What is Machine Learning?

Grade 8-12 Activity Write Up

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DAY OF AI

What is Machine Learning?

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About Actua

Actua is creating a Canada where every child has the skills and confidence they need to achieve their full potential. As a leading science, technology, engineering and mathematics (STEM) outreach organization, Actua includes over 40 universities and colleges, engaging 500,000 youth in 600 communities each year. For 25 years, Actua has focused on identifying and removing the barriers for entry into STEM and now have national programs dedicated to engaging Indigenous youth, girls and young women, Black youth, those facing economic barriers and youth in Northern and remote communities. For more information, please visit us online at www.actua.ca and on social media: Instagram, LinkedIn, Facebook and YouTube! For more information, please visit us online at www.actua.ca and on social media: Instagram, Facebook, LinkedIn, TikTok and YouTube!

What is Machine Learning?

Activity Summary

In this activity, participants will investigate how machines learn from data. They will discover how artificial intelligence (AI) systems recognize patterns, make predictions, and improve as they process information. Participants will explore different approaches to machine learning (ML) and understand the impact of ML on various industries and their daily lives. Using Google's Teachable Machine, participants will experiment with training machines to process data and make predictions.

Developed by Actua, 2025.

Delivery Environment	Activity Duration	Intended Audience	Tech
In-Person	90 minutes	Grades 8-12 (*Ages 13-18*)	Certain activities will require a laptop/tablet. With modifications, it is possible to run this entire lesson in pairs/groups. **Facilitators should have access to a laptop, projector, speakers, and a screen or blank wall to project onto.** • Projector • Speaker • Screen/Blank Wall • Laptops/Tablets

Achievement Goals

Learning Goals

Following this activity, participants will:

- **Understand** the basics of machine learning and how machines use data to learn.
- **Describe** the structure of a neural network.
- **Design** a basic machine learning model using labeled data, and **examine** how machine learning is used in communities and industries.

Success Criteria

Following this activity, participants can express:

- **I can explain** different ways machines learn from data and give examples of machine learning in everyday life.
- **I can label** the main parts of a neural network and describe what each part does.
- **I can build and test** a simple machine learning model with labeled data.

Logistics (Timing, Group Sizing, Materials)

Section Title	Time	Group Size	Materials
Opening Hook	10 minutes	*Whole Group*	**Facilitators** • What is Machine Learning? 8-12 - Activity Slide Deck (*Appendix C*) • Writing Surface (e.g. Whiteboard) • Writing Utensil (e.g. Marker)
Section 1: Learn Like a Machine	20 minutes	*Whole Group*	**Facilitators** • What is Machine Learning? 8-12 - Activity Slide Deck (*Appendix C*)

Section Title	Time	Group Size	Materials
			• AI 101: What is Machine Learning? (Accenture, 1:00s) • Supervised vs Unsupervised vs ... (dataroots, 1:08s)
Section 2: Brainy Networks	20 minutes	*Whole Group*	**Facilitators** • What is Machine Learning? 8-12 - Activity Slide Deck (*Appendix C*) **Per Individual** • Index Cards • Writing Utensil
Section 3: The Learning Machine	30 minutes	*Pairs or Small Groups (3-4)*	**Facilitators** • What is Machine Learning? 8-12 - Activity Slide Deck (*Appendix C*) **Per Pair or Small Group** • Computer Device or Tablet with Internet Access
Reflection & Debrief	10 minutes	*Whole Group*	**Facilitators** • What is Machine Learning? 8-12 - Activity Slide Deck (*Appendix C*)

Safety Considerations

Safety considerations have been provided below to support safety during this activity, however they are not necessarily comprehensive. It is important that you review the activity and your delivery environment to determine any additional safety considerations that you should be implementing for the delivery of these activities.

Emotional Safety

- Facilitators should understand that participants have different lived experiences and prior knowledge about AI safety, AI, and digital citizenship. This activity may involve or lead to discussions of sensitive topics, such as ethical implications of AI. Facilitators should encourage open, respectful discussions and acknowledge all perspectives. Facilitators should always keep the participants' emotional safety in mind in these discussions, and defer to training from their institution and training received.

Electronic and Technology Use

- Participants are to be advised about safe practices for handling electronic devices such as laptops/computers. This includes guidelines for avoiding liquids, using devices in safe locations to prevent accidental falls and damage.
- Facilitators should check cords and electronic components for damage before distributing them to participants.

Online Safety

Some components of this activity require the use of devices connected to the internet.

