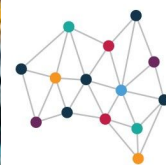# Discovering
Artificial Intelligence (AI)

in the Secondary classroom

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Achievement standards:

Achievement Standard

By the end of Year 6, students expla[in]
digital system components (hardwa[re]
and how digital systems are conne[cted]
explain how digital systems use wh[...]
representing a variety of data types[...]

Students define problems in terms [of]
requirements and design solutions [to]
address the problems. They incorp[orate]
repetition and user interface desig[n...]
implement their digital solutions, i[n...]
They explain how information sys[tems]
needs and consider sustainability[...]
creation and communication of id[eas...]
collaborative digital projects usin[g...]
protocols.

Achievement Standard

By the end of Year 8, students distingu[ish]
types of networks and defined purpos[e...]
image and audio data can be represe[nted and]
presented in digital systems.

Students plan and manage digital pr[ojects...]
information. They define and decomp[ose...]
functional requirements and constrai[nts...]
experiences and algorithms incorpo[rating...]
iterations, and test, modify and imple[ment...]
They evaluate information systems a[...]
of meeting needs, innovation and su[...]
and evaluate data from a range of s[ources...]
solutions. They use appropriate prot[ocols...]
and collaborating online.

Achievement Standard

By the end of Year 10, students explain the control and management of networked digital systems and the security implications of the interaction between hardware, software and users. They explain simple data compression, and why content data are separated from presentation.

Students plan and manage digital projects using an iterative approach. They define and decompose complex problems in terms of functional and non-functional requirements. Students design and evaluate user experiences and algorithms. They design and implement modular programs, including an object-oriented program, using algorithms and data structures involving modular functions that reflect the relationships of real-world data and data entities. They take account of privacy and security requirements when selecting and validating data. Students test and predict results and implement digital solutions. They evaluate information systems and their solutions in terms of risk, sustainability and potential for innovation and enterprise. They share and collaborate online, establishing protocols for the use, transmission and maintenance of data and projects.
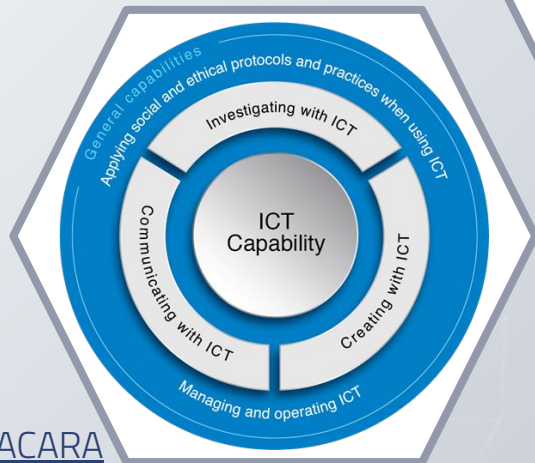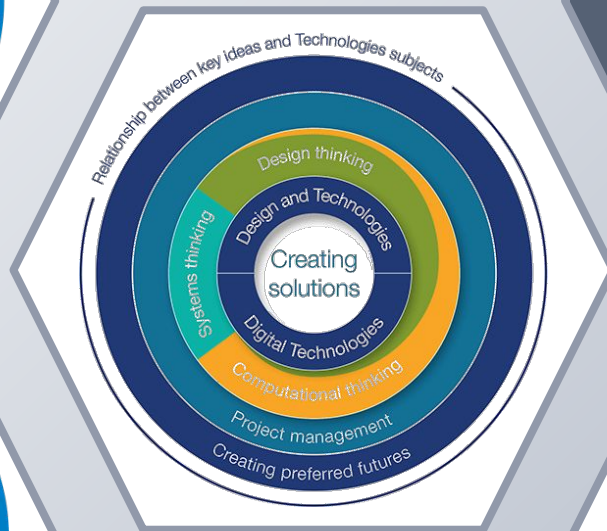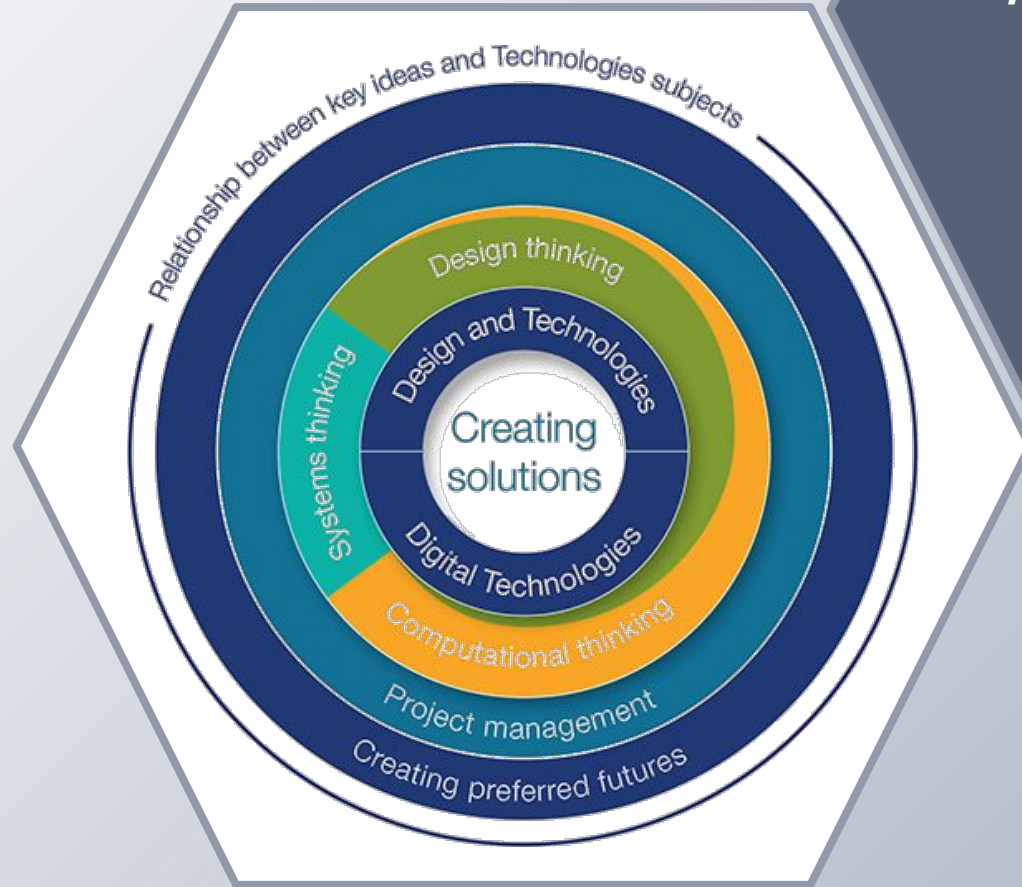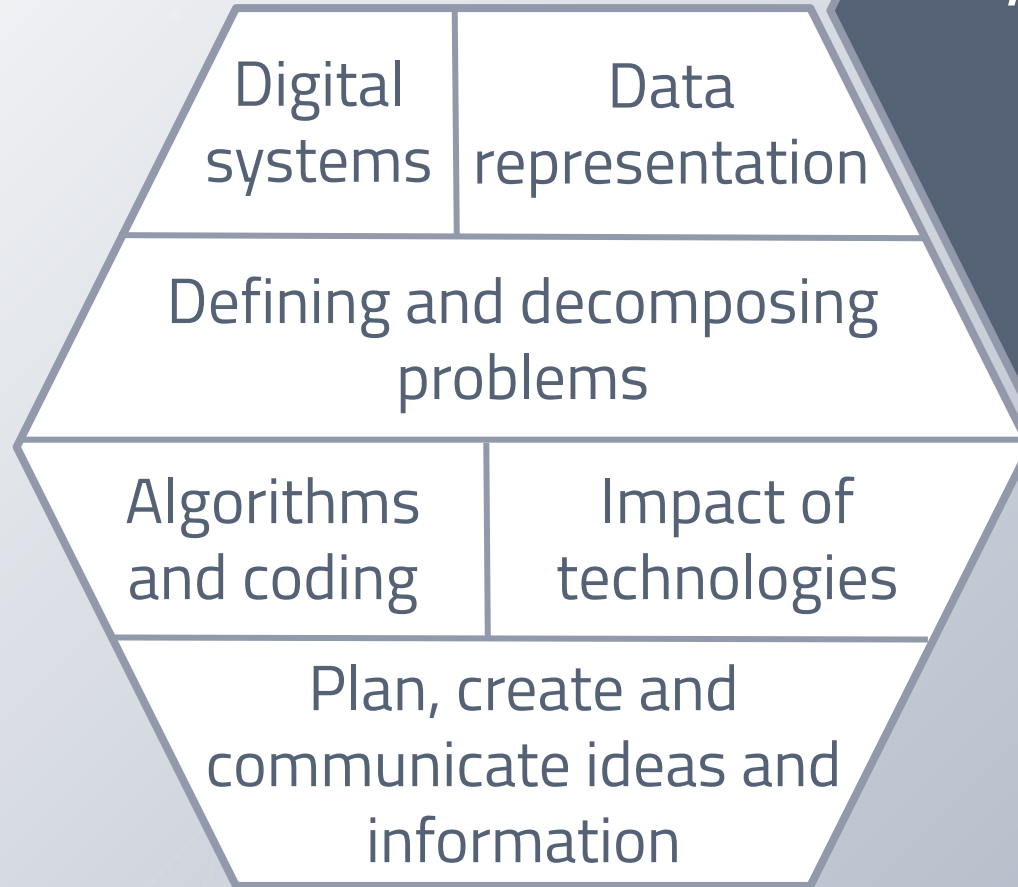
Source: ACARA

