Lesson 2: How computers learn from data

Experience AI

Raspberry Pi Foundation

How tall is the Eiffel tower?

" The height of the Eiffel tower is 330 m or 1083 ft. "
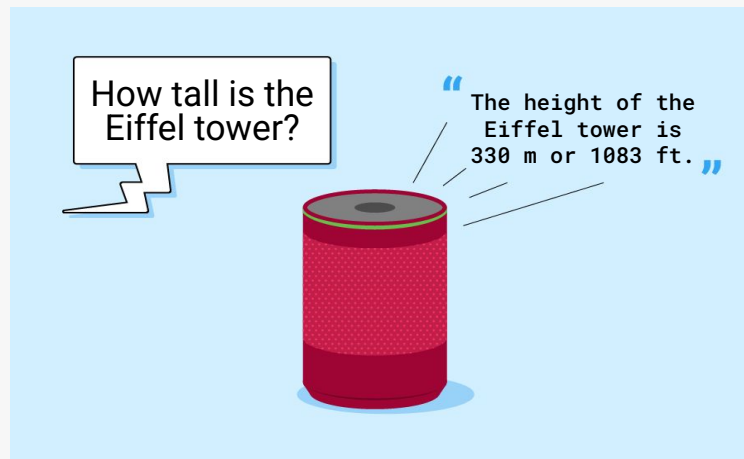
Is a 'smart' speaker an AI application? Why?

Discuss with the person next to you.

You can use a 'smart' speaker (like Amazon Echo or Google Home) to do things like answer a question, play a song, or set an alarm.

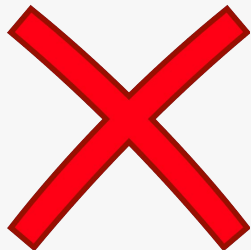# Lesson 2: How computers learn from data

In this lesson, you will:

- Define machine learning's relationship to artificial intelligence

- Name the three common approaches to machine learning

- Describe how classification can be solved using supervised learning

Two different approaches

Spreadsheet that uses formulas to work out the total cost of a holiday

Online streaming service that recommends films based on users' viewing habits

Two different approaches

Rule-based —

Spreadsheet that uses formulas to work out the total cost of a holiday ✗

Data-driven —

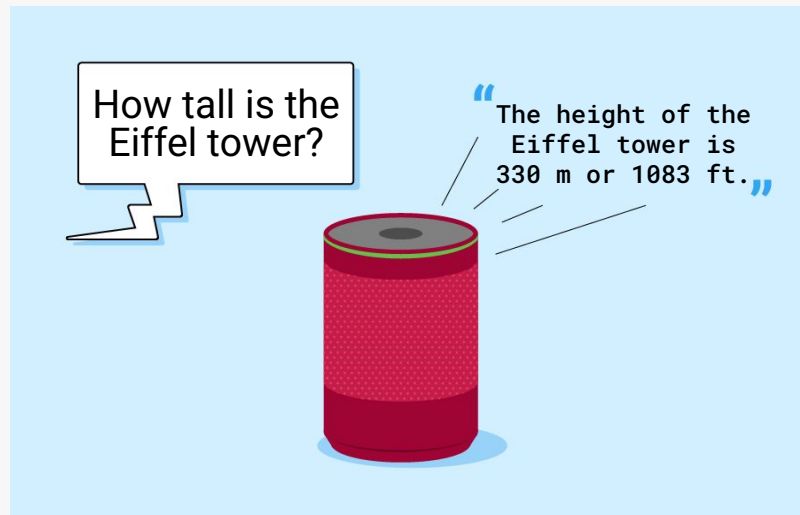Online streaming service that recommends films based on users' viewing habits ✓

Some uses of a 'smart' speaker

- Interpreting voice commands

- Answering questions

- Playing music

- Setting alarms

These are all things *you* use a 'smart' speaker to do.

How tall is the Eiffel tower?

"The height of the Eiffel tower is 330 m or 1083 ft."

Which uses would benefit from a *data-driven* approach?

A data-driven approach

- **Interpreting voice commands**
- **Answering questions**
- ~~Playing music~~
- ~~Setting alarms~~

There are many ways a person can phrase a command, and people speak in different languages and have different accents.

In order to respond to as many people as possible, a model is beneficial.

A data-driven approach

- **Interpreting voice commands**

- **Answering questions** ←

- ~~Playing music~~

- ~~Setting alarms~~

Answers are found on the web using a search engine.

Search engines might use a model to provide high-quality results. There might also be a model to help pick which result is the most relevant for the current question.
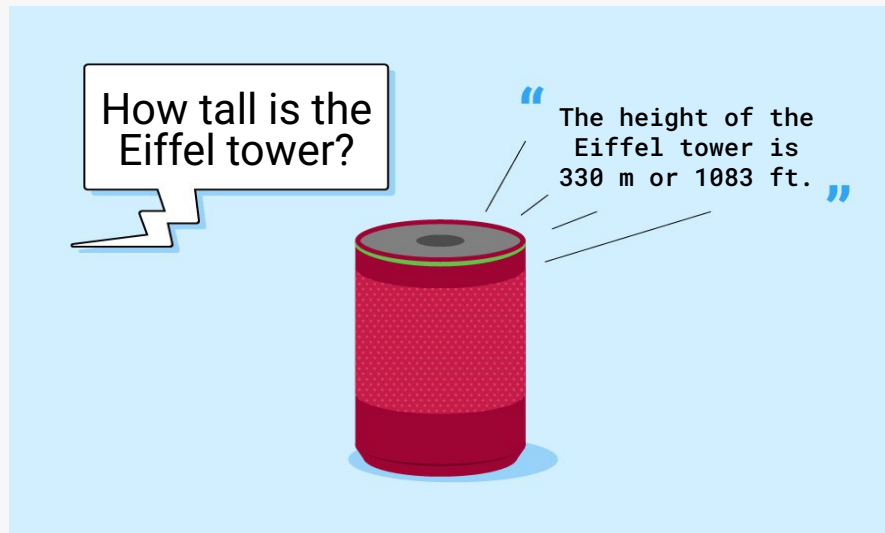
Is a 'smart' speaker an AI application?

