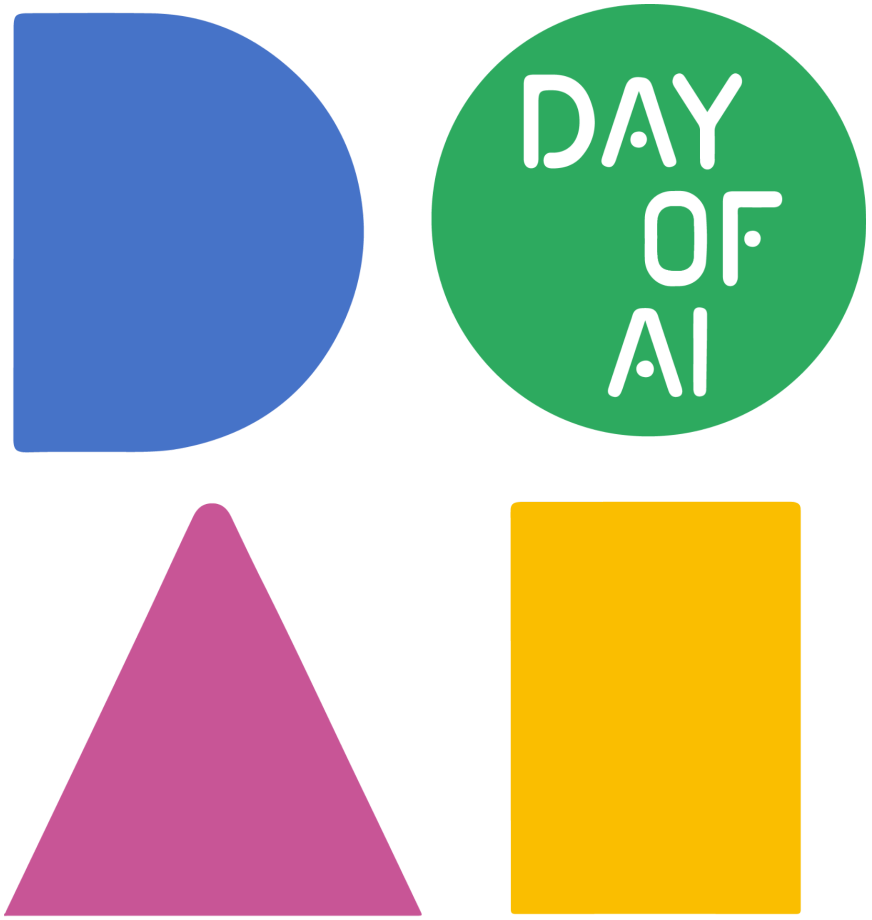

AUSTRALIA

Lesson 2: How do Machines Learn?

LESSON PLAN

Lesson 2: How do Machines Learn? | 45 mins

Lesson Summary

In this lesson, students delve into machine learning, a cornerstone of AI, through interactive activities and discussions. They explore how AI systems learn using curated datasets, experimenting with image recognition and sound classification. By engaging with hands-on exercises using Google's Teachable Machines platform and analysing case studies, students grasp the essence of training, testing, and prediction in AI. Through these activities, they uncover the intricate process of how machines learn from data to make predictions, fostering a deeper understanding of AI principles.

Objectives

- Students will explore **Learning**, the third **Big Idea of AI**
- Students will build on their understanding of data, including images, sound and text
- Students will learn how machines require curated datasets to learn, or gain intelligence
- Students will explore and interact with AI systems through their browsers

Curriculum Alignment

This lesson is linked to the following Australian Curriculum (Version 9) content descriptors:

