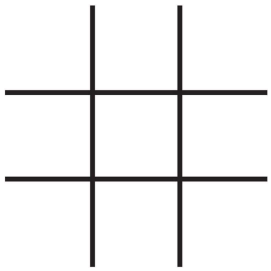
ARTIFICIAL INTELLIGENCE

Ages 11-14 (Level 3)

Description:	Learners will explore the basic mechanics of artificial intelligence to mimic human-like behaviors, and consider its promise and potential challenges.
Leading question:	Can computers display intelligence like humans to solve challenges?
Age group:	11 – 14 years
Subjects:	Computer science
Total time required:	4.5 hours over 4 days
Self-guided / Supervised activity:	Low Supervision
Resources required:	Paper, Pencil, Eraser, Scissors, Straws, String

Day	Time	Activity and Description
1	(40 minutes) 10 minutes	This activity has been adapted from *The Intelligent Piece of Paper* by cs4fn.org. <u>Introduction</u> Learners will begin by exploring the concept of "intelligence." - On a piece of paper, write or draw what the word "intelligence" means to you. - Based on your description, can animals be intelligent? How might you modify your definition of intelligence based on what you know about animals? - Can a piece of paper be intelligent? What about something written on a piece of paper or a book? - What is the difference between intelligence and knowledge? We should agree that the paper or book itself are not intelligent. They may contain knowledge or wisdom, but that does not make the paper or book itself intelligent. - What about playing a strategy game where you are trying to win? Does that require intelligence? How do you show intelligence in a strategy game? - Have you ever played a game against a computer or phone? How does the computer program or phone know how to play with you in an intelligent manner?
	5 minutes	<u>Activity Part 1: Introduce the game</u>

		Learners will now play a simple strategy game against an "intelligent" piece of paper. The game is called Noughts and Crosses (also called Tic-Tac-Toe). The rules of the game are as follows: - Draw a grid with two lines across and two lines down, creating 9 boxes.  - One player uses an O symbol and the second player uses an X symbol. - Each player takes a turn placing their symbol in an open space. - The player that is able to make three symbols in a row (up, down, across, or diagonal) wins. - Players go back and forth putting their symbols in, until one wins or there is a draw.
	20 minutes	<u>Activity Part 2: Play against the "intelligent" paper at home</u> - Preparation: Print or write out the rules from the "intelligent piece of paper" included in the appendix. - Create a grid for the game. Since you will play the game a few times against the intelligent piece of paper, it is best to use a pencil or something else that can be easily erased. - Ask a family member or friend to be the "intelligent piece of paper." Their job is to follow the instructions of the paper, not to use their own intelligence to play against you. They are simply doing what the paper tells them to do. In this way, you are playing against the paper's intelligence, not another human. - Play a few times to see if you can win against the paper. - How many times did you win against the paper? How many times was it a draw between you and the paper?
	5 minutes	<u>Debrief:</u> - After playing the games a few times, it will be clear that either the paper will win or it will be a draw. The paper never loses. - Is the paper intelligent? Point out that the paper does show evidence of intelligent behavior, so there must be intelligence somewhere related to the paper. Where is that intelligence? Learners should identify that the person who wrote the instructions is the one who is intelligent. The paper is simply a list of rules that are to be followed. - Tell learners that these instructions on paper are similar to a computer program. The job of people is to write these instructions in the language of

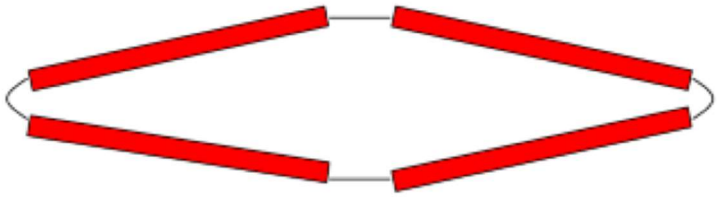
		computers, called code. People who write codes for computers are called computer programmers. These codes can be simple, like our game, or very complex. The computers follow these codes, displaying behaviors that seem intelligent. - *Artificial intelligence* is the ability of a computer program to "think" and complete a task, such as winning a game. How is artificial intelligence similar or different to human intelligence? Ask learners to make a list of examples of AI in everyday life such as robots, autopilot, live chat bots on websites etc.

