Experience AI: Ecosystems

Biology

Raspberry Pi Foundation

What animals can you see?

What animals can you see in this image?

What type of ecosystem do you think this is?

Why do you think it is important for conservationists to track animals and their environment?

Experience AI: Ecosystems

In this lesson, you will:

- Recall the importance of maintaining biodiversity
- Describe why artificial intelligence (AI) is a useful tool in helping to maintain biodiversity
- Discuss some of the benefits and drawbacks of using AI

The Serengeti ecosystem

The Serengeti

The Serengeti is a vast national park in Tanzania.

The park is known around the world for its amazing wildlife and great **biodiversity**.

The Serengeti **ecosystem** is one of the largest and oldest in the world. The habitat is believed to have remained largely unchanged for over a million years.

The park is inhabited by around 70 different species of large mammals.

Risks to the ecosystem

As the risks from human activity and climate change increase, it becomes more important for us to understand how the different animal communities are **affected**.

Changes in the environment may leave some species **less well adapted** to compete successfully and reproduce, which in turn may lead to **extinction**.

Image source: Swanepoel at English Wikipedia, CC BY-SA 3.0

Tracking animals

The Snapshot Serengeti research programme installed hundreds of **motion-sensitive cameras** within the core of the protected area to find out what was happening.

Volunteers from across the world viewed and labelled the camera images with the species and behaviour.

Label:
Species: Cheetah
Number: 1
Behaviour: Resting

You're the volunteer

What labels would you apply to the following image?

Species?

Aardvark	Elephant	Ostrich
Baboon	Gazelle	Warthog
Buffalo	Human	Zebra

How many?

1	2	3+

What behaviours do you see?

Resting	Standing	Moving
Eating	Drinking	Interacting

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Resting	**Standing**	Moving
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Think, pair, share

Thousands of **community volunteers** were recruited to label the data in this way. However, it could take **up to a year** from an image being captured to it being labelled, and longer before useful information could be presented to conservationists.

Question 1. What problems did you face in attempting to label the data?

Question 2. Why might the delay of a year be an issue for conservationists?

Time costs lives

The length of time it took to provide useful information made it hard for conservationists to react quickly to events affecting the ecosystem, such as local flooding, drought, disease.

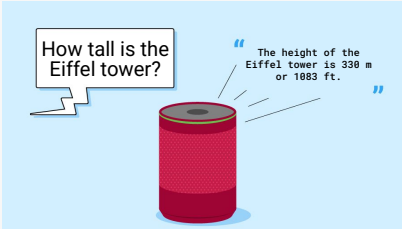
Timely interventions to protect vulnerable species is essential to preserve biodiversity and maintain a fragile ecosystem.

Image source: Oxfam East Africa, CC BY 2.0 via Wikimedia Commons

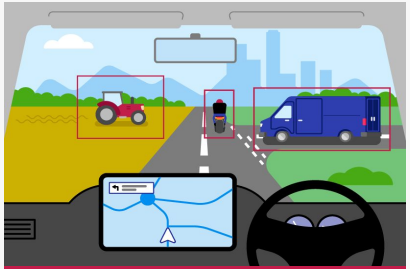
Artificial intelligence (AI)

Artificial intelligence

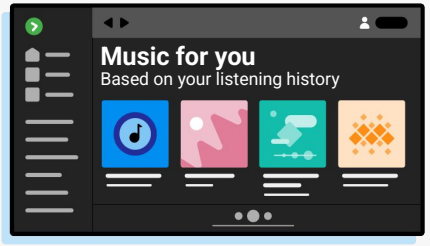
Artificial intelligence is the design and study of systems that appear to demonstrate intelligent behaviour.



Smart speakers



Driverless cars



Content recommendation

Using AI to solve problems

Traditional computer systems are **rule based** (step-by-step instructions).

Move 1:
Place an X in a corner.

