts and feelings with the whole class.

#### Conscious vs Unconscious Bias

- Show students the images on the Day 12 Bias Resource PowerPoint and ask them to individually write down what assumptions they have made about the people in the PowerPoint. What made them make these assumptions? Was that fair?

- 
- Extend the activity by reading the following job titles to students and having them write no more than 3 words about what sprung to mind for each title.
    - Female firefighter
    - Female plumber
    - 100-meter sprinter
    - Cabin crew
  - Then have students work with an elbow partner and share their assumptions. Choose a few students to share their assumptions with the class. Explain that what leads to our biases, assumptions, feelings, and thoughts is very deeply ingrained in all of us and within society.

### Deployment for good/legislation

- In groups, ask the class to think back to when they came up with ideas for deployment of deep learning technology. Could their application of AI be biased in any way? Is there room for bias? Students are to choose one of their deployment ideas and then give reasons why/why not and record these on flipchart paper in the format of the Deployment Ideas and Bias sheet or on the sheet itself. Encourage students to reflect on the training data being used and where any bias could potentially arise.
- Each group is to share their AI deployments and the reasons for and against bias with the rest of the class.
- Develop the discussion by asking students to consider what new laws are required to ensure that developers of AI applications produce algorithms that are unbiased. Should individual developers be responsible, or should companies be responsible, or both? How can we ensure that algorithms are bias-free? Is this a realistic expectation? Why/why not?
- Should we be able to report products that we feel are biased? Why/Why not?

### Research on algorithmic bias

- In pairs, conduct research and find at least one article or short video that deals with algorithmic bias in a sensitive manner. Pick out the main area of bias from the article or video and the impact or possible impact of the bias. Then share this information back to the class.

---

## Deployment Ideas and Bias

*Group Members' Names:*

_____	_____
_____	_____

**DEPLOYMENT IDEA:**

**REASONS WHY THE DEPLOYMENT IS  
NOT BIASED**

**REASONS WHY THE DEPLOYMENT  
COULD POTENTIALLY BE BIASED**

### Topic Description

In this lesson students will investigate accessible AI.

### Objectives

The student will be able to:

- Identify AI that can be used to improve accessibility for disabled people, elderly people, and other underserved populations.

### Outline of the Lesson

- Make the link (10 minutes)
- Helper robots (15 minutes)
- Accessible AI (25 minutes)
- Journal Entry (5 minutes)

### Student Activities

- Groups participate in discussions on image/product links.
- Groups participate in discussions on helper robot and accessible AI.
- Complete journal entry.

### Resources

- Teachers PowerPoint Day 13 *(for teacher reference and background knowledge only)*
- AI Accessibility Sheet

### Teaching/Learning Strategies

#### Make the link

- Show students the Make the Link slide of the Teachers PowerPoint and ask them to speak to their elbow partner and identify what links they can make between the images/products.
- Guide students to all of the images/products that utilize AI and can help people such as the disabled, the elderly, or other underserved groups. The “How they Help” slide of the teacher’s PowerPoint gives explanations, which are provided to support the teacher in explaining to students.
- Choose a few students to share their thoughts and ensure that all images on the “How they help” slide are explained to the class. Encourage students to state the type of AI in use, such as voice recognition, image recognition, speech recognition.

#### Helper robots

*(\*If students have previously studied Unit 6 then remind them that they have previously encountered robots and that in their final project they looked at robots helping in a given scenario—Rescue Robot.)*

- In groups of 3–4 ask students to draw and label the features of a helper robot on flipchart paper. (Note that some students may draw humanoid robots, and some may draw other types of robots. It may be necessary to clarify to the class that a helper robot works with/alongside humans.)

- 
- Ask the first group to then show their helper robot to the rest of the class and explain the features. Then subsequent groups are to highlight anything that they have different on their robot.
  - Encourage students to identify inputs, outputs, and any sensors on their helper robot.