AI topics

Digital systems

Data representation

Defining and decomposing problems

Algorithms and coding

Impact of technologies

Plan, create and communicate ideas and information

Systems Thinking

Design Thinking

Computational Thinking

What is
Artificial Intelligence?

and what is it *not*?

The creation of machines to mimic human capabilities.

Teaching a machine to "see" (recognise objects in an image).

Teaching a machine to "read" and "listen" (interpret and analyse text and sounds).

... solve problems autonomously without explicit guidance from a human being.

We're usually not talking about General Intelligence.

Instead, it is **specific applications**.

Used an AI... today, this week, this month?

Used a virtual assistant?

Had spam blocked from your email?

Used predicted text while sending an SMS?

Had a YouTube clip recommended by the system?

Had search terms suggested in a Google search?

Translated a language by speaking into an app?

Chatted online to a chatbot for product information?

Used thumbprint or iris scan to unlock your smartphone?

Had your photo tagged on a social media site?

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How AI is a part of our daily lives

A photo is au...
tagged in a socia...

www.dthub.edu.au

Use thumbprint
to unlock a phone

www.dthub.edu.au

Control home appliances
using a virtual assistant

www.dthub.edu.au

What can I
...lp you with?

...chatbot to get
information

www.dthub.edu.au

RESOURCE: AI cards (PDF)

LESSON: Recognising AI (years 5-8)

EXPLAINER VIDEO: AI in our everyday life
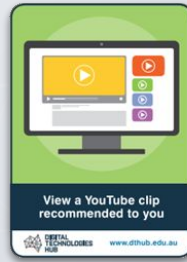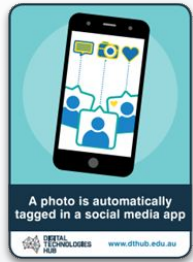
00:10   04:28 HD CC

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See, move & sense
Computer Vision

Listen, read & respond
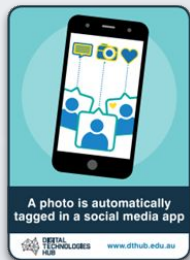**Natural Language Processing**

Think & recommend
Clustering information

See, move & sense
Computer Vision

Listen, read & respond
Natural Language Processing
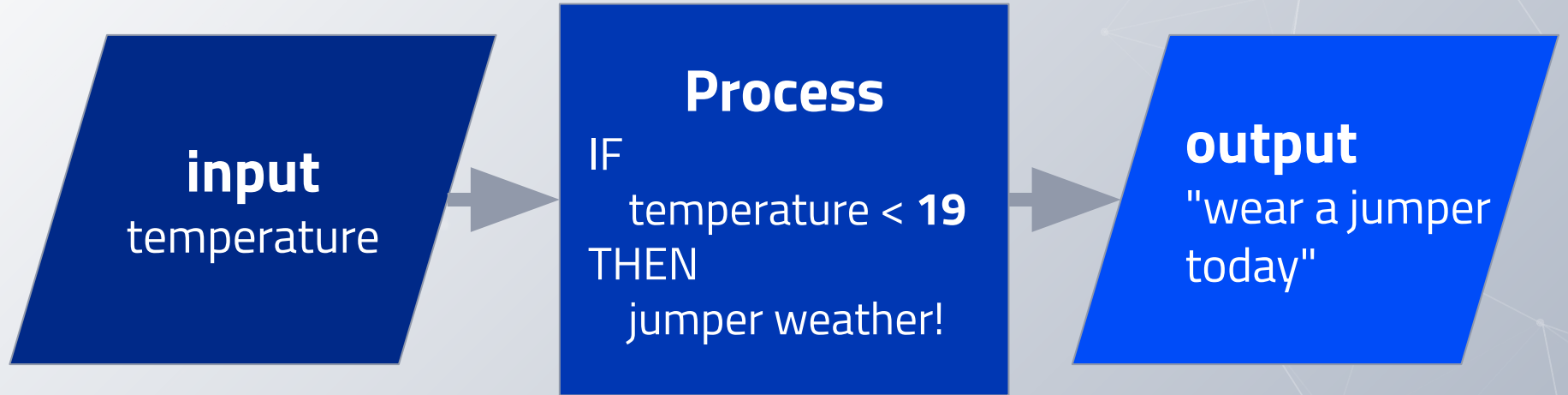
Think & recommend
Clustering information

A digital system

Traditional programming

input
temperature

Process
IF
temperature < **19**
THEN
jumper weather!

output
"wear a jumper today"

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Machine learning: training

input

shark

Process
Add to AI model as "shark".

output
"OK, this is a shark."
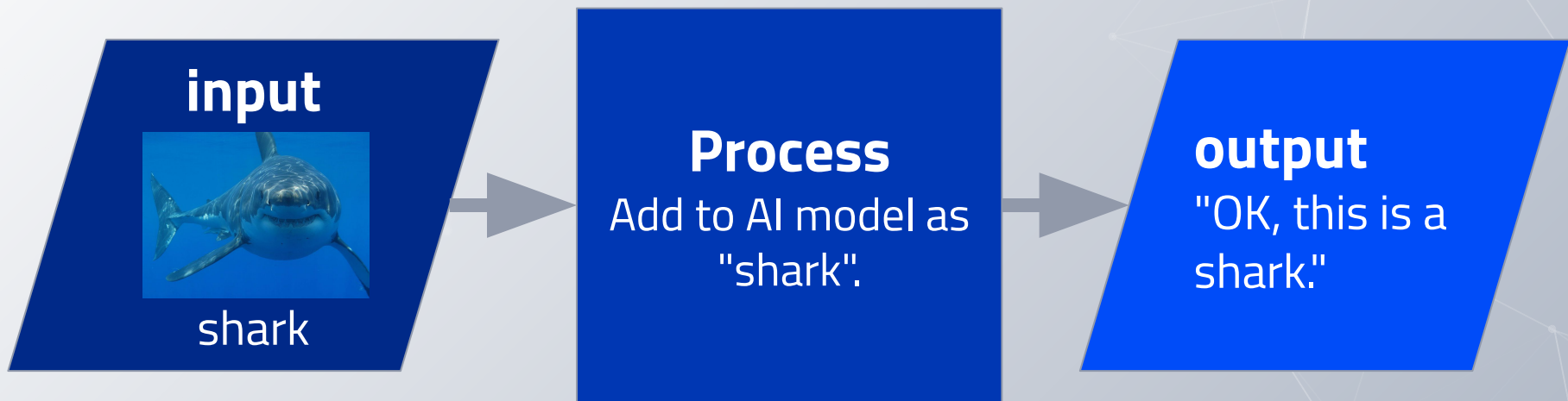
Do this with 100s of known shark images...