Yes.

But just because something is an AI application doesn't mean every bit of it uses a data-driven approach.

When discussing AI applications, you should be specific about which use requires AI techniques.

Creators of 'smart' speakers make use of AI to help *interpret voice commands* and *answer questions*.
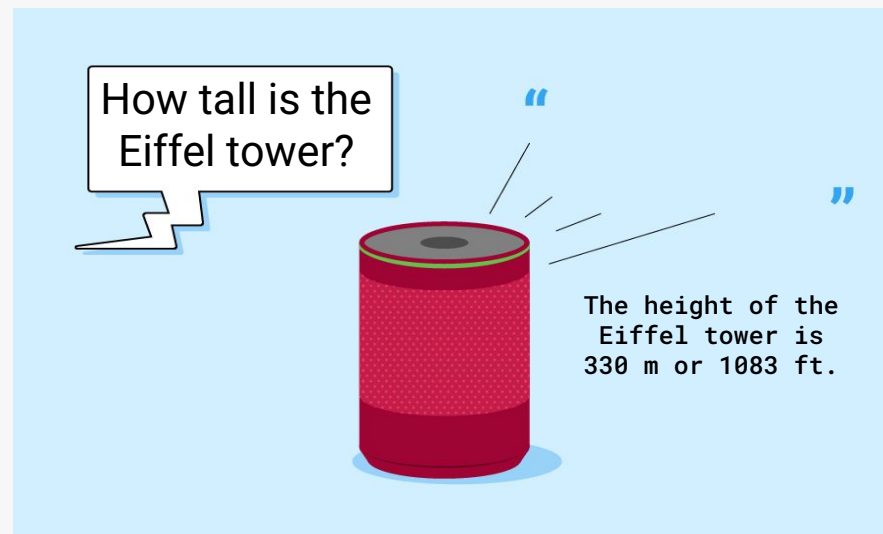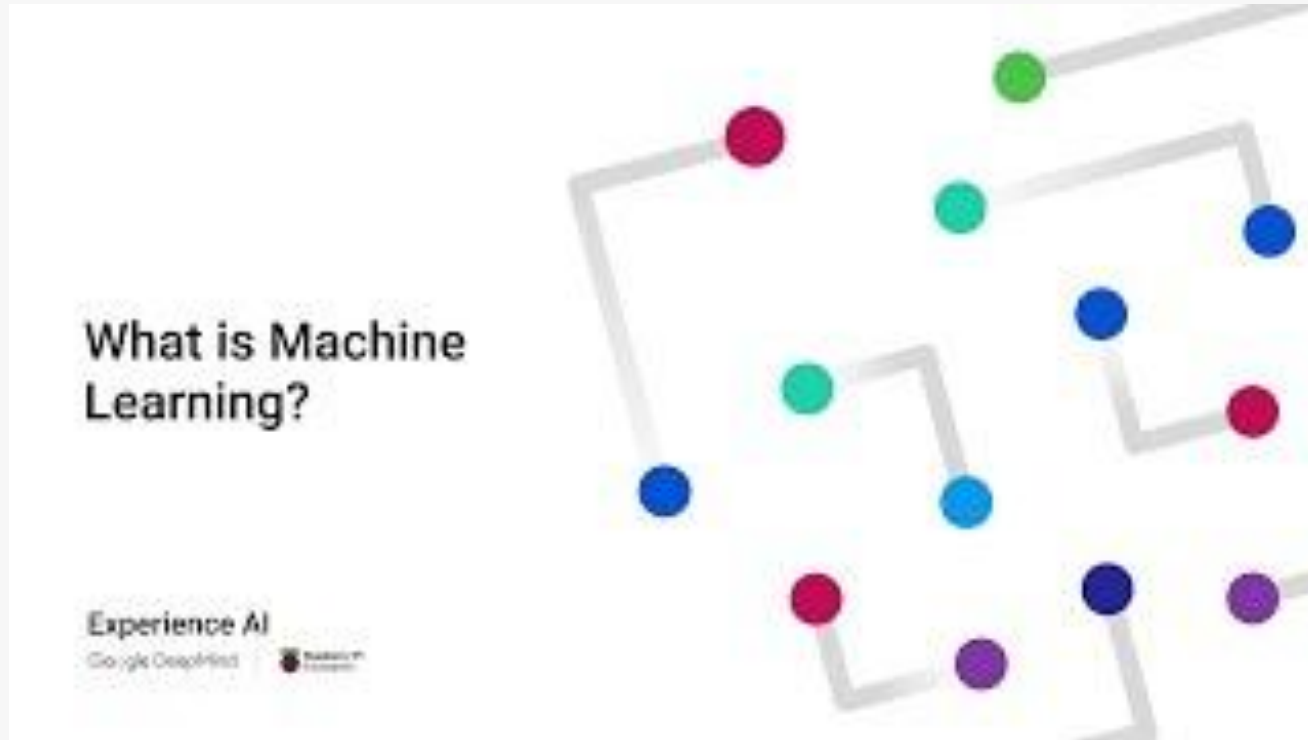
How do models 'learn'?