- **Years 5 and 6**
  - AC9M6P01: recognise that probabilities lie on numerical scales of 0 – 1 or 0% – 100% and use estimation to assign probabilities that events occur in a given context, using common fractions, percentages and decimals.
  - AC9S6H01: examine why advances in science are often the result of collaboration or build on the work of others.
  - AC9TDI6K01: investigate the main internal components of common digital systems and their function.
  - AC9TDI6K03: explain how digital systems represent all data using numbers.
  - AC9TDI6P02: design algorithms involving multiple alternatives (branching) and iteration.
  - AC9TDI6P05: implement algorithms as visual programs involving control structures, variables and input.
  - AC9TDI6P10: explain the creation and permanence of their digital footprint and consider privacy when collecting user data.
- **Years 7 and 8**
  - AC9M7SP04: design and create algorithms involving a sequence of steps and decisions that will sort and classify sets of shapes according to their attributes, and describe how the algorithms work.
  - AC9M8P01: recognise that complementary events have a combined probability of one; use this relationship to calculate probabilities in applied contexts.

    - AC9M8ST02: analyse and report on the distribution of data from primary and secondary sources using random and non-random sampling techniques to select and study samples.
    - AC9TDI8K03: explain how digital systems represent all data using numbers.
    - AC9TDI8P02: analyse and visualise data using a range of software, including spreadsheets and databases, to draw conclusions and make predictions by identifying trends.
    - AC9TDI8P06: trace algorithms to predict output for a given input and to identify errors.
    - AC9TDI8P14: investigate and manage the digital footprint existing systems and student solutions collect and assess if the data is essential to their purpose.
- **Years 9 and 10**
    - AC9S9H04: examine how the values and needs of society influence the focus of scientific research.
    - AC9TDI10P02: analyse and visualise data interactively using a range of software, including spreadsheets and databases, to draw conclusions and make predictions by identifying trends and outliers.
    - AC9TDI10P06: validate algorithms and programs by comparing their output against a range of test cases.

Vocabulary

- **Data,** n. information that is represented digitally on a computer
- **Dataset,** n. a curated, organised collection of related data

Resources

- Presentation Slides for the lesson (available on website once logged in)
- Teachable Machines (Image model)
- A functional webcam for use with Teachable Machines
- Cockatoo and Kookaburra sound bites (embedded in the lesson slides)

Activity Steps

1. **1 min**. Introduce **Learning** as the third **Big Idea of AI.**
2. **2 mins.** Explain to students that we will now explore how AI systems “learn”, and we will begin by investigating how humans learn certain types of knowledge.
3. **2 mins.** Present each of the “fleep” and “bloop” slides, pausing for several seconds to allow students to visually process each of the images.
4. **1 min.** Present the summary slide and pause for several seconds to allow students to mentally group the “fleep”s and “bloop”s in their minds.
5. **2 mins.** Present the test slide and ask students to decide whether they would consider it a “fleep” or a “bloop”. Then ask the class to stand up and move to a corner of the class for those students who think it is a “fleep” and to the opposite corner for those who think it is a “bloop”.
6. **2 mins.** Show the confidence slide and allow any students who wish to change their mind to move to the other group. Ask each group discuss among themselves to:

    Summarise what a “fleep” looks like and what a “bloop” looks like.

 Agree on a confidence number between 1 - 10.

 (1 = not confident, 10 = 100% confident) in their prediction.

 Explain how they reached their confidence score.

 What extra data they might need to improve their confidence.

7. **2 mins.** Ask a representative from each group to report their findings.
8. **1 min.** Show the answer slide. It's a "fleep"! Ensure everyone understands and can agree with the result (or dispute it).

> ✎ **NOTE**
>
> **Your students may be interested to know that these images were created using the AI tool https://www.craiyon.com/ with variations of the prompt "an animal or creature that has fur, pointy ears OR round ears and big eyes" (for "fleep"s) and "an animal or creature that has skin or scales or no fur, pointy ears OR round ears and very small eyes" (for "bloop"s).**

9. **1 min.** Explain that labelling data is important to avoid confusion caused by an AI "learning the wrong thing" e.g. getting "fleep"s and "bloop"s the wrong way around, or cats and dogs the wrong way around!