2	5 minutes
	
	20 minutes
		This activity has been adapted from *The Emotional Robot* by cs4fn.org.
		
		<u>Introduction:</u>
		- In the previous lesson, learners experienced how a code can make a computer show evidence of intelligent behavior.
		- In this activity, learners will create their own code related to emotions. Discuss with learners how emotions are much more complicated than a strategy game of rules. Being able to show and respond to other's emotions is a type of intelligence. It means that you are aware of yourself and others around you. How might a computer show or respond to human emotion?
		- Discuss robots with learners. Have they seen a robot display or respond to emotion? Is that a sign of artificial intelligence?
		
		<u>Activity: Preparation</u>
		- Using scissors, paper, and pencil, each learner should make the following elements of their robot face:
		  - Two eyes: wide circles
		  - Two eyes: ovals or narrowed circles
		  - Two eyebrows
		- Learners should make a mouth made from four tubes threaded together in a circle. This can be two straws that have been cut in half or four pieces of paper that have been rolled and taped. Either string or a wire can be used to thread the four rolls.

wide eye (x2)

narrow eye (x2)

eyebrow (x2)



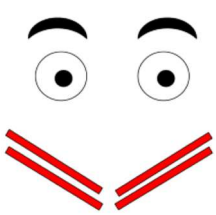
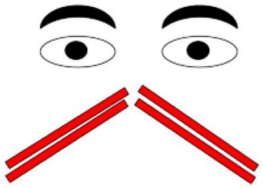
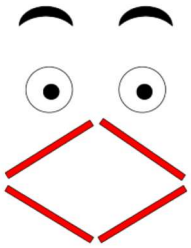
mouth made from four tubes with rope
or wire threaded through and tied

30 minutes

- Each learner now has a robot face. The robot can only do what it is programmed to do, so we need program cards. These are the code or the instructions that the robot's face will follow.
- Each learner should use scissors to cut out the six program cards included at the end of this lesson (left eye, right eye, left eyebrow, right eyebrow, left side of mouth, right side of mouth).

<u>Activity: Operating the Robot Face</u>

- In order to move the robot face, the learner must follow the instructions of their six program cards. The instructions require noise as *input*. This is just like us! Our face expression changes based on what we sense - such as hearing, smell, and sight. These sensations are our inputs based on which we produce the outputs of facial expressions. Artificial intelligence works in a similar way; it requires some information, which it then categorizes and sorts to produce an *output*. For our robot, the output is its expression. The learner, as the robot, will move each of the six elements of their robot face according to the type of noise they hear.
- Ask a family member or friend to make one of the three sounds on their program cards: nice, bad, sudden.
- Using the program cards, arrange the robot face according to the sound. The resulting faces should look like this and will correspond to the emotions of *happy* (nice sound), *sad* (bad sound), and *surprised* (sudden sound).

	30 minutes 10 minutes	   *Happy face* *Sad face* *Surprised face* - Repeat this with different family members or friends, asking them to make one of the three sounds. Remember that the robot only responds to sound, not to expressions, words, or body language. As a challenge, the learner can sit with their back to the family member, so that the only input is sound. <u>Activity: Programming the Robot Face</u> - Have learners come up with three new facial expressions of their choice (e.g. winking). - Learners may want to work with a family member or friend to act out different faces to see how that would look on their robot face. - Learners may also add different face elements (e.g. a closed eye) to match the three new facial expressions. - Learners must draw out their three facial expressions. This is an important step to writing their code for their robot's emotional intelligence. - Next, learners must determine the kind of sound input that would cause their robot to make that facial expression. For example, what kind of sound makes us wink? Have learners write the corresponding sound down next to each of their three robot face drawings. - Ask learners to choose one of their robot facial emotions or expressions and to create the program for making that face. - The program code must be written the same way as the program cards, using the form of "If…..then…." One rule must be written for each of the six robot face elements. - Test the code by asking a family member to follow the instructions, while the learner creates the sounds. <u>Debrief:</u> - What was something surprising or new that you learned from this activity? - Can robots display emotional intelligence? - Today, there are robots with human-like faces. How do you feel about such robots showing emotional intelligence when interacting with humans?