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Machine learning: training

Do this with 100s of known dolphin images...

Machine learning: testing

input

?

Process
Check the AI
model

output
"Probably a
shark."

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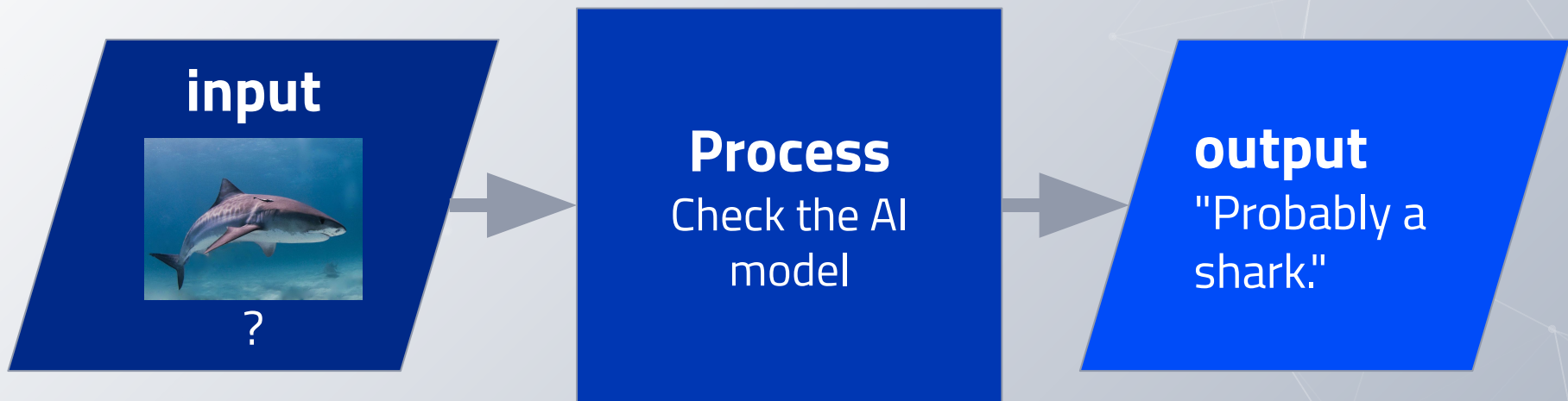
What do you notice about the input data...

...in traditional programming?

...with machine learning?

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What do you notice about the input data...

...in traditional programming?

- discrete, quantifiable

...with machine learning?

- text, sound, image, sensory
- often very large amounts of data

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Image recognition

The ability of machines to recognise objects in images or videos (part of **computer vision**).

Examples include face tagging on social media photos and vision used by self-driving cars.
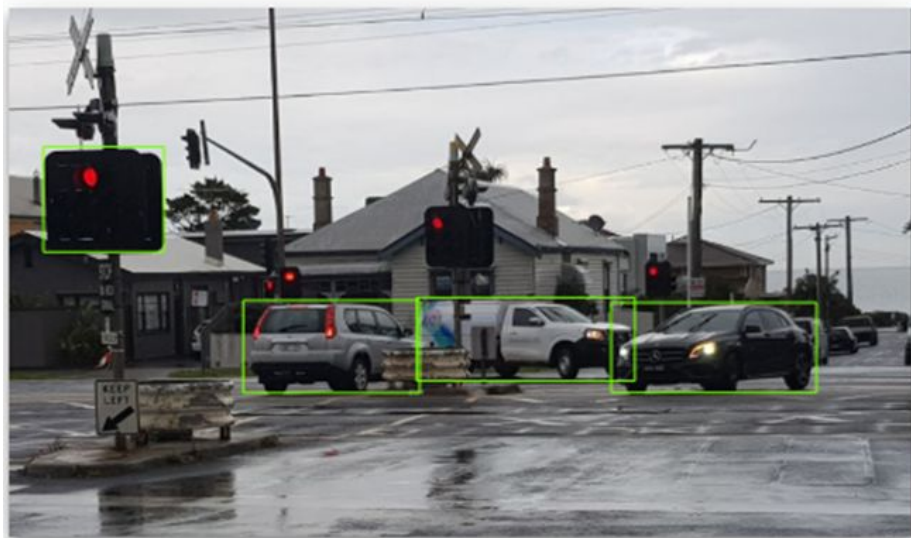
traffic.jpg

Car — 91%

Car — 82%

Truck — 78%

Traffic light — 73%

I see, I think, I wonder

Image: M. Richards

DIGITAL TECHNOLOGIES HUB
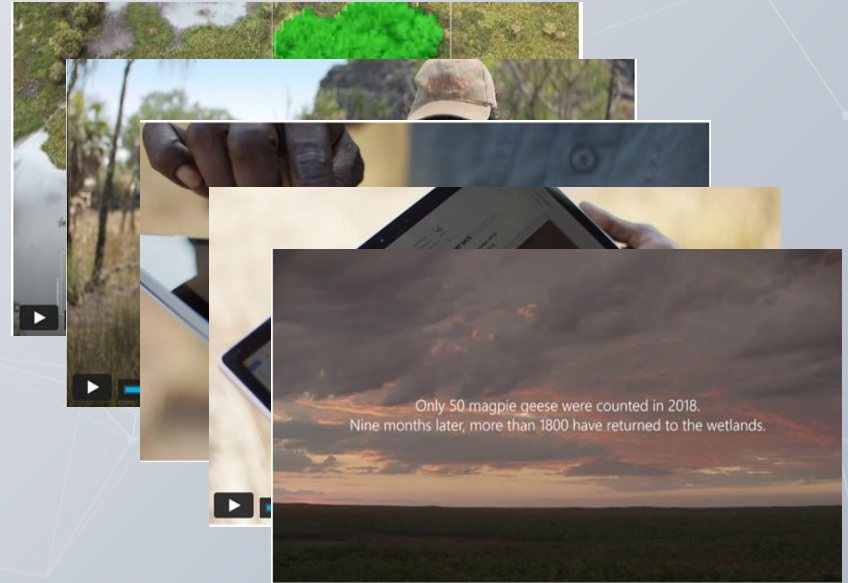
Image recognition in action
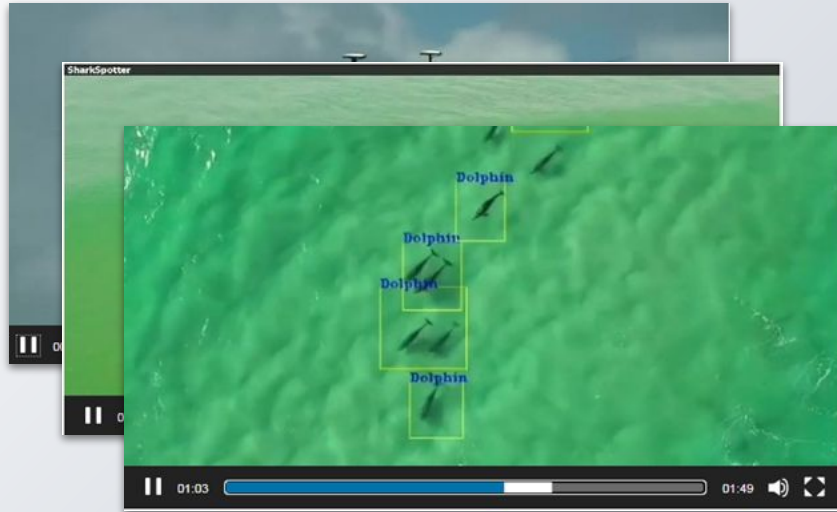
Shark spotting drone