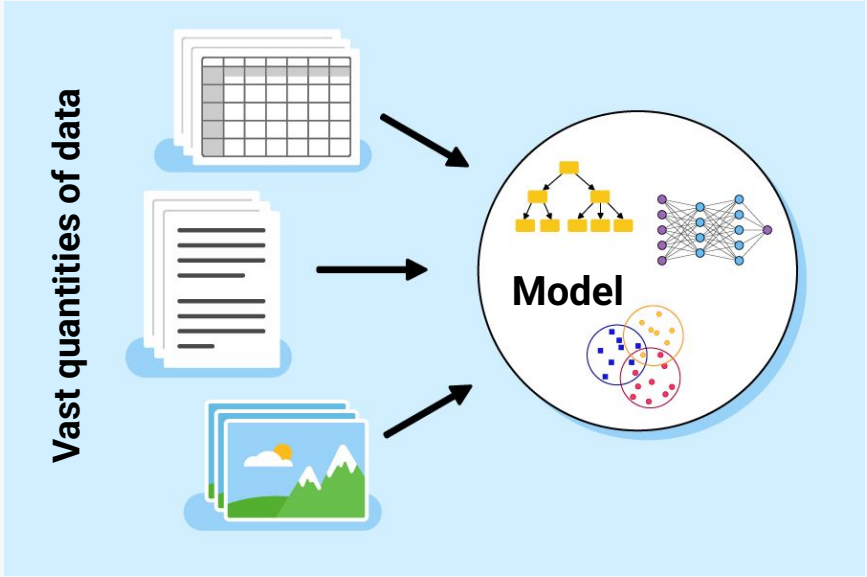
Move 2:
IF the other player did not place an O in the opposite corner
THEN place an X in the opposite corner to move 1.
ELSE place an X in a free corner.

Move 3:
IF there are 2 Xs and a space in a line
THEN place an X in the free space on that line.
ELSE IF there are 2 Os and a space in a line
THEN place an X in that space.
ELSE place an X in a free corner.

Move 4:
IF there are 2 Xs and a space in a line
THEN place an X in the free space on that line.
ELSE IF there are 2 Os and a space in a line
THEN place an X in that space.
ELSE place an X in a free corner.

Move 5:
Place an X in the free space.

Modern AI systems use **vast quantities of data** to produce **models** that make **predictions**.

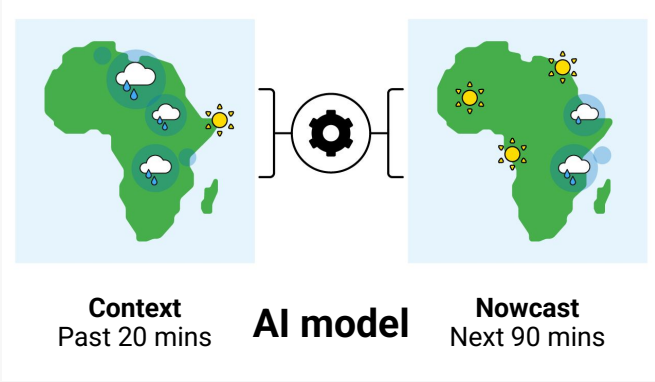


Example AI application: Nowcasting

Traditional weather forecasting uses rule-based equations, which are able to predict weather several days ahead, but struggle to produce **short-term predictions**.

Google DeepMind has created a model that is able to accurately **predict** rainfall over the next 1 to 2 hours.

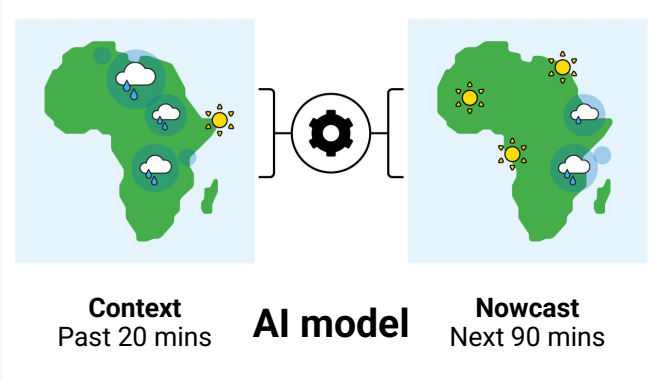
The model uses **vast quantities of radar data**, which records the amount of precipitation at ground level.