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- Humans have a wide range of emotions, including subtle micro emotions, which are facial expressions that only last for a short moment. Discuss with learners how robots can be made to be more humanoid by programming such detailed micro emotions.
- Draw a picture of what you think robots will look like and do in the future. Imagine them in your community - what are they doing? How are they interacting with others?
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5 minutes

40 minutes</td><td>
This activity has been adapted from MIT Media Lab AI+Ethics Curriculum.

Today the learners will explore the concept of machine learning, a key element of artificial intelligence.

<u>Introduction:</u>
- Ask learners if machines, computers, and robots are capable of learning.
- Have learners describe what learning is, in their own words.
- Use the example of a toddler learning to walk. How does the toddler get better at walking? Describe learning as a trial-and-error experience, through which one gets better by doing the activity repeatedly.

<u>Activity: Classification and Feature Extraction</u>
- Provide learners with the following six images of cats.

- Ask learners to determine how they know these are cats. What are the distinguishing features that make all six of these cats and not, for example, monkeys, dogs, or another animal?
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- This task is called *classification*. Humans can do this easily because our brains extract and match key pieces of information quickly. However, it is not so easy for a computer.
- Imagine we are designing a program that uses these six pictures as the *data* for the computer to recognize cats. This is an aspect of artificial intelligence - being able to recognize something new and classify it. Providing data is a critical role that humans play in making artificial intelligence. The computers use this data to complete a task. The more data it has, the better the artificial intelligence gets at completing its task effectively. As we explored in the prior activities, computers must use rules or code to complete tasks, such as classification. Have learners identify 4-5 key features that identify the six animals as cats. The features can be quantitative (for example, two ears) or qualitative (for example, fur color). Identifying these key features is called *feature extraction* - the conversion of data in the original form (such as an image) into a series of quantitative or qualitative features that can be used to distinguish different objects in the original data. By converting the images into a series of features, a computer can behave like a human in terms of recognizing the object inside each image.
- Remind learners that they can only extract features from the images. As humans, we have more experience or *data* with cats. For example, we might recognize cat shadows, sounds, the way they walk, and so on. Our computer ONLY has these six images.
- Once learners have a set of “cat” features that they’ve derived directly from these images, have them test the quality of this feature extraction with family members. Ask family members to draw the animal based on the features without telling them that the output is supposed to be a cat. Did they draw a cat? Another animal or object?

<u>Activity: Testing Machine Learning</u>

- After learners have completed their feature extraction of their cat data set, provide them with the following three images.

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	                10 minutes	- Have learners reflect on why or why not these three were identified as cats. - How might the feature extraction be improved so that the computer can learn to identify the third image as a cat and exclude the first two? <u>Debrief</u> - Discuss the limits of feature extraction with just six images. Why is more data needed in the beginning? Why is a diversity of images important? A computer's accuracy to recognize and classify is improved by *big data*, large sets of data. The more data it has, the more it "learns" and the better it gets at classifying. - How is machine learning with big data similar to our earlier example of a human toddler learning to walk? - Facial recognition is an important part of machine learning and artificial intelligence. Who could such artificial intelligence help? How could it be problematic? What concerns do you have about facial recognition?

4	(50 minutes)
	
	10 minutes
	
	20 minutes
		Today learners will imagine a future of big data used by artificial intelligence. They will speculate on the potential promises and challenges that such a future holds.
		
		<u>Introduction:</u>
		- Ask learners to consider how features of artificial intelligence that we have explored in this unit (prediction of a player's next move, responding to input, feature extraction, classification, and the use of big data), can help us better understand and contain COVID-19.
		- Present learners with some existing examples:
		    - InterVision is artificial intelligence that uses images of lungs to diagnose COVID-19 faster than human doctors can.
		    - Blue Dot is artificial intelligence that monitors social media to track the spread of the virus.
		- How might such technology be helpful?
		- What might be the negative effects of this technology? For example, what if the company shared people's health data with the government, other individuals or companies? How might people's privacy be affected? Do you think there are some people who do not want to share their social media or health data with others?
		