- Facilitators should review the provided videos and read/explore provided websites and materials to determine if they are suitable for your participants.
- Where applicable, facilitators should remind participants to stay on task and only use the links provided within this activity.
- Facilitators should also model and encourage appropriate online behaviour by all participants in the group (e.g., using chat boxes to answer and ask questions, using positive and encouraging language, using devices for the purpose of the task).
- Discuss the use of any online application with your team and/or supervisor and follow any organizational guidelines and policies related to technology use. Ensure participants' privacy and consent are respected.

Curriculum Links

This activity aligns with these components found in the UNESCO AI Competency Framework for Students:

AI Techniques and Applications: AI Foundations

- Learners are expected to develop basic knowledge, understanding and skills on AI, particularly with respect to data and algorithms, and understand the importance of the interdisciplinary foundational knowledge required for gradually deepening understanding of data and algorithms. They should also be able to connect conceptual knowledge on AI with their activities in society and daily life, concretizing a human-centred mindset and ethical principles through an understanding of how AI works and how AI interacts with humans (p. 32-34).

AI Techniques and Applications: Application Skills

- Learners are expected to be able to construct an age-appropriate knowledge structure on data, AI algorithms and programming, and acquire transferable application skills. (p. 41).

AI Techniques and Applications: Creating AI Tools

- Learners are expected to deepen and apply knowledge and skills on data and algorithms to customize existing AI toolkits to create task-based AI tools. Learners are expected to integrate their human-centred mindset and ethical considerations into the assessment of the existing AI resources and the test of self created AI tools. They are also expected to foster social and emotional skills needed to engage in creation with AI including adaptivity, complex communication and teamwork skills.(p. 49).

Human-Centered Mindset: Human Agency

- Learners are expected to be able to recognize that AI is human-led and that the decisions of the AI creators influence how AI systems impact human rights, human-AI interaction, and their own lives and societies (p. 29-30).

AI Systems Design: Problem Scoping

- Learners are expected to be able to understand the importance of 'AI problem scoping' as the starting point for AI innovation. They are also expected to acquire the knowledge and project-planning skills needed in order to conceptualize and construct an AI system (p. 35).

This activity can be connected to the following subject areas:

Science

- Understanding the role of science and technology in society and daily life.
- Apply the principles of the design process to diagnose problems and hypothesize solutions when a model fails.
- Demonstrate an understanding of how neurons in the human brain transmit and process information.
- Explore how natural systems inspire technological systems.

Mathematics

- Collect, organize, and interpret data to identify patterns and make informed decisions.
- Apply mathematical modeling and representations to explain and investigate complex systems.
- Apply logical reasoning, pattern recognition, and problem-solving strategies to analyze information and draw conclusions.
- Explore and interpret probabilities and predictions to understand uncertainty and variability in outcomes.

Community Connections

Community connections are suggestions from Actua, grounded in our approach, on how facilitators can adapt the activity to reflect the strengths, interests, and priorities of the community where or with whom it is delivered. Consider the following guiding questions to adapt the activity in meaningful ways:

- **Consult with community:** Are there local organizations, Knowledge Keepers, or community members who could contribute insight or context to this topic?
- **Draw on youth experience:** How can you give participants opportunities to share, reflect on, and apply how this learning is relevant to them or their community? Invite participants to identify what knowledge, who, and where they already learn from.
- **Integrate local examples:** How can you tailor this activity to local or regional interests, industries, or community priorities (e.g. land and environment, health, technologies)?

Activity Procedure

To Do in Advance

SECTION	PREPARATION

General	• **Think ahead and be ready to adapt:**
	  ◦ Determine your **delivery method** and leverage ideas from the delivery recommendations and adaptations sections.
	  ◦ While **estimated times** are provided, it will be helpful to think about how much time you would like to spend on different activities and discussions.
	  ◦ While **group sizes** (individual, pairs, groups) are suggested, many activities are flexible for whatever will work in your classroom.
	• **Prepare for the content:**
	  ◦ Have **answers in mind** to share with participants for the various reflection questions asked.
	  ◦ Examine the provided materials to determine if they are **suitable** for your participants.
	• **Equipment:**
	  ◦ Ensure device, screen and projector are set up.

Opening Hook	• Think of 3-4 simple images or objects to draw on the board. Some examples include a cat, a bicycle, a tree, or a fish.
Section 1: Learning Like A Machine	• Look up or gather examples from your local community of how machine learning is being used in different areas to help people, to use in discussion.
Section 2: Brainy Networks	• Ensure there are enough index cards and markers or pens for every participant.

SECTION	PREPARATION
	• Decide how to present the images: you can show them on a screen or print them out from the What is Machine Learning? 8-12 - Activity Slide Deck (*Appendix C*). • Plan the room layout to allow easy movement and passing of cards, ensure accessibility for all participants, and make it easy for the Hidden and Output groups to turn away from the screen while the Input group views the image.