### Accessible AI

- Have students recap the difference between artificial intelligence (AI), machine learning (ML), and deep learning (DL) in their groups. Ensure they are clear on what each term means.
- In groups of four, have students consider how AI can improve accessibility for underserved groups. Students are to record their thoughts on the AI Accessibility Sheet.
  - Identify 1 or 2 underserved groups.
  - Consider the AI that can be used to help that group. Some examples might be: self-driving cars, voice assistants, text to speech (and vice-versa), a robot. Will any issues arise around the data that the AI is trained on? Will any issues arise around data collection by the AI device/app? Where will that data be stored and who will have access to the data?
  - Students should begin to realize that AI that is useful for underserved groups is also very helpful to the main population and also carries the same considerations around bias, data collection, and privacy.
  - Develop the lesson by asking students to consider any cost implications and if they think the AI should be freely available to all in the groups or whether it should cost. Ask them to give reasons why/why not.
  - Have each group do a “quick share” of their Accessible AI with the class.

**Journal Entry:** *Do you think any of the accessible AI will replace jobs that humans are currently doing such as giving care to people in some vulnerable groups? How do you feel about this?*

- Let students know that in the next lesson the discussion around jobs will be developed.



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## AI Accessibility Sheet

*Group Members' Names:*

_____	_____
_____	_____

Underserved group:

Examples of how AI can support this group:

Issues with data collection/privacy:

Cost implications:

### Topic Description

In this lesson students will investigate how AI is changing the world of work.

### Objectives

The student will be able to:

- Explain the automation risks to jobs, skills they will require in an increasingly automated world, and the changing world of recruitment.

### Outline of the Lesson

- Journal Entry (10 minutes)
- Automation risk (25 minutes)
- Job skills (20 minutes)
- Changing recruitment (20 minutes)
- What is work? (5 minutes)
- AI dilemmas (25 minutes)
- Journal entry (5 minutes)

### Student Activities

- Complete journal entry.
- Complete automation risk activity.
- Complete activity on knowledge vs skills.
- Participate in. discussions on:
  - Automation risk
  - Skills
  - Changing world of recruitment
  - What is work
  - Morals and Ethics

### Resources

- Teachers PowerPoint Days 14–15 (*for teacher reference and background knowledge only*)
- <https://www.bbc.co.uk/news/technology-34066941>
- Morals and Ethics Supporting Cards

### Teaching/Learning Strategies

**Journal Entry:** *What job would you like to do in the future? Will it be affected by Artificial Intelligence? Why/why not? How do you know either way? Have you made any assumptions about jobs existing or not existing?*

- Choose a few students to share their answers with the class.

#### Automation risk

- In pairs, have students use the following website to look at automation risk of jobs as well as their potential jobs and those of friends and/or family members: <https://www.bbc.co.uk/news/technology-34066941>.
- Lead a class discussion and have students share which jobs are going to be automated. Ask them to articulate how they feel about this. Will it affect what courses they will study in the future?

- In the same pairs, ask students to consider these specific areas: driving jobs, jobs sitting at desks, jobs on construction sites, factory workers, pilots, ships captains, supermarket workers, doctors, accountants. Are any of these likely to change? Why/Why not?
- Have each pair share one response. Ask questions that get students to realize any driving job can and is being automated, supermarkets are already becoming automated, we have chatbots who we can speak to and they can make medical diagnoses. At which stage will we need to see a doctor? Additionally, some surgery is being carried out by robots being guided by humans.
- Then develop the class discussion and ask students to consider any job that utilizes or generates large volumes of data, numerical or otherwise. In pairs have students note down jobs that rely on large volumes of data and explain how AI would be effective in dealing with big data. Have students consider which jobs would then disappear, giving reasons for their answers. Explain that many accountancy jobs are already being automated as machines are better at carrying out repetitive tasks and quick calculations and dealing with large volumes of data.
- In small groups of 3–4 ask students to consider what new jobs can and will be created in an increasingly automated world. The new jobs slide of the Teachers PowerPoint offers some guidance. Let students know that new jobs that are being created are collectively being called “New Collar Jobs”.
- Let students know that the changes we are going through as a world with automation are called the “Fourth Industrial Revolution” or “Industry 4.0”.

### Job skills

- Give students flipchart paper and ask them in groups to consider the skills that they will need in an age of automation and rapid change. Encourage them to present knowledge required on one side such as courses on digital skills, programming, etc., and on the other side the more general skills such as collaboration. Hang the flipchart paper around the classroom and have the first group share their findings and each subsequent group share what they have that is different. Discuss the points raised.

