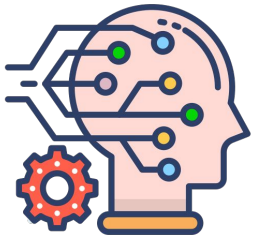
Lesson 2

Pattern Based AI and Classification

CS IN SCHOOLS

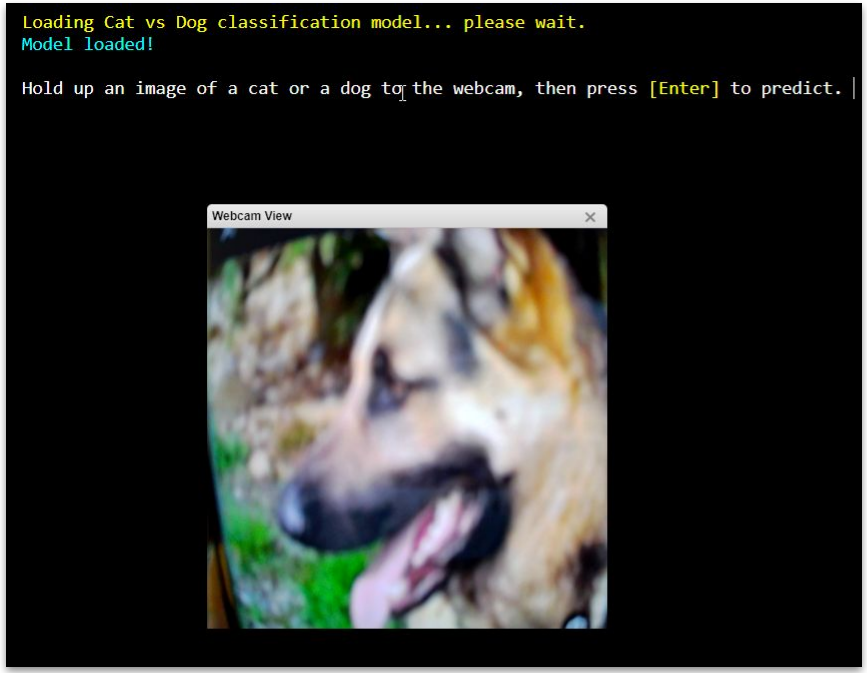
Learning objectives



By the end of this lesson, you should be able to:

- Understand how pattern-based AI works
- Understand the difference between AI and Machine Learning (ML)
- Understand classification as a form of machine learning
- Identify terms in data used to train a classifier
- Understand the importance of data in ML
- Build your own classifier online!

Demo: The Cat and Dog classifier



[Can AI Tell Apart a Cat or a Dog?]

Artificial Intelligence vs Machine Learning

- Would you regard the dogs vs cats classifier at the start as “**intelligent**”?
- Why or why not?

Artificial Intelligence vs Machine Learning

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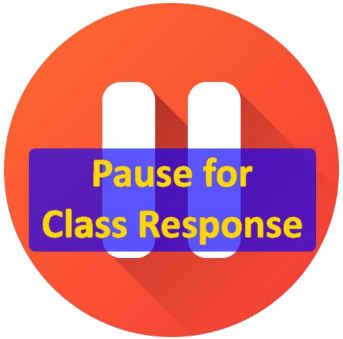
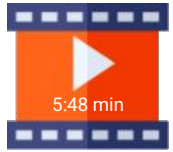


Play Video



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Patterns-based AI

- When all the rules aren't known in advance, we can use another form of AI called "Pattern-based" AI
- Here, the AI system doesn't follow exact rules, but makes predictions based on patterns in examples it has seen before.
- It is also able to learn to make better predictions by being shown more and more examples.