Section 3: The Learning Machine	• Explore and understand the interface of Google Teachable Machine, and familiarize yourself on how to prepare, train, and test a machine learning mode.
	• Refer to the following videos for additional support:
	  ○ Teachable Machine Tutorial 1: Gather (Experiments with Google, 2:15s)
	  ○ Teachable Machine Tutorial 2: Train (Experiments with Google, 0:55s)
	  ○ Teachable Machine Tutorial 3: Export (Experiment with Google, 0:59s)
	• Have sample web-based images or drawings ready in case participants need inspiration.

Opening Hook

1. Tell participants that you will be drawing an image on the board, and they are encouraged to call out their guesses as you draw.
2. Slowly draw at least 3 to 4 images. You can choose any simple object or animal that you feel comfortable drawing and that will be easy for participants to recognize.
3. As you draw, encourage participants to make quick predictions and think about the clues that help them figure out each image.

4. After completing the drawings, invite participants to a discussion
    a. Ask participants: “Which drawings were easiest to recognize, and which were more difficult?”
    b. Ask participants: “What helped you figure out the correct answers?”
        i. Our brains build a mental collection of images from life, and drawings can be recognized by matching their patterns and shapes to what is already known.
5. Display the What is Machine Learning? 2-7 - Activity Slide Deck (*Appendix C*), explain that computers and machines do not have memories like humans, but they can learn from examples called **data**.
    a. Each example, such as one drawing or one image, is called a **data point**. When many data points are collected together, they form a **dataset**. Just like how our brain uses past experiences to recognize new drawings, computers and machines use a dataset to learn patterns and make predictions.
    b. Highlight that machines can learn from many types of data, including images, measurements, text, video, and audio. Provide examples for each type and explain how a computer or machine can use that data to recognize patterns, make predictions, or perform tasks.
6. Invite participants to share other examples of data they encounter in their daily lives.
    a. Possible Responses: Photos or videos on social media; GPS or location data from phones or apps; voice recordings; sensor readings from smart home devices; heart rate or step counts from fitness trackers; music or movie preferences from streaming services.

Section 1: Learn Like a Machine

1. Using the What is Machine Learning? 8-12 - Activity Slide Deck (*Appendix C*), gather participants and ask: “Take a glance at these everyday programs. What do they all have in common?”
    a. They all use **artificial intelligence (AI)**. AI works because of algorithms, a list of instructions created by people, that help machines and

computer programs learn from data, solve problems, and make decisions. These algorithms teach computers to use the data they have, like pictures, sounds, or repeated experiences, to recognize patterns, make predictions, and improve over time.

   b. AI follows instructions from the data, but they don't understand or think like humans. This means that even though AI can make predictions or suggest decisions, it doesn't have feelings, opinions, or awareness like we do, it's just using the information and rules it's been given.

2. Ask participants: "How can we help machines learn and get better at a task over time?"
   a. Possible Responses: Providing it with more data or examples; updating its algorithm, collecting feedback and adjusting it; training it with different scenarios; comparing its answers to the right ones.
3. Introduce the concept of **machine learning (ML)** - a type of AI where a machine or computer program learns from data and improves and adapts its performance on a task over time, without needing someone to program every step.
   a. The process starts with a dataset, the information or examples the machine is given. An AI algorithm, created by people, searches for patterns in that data. Once it recognizes enough patterns, the machine can make predictions, and as we continue to feed it more data, it gets better and more accurate over time.
   b. Present the AI 101: What is Machine Learning? (Accenture, 1:00s) video to summarize what machine learning is.
4. Explain to participants that, just as people learn in different ways, AI systems can also learn in different ways. Then introduce the three main types of machine learning.
   a. **Supervised Learning:** The AI system is given many labeled examples and learns to identify the patterns linked to each label.
      i. In supervised learning, the model is trained using input data paired with correct labels, such as images labeled 'dog' or 'cat'. The model analyzes these examples to learn patterns and

features that define each category (e.g. images labelled as ‘cat’ have whiskers). Once trained, it can make predictions on new, unlabeled data, providing the most likely label.

   ii. This type of learning is used by machines in image recognition apps or in filtering spam emails.

b. **Unsupervised Learning:** The AI system analyzes the data and identifies patterns, grouping or organizing it on its own without any pre-assigned labels or categories.

   i. Unsupervised learning is like a student exploring a new library without a catalog. The model is given a set of input data, such as different vegetables, but unlike supervised learning, it isn’t told what each item is. It analyzes the data and searches for patterns, grouping items based on similarities like color, shape, or size (e.g. all long vegetables are in one group). The output is a set of clusters created by the model, which aren’t ‘correct’ labels but reflect patterns it discovered.

   ii. This type of learning is used in recommendation systems, for example, grouping music based on what users listen to.

c. **Reinforcement Learning:** The AI system is given a goal and learns by trying different actions, receiving rewards for success and penalties for mistakes. Over time, it improves at reaching the goal.

   i. The machine interacts with an environment and chooses actions, receiving positive feedback for good decisions and negative feedback for bad ones. Through trial and error, it learns which actions lead to the most rewards and adjusts its behavior over time. It figures out the best strategy to achieve its goal by maximizing rewards.

   ii. This type of learning is used to train robots to perform specific tasks or navigate their environment independently.