### Changing recruitment

- Currently we tend to apply for jobs via curriculum vitae (CVs) and job application forms, which are read by human beings. However, this is changing, and AI is increasingly being used in recruitment processes.
- Ask students to discuss in pairs: Do we need to be interviewed by a human? What about if the system is trained incorrectly when recruiting—what issues can this lead to? Let students think back to the lesson on bias. How will we ensure that the AI and systems in use are fair? Ask a few pairings to share their thoughts with the class.
- As the discussion develops ask students to consider where jobs are advertised. Traditionally they were advertised in newspapers, and now they are increasingly online on websites. Will there be more jobs appearing in the apps that we use? In a case of “the job finding us vs us finding the job?” what criteria and algorithms would companies be using in such situations? What issues could arise? Ask a few students to share their views.
- As the discussion develops further remind students that AI can help in the selection of candidates more quickly, but this must be balanced with a suitable and fair system. How would students feel being interviewed by AI whether through a chatbot system or a humanoid robot? Ask students to share their thoughts.

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### What is work?

- In their pairs, ask students to consider how society can evolve in a possible world where processes are automated, and machines can do the current work of humans. What will humans do? Can humans work well alongside AI driven systems? Will this give us more time to dedicate to family and living in communities? What would be driving those communities? Have students share their thoughts with the class.

### AI dilemmas

- Create groups of 3–4 students. Provide each group with the Morals and Ethics Supporting Cards and ask them to consider and discuss a few of the points on the cards. Each group is to share thoughts on at least one of the cards with the whole class.

**Journal entry:** *Summarize what changes or considerations, if any, you will have to think about in your future careers, lifestyles, and society.*

- Let students know that in the next lesson they will be looking at images that represent AI. In preparation they need to bring in either images or text that they think “tells a story of AI.”

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## Morals and Ethics Supporting Cards

<b>Do you control computers or do they control you?</b>	<b>Who is responsible for an accident caused by a driverless car?</b>	<b>Will Artificial Intelligence ever be more intelligent than humans?</b>
<b>How intelligent will Artificial Intelligence become?</b>	<b>Are there further ways you would like Artificial Intelligence to help you?</b>	<b>Will Artificial Intelligence ever completely replace humans in the workplace?</b>
<b>Are computers capable of original thought?</b>	<b>Is it a matter of time before computers become more intelligent than humans?</b>	<b>Is consciousness uniquely human?</b>
<b>In the future, should computers have the same rights as humans?</b>	<b>In the future, would it be right to turn off a computer?</b>	<b>In the future, how would computers treat us?</b>

### Topic Description

In this lesson students will consider the imagery and text that is used to portray AI and if they are realistic ways to portray AI.

### Objectives

The student will be able to:

- Create an image for AI that is diverse and inclusive.
- Write news stories/headlines for a future in which AI is prevalent.

### Outline of the Lesson

- AI imagery/text (10 minutes)
- Design of AI imagery (40 minutes)
- Presentation of AI imagery (30 minutes)
- Future news/headlines (30 minutes)

### Student Activities

- Groups discuss examples of AI images and text.
- Pairs design an AI image.
- Pairs present AI images.
- Groups participate in discussions of news stories and headlines.

### Resources

- No additional resources necessary

### Teaching/Learning Strategies

#### AI imagery/text

- In groups of 3–4 ask students to show their image/text to the group and explain what it says about AI. Ask the students to explain whether the AI represents utopia (an imagined future where everything is perfect) or dystopia (a world filled with disaster and misery) or a world that is similar to our current world with enhancements or otherwise?
- If students bring in many images of robots, ask them why the robot is a representation of AI. Could there be another representation?
- Display all of the AI imagery on a board.
- \*Students can and should also be encouraged to discuss films/books in which they have seen AI imagery. If students do not bring in imagery, then images of robots, part-human-part-robots, brains, computers, AI film covers, AI book covers, etc. can be sourced by the teacher to prepare this lesson.

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### Design of AI imagery

- In pairs students should consider what they have discussed about AI imagery and design an inclusive and diverse AI image that can be used across the world to represent AI. They can do this in any form, either on a computer or on paper.