Images: Channel 9 News

Weed spotting Kakadu National Park

Images: CSIRO

Image recognition: feature extraction
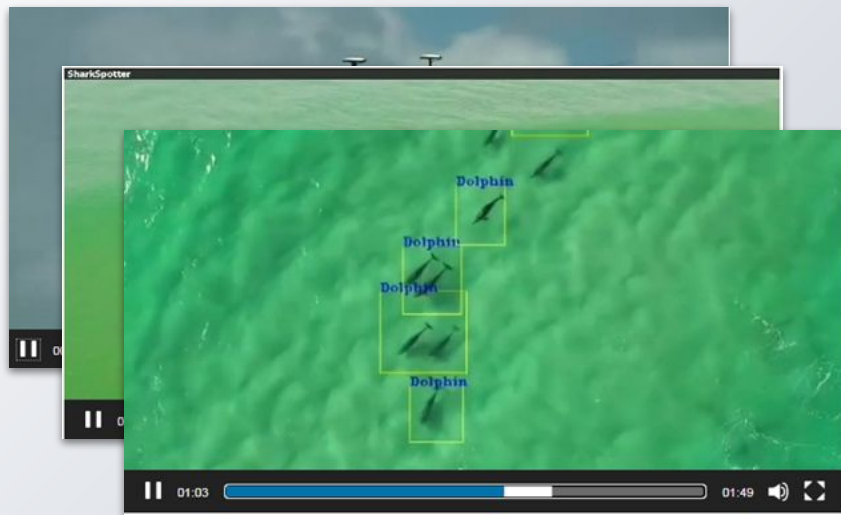
A shark or a dolphin?

What features help us to tell them apart?

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Image recognition: feature extraction

A traditional programming approach works by asking YES/NO questions then making a decision tree.

Does it have a triangular top fin?

YES

NO

It's a shark.

It's a dolphin.
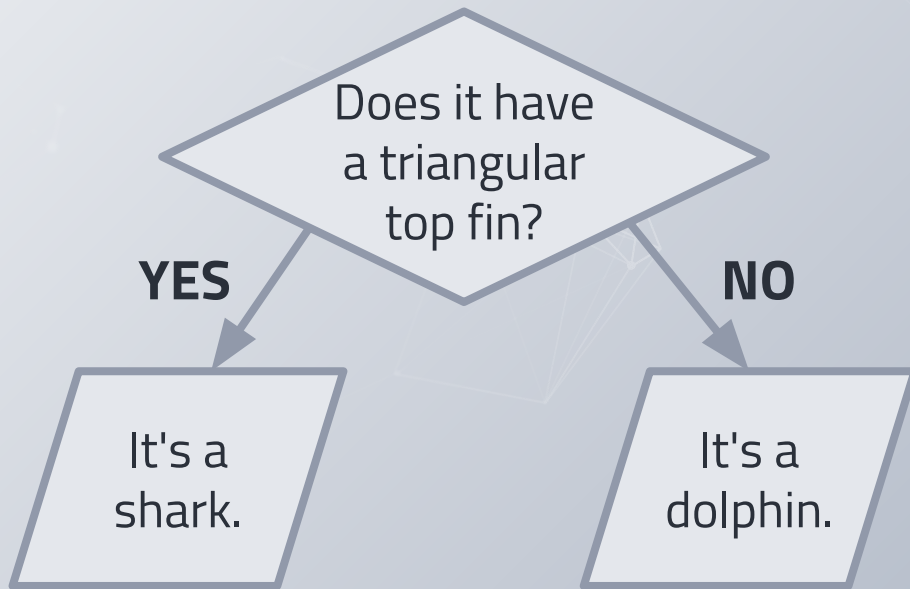
Image recognition: feature extraction

Shark	**Dolphin**
Pointed nose	**Rounded nose**
Eyes on side of its head	Eyes on side of its head
Long thin body	Long thin **curved** body
Jaws with triangular teeth	**Mouth looks like its smiling**
Gills behind its head	**Blowhole on its head**
Triangular top fin	**Curved** top fin
Two side fins	Two side fins
V shaped tail fin	**Flat curved** tail fin

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Image recognition: shape patterns

Now try drawing a shark or a dolphin in **Autodraw**.
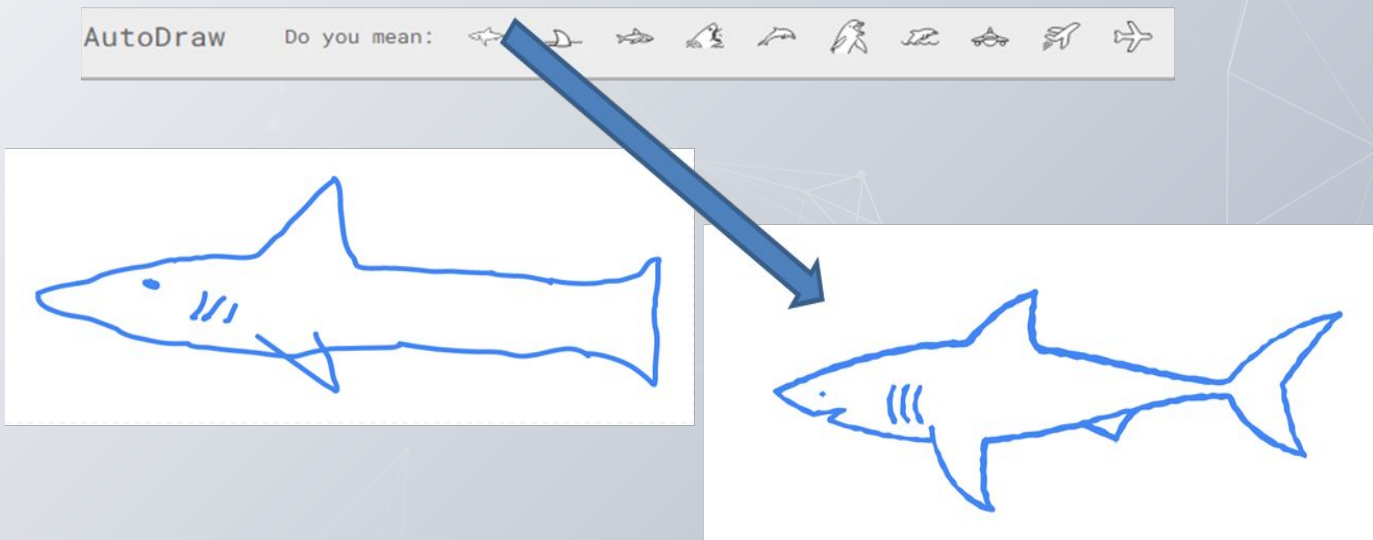
Image recognition: shape patterns

The AI may be looking for 2D Mathematical shapes combined together.

Image recognition: pixel colour patterns

The AI often starts with the positions of pixels with certain colours.

CS Field Guide **pixel viewer**

Image recognition: confidence level

Objects | **Labels** | Properties | Safe Search

Marsupial	70%
Kangaroo	70%
Landscape	65%
Pasture	63%
Wildlife	58%
Cow-goat Family	53%
Prairie	53%
Savanna	51%