		<u>Activity: Brainstorming Benefits and Risks of Artificial Intelligence Technologies</u>
		- Present learners with two scenarios that describe the use of artificial intelligence technologies.

		- *Scenario 1*: Face recognition is being increasingly used at country borders. This works by a computer taking a picture of the person and checking that person's picture against their passport picture and a database (collection of information) of citizens. If the person's picture is matched with their passport and the citizen database, they are allowed into the country. - *Scenario 2:* Some new cars come with artificial intelligence applications. These cars have sensors and cameras that provide the computer in the car with input, which the artificial intelligence uses to steer, brake, or accelerate the car. - Ask learners to consider some of the benefits of artificial intelligence in these two scenarios. Who does artificial intelligence help in these scenarios? What tasks are made easier? - Ask learners to consider some of the risks of artificial intelligence in these two scenarios. Who are some harmful effects of these applications in these scenarios? What are some unintended outcomes that could be harmful? Would you feel safe using these artificial intelligence technologies in these two scenarios? What could be done to reduce the possible harm of these technologies?
	20 minutes	<u>Activity: Drawing the Future of my Artificial Intelligence</u> - Fold a piece of paper in half. - Imagine you have built out your artificial intelligence technology. In 25 years, how will your technology be used for the most good? What problems is it solving or predicting? Draw this future on one side of your paper. - On the other side, draw how your artificial technology might be used for the most harm. Who or what will it impact the most in a negative way? Draw this future on the other side of the paper. - Share your drawing with family and peers. Explain what *artificial intelligence* means and how it can be used in both positive and potentially harmful ways.

Learning outcomes:	- Understanding some basic mechanics of how artificial intelligence systems work, including data sets, code, feature extraction, and prediction. - Understand that humans have agency in designing and developing accuracy of an artificially intelligent system. - Understanding the promises and unintended consequences of artificial intelligence.
Required previous learning:	None
Inspiration:	- *The Intelligent Piece of Paper* by cs4fn.org - *The Emotional Robot* by cs4fn.org - MIT Media Lab AI+Ethics Curriculum

Additional enrichment activities:	None
Modifications to simplification	Learners can focus on the instructions and draw images rather than using the ones from the lessons.

DAY 1 ACTIVITY

I am a highly intelligent piece of paper. Let's play Noughts and crosses.

I am X, and I go first. These are my moves. You are the other player.

Move 1: Put X in a corner.

Move 2:

IF the other player did not put an O there, THEN put an X in the opposite corner to move 1.

ELSE put an X in a free corner.

Move 3:

IF there are 2 Xs and a space in a line THEN go in that space.

ELSE IF there are 2 Os and a space in a line THEN go in that space.

ELSE go in a free corner.

Move 4:

IF there are 2 Xs and a space in a line THEN go in that space.

ELSE IF there are 2 Os and a space in a line THEN go in that space.

ELSE go in a free corner.

Move 5: Go in the free space.

**Adapted from The Intelligent Piece of Paper.*

DAY 2 ACTIVITY

Cut out the following cards:

The Left Eye If NICE SOUND then WIDE OPEN If BAD SOUND then NARROWED If SUDDEN SOUND then WIDE OPEN	**The Right Eye** If NICE SOUND then WIDE OPEN If BAD SOUND then NARROWED If SUDDEN SOUND then WIDE OPEN
The Left Eyebrow If NICE SOUND then DOWN If BAD SOUND then DOWN If SUDDEN SOUND then UP	**The Right Eyebrow** If NICE SOUND then DOWN If BAD SOUND then DOWN If SUDDEN SOUND then UP
The Left Side of the Mouth If NICE SOUND then UP If BAD SOUND then DOWN If SUDDEN SOUND then OPEN	**The Right Side of the Mouth** If NICE SOUND then UP If BAD SOUND then DOWN If SUDDEN SOUND then OPEN

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