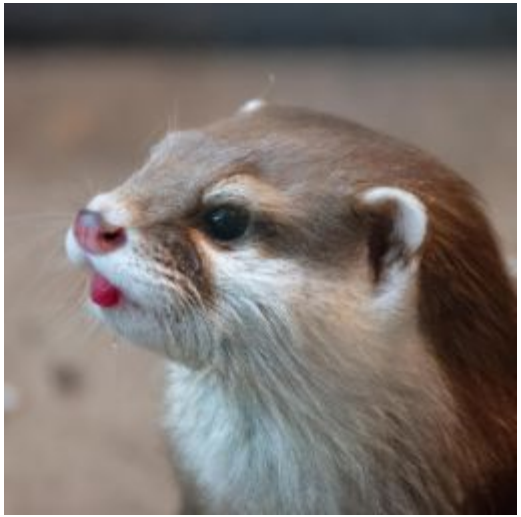
Let’s try to see if you can do some pattern matching...

Here is a Blapp

Here is a Blapp

Here is a Blapp

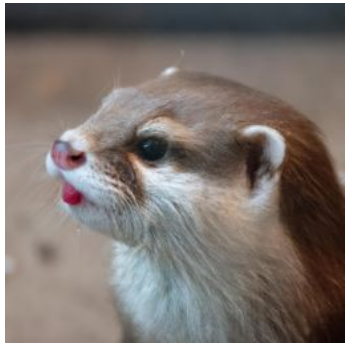
Here is a Plupp

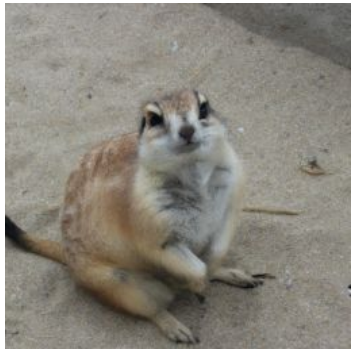


Here is a Plupp

Here is a Plupp

Plupps

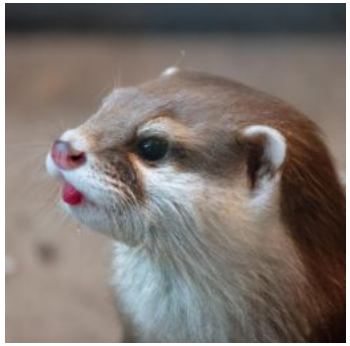


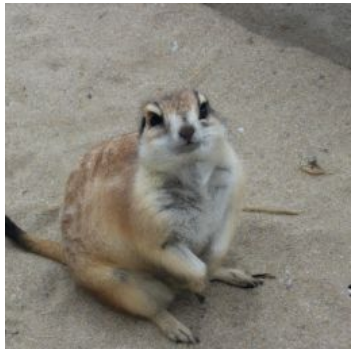


Blapps

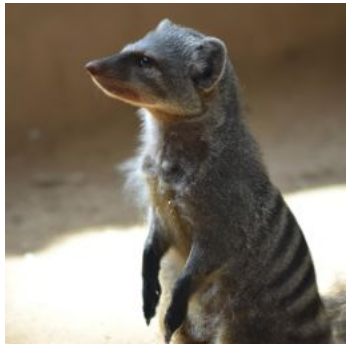
Is this a Plupp or a Blapp?

Plupps





Blapps



Plupp or Blapp?

Out of a score of 0.0 - 1.0, how confident would you say you are? (0.0 = not confident, 1.0 = certain)

Classification

- How did **you** “learn” to identify Plupps and Blapps?
- How did you come up with a “confidence” number at the end?

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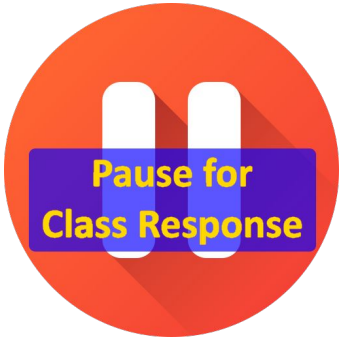
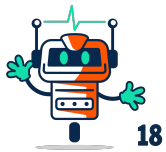
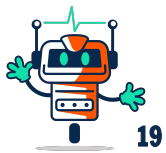




Rules Based AI vs Pattern Based AI

- Did anyone tell you the “rules” to determine what was a “Plupp” or what was a “Blapp”?
- How did you come up with your own rules?



