I Know My Cats!

Gr. 9-10 Activity Write Up

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I Know My Cats!

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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: Twitter, Facebook, Instagram and YouTube!

I Know My Cats!

Activity Summary

In this activity, participants will be introduced to machine learning (ML) and deep machine learning (DML) by developing a simple human powered machine learning network to detect cats based on a set of features. Participants will explore fundamental artificial intelligence (AI) concepts such as nodes and neural networks, and understand how machines can recognize and categorize objects.

Developed by Actua, 2025

Delivery Environment	Activity Duration	Intended Audience	Tech
In-Person	1 Hour and 30 minutes	Grades 9-10 (*Ages 13-16*)	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** how machine learning works and how more layers in a network help computers get better at spotting features.
- **Build** a neural network that can find and identify features in pictures.
- **Recognize** the role of machine learning in analyzing large datasets.

Success Criteria

Following this activity, participants can express:

- **I can describe** how a neural network uses nodes and layers to recognize features in images.
- **I can train and test** a neural network that identifies specific cat features.
- **I can** understand a network's results, compare them to human decisions, and explain how machine learning processes large data sets.

Logistics (Timing, Group Sizing, Materials)

Section Title	Time	Group Size	Materials
Opening Hook	10 minutes	*Whole Group*	**Facilitators** • I Know My Cats - Activity Slide Deck (*Appendix C*) • Whiteboard or Chart Paper • Marker
Section 1: What is a Cat?	30 minutes	*Pairs or Small Groups (3)*	**Per Small Group or Pair** • Tablet or Computer Device with Internet Access • Paper • Writing Utensil

Section Title	Time	Group Size	Materials
Section 2: I Know My Cats!	20 minutes	*Whole Group, Pairs or Small Groups (3)*	**Facilitators** • I Know My Cats - Activity Slide Deck (*Appendix C*) • Whiteboard or Chart Paper • Marker **Per Small Group or Pair** • Completed Node(s) (*Section 1*) • Paper • Writing Utensil
Section 3: Deep into Cats!	20 minutes	*Whole Group, Pairs or Small Groups (3)*	**Facilitators** • I Know My Cats - Activity Slide Deck (*Appendix C*) • Whiteboard or Chart Paper • Marker **Per Small Group or Pair** • Completed Node(s) (*Section 1*) • Paper • Writing Utensil
Reflection & Debrief	10 minutes	*Whole Group*	• N/A

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.

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).

Curriculum Links

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

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 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).

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.

SECTION	PREPARATION
	○ Examine the provided materials to determine if they are **suitable** for your participants. • **Equipment:** ○ Ensure device, screen and projector are set up. ○ Prepare participant devices for use in the activity.

Opening Hook

1. Using the I Know My Cats - Activity Slide Deck (*Appendix C*), share an image of a cat (Slide 2-3). Ask participants to identify what is in the image.
    a. Ask participants: "How do you know it is a **cat**?"
2. Build on the discussion by highlighting that the image of the cat is made up of many different features.
    a. Ask participants: "What **aspects of the image** show that it is a cat?"
    b. Ask participants: "How do YOU know **it is a cat**? Why do you know what a cat is? Have you encountered one before?
    c. Ask participants: "Did your **knowledge of cats** help you recognize this image as a cat? Would you be able to identify it as a cat if you had **never encountered** a cat before??
3. As a group, invite participants to name specific features that help define a cat. Record these down on a whiteboard or chart paper, as they will be used in the next part of the activity.
    a. Common examples might include:
        i. Ears
        ii. Eyes
        iii. Nose
        iv. Tail
        v. Fur
        vi. Whiskers
        vii. Activities
        viii. Environment
    b. ***Note:*** Features should not be limited to this list, allow the participants to make a complete list

Section 1: What is a Cat?