    **EXTENSION QUESTIONS:** What could happen if training data is mislabelled? What could go wrong?
10. **1 min.** Tell students that it is now time for them to train their own machines to become intelligent. Present the slides showing inputs for image recognition and take them through the steps of AI again.
11. **2 mins.** Tell students that we are going to first train a machine together before they work on their own model. Our machine is going to learn how to play the game 'Rock, Paper, Scissors'. (If you don't know that game yourself you can learn about it here.)
    a. Navigate to the Teachable Machines website on your computer to demonstrate the interface. It is helpful if the whole class watches this together, so you can pause for any questions the students might have. Tell everyone to click on **Image Project** and then **Standard Image Model**. As a class, start by training just two of the three hand shapes in 'Rock Paper Scissors'. You will need to add and rename the "classes" in the website accordingly.
12. **3 mins.** Have students take photos of their hand using their webcam, following the steps in the instructions slide. They should aim to have about 100 pictures (you can constantly take pictures by clicking and holding the trackpad/mouse button over the **"Take Image"** button in the interface.
13. **3 mins.** Train the model by clicking on the "**Train Model"** button on the Teachable Machines website. It will take a few minutes to train the model. Once trained, test the model out by putting a hand in front of the camera in one of the three 'rock', 'paper' or 'scissors' positions.

NOTE

Since you've only trained one shape so far, there are only two possible answers!

14. **4 mins.** Ask students to complete the model by training the third and final hand shape, repeating the steps above and re-training the model.

NOTE

When students test the machine, they will find that the machine cares more about the background behind them rather than the shapes their hands are making. The background in the image is a feature that the machine is using unintentionally! As the instruction slide suggests, encourage students to use a blank sheet of paper or a white wall as the background when they are taking their images.

If you have time, you can help the machine learn that the background should not be an important feature by taking more sample images for each hand shape with multiple different backgrounds and other conditions (like how close the object is to the camera, the amount of light, and the people pictured in the image).

15. **5 mins. CASE STUDY:** The CSIRO uses the same technology as Teachable Machines to capture human joint movements to better understand how the human body moves, and uses that information to make us healthier in work and sport. CSIRO calls these models "Digital Humans". Watch the videos to learn more about Digital Humans!
16. **1 min.** Mention how training, testing and prediction doesn't just have to work with video, images or motion – it can also be applied to sounds!
17. **1 min.** Present and play the sound of a "kookaburra" and a "cockatoo," pausing for several seconds to allow students to listen to the recording of each animal's sound.
18. **2 mins.** Present and play the audio on the test slide and ask students to decide whether they think it is a "kookaburra" or a "cockatoo," based on the sounds they listened to on the previous slide. Then ask the class to stand up and move to a corner of the class for those students who think it is a "kookaburra" and to the opposite corner for those who think it is a "cockatoo".

NOTE

It is helpful to clearly identify the "kookaburra" and the "cockatoo" as notable birds that are both native to Australia. Not all students may be familiar with both birds, or their calls.

19. **2 mins.** Ask each group discuss among themselves to:

     Summarise what a “kookaburra” sounds like and what a “cockatoo” sounds like.

     Agree on a confidence number between 1 - 10 (1 = not confident, 10 = 100% confident) in their prediction.

     Explain how they reached their confidence score.

     What extra data they might need to improve their confidence.
20. **2 mins.** Ask a representative from each group to report their findings.
21. **1 min.** Reveal the answer! It’s a ”kookaburra”!
22. **2 mins.** Ask students what they think the AI would do if it heard a “rooster”. Remind them that the AI has only been trained to recognise “kookaburras” and “cockatoos”.

     **Answer:** The AI would say the “rooster” is either a “kookaburra” or a “cockatoo”. We cannot say for sure which one it would say, since the AI we’re talking about is imaginary and we can’t test it. But since there are only two options, the AI must give an answer (even if that answer is obviously incorrect). AI does not usually say “I don’t know!”
23. **2 mins.** Talk through the final points on how machine learning works; recapping that AI learns information by looking at samples and finding patterns and in the data, which allow it to make predictions. The more data we give an AI, the more accurate it becomes.

     **EXTENSION QUESTIONS:** How important do you think the confidence rating is? Would you trust an AI system without a confidence rating?

END OF LESSON PLAN