5. Present the Supervised vs Unsupervised vs Reinforcement learning (dataroots, 1:08s) video to summarize the key methods for training machines.

6. Explain that we will play a game to apply what we've learned about different types of machine learning.
    a. Using the What is Machine Learning? 8-12 - Activity Slide Deck (*Appendix C*), we'll explore different AI applications and guess how each machine was trained, whether it's supervised, unsupervised, or reinforcement learning.
    b. After each example, reveal the next slide to show the correct learning type and explain the reasoning behind it.

Section 2: Brainy Networks

1. Explain to participants that we will explore what happens inside an AI system when it tries to learn, by acting it out together in a game.
    a. In this game, we will observe if one person can guess the caption of an image using only a few hints shared by the group.
    b. For example, the caption might be something silly like: A fish riding a bike down a hill. The person guessing won't be able to view the picture and will only get hints passed through the group.
2. Arrange participants into three groups and explain their roles as follows:
    a. **Input** (*approximately two-thirds of the group*): Each member gets four blank index cards and something to write with. They will view the image, write one hint word on each card, and pass each card to a participant in the Hidden group.
    b. **Hidden** (*approximately one-thirds of the group*): Each member gets two blank index cards and something to write with. They will receive the hint words from the Input group, choose the ones they find useful, and write two new hint words.
    c. **Output** (one participant): This member gets one blank index card and tries to guess the secret caption based on the hint words received from the Hidden group.

3. **Round 1 - The Full Image**
    a. Begin by asking the Hidden and Output groups to turn away from the screen so only the Input Group can view the image. Remind everyone to stay quiet while the game is in progress.
    b. Show the image to the Input group (for example, a Chihuahua playing basketball with 4 black cats).
        i. Ask each participant in the Input group to write four descriptive words about the image, one word per card.
        ii. Have the Input group randomly pass their cards, one at a time, to any member in the Hidden group.
    c. Each Hidden Group member reviews the words they received and searches for patterns or connections. Using this information, they write two new hint words on blank cards that they think will best help the Output group member guess the full caption. Afterwards, they pass these new cards to the Output group member.
    d. The Output group member collects all the cards from the Hidden group and tries to guess the secret caption based on the hints they received.
    e. Reveal the original image and compare it to the guess made by the member of the Output group.
    f. Gather all participants for a debrief. Discuss which hints were most helpful, what information was lost or unclear, and how the hints could be improved for the next round.
4. Explain to participants that we will repeat the game, but this time each Input group member will only view a small part of the image instead of the whole picture. Provide blank index cards to each participant.
5. **Round 2 - Sectioned Images**
    a. Show each Input Group member only their assigned section of the image. For example:
        i. Section 1: Left side of the red curtain and part of the stage
        ii. Section 2: The squirrel juggling 4 balls under a spotlight
        iii. Section 3: The cat playing the piano under a spotlight

iv. Section 4: Right side of the red curtain and part of the stage

b. Each member of the Input writes four descriptive hint words on index cards based only on what they can view in their slice. Emphasize that they should focus on details in their section, because no one can view the whole image.

c. Have the Input group randomly pass their cards, one at a time, to any member in the Hidden group.

d. Each Hidden Group member reviews the words they received and searches for patterns or connections. Using this information, they write two new hint words on blank cards that they think will best help the Output group member guess the full caption. Afterwards, they pass these new cards to the Output group member.

e. The Output group member collects all the cards from the Hidden group and tries to guess the full caption based on the hints. Remind them that the hints come from different sections of the image, so they'll need to combine the information to make the best guess.

f. Reveal the original image and compare it to the guess made by the member of the Output group.

g. Gather all participants to reflect on the hints. Discuss which details were most helpful, which were unclear or missing, and how the hints affected the Output group's prediction.

6. Explain to participants that what they just did is similar to how an AI algorithm works. Specifically, it models a **neural network**, a type of machine learning algorithm inspired by how the human brain processes information.

   a. It's made of layers of connected nodes, and each layer has a job in helping the system make decisions.

   b. Neural networks are used in many everyday applications, like facial recognition, language translation, and self-driving cars, where the system needs to combine many small pieces of information to make accurate decisions.