### Presentation of AI imagery

- Give pairs time to review comments and then have each pair present their image to the whole class and explain what they have done and why they feel it is a representative and inclusive image. Have the class display all images around the classroom and then have students walk through the “AI gallery” to view the representations of AI. Ask them to write comments/questions on post-its as they walk through the gallery.

### Future news/headlines

- In groups of 3–4 ask students to consider how future news stories/headlines could possibly be influenced by AI technology. For example, with more connected technologies and cyber security issues, what could the headlines of tomorrow be? Students are to come up with short news stories/headlines for the future.
- Ask students to consider: What needs to be implemented to ensure that security threats in the age of AI are minimized?
- Have each group share their headlines and stories with the whole class; these can be in whatever format each pair chooses.



## Topic Description

Students will plan and prepare an AI presentation with a list of criteria. The presentation will also require students to conduct an element of research.

## Objectives

The student will be able to:

- Incorporate all of the knowledge that they have gained in this unit, along with independent research and personal opinion, to create and deliver a “pitch” to a specific target audience.

## Outline of the Lesson

- Explanation of the final project (15 minutes)
- Completion of final project (95 minutes)

## Student Activities

- Groups complete final project.

## Resources

- Final Project “AI for Everyone”
- Final Project “AI for Everyone” Sample Rubric

## Teaching/Learning Strategies

### Explanation of the final project

- Distribute Final Project “AI for Everyone”.
- Explain the final project requirements and share the rubric; answer any clarifying questions.

### Completion of final project

- Students work on final project.
- Circulate the room and respond to any clarifying questions.

# Final Project

## AI for Everyone

Explain to someone from one of the below target audiences the impact that AI and the items on the topic list will have on their lives.

- Students in grades 6–8
- Pensioners/the elderly
- Students of your own age group
- Your parents
- People living in rural areas

**Group Size:** 4 people

**Presentation length:** 5–7 minutes, which can be done either in a paper-based, electronic, or other format.

**Rubric:** Each class member will complete a rubric as each group presents.

**The presentation must include the following:**

- Title and group member names
- Explanation of what the target audience will learn
- Explanation of AI, ML, and DL
- Explanation of image recognition
- At least 3 current uses and deployment of image recognition
- Group opinion (and justification) on whether AI will be a benefit or not
- 1 piece of research (*see the research options below*)
- Question and answer: Take and respond to at least 2 questions from the audience

**In addition:**

Choose **4 items** from the topic list below to include in the presentation.

1. Explanation of the term “algorithm” (used in context)
2. AI in the smart city
3. AI in the smart home
4. Security considerations for AI and the use of connected technologies with big data
5. Chatbots
6. Assistive AI
7. Legal and ethical issues that can arise from big data, chatbots
8. Impact of AI on work/jobs and the workforce

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### ***Research***

This must be on one untaught area of AI and why it is important that this target audience knows about how AI will affect this area. Some suggested areas are:

- Education (this can include delivery of courses online)
- Entertainment (this can include AI gaming)
- Finance (block chain, cryptocurrencies)

## Final Project — “AI for Everyone” Sample Rubric

Group Members’ Names:

_____	_____
_____	_____

DO YOU HAVE?	POINTS POSSIBLE	YES	NO	POINTS EARNED
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### REQUIRED ITEMS

Title and group member names	5			
An explanation of what the target audience will learn	5			
An explanation of AI, ML, and DL	10			
An explanation of image recognition	5			
At least 3 current uses and deployment of image recognition (5 points for each given)	15			
Group opinion (and justification) on whether AI will be a benefit or not	5			
1 piece of research	5			
Question and answer—Take and answer at least 2 questions from the audience	10			

### OPTIONAL 4 ITEMS

Write the number of the item and a short description in each row.

	10			
	10			
	10			
	10			
<b>TOTAL:</b>	<b>100</b>			

### Topic Description

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Students present their final project, "AI for Everyone".

### Objectives

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The student will be able to:

- Present the final project.

### Outline of the Lesson

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- Final project presentations (55 minutes)

### Student Activities

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- Groups present final projects.
- Students ask questions about the final project.

### Resources

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- Final Project "AI for Everyone" Sample Rubric

### Teaching/Learning Strategies

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#### Final project presentations

- Each group presents their findings.
- Audience members complete the rubric for each presentation.
- Encourage students to ask questions of each group.