If I wanted the model used in my 'smart' speaker to accurately interpret commands from as many people as possible...

What would I need to train the model?

Data!

What is machine learning?

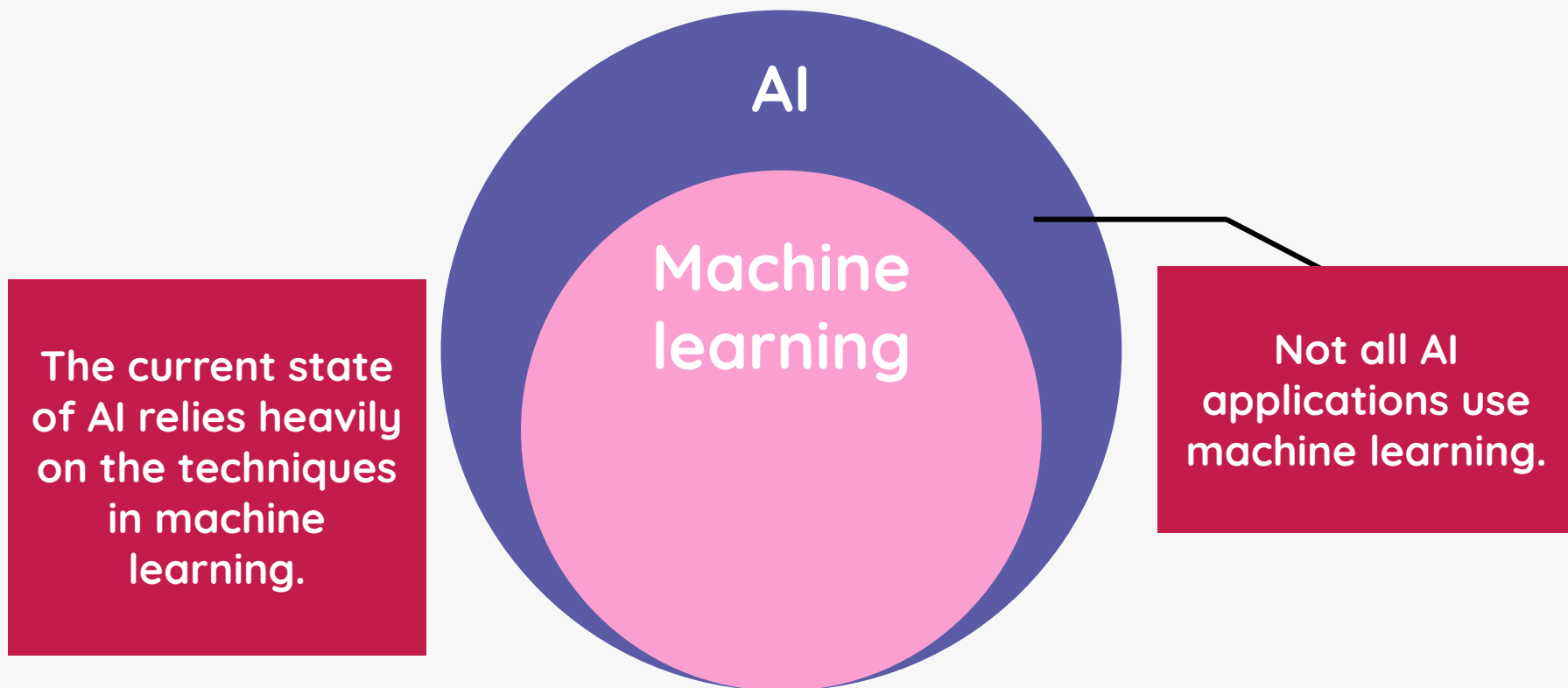

Watch the video on YouTube

How do models 'learn'?

Machine learning is how the **models** you have heard about are created.

Reminder: A model is a representation of a real-world context.

Machine learning:

Machine learning (ML) is a way of building artificial intelligence systems using statistics, instead of by writing out the rules in a program. Machine learning systems are called 'data-driven', because they use a lot of examples — data — to work.

How do models 'learn'?

AI

Machine learning

The current state of AI relies heavily on the techniques in machine learning.

Not all AI applications use machine learning.

How do models 'learn'?

Traditional programming is great when we can **define** the exact steps to solve a problem.

Models help solve **complex** problems that require more than a rule-based approach.

Unlike traditional programming where step-by-step instructions are written to solve a problem, machine learning systems are designed to make **predictions** based on lots of data.

How do models 'learn'?

The outputs from a machine learning model are **predictions** based on the data used to create it. There is always some uncertainty in the output.

Where have you seen **uncertainty** in a model's output before?

Unlike traditional programming where step-by-step instructions are written to solve a problem, machine learning systems are designed to make **predictions** based on lots of data.

Would you use machine learning?

Not all problems **require** a machine learning model.

On your worksheet, there are three **desired uses** for an application.

Label the uses with the **approach** you think would be appropriate, either traditional instructions or a machine learning model.

Would you use machine learning?

Calculating the distance to a star

Forecasting air pollution

Identifying animals in a video

Would you use machine learning?

Calculating the distance to a star

Forecasting air pollution

Identifying animals in a video

Probably instructions

Could use an ML model

Could use an ML model

What data would you need?