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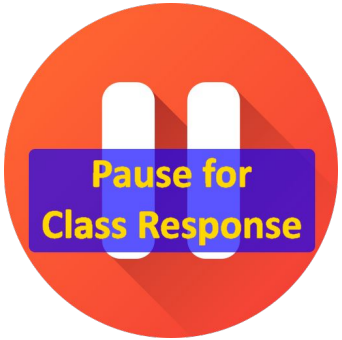

Rules Based AI vs Pattern Based AI

- Did anyone tell you the “rules” to determine what was a “Plupp” or what was a “Blapp”?
- How did you come up with your own rules?
  - You probably needed **lots of examples**!
  - And **your brain** did some “pattern-matching” and “pattern-recognition” based on those examples
  - This is the main difference between Rules-Based AI and Pattern-Based AI!

Pattern Based AI

- In Pattern-Based AI, there are **no firm set of rules** that we tell the computer to follow
- Why not?

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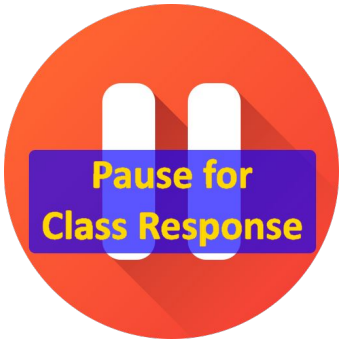


Pattern Based AI

- In Pattern-Based AI, there are **no firm set of rules** that we tell the computer to follow
- Why not?
  - We might not know all the rules
  - It is too difficult to list out all the rules
  - The rules might change over time

Pattern Based AI

- One form of pattern-based AI is used for **prediction**
- Prediction systems can be used to **classify data** into different categories. For example:
  - Classifying an image as either containing a fleep or a bloop
  - Classifying music according to the genre
  - Classifying audio segments according to the word heard
  - Classifying text as news or gossip

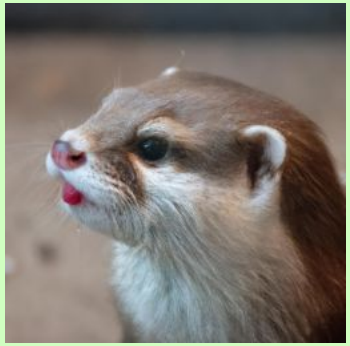
Pattern Based AI

- Pattern-Based AI systems need to be able to “learn” the rules by giving them lots of data
- When a computer system “learns” how to accomplish a task by using data and algorithms, this is called **machine learning**
- But not all AI systems use machine learning (e.g. the rules-based systems where humans supply the rules as seen in the last lesson)

Classification

- Let’s consider the case of classification.
- Classification is only one form of predictive AI which uses machine learning.
- In order to learn, we need to supply **data samples** with **labels** to tell the system what the “correct” answers are first

Training Samples



Label: Plupp

Label: Plupp

Label: Plupp

Label: Blapp

Label: Blapp

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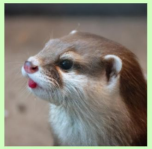
Prediction

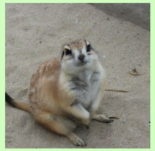
Plupp or Blapp?

Out of a score of 0.0 - 1.0, how confident would you say you are? (0.0 = not confident, 1.0 = certain)

Training Samples



Label: Plupp



Label: Plupp

Label: Plupp

Label: Blapp

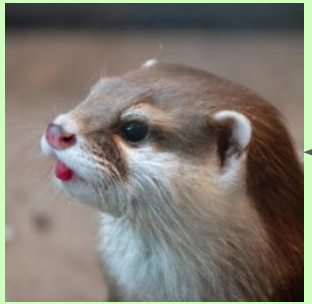
Label: Blapp

Label: Blapp

Prediction

Plupp or Blapp?