7. Explain that the groups in the simulation represent the layers of a neural network.
    a. In the simulation, each person acted like a node in a neural network, passing and transforming information through layers.
    b. Just like in the game, the Input group only saw part of the image, which mimics how input nodes in a real neural network each process just a small piece of the data.
    c. The hidden layer then worked to spot patterns or connections from those pieces, similar to how real hidden nodes might detect shapes, edges, colours in images, or word patterns in text.
    d. Finally, the Output group made a prediction, just like the output layer does in an actual model. Neural networks work best when different nodes focus on different aspects of the data. If too many focus on the same thing, important details can be missed.

Section 3: The Learning Machine

1. Explain to participants that they will train an AI model to recognize different images or objects by showing it examples (i.e. Supervised Learning).
2. To program our AI model, we will use Google Teachable Machine (teachablemachine.withgoogle.com), a free, browser-based tool, to create and train our model.
3. Inform participants that they will train an AI model to recognize two emotions: Happy or Sad. They will provide examples using drawings or web-sourced pictures representing these emotions and then test how well the model can identify them.
4. Distribute devices to each pair or small group of participants. Ask participants to open Google Teachable Machine and begin setting up their model by selecting 'Image Project' followed by 'Standard Image Model'.
5. The first step is for participants to gather **training data** - a set of examples that the model uses to learn patterns and make predictions.

a. Participants should start by renaming each class to the two emotions: Happy and Sad. Explain that each class represents a different category that the model will learn to recognize.
b. Ask participants: “What visual features help you recognize happy or sad emotion?”
    i. Happy - Smiling or showing teeth, Eyes slightly squinted, Laughing or giggling, Thumbs up.
    ii. Sad - Frowning or downturned mouth, watery eyes, Eyes looking down or away, Thumbs down.
c. Demonstrate how participants can gather data for each class in their model.
    i. **Uploading Files:** Participants can also upload images they’ve created or found online that represent the emotion. This could include drawings, clip art, or web-based pictures. Encourage them to choose clear, distinct images that match the category to help the model learn effectively.
    ii. ***Note:*** If participants are gathering web-based pictures, remind them to find appropriate images that are program-appropriate and to avoid uploading photos of real people or personal information.

6. Once participants have collected the training data, guide them to train their model. Explain that training is the process where the model learns to recognize patterns from the examples provided. The time it takes for the model to train depends on the number of examples and how similar or different the classes are.
    a. ***Note:*** Remind participants **not** to close the tab during training. This will interrupt the training process and they will have to click “Train Model” again.
7. Once the model has been trained, encourage participants to test it. They can upload new images or drawings to test how accurately the model recognizes each emotion.

    a. Encourage participants to observe the two output bars, which show the model's predictions for each class. Ask them to note how confident, consistent, or accurate the model is, and to identify any test images that produce incorrect or unexpected results.
    b. Gather all participants for a debrief discussion. Ask them to share observations about which images or situations caused the model to make mistakes and why that might have happened.
8. Encourage participants to improve their model by retraining it. They can do this by uploading additional training data (for example, using images that were misclassified during testing) or by removing any training data that may have negatively impacted the model's performance. Highlight that iterating and refining the dataset is a normal part of training AI models.

Reflection & Debrief

1. Gather participants for a group discussion to reflect on what they learned.
    a. Ask participants: "How might machine learning shape the way we live and work, and what surprises could come from its use?"
    b. Ask participants: "Why does the quality and type of data we give a machine matter, and what could happen if the data is missing, limited, or unbalanced?"
2. Discuss the different careers listed in *Appendix A: Career & Mentor Connections*.

Delivery Adaptations

How might you adapt the time, space, materials, group sizes, or instructions to make this activity more approachable or more challenging? **Modifications** are ways to make the activity more accessible, **extensions** are ways to make the activity last longer or more challenging.

Modifications

GENERAL

- Each part of this activity can be delivered as a short, 10–30 minute session, spread out over multiple days / class sessions.

SECTION 1: LEARN LIKE A MACHINE

- Focus on Supervised Learning as it directly relates to the upcoming activities where participants will build a Supervised Learning model.
- If time is limited, either select 2–4 AI examples and guess their training type, or simply review the examples and explain how each was trained instead of playing the game.

SECTION 2: BRAINY NETWORKS

- Ask the Input group members to write only 2-3 words instead of 4.
- Provide a list of possible nouns, adjectives, or verbs to choose from.
- Physical Limitations: Be mindful of your participants and their physical limitations. Ensure all participants can easily access and handle the cards, whether by placing them on tables or using trays. Allow participants to stay seated and have cards passed to them.