In order to create a machine learning model, you need data!

Pick one of the two uses of machine learning models. What data would you need to create a model?

Write your answers on your worksheet.

Identifying animals in a video

Forecasting air pollution

Types of machine learning
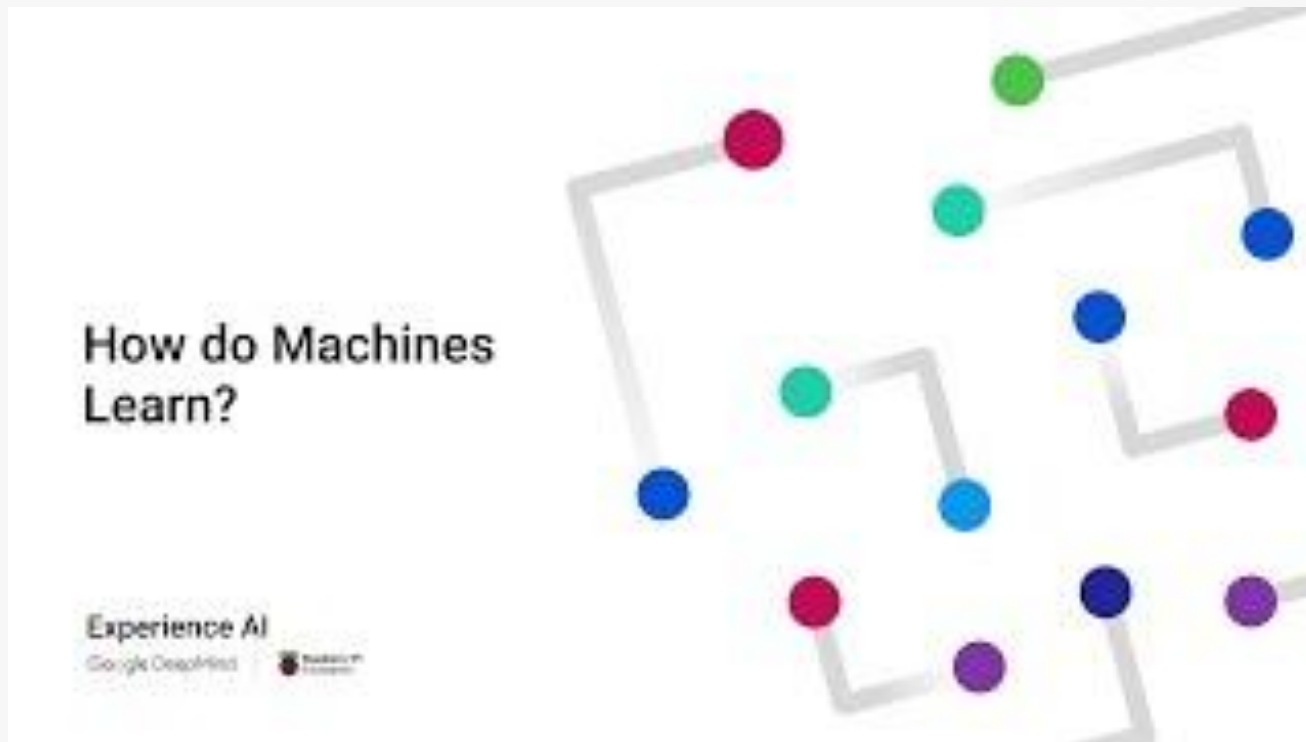
Watch the video on YouTube

Types of machine learning

Which type of machine learning do the following statements apply to?

Supervised learning
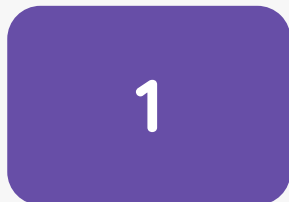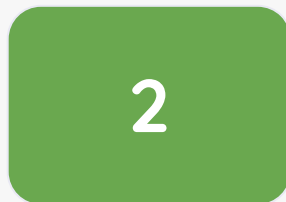
1

Unsupervised learning

2

Reinforcement learning

3

Types of machine learning

Uses **an agent** that has direct access to the environment
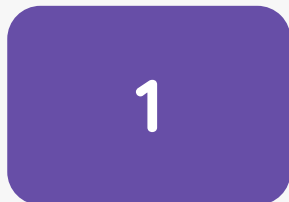
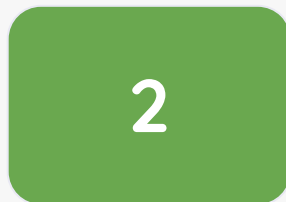| Supervised learning	Unsupervised learning	Reinforcement learning
1	**2**	**3**
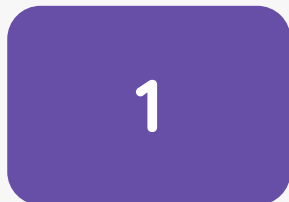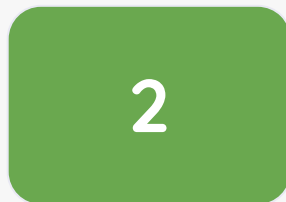
Types of machine learning