1. Explain that data scientists often work on problems where computers need to learn how to identify and categorize different types of objects (e.g. cat or non-cat).
    a. Highlight that when a computer learns to find patterns in data and make decisions based on those patterns, it's called **machine learning**.
    b. A common way to train a computer is by using labeled images - for instance, marking some as “cat” and others as “not-cat”. This process is known as **supervised learning**, since the computer learns from examples that include the correct labels.
    c. Once the computer is trained and a model is set up, it can start to **categorize new, unseen data using what it learned from the training examples**.
2. Let participants know they’ll be creating a simple, human-powered machine learning network. This network will be a simplified neural network (a network made up of nodes, similar to the human brain).
    a. Group the participants into small groups of 2-3 people.
    b. Taking turns, have each group choose one key feature from the list that helps define a cat (*Section 1*). Continue until each group has at least one feature and most features have been selected.
        i. Ask them to consider which features are most important for identifying a cat. At this stage, each feature should be unique - no duplicates allowed. The network needs at least 6 **nodes** (small parts in a network that help process information) to function properly, but adding more will improve its accuracy.
3. Each feature chosen by a group will become the node(s) they are responsible for in this activity.
    a. Give each group one blank sheet of paper per feature. This paper represents all the information the node ‘knows’ about cats.
    b. Have the group write their feature in the center of the paper and circle it.

c. ***Note:*** Make sure there is enough space around the feature name to add more information as the activity progresses.

4. Participants will now carry out the supervised learning process to train their node to recognize the selected feature. Acting as data scientists, they will gather information about what to recognize in their feature and record it on their node sheet.
    a. Provide each group with a computer device or table. Encourage participants to use the online web to find visual evidence (e.g. images or videos) that supports the details they write down.
        i. ***Note:*** Encourage participants to not rely on memory but to find real examples to back up their notes.
    b. For example, if we are training the 'nose' node:
        i. Document clear details about the features of a cat's nose. Include drawings, describe its shape, size, location on the face, and typical colours. Include anything that stands out or is common.
        ii. Record details about what does *not* match the feature. Set clear boundaries - for example, a cat's nose doesn't have more than two nostrils, isn't larger than the eyes, and typically isn't lime green."
    c. Remind participants that the node has no prior knowledge of cats, so include everything it needs to understand this feature.
    d. Give participants 20–25 minutes to complete the supervised training of their node(s). Remind groups to write clearly and neatly, as other participants will be reading and using this information later

Section 2: I Know My Cats!

1. Inform participants that now that the nodes have been trained, it's time to test how well the neural network works.
    a. Ask each group to exchange their completed node sheets with another group, so everyone has a new node to work with.
    b. Give groups a few minutes to review and get familiar with their new node.

2. Using the I Know My Cats - Activity Slide Deck (*Appendix C*), share a variety of images (Slides 4-15), including cats and non-cats, in different forms to test the neural network.
    a. Ask participants to take on the role of a node. They should use only the information written on the exchanged node sheets to decide whether the feature they're trained to detect is present in each image. Remind them that, as nodes, they have no additional context, only what's on their training sheet.
        i. For example, if the image shows a cat but its nose isn't visible, the 'nose' node should conclude that the image is not a cat because it cannot detect the feature it was trained to recognize.
        ii. Nodes should only respond based on the specific feature information written on the sheet, regardless of what the full image might suggest.
    b. For each image, have each node take a turn announcing whether the image is a cat based on their trained feature. Record each response as either "Cat" or "Not a Cat" on a whiteboard or chart paper. Once all nodes have shared their decision, use the majority vote to determine the final verdict of how the network will categorize the image. .
    c. After an image has been categorized, ask participants whether a human would have identified the image as a cat. Mark a check (✔️) if the network's decision matches the human answer, or a cross (❌) if it does not. This step helps evaluate how well the human-powered machine learning network is performing - its success is measured by how closely it mirrors human decision-making.
3. Debrief with participants about their machine learning experience:
    a. Ask participants: "How well did your neural network **learn** to recognize a cat? Do you think it was **effectively trained**?"
    b. Ask participants: "What changes would you make to **how the nodes were trained**? Would you **remove** any of the nodes or **add** new ones? If so, which ones and why?"

c. Ask participants: “How might the data we use to train our nodes **influence** the results the network produces?”

Section 3: Deep Into Cats!