Out of a score of 1 - 10, how confident would you say you are? (1 = not confident, 10 = certain)

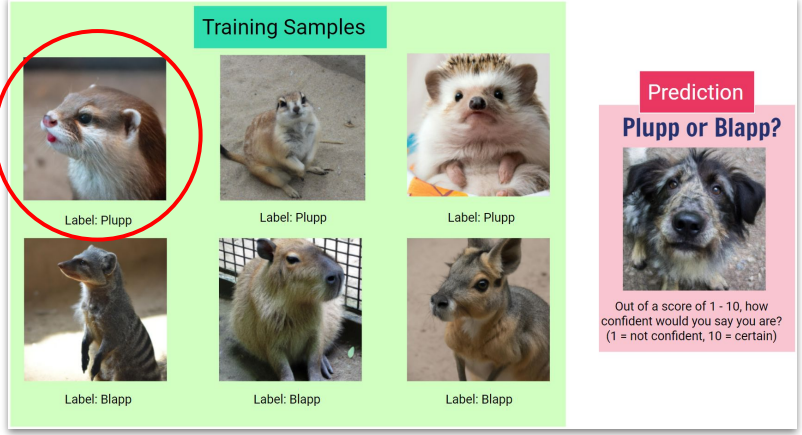


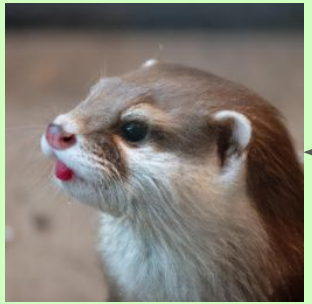
label: Plupp

Sample

Image Data

Label





label: Plupp

Sample

Image Data

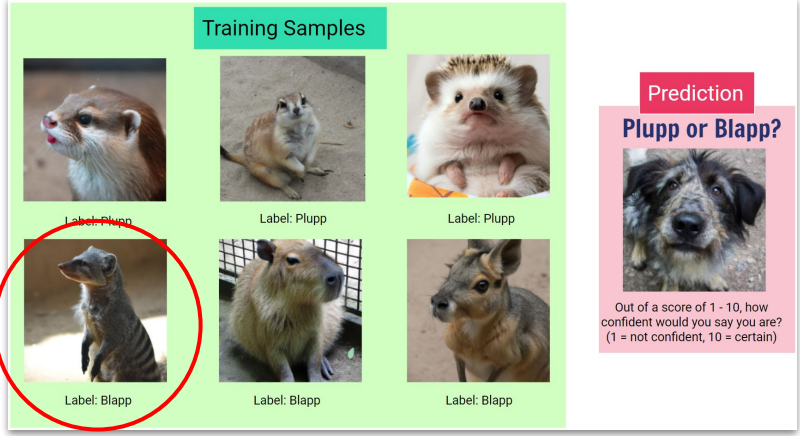
Label

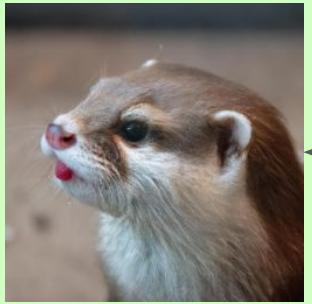
label: Blapp

Sample

Image Data

Label



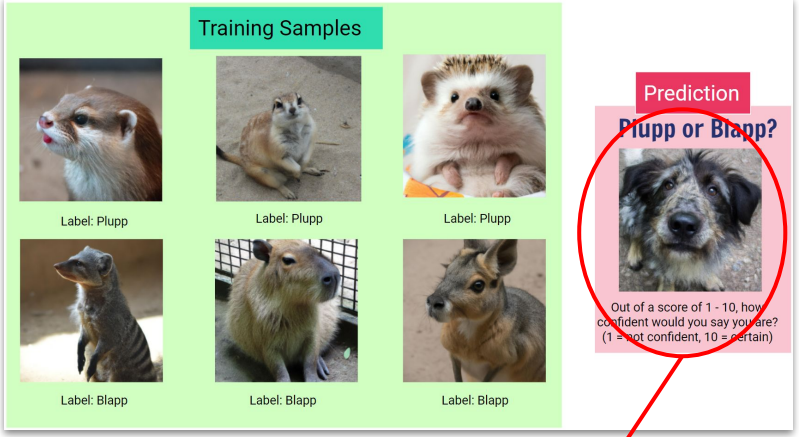


label: Plupp

Sample

Image Data

Label



label: Blapp

Sample

Image Data

Label

Prediction

Image Data

Predicted Class

Confidence Score

Predicted Class: Blapp

Confidence: 0.84

Worksheet Activity

Complete Question 1 - 3

(PDF, MS Word)