Uses **an agent** that has direct access to the environment

Reinforcement learning

Supervised learning

Unsupervised learning

| 1 | 2 | 3 |

Types of machine learning

Training requires **example** data

Supervised learning

1

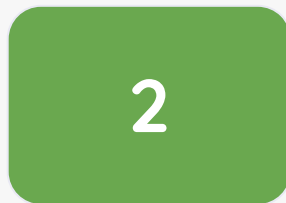**Unsupervised learning**

2

Reinforcement learning

3

Types of machine learning

Training requires **example** data

Supervised learning

1

Unsupervised learning

2

Reinforcement learning

3

Types of machine learning

Grouping data that is **similar**
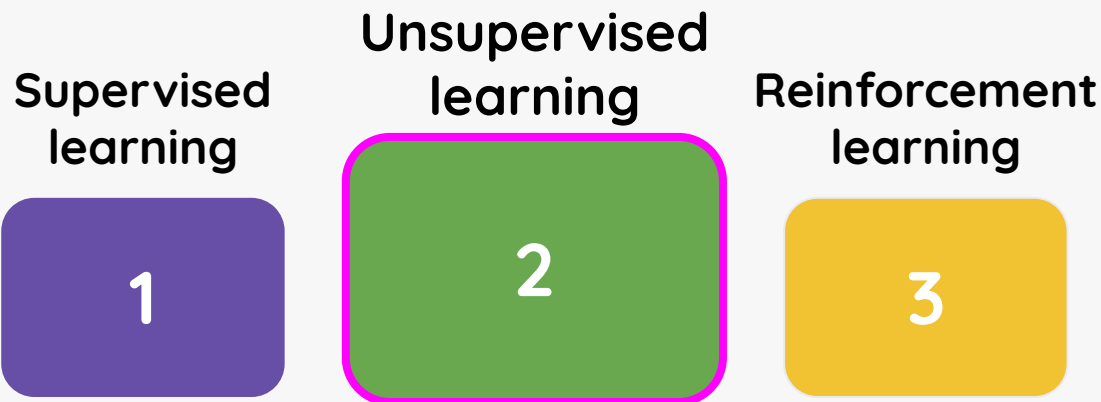
Supervised learning
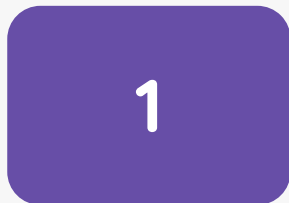
Unsupervised learning

Reinforcement learning

1

2

3

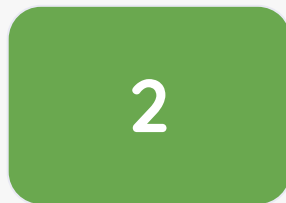# Types of machine learning

Grouping data that is **similar**

Supervised learning
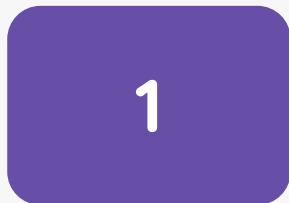
1

Unsupervised learning

2

Reinforcement learning

3

Types of machine learning

Learning by **trial and error**

Supervised learning

Unsupervised learning
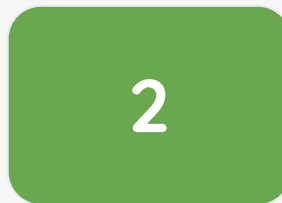
Reinforcement learning

1

2

3

Types of machine learning

Learning by **trial and error**

Reinforcement learning
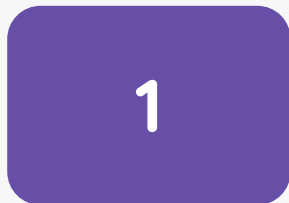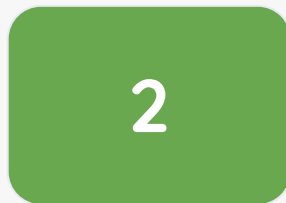
Supervised learning

Unsupervised learning

1

2

3

Types of machine learning

Requires lots of **training data**

Supervised learning	Unsupervised learning	Reinforcement learning
1	**2**	**3**

Types of machine learning

Requires lots of **training data**

Supervised learning

Unsupervised learning

Reinforcement learning

1

2

3

Types of machine learning

| Supervised learning	Unsupervised learning	Reinforcement learning
Needs data that has been preprocessed by a human	Clusters similar data together	Learns by trial and error
Requires a lot of data to train	Gives you ideas for how to group the data	Model needs time to get good at its tasks

Classification

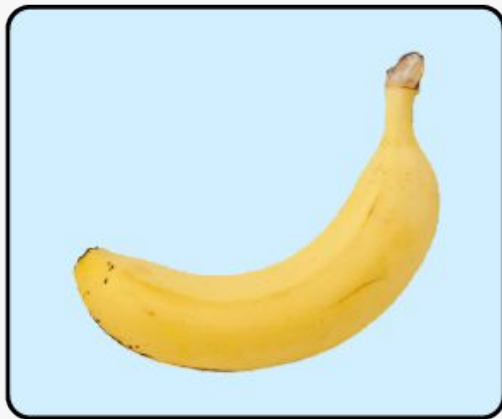Classification is a way of using **supervised learning** to categorise data.