kangaroo.png

Google
Cloud Vision

Image recognition: machine learning

Artificial Neural Network

Input Layer • Hidden Layer 1 • Output Layer
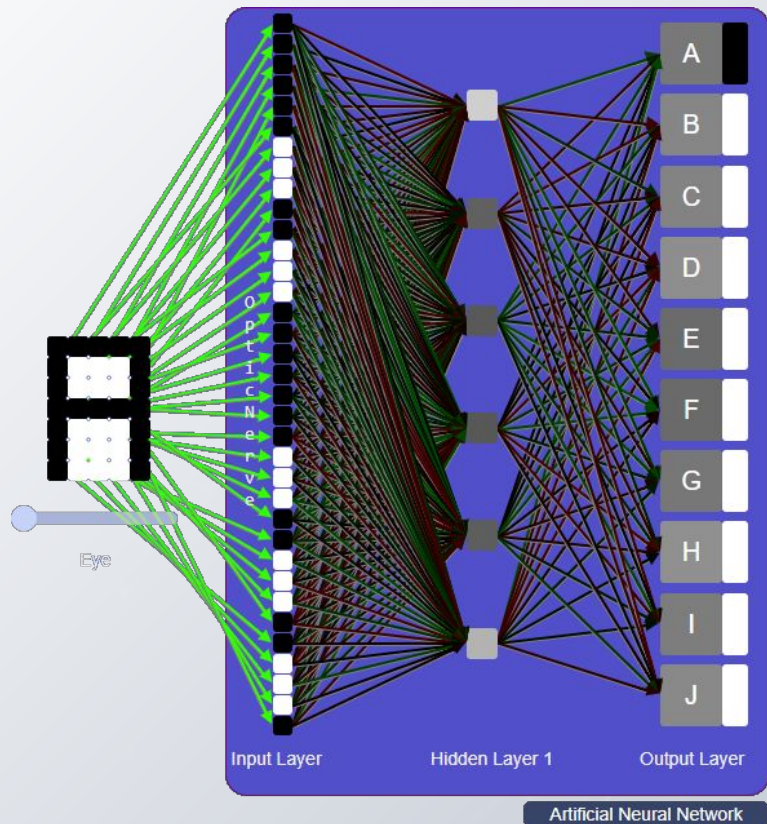
RESOURCE: Simulation at **My Computer Brain**

LESSON: Anti-bullying AI (Years 5-8)

EXPLAINER VIDEO: Introduction to AI and machine learning

Same ... but different

DEEP DIVE 2: Investigate training a machine learning model

Training an AI model to use in an application
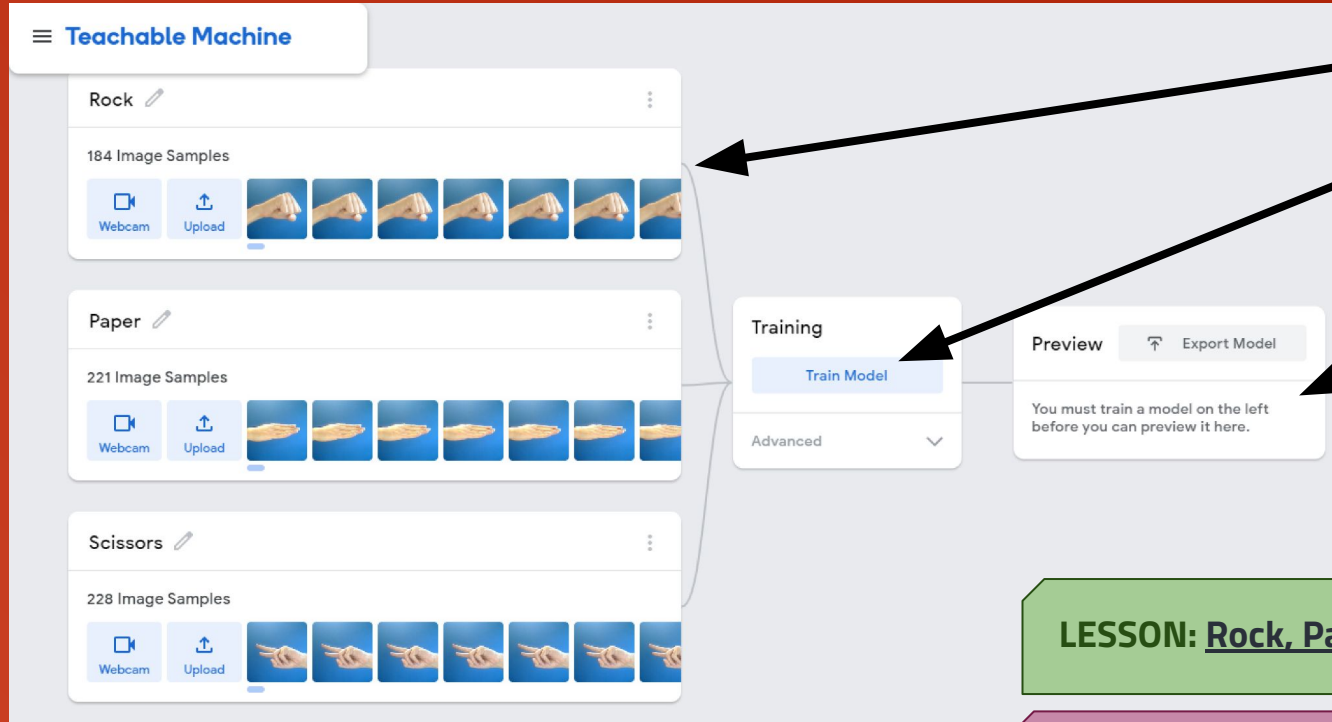
1. **Collect data**.

2. **Train** the AI model.

3. **Test** the trained model.

Google **Teachable Machine**

LESSON: **Rock, Paper, Scissors, AI!** (Years 7-8)

DEEP DIVE 1: AI and conventional programming

Test the trained model

Training

Model Trained

Advanced

Preview ⬆ Export

Input ⬤ ON Web

Logitech QuickCam Pro 9000 (04

Output

Rock

Paper

Sciss...

Preview ⬆ Export

Input ⬤ ON Webc

Logitech QuickCam Pro 9000 (04

Output

Rock

Paper

Sciss...

Preview ⬆ Export Model

Input ⬤ ON Webcam ⌄

Logitech QuickCam Pro 9000 (046d:... ⌄

Output

Rock

Paper

Sciss... 91%
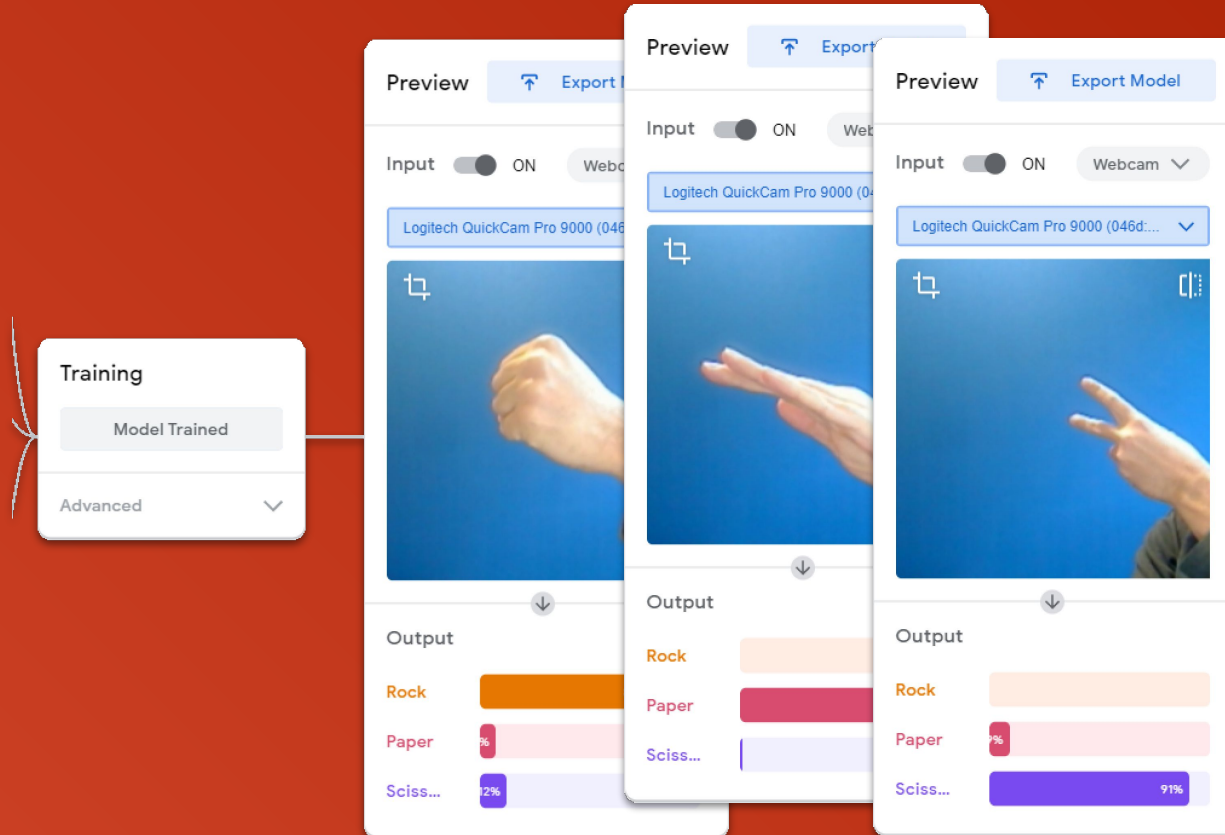
Trained model

This model works with remarkable confidence, but...