Input data → Model → Prediction

Example AI application: Nowcasting

Who do you think would benefit from these rainfall predictions and why?

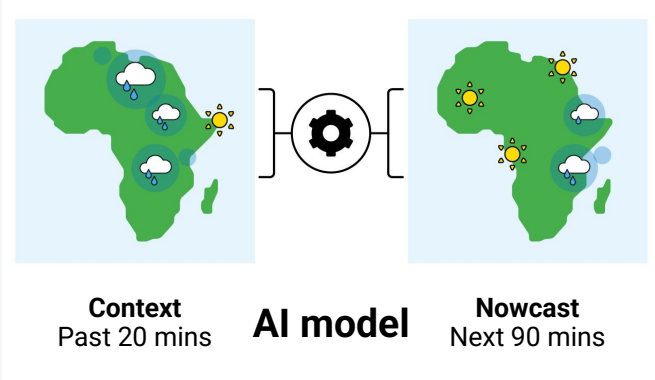


Input data ⟶ Model ⟶ Prediction

Example AI application: Nowcasting

Many different people would benefit from knowing rainfall levels for short-term periods:

- Farmers, to alert them to harvest crops before heavy rain
- Conservationists, to alert them to flood risks
- Outdoor event planners, to act on plans made for such circumstances



AI in the Serengeti

Artificial intelligence and the Serengeti

Google DeepMind took on the challenge of developing an AI system that can **predict** the animals that are present in the images captured by the camera traps.

Prediction: **Ostrich**

Artificial intelligence and the Serengeti

Think, pair, share

- What data do you think was used to train the model designed to identify animals in the images?
- What advantages do you think there are of using an AI system instead of relying on human volunteers?
- Who benefits from the predictions that are made?

Prediction: **Ostrich**

Answers

What data do you think was used to train the model designed to identify animals in the images?

Vast quantities of **images** captured by the camera traps.

The images were **labelled** (by human volunteers, just like you did) to help train the model.

Labels:
Species: Elephant
Number: 3+
Behaviour: Moving

Labels:
Species: Lion
Number: 1
Behaviour: Resting

Answers

What advantages do you think there are of using an AI system instead of relying on human volunteers?

Predictions can be made much **faster** and **more accurately** than by the human volunteers.

Answers

Who benefits from the predictions that are made?

Conservationists can respond quickly to events affecting the ecosystem. This significantly improves conservation efforts and helps to preserve and maintain biodiversity.

Who benefits from using an AI system?

Using AI for the Serengeti project will help:

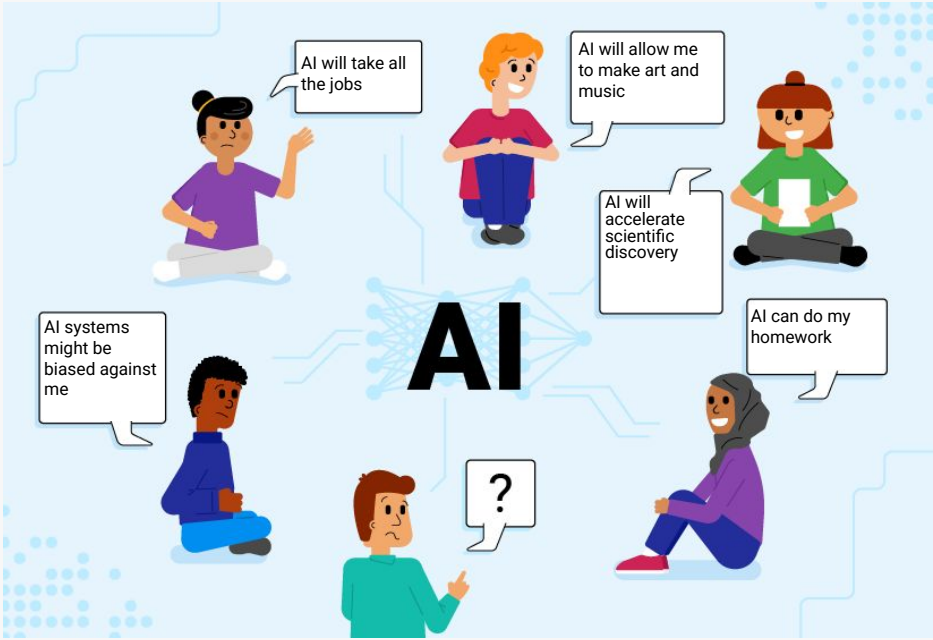
- The **animals** of the Serengeti in their fight to survive
- **Us** to understand more about how different **organisms** are affected by human activity and climate change
- **Conservationists** to make effective plans to protect this special ecosystem
- **Ecology students** to learn how to develop their own models