A classification model assigns data to a **class** by applying labels.
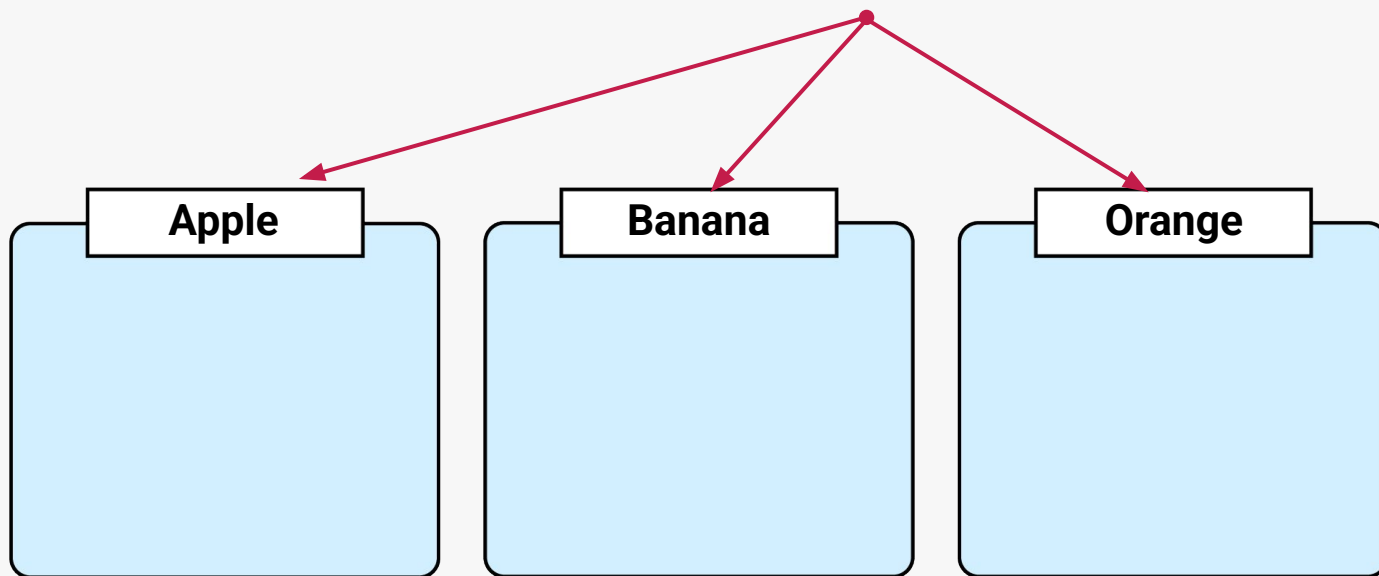
Apple

Banana

Orange

Classification

Classification models must be **trained with example data** that already has labels assigned by a human.

What labels would you apply to these images?

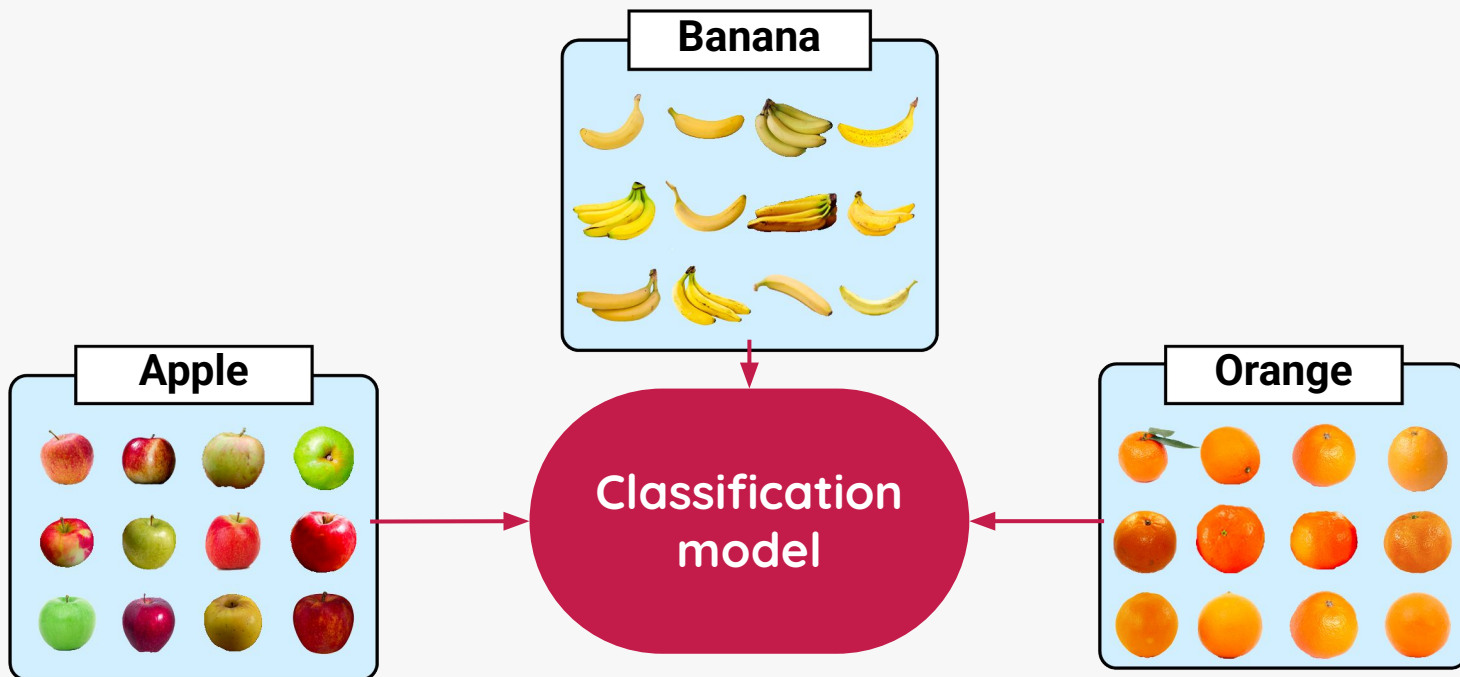# Classification

Classification models must be **trained with example data** that already has labels assigned by a human.