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Testing the trained model

Training

Model Trained

Advanced

Preview   ↑ Export Model

Input [ON] ON   Webcam ⌄

Logitech QuickCam Pro 9000 (046d:... ⌄

Output

Rock — 80%
Paper — %
Sciss... — 2%

Preview   ↑ Export Model

Input [ON] ON   Webcam ⌄

USB2.0 HD UVC WebCam (0bda:58d2) ⌄

Output

Rock — 20%
Paper —
Sciss... — 80%

What went wrong?

My training data was not diverse.

- all blue background

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Using the model in a coded program

Export your model to use it in projects.   ✕

Tensorflow.js ⓘ   Tensorflow ⓘ   Tensorflow Lite ⓘ

Export your model:

◉ Upload (shareable link)   ○ Download   ☁ Update my cloud model

Your sharable link:

https://teachablemachine.withgoogle.com/models/pAqVlyRWs/   Copy ⧉

When you upload your model, Teachable Machine hosts it at this link for free. (FAQ: Who can use my model?)
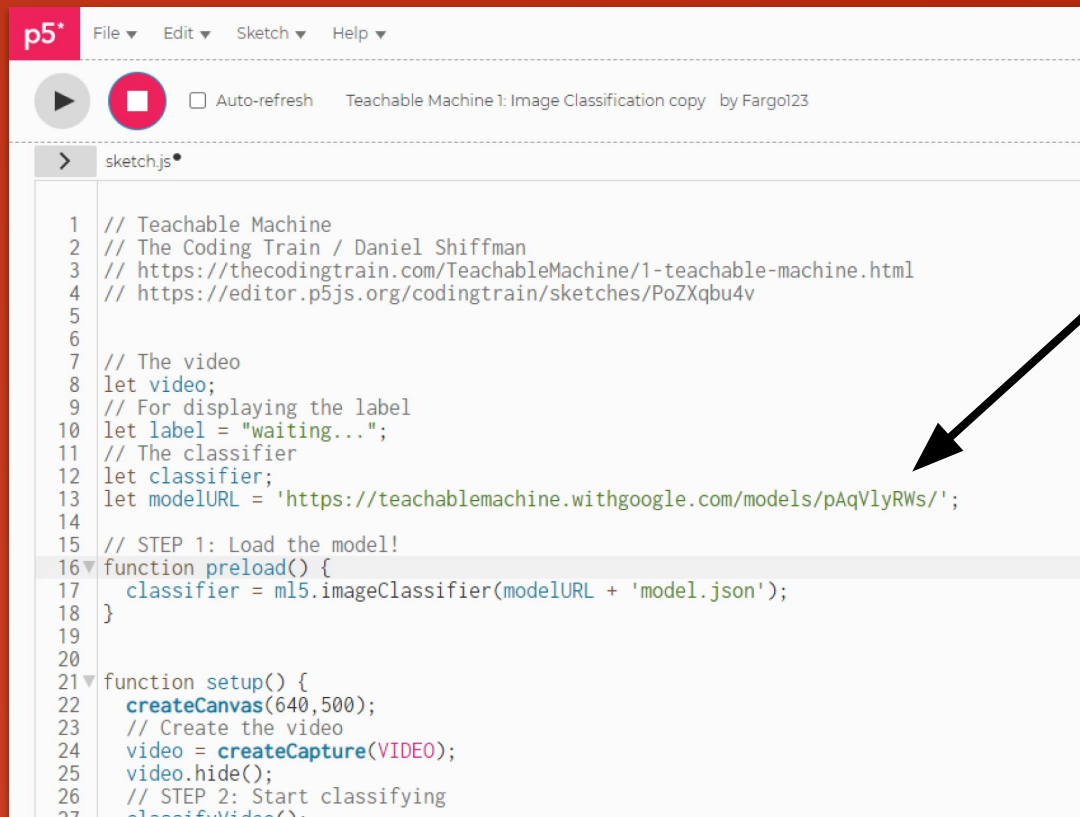
✓ Your cloud model is up to date.

Teachable Machine hosts the model with a unique URL.

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Using the model in a coded program


```
p5*    File ▼   Edit ▼   Sketch ▼   Help ▼

  ▶      ⏹    ☐ Auto-refresh    Teachable Machine 1: Image Classification copy   by Fargo123

  >     sketch.js●

 1   // Teachable Machine
 2   // The Coding Train / Daniel Shiffman
 3   // https://thecodingtrain.com/TeachableMachine/1-teachable-machine.html
 4   // https://editor.p5js.org/codingtrain/sketches/PoZXqbu4v
 5
 6
 7   // The video
 8   let video;
 9   // For displaying the label
10   let label = "waiting...";
11   // The classifier
12   let classifier;
13   let modelURL = 'https://teachablemachine.withgoogle.com/models/pAqVlyRWs/';
14
15   // STEP 1: Load the model!
16 ▼ function preload() {
17     classifier = ml5.imageClassifier(modelURL + 'model.json');
18   }
19
20
21 ▼ function setup() {
22     createCanvas(640,500);
23     // Create the video
24     video = createCapture(VIDEO);
25     video.hide();
26     // STEP 2: Start classifying
27     classifyVideo();
```

Paste the URL into a JavaScript program in the **p5 environment**.

Now your trained model can be used as part of a General Purpose program.

Systems Thinking

Seeing connections between solutions, systems and society.

Identifying components of systems.

Identifying intended and unintended outputs of a system

AI components within larger systems

Shark spotting drone

Images: Channel 9 News

Where does the **new AI component** fit?

How does it interact with the **existing system** (beach safety)?

software developer

updates and supports

gives automated instructions to

sends video to

repairs and upgrades

drone engineer

shark spotting computer
- video displaying
- AI image recognition

drone with camera
- flying
- video capturing
- rescue assistance functions

monitors, maintains

alerts

gives manual instructions to

captures on video

captures on video, assists

lifeguard and rescue authority

shark

swimmer or surfer

rescues, alerts

AI components within larger systems

- State the overall **purpose** of the system.
- Identify **hardware**, **software**, **people** and **procedures**.
- Speculate on **effects** if any components are missing / inactive.
- Consider the movement of **data**.
- Identify a **causal loop**.
- Place within a **supra system**.
- Consider multiple **viewpoints**.

Completed template

LESSON: Habits of a Systems Thinker
(Years 7-10)

LESSON: Systems Thinking and AI applications
(Years 7-10)

DEEP DIVE 4: AI: a context for Systems Thinking and Ethical Understanding

Speech recognition

Natural Language Processing (NLP) is the ability of machines to interpret and analyse forms of human communication, such as text and speech.

Examples of speech recognition include chatbots and virtual assistants.

Programming a virtual assistant

Let's apply Computational Thinking:

Decomposition

- What is interacting?
- What needs to happen first, next, etc.