SECTION 3: THE LEARNING MACHINE

- Participants could explore other types of models beyond detecting Happy or Sad emotions:
    - Expand the model to detect other emotions including surprise, fear, anger, and/or disgust.

    - Train a model to recognize hand gestures like Rock, Paper, or Scissors
    - Identify everyday objects such as a pen, notebook, or water bottle
- Curate a set of training and testing data and provide the same dataset to each group
- Prepare a machine learning model in advance and test it together as a group.

Extensions

OPENING HOOK

- Play Google Quick, Draw! (quickdraw.withgoogle.com) with participants - an online game where you draw an object or idea, and AI tries to guess what your drawing is. This demonstrates how AI uses a dataset of previous drawings to learn patterns and make predictions.

SECTION 2: BRAINY NETWORKS

- Prepare additional images and captions so the activity can be repeated for multiple rounds. Each new round can introduce more complex images, more objects, or more actions, giving participants a chance to practice and refine their strategies.
- Rotate participants through different roles in each round so they can experience being in the Input, Hidden, and Output groups.
- Introduce an additional Hidden group between the original Hidden and Output groups to mimic deeper layers in a neural network, requiring hints to pass through more layers before reaching the Output group
- Encourage participants to focus on different types of words in the next round, such as nouns, action verbs, adjectives, or numbers. This gives the network more useful information, just like real neural networks use different nodes to detect different patterns.
    - Facilitators can suggest assigning roles within the Input and Hidden groups. For example, some participants focus on verbs, some on nouns, and some on adjectives.

SECTION 3: THE LEARNING MACHINE

- Invite other participants to test each group's model. Encourage discussion about the training data, including how it was collected, its variety, and how it may have affected the model's predictions.
- Encourage participants to expand their model by adding more classes to represent additional emotions, such as Surprised, Angry, or Neutral.
- Ask participants to reflect on the needs of their community and identify areas where machine learning could bring improvements. Guide them to design and prepare a machine learning model that addresses one of these opportunities. Some examples include:
    - **Recycling sorting**: Train a model to identify recyclable versus non-recyclable items, or to distinguish between different materials such as plastic, glass, and paper.
    - **Wildlife Monitoring:** Train a model to identify animals or plants from images to support conservation, research, or local environmental projects
    - **Accessibility tools**: Train a model to recognize hand gestures or facial expressions to support communication

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Appendices

Appendix A: Career & Mentor Connections

AI/MACHINE LEARNING ENGINEER

- Builds and trains artificial intelligence systems that can learn from data to make predictions or perform complex actions. They support the machine learning researcher.

COMPUTER PROGRAMMER

- Computer programmers write, modify, and test code and scripts in a variety of programming languages that allow computer software and applications to function properly.

MACHINE LEARNING RESEARCHER / DATA SCIENTIST

- Machine learning researchers or data scientists clean and interpret data while building models using a combination of that data and machine learning algorithms.

Appendix B: Background Information

DATA AND DATASETS

Data comes in many forms, including numbers, images, words, and other types of information. They provide insights about individuals, groups, and the world around us. It is a key resource for understanding patterns, making decisions, and predicting outcomes. Specifically, data can be used to:

- Identify correlations and trends that might not be obvious at first glance.
- Develop a deeper understanding of complex systems and behaviors.
- Inform decisions in real time or future planning.
- Make decisions based on past patterns or observed information.

Datasets are also essentials for creating algorithms, which are sets of instructions or rules that a computer follows to solve problems or make decisions. By analyzing and learning from data, algorithms can help humans understand and act on information more effectively.

Some applications of how data drives algorithms include:

- **Traffic and navigation apps:** Analyzing road and traffic patterns to suggest the fastest routes.
- **Outer space and weather systems**: Studying patterns to predict astronomical events or weather changes.
- **Shopping and media recommendations**: Using purchase and viewing history to suggest products or content that people may like.
- **Healthcare and diagnostics**: Analyzing medical data to identify health risks, suggest treatments, or support research.

ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) is a branch of Computer Science that deals with a machine's ability to simulate intelligent behaviour. This includes cognitive functions we associate with human minds, such as perceiving, reasoning, learning, and adapting.

AI is becoming increasingly vital in our lives. From digital assistants, GPS navigation, and autonomous vehicles to tools like Siri/Google Home and generative AI tools (e.g., OpenAI's Chat GPT), its impact on our daily lives is growing. AI plays a crucial role in various aspects of work, enhancing efficiency, and taking on hazardous or monotonous tasks. As AI applications grow, discussions on AI ethics and responsible practices are increasingly important.