What labels would you apply to these images?

Orange

Banana

Apple

Classification

The **more training data** you use, the **more accurate** the model will be.

Classification

Once the model is trained, new data can be fed into the model and it will produce a **prediction** of which class the data belongs to.

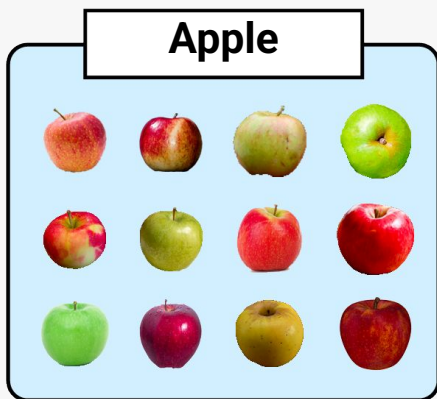**New data**

Classification model

Prediction:
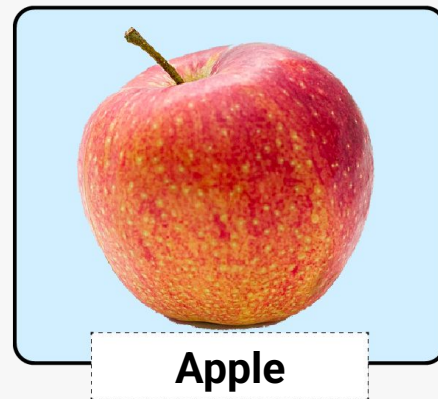**Orange**
Confidence 92%

Classification

Class

Label

A **category** that the data can be assigned to

Applied to a **single piece** of data to indicate which class it belongs to

Apple

Apple

Classification — example 1

Classification can be used to determine whether reviews or comments are **positive** or **negative**.

The model is trained with **text data**.

This is called **sentiment analysis**.

Classification — example 1

Sentiment analysis

Classes: Positive and Negative

Benefits: Can process a larger number of reviews to get an accurate picture of how well your product or service has been received

Elena
⭐⭐⭐⭐⭐ **Beautiful Colour**
Reviewed in the United Kingdom 🇬🇧 on 22 September 2022
Size Name: 128GB | Colour: Alpine Green | Configuration: Without AppleCare+ | **Verified Purchase**

Very happy with this phone.
Is my first iPhone, as I always had Windows Phone and then Android, but now I don't think I could go back.
Apple is super pricey so I think I will keep this phone for many years, but generally, I'm happy and the colour is stunning.
Great battery life, great photos, and videos, very smooth.

Helpful   **Report abuse**

Armand
⭐⭐⭐☆☆ **Waste of money**
Reviewed in the United Kingdom 🇬🇧 on 20 September 2022
Size Name: 128GB | Colour: Graphite | Configuration: Without AppleCare+ | **Verified Purchase**

Disappointed after two weeks only battery drain was so big i had to charge it 2-3 times a day waste of money
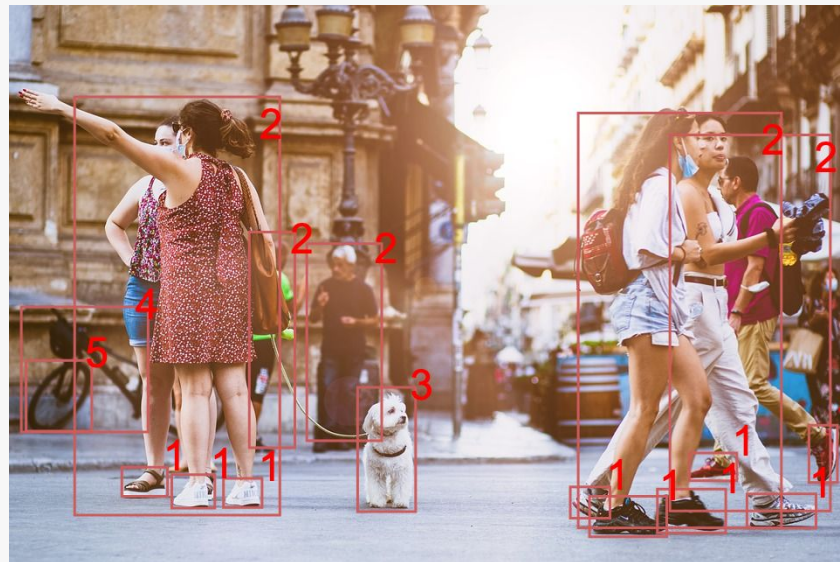
Helpful   **Report abuse**

Classification — example 2

Computer vision

Using a model to find **a range** of objects in a photo or video.

The model is trained with images of individual objects and of multiple objects, like this image.