1. Introduce the concept of **Deep Learning** with participants.
    a. Explain that deep learning refers to adding extra layers of complexity to a neural network. This happens in different ways.
        i. Organizing layers of nodes where nodes will take information from other nodes and use that to help categorize. For example, the network could have the ‘nose’, ‘eyes’, ‘mouth’, and ‘ear’ node feed into a ‘face’ node. This ‘face’ node can then use details like the position of these features in the image to more accurately decide whether a cat’s face is present.
        ii. Weighting nodes allows some nodes to have more influence on the final result than others. For example, if the ‘legs’ node detects two legs, that might carry less importance compared to the ‘eyes,’ ‘ears,’ and ‘nose’ nodes identifying features that strongly resemble a cat.
        iii. Nodes can also be designed to cluster results, meaning they group together images that share similar features. These clusters of images can then be analyzed by a different neural network to identify more specific patterns or details.
        iv. Networks can use undefined nodes - nodes that are not assigned specific features beforehand. Instead of training the network to recognize a cat’s nose explicitly, the network learns on its own which features are important. As it processes training images, the network defines and adjusts these nodes based on the patterns it detects.
2. Ask participants: “How could you build your neural network to **think more deeply**? What **changes** might the group make to how the network operates?”
3. Give participants 10 minutes to refine and improve their neural networks. Encourage each small group to:

    a. Review their own nodes and results from the first round.
    b. Share ideas and strategies with other groups who have different nodes.
    c. Collaborate across groups to combine insights, suggest new features, or rethink how nodes are trained.
    d. Experiment with adding, removing, or weighting nodes based on feedback from others.
    e. Consider how their nodes might connect or feed into higher-level nodes for deeper learning.
    f. Prepare to test the improved network together using images from the slide deck.
4. When they're ready, select a few images from the I Know My Cats – Activity Slide Deck (*Appendix C*) to test their updated networks.Be sure to include at least one image that was correctly identified before, along with several that were previously misclassified. Keep track of the new results by tallying them on the whiteboard or chart paper.
5. Ask participants: "Did the network do **a better job at identifying cats** this time? What **other changes** would you consider making to improve it further"

Reflection & Debrief

1. Ask participants: "How can machine learning and deep learning **help solve problems in real life** besides recognizing pictures?"
    a. Machine learning can help spot health issues, forecast the weather, and power self-driving cars. It also enables apps to recognize your face or voice, suggests songs and videos you might like, blocks spam messages, and makes video games smarter.
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

SECTION 1: WHAT IS A CAT?

- Create a few sample node sheets to use as examples during the activity.
- Have the whole group work and brainstorm together to prepare the node sheets instead of dividing into smaller groups.
- If internet access is limited, prepare by printing several pages of image search results for “cats” ahead of time.

SECTION 3: DEEP INTO CATS!

- Encourage groups to improve their network by asking guiding questions, such as:
    - What if the cat is facing away from the camera?
    - What if the image is a cartoon version of a cat?
    - What if a dog is in the picture instead, could your node tell the difference?
- As a whole group, collaborate and brainstorm together to improve the nodes.

Extensions

SECTION 3: DEEP INTO CATS

- Encourage participants to build a deep learning network with three layers of nodes. Ask them to think about how each layer could build on the previous one, what information could be combined at each layer, and how might a third layer help the network make more accurate decisions.

- Ask participants to reflect on images featuring items that include the word “cat,” such as CAT 5 cables or cat treats. Should these be identified as cats? Why or why not?

REFLECTION AND DEBRIEF

- Extend the discussion with the following guided questions
    - Think about how Google Images shows pictures of cats when you search for “cats.” Do you think Google uses machine learning to organize and categorize those images?
    - In this activity, there has been a lot of human involvement with the training of the nodes.
        - Ask participants: “How is the machine learning process **similar to human learning**? How are human brains set up like a neural network? Are these networks trained in the same way?”

References & Gratitude

Edureaka. (2025). AI vs Machine Learning vs Deep Learning. edureka.co/blog/ai-vs-machine-learning-vs-deep-learning/

Teaching London Computing. (n.d.). Learning about Machine Learning. teachinglondoncomputing.org/machine-learning/

United Nations Educational, Scientific and Cultural Organization. (2024). UNESCO AI framework: Competency levels. unesdoc.unesco.org/ark:/48223/pf0000391105

Appendices

Appendix A: Career & Mentor Connections

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.

MACHINE LEARNING ENGINEER

- Machine learning engineers (ML engineers) focus on researching, building, and designing self-running artificial intelligence (AI) systems to automate predictive models. They support the machine learning researcher.Their job heavily involves generating algorithms that can learn and make predictions, so many ML engineers are proficient in programming languages like Swift, Python, Java, and C/C++.

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.

Appendix B: Background Information

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 the ability for computers to uncover patterns in data without explicit instructions. It usually follows three steps: collecting the data set, learning the algorithm, and classifying new data. Computers are given access to data and begin sorting the data based on patterns it finds. As computers can test out their patterns across more data, it can adjust how it sorts the data for better accuracy.