Play Video

3:13 min

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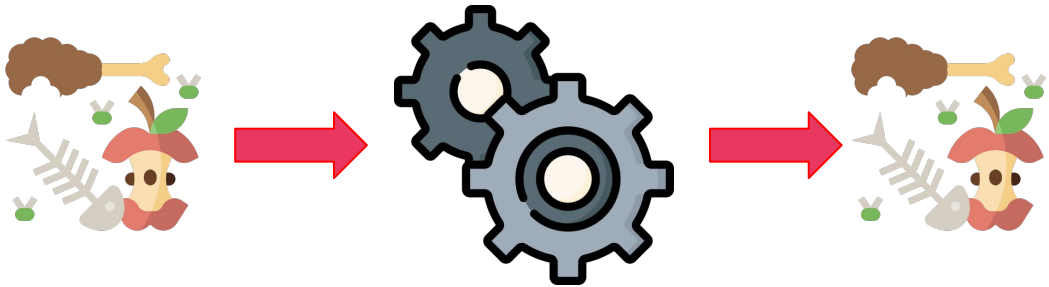
Classification

- Data is important!
- The **GIGO** principle: Garbage In, Garbage Out
- The system will only learn based on the samples you give it
- It may learn the wrong thing if:
  - You give it samples with the **wrong labels**
  - You **don't give it enough samples**



Maths textbook analogy

- Think about when you are doing math exercises
- You see a problem in the maths textbook
- You have a go at it
- You **check** your answers (at the back of the book) - or your teacher tells you
- If you got it right, you confirm your understanding
- If you got it wrong, you adjust your understanding as required
- The more problems you do, the more your understanding improves
- At the end of the unit, your teacher gives you a “test” - with no answers!

Maths textbook analogy

- You use the answers at the end of the book (**labels**) to better improve your understanding (**model**) of how to solve the problem (**prediction**)
- Imagine if the answers at the end of the book were wrong…
  - For example, the + sign was interpreted as subtraction instead of addition
- What might happen?

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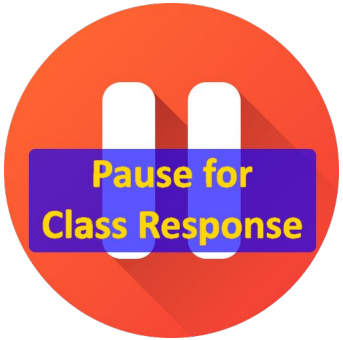

Maths textbook analogy

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- Imagine if the answers at the end of the book were wrong…
  - For example, the + sign was interpreted as subtraction instead of addition
- What might happen?
  - When you check your answers and see that they are wrong… you might realise that the way to get the correct answer is to interpret the sign + as subtraction
  - And you'll begin to learn that + means subtraction, which is the wrong thing
  - Once again, data is important! GIGO

Classes

- So far, we've only considered classifications involving **2 classes** (e.g. dogs vs cats, blapp vs plupp)
- But classifiers can work with **many, many more classes**!
- However, building classifiers with more classes also means:
  - **More data** is required to train / learn
  - It will **take longer** to train / learn
  - It might **not be as accurate** as classifiers with fewer classes to choose from

Worksheet Activity

Complete Question 4

(PDF, MS Word)

Generative AI

- You may have also heard of “**Generative AI**” systems.
  - E.g. ChatGPT, DALL.E, Midjourney, Gemini, Claude, Stable Diffusion
- These systems are based on, and extend upon, prediction systems to produce new works of text, art, music etc.
- We’ll discuss this further in the next lesson.

Worksheet Activity

Complete Question 5

(PDF, MS Word)

Summary

You should now be able to:

- Understand how pattern-based AI works
- Understand the difference between AI and Machine Learning (ML)
- Understand classification as a form of machine learning
- Identify terms in data used to train a classifer
- Understand the importance of data in ML
- Build your own classifier online!

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