Google DeepMind hopes to empower local experts to use AI techniques to address problems in their own communities.

The impact of AI

Discussion: Impact of AI

- Work in a small group (as directed by your teacher)
- Study your concept cartoon
  - Discuss each statement
  - Decide which statement(s) you agree with
  - Give a reason for your choices
  - Challenge (respectfully) others in your group with different opinions



Careers in science using AI

AI in science

AI is not just for computer programmers.

In this lesson, you have seen examples of AI being used for conservation and weather predictions.

Can you think of any other areas where it would be useful for scientists to use AI applications to make predictions?

AI in science

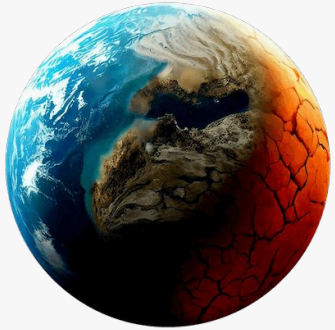
AI systems are able to work with large volumes of data to:

- Identify patterns
- Make predictions

Discovering new medicines

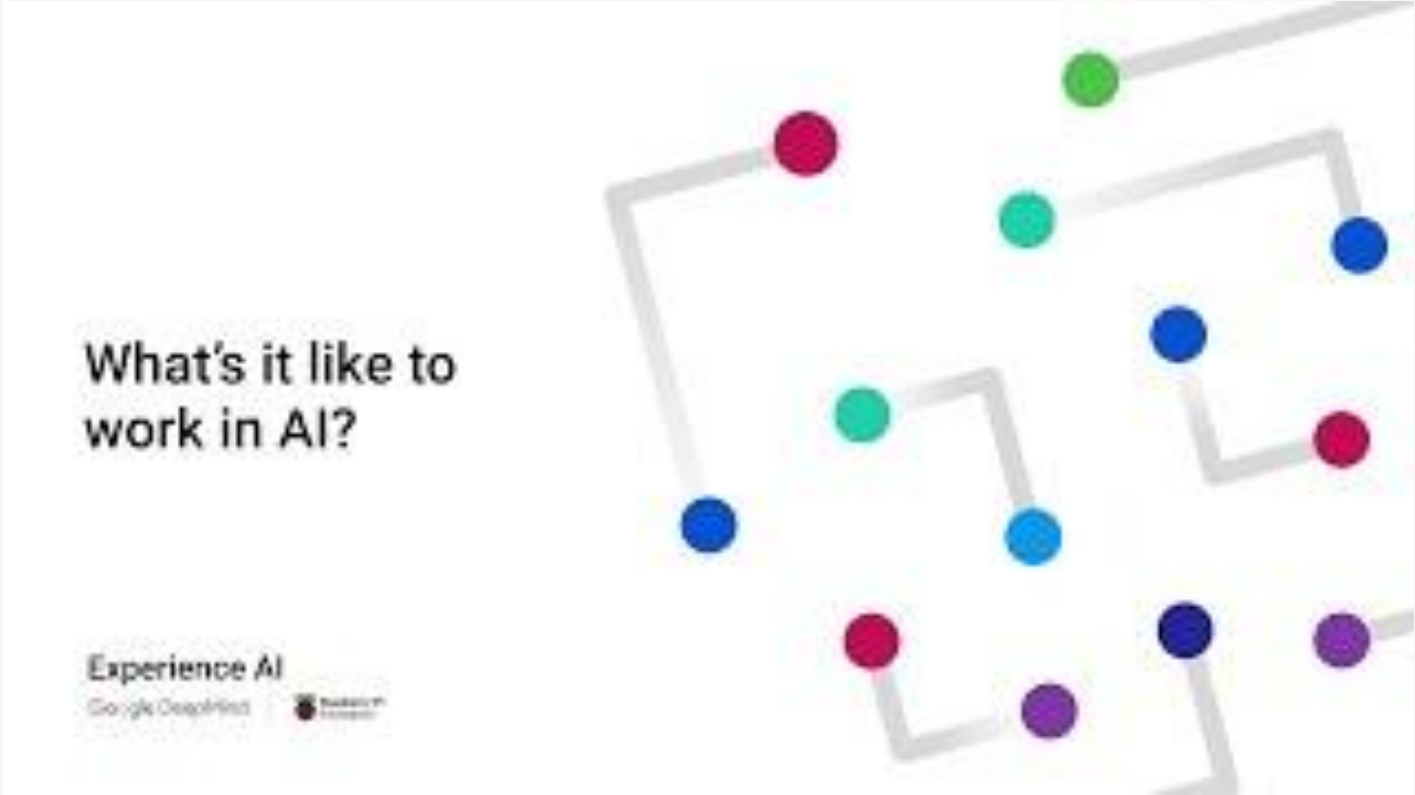
This will have an impact on many different areas.