MACHINE LEARNING

Machine learning (ML) is a type of artificial intelligence where computers learn from data, improve at tasks over time, and adapt without being programmed step by step. Instead of giving the computer every possible instruction, we give it ways to learn from experience, similar to how people practice and improve.

For example, you might teach a computer to play checkers. Rather than listing every possible move, you could program it to learn from playing many games. Eventually, it could get so good that it plays better than the person who wrote the program

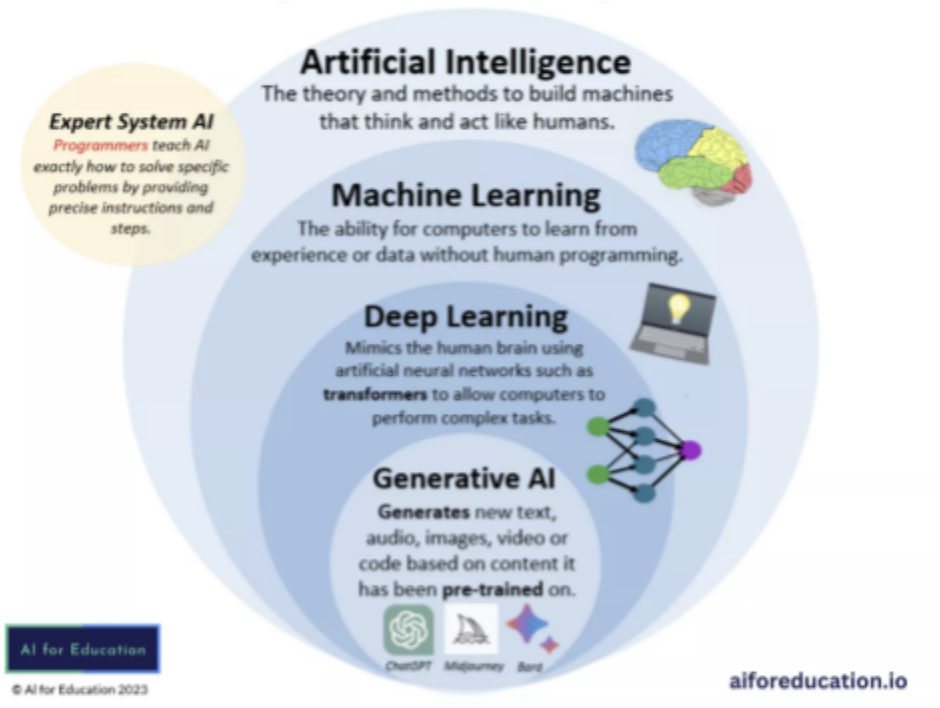
The learning process usually includes a few steps:

1. **Give it Data:** First, the computer is given a lot of data to process. This could be pictures, numbers, text, or sounds.
2. **Find the Patterns:** The computer then analyzes all this data and starts to find patterns, building its own “rules” based on experience.
3. **Make Predictions or Actions:** Using these patterns, the computer can make decisions or predictions when it encounters new data.
4. **Get Better and Better:** As the computer gets more data, it can adjust its patterns to become more accurate. The more data and computing power it has, the better its predictions become

Machine learning is used across different fields and in our everyday lives. In your daily life, ML works quietly behind the scenes in many of the tools and apps you use. It powers autocorrect and predictive text on your phone, suggests videos to watch on streaming platforms, and runs the filters on social media apps that recognize and

track your face. It also helps your phone unlock through facial recognition by learning your unique features, and it keeps your email inbox clean by filtering out junk mail.

In addition, ML is making an impact in the wider world. In healthcare, it helps doctors diagnose illnesses more accurately, such as spotting broken bones in X-rays. It is also the "brain" behind self-driving cars, enabling them to observe and respond to the world around them. In industries like agriculture and manufacturing, ML supports smarter ways to grow food and produce goods more efficiently.



AI for Education. (2023). *Generative AI Explainer*.
aiforeducation.io/ai-resources/generative-ai-explainer

Artificial Intelligence VS Machine Learning VS Deep Learning

You might come across the terms "artificial intelligence" and "machine learning" used together, but they aren't exactly the same thing. AI is the broad idea of creating machines that can act or think in ways similar to humans. This can range from simple tools like a smart thermostat that adjusts the temperature based on rules, to more advanced systems like voice assistants or even robots. AI systems can learn over time, sense their environment, and make decisions on their own. Within AI, there are different types:

- **Classification AI**: Systems that identifies and sorts things (e.g. Tiktok or Snapchat face filters).
- **Predictive AI:** Systems that use data to make decisions about the future (e.g. Spotify and Apple Music recommendations).
- **Generative AI:** Systems which create new things, such as text, images, or music (e.g. CoPilot and ChatGPT).