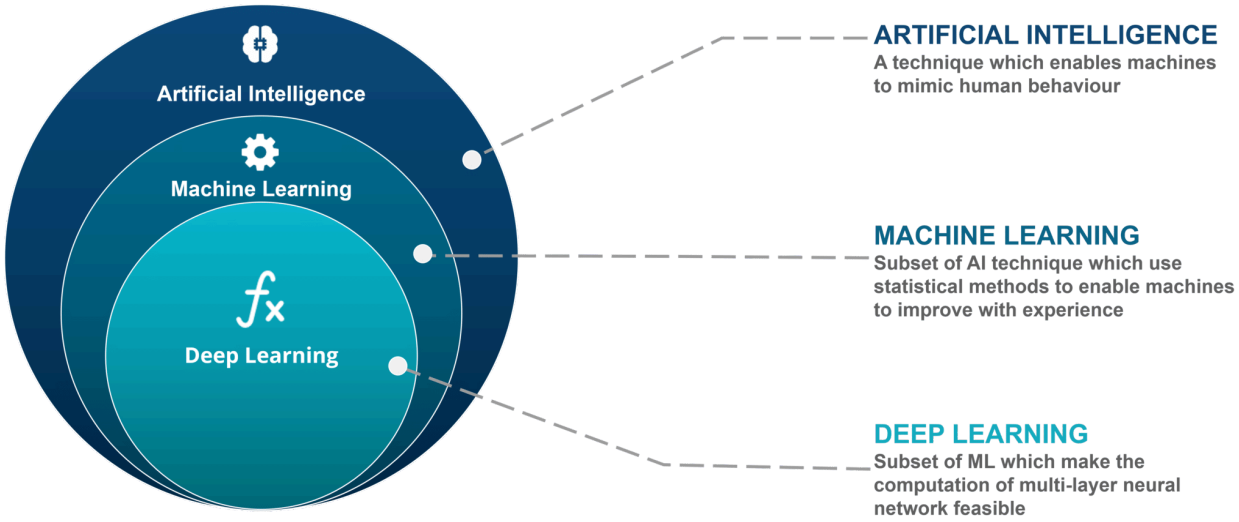
Machine learning is used across different fields and in our everyday lives. Features like autocorrect or predictive text, Snapchat filters, Touch or Face ID, advertisement or video recommendations, all use machine learning to analyze our behaviours and features to provide personalized options.

Exciting avenues that machine learning is being applied to in order to help improve standard of living for humans are autonomous vehicles, agriculture, and health care. In health care, ML is being utilized to help with diagnosing issues, such as specific bone fractures, to help assist doctors in accurate diagnoses.

Artificial Intelligence VS Machine Learning VS Deep Learning

Machine learning (ML) and deep learning fall under the umbrella term of artificial intelligence (AI). AI is the concept of machines being able to carry out tasks in a way that is similar to humans. All AI can learn over time, sense its environment, and make its own decisions. There are three types of AI: **classification AI** (e.g., Siri, Snapchat filters) which identifies and sorts things, **predictive AI** (e.g., social media advertisements) which makes decisions about the future, and **generative AI** (e.g., ChatGPT) which can create new and transformative things.

ML is a subset of artificial intelligence whereby machines are given access to data that they can use to extract patterns and "learn". ML can be utilized for classification and predictive AI. Deep learning is a subset of ML that allows for the training of neural networks to gain better accuracy in performance compared to ML, allowing for the development of generative AI.



Edureka. (2023). AI vs. machine learning vs. deep learning. edureka.co/blog/ai-vs-machine-learning-vs-deep-learning/

Types of Machine Learning

Machine learning can be trained to analyze data through supervised and unsupervised learning. **Supervised learning** is the act of training a computer by providing it with examples of specific labels. In this activity, we use supervised learning by providing labeled images of different cat features, such as noses, eyes, or ears, so the network can learn to recognize these features.

Unsupervised learning is the act of teaching a computer by providing it with examples without specific labels. Instead of telling the computer which images show a cat's nose or eyes, we simply provide a set of images and let the computer group or find patterns on its own. This approach is useful when labels aren't available or when exploring large amounts of data without knowing exactly what to recognize.

Appendix C: Additional Resources

GENERAL

Activity Slide Deck

- I Know My Cats - Activity Slide Deck