Forensics



Fighting climate change

Careers in AI

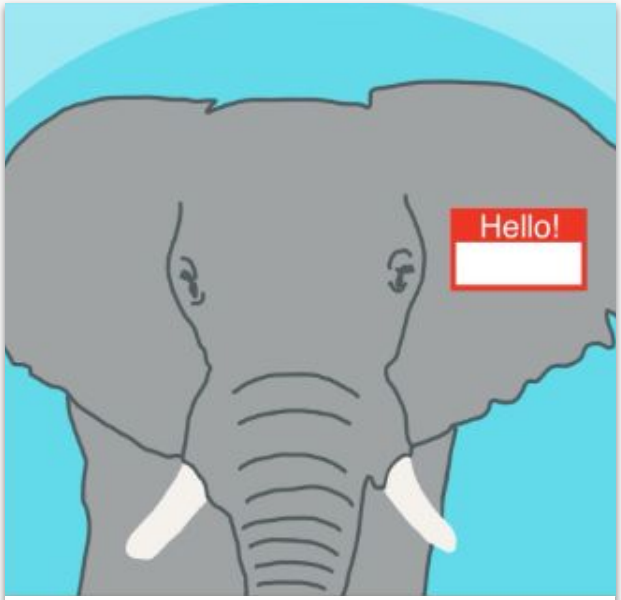


Watch the video on YouTube

Citizen Science projects

Citizen Science is a term given to research conducted with participation from the general public.

The Zooniverse (website and app) has a wide range of projects that will allow anyone to take part in real, cutting-edge research in biology and many other fields.



ELEPHANT ID

What you have achieved

In this lesson, you...

- Recalled the importance of maintaining biodiversity
- Described why artificial intelligence (AI) is a useful tool in helping to maintain biodiversity
- Discussed some of the benefits and drawbacks of using AI

Credits

These resources have been produced by computer science educators and researchers at the Raspberry Pi Foundation with the support of Google DeepMind.

Members of the Biology Education Research Group of the Royal Society of Biology provided us with advice and guidance. In particular, we would like to thank Ann Fullick, Anthony Short, Liam Cini O'Dwyer, Charlie Pettit, and Henry Ward for their valuable contributions.