Hello I'm your virtual assistant, what do you want me to do?
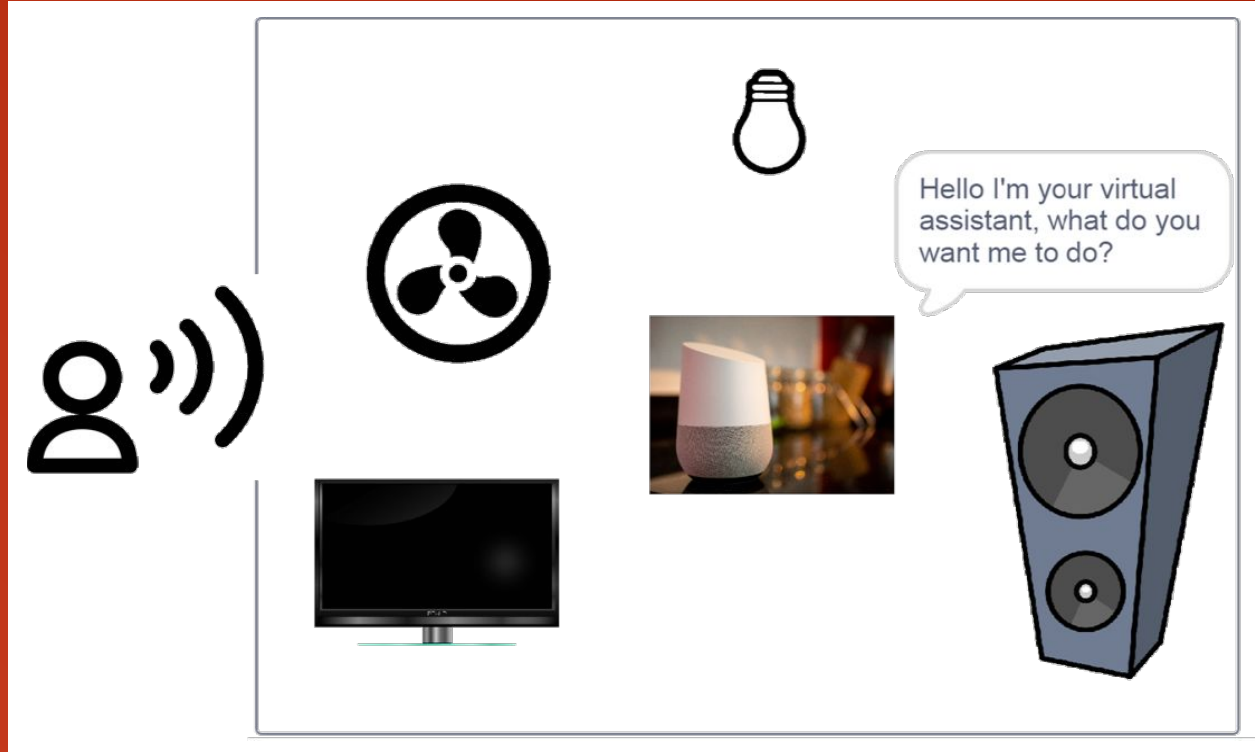
Programming a virtual assistant

Let's apply Computational Thinking:

Abstraction

- What data and functionality really matters?

Programming a virtual assistant

Let's apply Computational Thinking:

Pattern recognition

- Does anything repeat?
- Natural Language Processing

Let's apply Computational Thinking:

Algorithm design

Turn on lamp.

Does text include "on"?

Process **speech** into **text**.

Receive **speech** from user

START

Instruct user to speak

Turn off lamp.

Does text include "off"?

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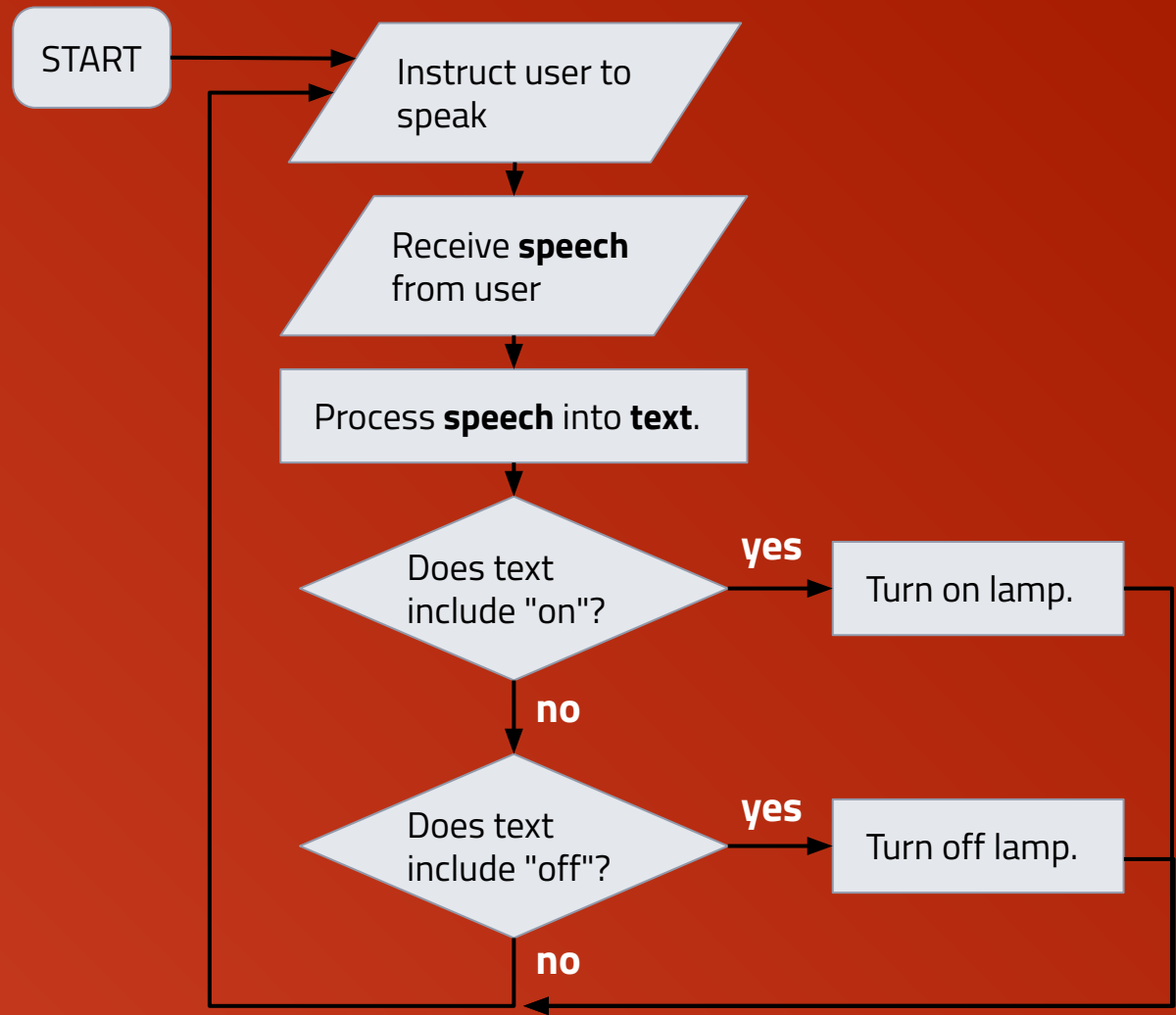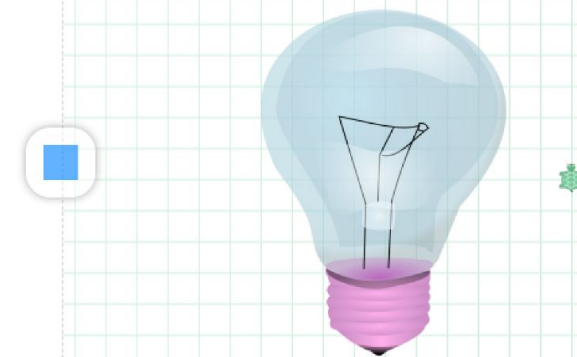
Training an AI model to use in an application

```js
{} code                                              ⚙
 1  // Create and position the sprite.
 2  var light = new Sprite();
 3  light.jumpto(-150, 0);
 4
 5  // Change the light based on speech text.
 6  function changeLight(speechText) {
 7    if (speechText.includes('on')) {
 8      light.wear('https://bit.ly/light-on-image');
 9    }
10    if (speechText.includes('off')) {
11      light.wear('https://bit.ly/light-off-image');
12    }
13    listen(changeLight);
14  }
15
16  // Main program.
17  light.wear('https://bit.ly/light-off-image');
18  write('Speak to turn the light on and off.');
19  listen(changeLight);
```

output

Speak to turn the light on and off.
⇒
⇒

Pencil Code environment

LESSON: Rock, Paper, Scissors, AI! (Years 7-8)

Large text analysis

Natural Language Processing allows us to do **sentiment analysis**.