Classification — example 2

Shoe 1
- Confidence: 100%

Person 2
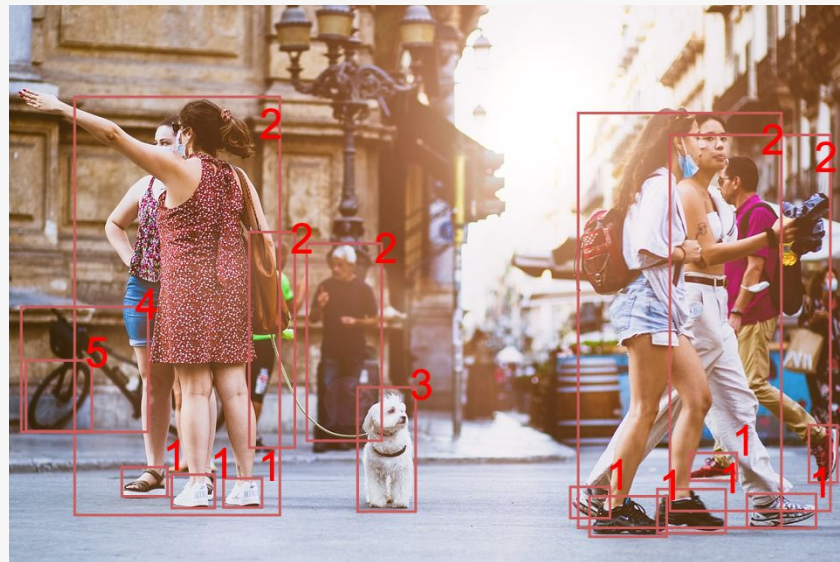- Confidence: 99%

Dog 3
- Confidence: 98%

Bicycle 4
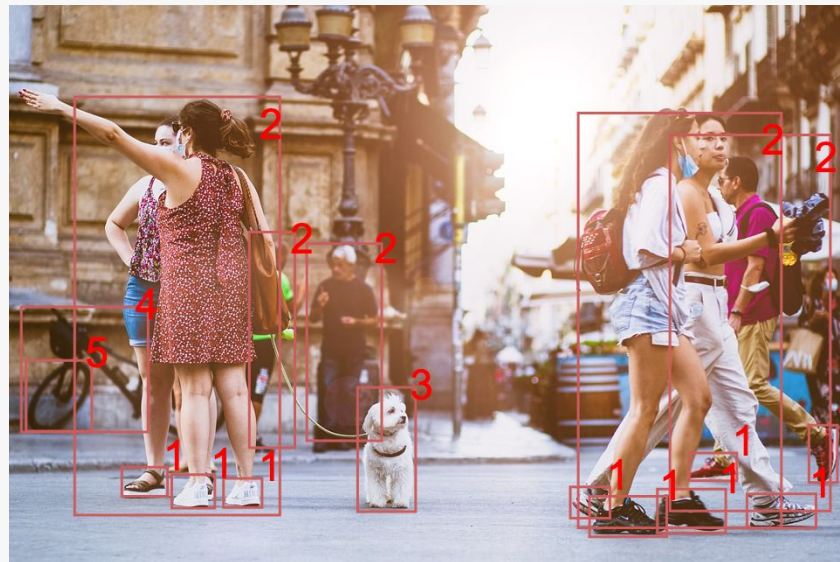- Confidence: 95%

Wheel 5
- Confidence: 81%

Classification — example 2

Computer vision

Classes: Shoe, person, dog, bicycle, wheel, etc.

Benefits: Can identify multiple objects in an image — useful for technological advancements such as driverless cars

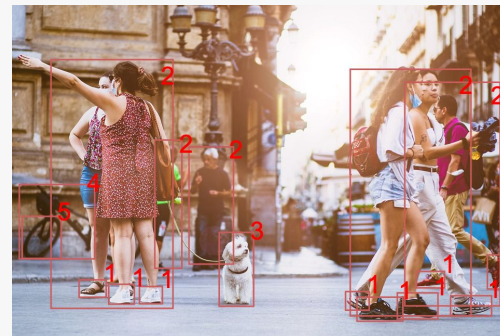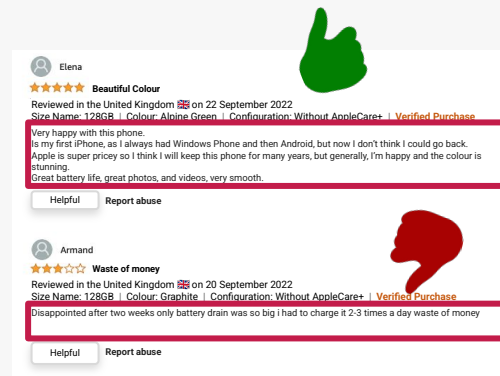# Data types for classification

You can use almost **any** type of data to train a classifier.

On your worksheet, look at the example classification problems.

- What type of data would you use?
- What could some of the classes be?

Data types for classification

Assigning a genre to music

Identifying spam emails

Language detection

What type of data would you use?

What could some of the classes be?

Classification — your turn

DeepMind want you to help them with their project of tracking animals in the Serengeti.

The Serengeti is a national park in East Africa. There are many endangered animals there.

They are using classification to find and track animals in order to protect them.

Classifying Lions in the Serengeti

Experience AI
Google DeepMind

Watch the video on YouTube

Classification — your turn

Classes

cheetah

hyena

gazelle

zebra

elephant

lion

They need your help to pre-label some images to help train their classification model.

What labels would you apply to the following images?

Classification — your turn

Classes

cheetah

hyena

gazelle

zebra

elephant

lion

Classification — your turn

Classes

Classification — your turn

Classes

cheetah

hyena

gazelle

zebra

elephant

lion

Classification — your turn

Classes

cheetah

hyena

gazelle

zebra

elephant

lion

Covert   04.22.2012 10:15:56

Next lesson

In this lesson, you...

Described which parts of a system use AI

Explored the role of data in AI applications

Defined 'machine learning'

Used classification to categorise data

Next lesson, you will...

Explore the importance of data

Learn about training and test data

Describe ways to identify and prevent bias in your ML models