Machine Learning is a specific approach within AI. It's a specific way of achieving AI by having computers learn from data instead of being programmed with a long list of rules. So, all machine learning is AI, but not all AI uses machine learning.

Deep Learning (DL) is a more advanced type of ML that uses structures called neural networks, designed to work a bit like the human brain. Deep learning is what enables high-performance AI systems, including many generative AI tools that can create new and transformative outputs.

Types of Machine Learning

Machine learning methods are usually grouped into three main types, depending on the goal and the kind of data they use.

- **Supervised learning** happens when the computer is trained with examples that already have the right answers (called labels). The computer learns the link and patterns between the input and output so it can predict answers for new data. This is used in things like email filters that sort *spam vs. not spam*, or in predicting numbers, like house prices.
- **Unsupervised learning** is when the computer is given data without any labels and has to find patterns on its own. It might group similar things together (clustering), or uncover hidden connections in the data. This is used for things like grouping customers into types or making product recommendations.
- **Reinforcement learning** is like learning by trial and error. A computer "agent" makes decisions in an environment, gets rewards or penalties for its actions, and learns strategies to do better over time. This approach is often used in robotics and training AI to play video games.

NEURAL NETWORKS

Neural networks are a method in AI that are inspired by how the human brain works. Just like our brains have neurons that pass signals to each other, neural networks are built from connected “artificial neurons” (or nodes) that pass information through layers to solve problems.

They are a type of machine learning process called deep learning, which is especially powerful for handling very complex data. DL is behind many of today’s most advanced AI systems, from face recognition to chatbots.

A basic neural network has three main parts:

- **Input Layer**: This is where information first enters the network. The input could be anything from the pixels of an image, to the words in a sentence, to numbers in a dataset. Each input is broken down into pieces the computer can work with, and then passed forward into the next layer.
- **Hidden Layers**: These are the “thinking” layers of the network, where most of the learning happens. Each hidden layer is made up of many nodes (artificial neurons) that combine the information from the previous layer, apply weights to the connections, and transform the data. With more hidden layers, the network can detect more complex patterns. For example, in an image, earlier layers might recognize edges and shapes, while deeper layers recognize eyes, faces, or entire objects. This step-by-step building of patterns is what makes a deep neural network powerful.
- **Output Layer**: This layer produces the final result after all the processing. Depending on the task, the output might be a single answer (yes/no, spam/not spam), a category (dog, cat, or horse), or even a generated response (like a sentence of text).

Because neural networks can capture extremely detailed patterns in data, they’ve become the state-of-the-art approach in AI. Some key applications include:

- **Computer Vision:** Recognizing objects, faces, and scenes in images and videos (e.g., self-driving cars, facial recognition).

- **Speech Recognition:** Converting spoken language into text or commands (e.g., voice assistants , transcription tools).
- **Natural Language Processing (NLP):** Understanding and generating human language (e.g., chatbots, translation, document summarization, analyzing social media sentiment).
- **Recommendation Engines:** Learning user preferences and suggesting new movies, music, or products.

ETHICS AND AI

Artificial intelligence offers powerful tools and new possibilities. As these systems learn from data, make decisions, and shape our world, it is important to consider their ethical impacts.

Actua has developed a resource (*Appendix C*) to support facilitators in leading discussions with youth about ethics and responsible AI use. Facilitators are encouraged to engage youth in meaningful conversations that empower them to think critically about how AI is designed, used, and experienced in the world around them. This resource emphasizes human agency and responsibility, supports values-based reflection, and creates space for curiosity, dialogue, and informed decision-making as digital citizens.

Appendix C: Additional Resources

GENERAL

Activity Slide Deck

- What is Machine Learning? 8-12 - Activity Slide Deck
    - ***Note:*** This link will automatically download to your device.

Supporting Resource

- AI in Context: Responsibility and Ethics in Artificial Intelligence

SECTION 1: LEARN LIKE A MACHINE

Video(s):

- AI 101: What is Machine Learning? (Accenture, 1:00s)
- Supervised vs Unsupervised vs Reinforcement learning (dataroots, 1:08s)

SECTION 3: THE LEARNING MACHINE

Supporting Resources:

- Teachable Machines with Google - FAQs
- Teachable Machine 2.0: Making AI easier for everyone (Google, 2:08s)
- Teachable Machine Tutorial 1: Gather (Experiments with Google, 2:15s)
- Teachable Machine Tutorial 2: Train (Experiments with Google, 0:55s)
- Teachable Machine Tutorial 3: Export (Experiment with Google, 0:59s)