- Rate a sentence for **positive / negative** sentiment.

- Rate how **objective / subjective** a sentence is.

- Determine the heroes and villains in a book!

```
Alice is a hero, score: 42
Queen is a hero, score: 16
Rabbit is neutral, score: 6
Duchess is a hero, score: 18
Illustration is neutral, score: 0
Hatter is a villain, score: -5
Majesty is a villain, score: -2
Alices is a hero, score: 11
Youre is neutral, score: 1
Hearts is neutral, score: 1
>
```

LESSON: Coding a sentimental chatbot
(Years 7-10)

LESSON: Book analysis with AI techniques
(Years 7-10)

DEEP DIVE 3: Natural Language Processing for large text analysis

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Ethical issues

A situation where there are competing alternatives and the right thing to do is not obvious or clear.

Sometimes terms such as good, bad, wrong, better or worse are used to consider the effect of particular actions on our lives, society, nature and the environment.

Scenarios: drawing on ethical understanding

A company is behind schedule and over budget in building an AI application.

The AI uses face recognition to unlock a smartphone.

Through testing, the company found that the AI worked with **most** people's faces.

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Exploring ethical issues further

Contexts that may interest Secondary students:

- video recommender systems

- self-driving cars and the Trolley Problem

- ...

Ethical considerations: Flowchart A

What is the ethical issue associated with the AI application?
For example, is it to do with privacy, safety, justice (equality, fairness)?
Consider if Australians have mixed views about this AI application.

Who (or what, such as the environment) is affected by the AI application?
Consider how important this AI application is to them.

What are some benefits of this AI application, and for whom?

What are some harmful or negative effects and risks from this application? Who is being affected?

Would you feel safe using this AI application?

Who is responsible if something goes wrong with the application?
What could be done to reduce the harmful or negative effects of the AI application.

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Exploring ethical issues further

Contexts that may interest Secondary students:

- video recommender systems

- self-driving cars and the Trolley Problem

- …

LESSON: Analysis of AI applications, drawing on ethical understandings (Years 7-8)

LESSON: AI Ethics – Possible, probable and preferred? (Years 9-10)

LESSON: Filter bubbles, bias, rabbit holes and nudging (Years 9-10)

EXPLAINER VIDEO: AI Systems

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DEEP DIVE 4: AI: a context for Systems Thinking and Ethical Understanding

Assessment

Artificial Intelligence is a rich field for assessment opportunities.

Here are a few examples in the core concept areas of data, algorithms, implementation and impact.

Data representation, Impact

Train and test an AI model

- Rate how well the AI recognised objects.
- Discuss the training data used.
- List ways it may be improved.

Research Algorithmic Bias

- Discuss real-world examples of algorithmic bias.
- Consider social impact.

Data representation, Algorithms, Implementation

Utilise a trained AI model in a coded program

- Design and develop a program in a suitable environment such as **p5** JavaScript.

- Import the AI model and use it to drive the program's decisions.

- Assess General Purpose Programming with a suitable rubric.

Students' use of apps & tools

Think Aloud: Student interview
- Screen captures or saved program

Self-reflection
- What they learned, challenges, checklist/rating their skills before/after
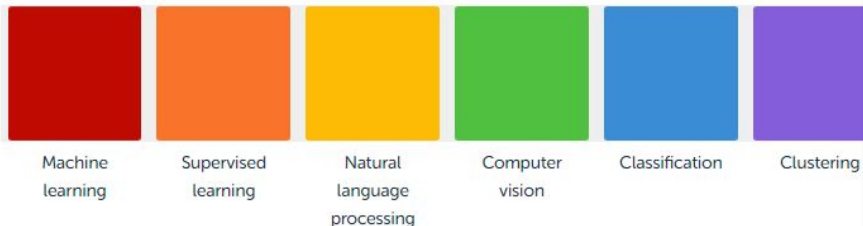
Analysis
- Artefacts such as worksheets or analysis of AI tools, applications and real world uses.
- Criteria used

Artificial Intelligence lesson plans

Humans display natural intelligence in contrast to machines that demonstrate artificial intelligence (AI).

AI has various definitions however for our purposes we are using the definition 'any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals' [1]. Read more...

The following lesson ideas cover a range of specialisations and subsets as indicated by the colour coding. Click on the coloured squares to learn more about each definition.

- Machine learning
- Supervised learning
- Natural language processing
- Computer vision
- Classification
- Clustering

F-2
5-6
7-8
9-10

F-2

Recognising AI
Use the tasks in this lesson to introduce concepts that artificial intelligence (AI... majority of the tasks a unplugged (do not re... digital device).

Can an...
An artific... use a co... vision an... features f... emotions... introduce... fun, easy t...

Home au...
Home au... voice of... recog... mobile... light... or d... inv...

9-10

Coding a sentimental chatbot in Python
Natural Language Processing (NLP) interprets text and speech. Chatbots provide a useful context to explore NLP. In this module students code a chatbot in Python, a conversational program capable of responding in varied ways to user input, including with the use of smart sentiment analysis.

Book analysis with AI techniques
Explore text analysis through Natural Language Processing, a significant application of Artificial Intelligence. View a series of video tutorials to develop a Python program that can break down and analyse the content of a complete text, such as Robert Louis Stevenson's *Treasure Island* and use smart sentiment analysis to attempt to determine the villain(s) and hero(s).

What would my preferred AI future look like?
Malyn Mawby, Head of Personalised Learning at Roseville College, explains how she implemented project-based learning (PBL) with her year 10 class to explore Artificial Intelligence (AI). Through the PBL task, students selected an area of interest and investigated what is possible, probable, and preferred.

AI ethics – What's possible, probable, and preferred?
The development and ubiquity of Artificial Intelligence raise a number of social and ethical matters that students can explore in the Digital Technologies classroom. This lesson idea outlines a project to help students frame such discussions using the curriculum...

Lesson plans

Artificial Intelligence
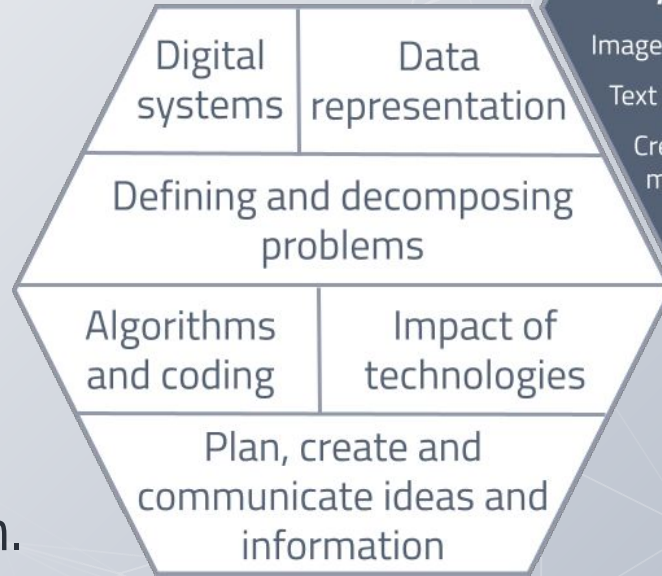
Access DT Hub AI lesson plans

Next steps

Making a commitment to implementing AI in your classroom

Use the chat to **write your idea** of where you will include AI as part of your teaching and learning program.

Connecting and sharing with the group.

email: **digitaltechnologieshub@esa.edu.au**

Digital systems

Data representation

Defining and decomposing problems

Algorithms and coding

Impact of technologies

Plan, create and communicate ideas and information

AI topics
Image recognition

Text & speech recognition

Creating & using AI models (machine learning)

Bias and ethical issues

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