

TEACHER GUIDE

Unit

Image recognition.

Unit Description

How computers can "see" our world, their capabilities and limitations.

Career

I'm a computer vision engineer.

Every unit is based on a career to help students see the relevance of what they are learning to the real world and to help schools achieve Gatsby benchmarks by linking curriculum learning to careers.

Career overview

As a computer vision engineer, I develop systems that enable machines to interpret and understand visual information from the world around them. My goal is to create reliable, intelligent systems to solve real-world problems.

Key question

How does image recognition work, what are the capabilities and limitations of AI?

Every unit is designed to help students answer one over-arching key question relating to the units four knowledge statements.

Unit objectives: knowledge statements

1. **Know** what human intelligence is and how it differs from artificial intelligence.
2. **Know** how models are trained using labelled examples.
3. **Know** how computers represent images as data and learn patterns from that data.
4. **Know** the capabilities, limitations and risks of AI systems that rely on image recognition.

Unit outcomes

1. Learn it workbooks evidencing the learning journey.
2. Make it workbook evidencing application of learning with an artefact.
 - a) A diseased cell detector.
 - i) A trained model that can identify normal and diseased cells.
 - ii) An explanation of how the model is working.
 - iii) An explanation of the benefits of AI for medical diagnosis.
 - iv) An explanation of the limitations and risks of AI for medical diagnosis.
 - v) A comparison of the Teachable Machine model and a real-world application.
3. Review it workbook evidencing assessment and review.

Prior learning / spiral curriculum

No previous learning is necessary because all units have been developed in a modular way to allow you to plug them into your existing scheme of learning.

However, if you are following our recommended pathway for curriculum 2028 here is how this unit fits into the year 7 → 9 progression pathway.

The big picture: a three-year progression

Once the national curriculum programme of study has been released, we will update this section with how this unit fits into a progressive pathway across Key Stage 3.

How the three units connect

Once the national curriculum programme of study has been released, we will update this section with how this unit fits into a broader theme of units.

Contents

In addition to this teacher guide this unit also includes the following resources:

- Folder: Extension work. Use these activities to extend any lesson or for 7–8-week terms.
 - 1 teacher extension answers.
 - 1 student extension workbook.
- Folder: Homework. Use these activities for work outside of the lesson. They are independent of the lessons and can be set at any time.
 - 1 teacher presentation.
 - 3 videos.
 - 3 video scripts.
 - 3 worksheets.
- Folder: Lesson 1 – Learn it. This lesson addresses the key question and first knowledge statement.
 - 1 lesson plan.
 - 1 introduction video.
 - 1 teacher presentation.
 - 1 student workbook.
 - Any associated resources required for the lesson.
- Folder: Lesson 2 – Learn it. This lesson addresses the key question and second knowledge statement.
 - 1 lesson plan.
 - 1 teacher presentation.
 - 1 student workbook.
 - Any associated resources required for the lesson.
- Folder: Lesson 3 – Learn it. This lesson addresses the key question and third knowledge statement.
 - 1 lesson plan.
 - 1 teacher presentation.
 - 1 student workbook.
 - Any associated resources required for the lesson.
- Folder: Lesson 4 – Learn it. This lesson addresses the key question and fourth knowledge statement.
 - 1 lesson plan.
 - 1 teacher presentation.
 - 1 student workbook.
 - Any associated resources required for the lesson.
- Folder: Lesson 5 – Make it. This lesson provides an opportunity for students to evidence their learning.
 - 1 lesson plan.
 - 1 teacher presentation.
 - 1 student workbook.
 - Any associated resources required for the lesson.

- Folder: Lesson 6 – Review it. This lesson provides an opportunity for students to check their understanding of the key vocabulary and knowledge statements plus dedicated improvement and reflection time.
 - 1 lesson plan.
 - 1 teacher presentation.
 - 1 student workbook.
- Folder: Reading. Use these activities to support reading initiatives in your school.
 - 3+ two-page reading passages with 5 questions.

PowerPoint format is used for workbooks as it allows for easy sharing on displays, animations, simultaneous collaboration and pasting without disrupting content on other pages. All PowerPoints have been checked for compatibility with Google Slides.

Differentiation

Differentiation should be provided through “adaptive teaching”. This is defined as, “The opportunity for all pupils to experience success, by adapting lessons, whilst maintaining high expectations for all, so that all pupils have the opportunity to meet expectations”. This also meets the expectations of Deborah Eyre’s [High Performance Learning](#) strategy. Differentiation is provided by instruction and support rather than by task.

Vocabulary

Term	Definition
AI model	A computer program that learns patterns from lots of examples like pictures, words, sounds or other data so it can recognise or create things when prompted.
Artificial intelligence	A computer program that can learn from data to solve problems similar to how humans do.
Artificial narrow intelligence	A computer program that is really good at learning how to do one specific task.
Artificial general intelligence	A computer program that can understand and learn anything a human can, not just one task.
Class	One type of item that you train an AI model to recognise.
Domain matching	Making sure the samples you train the model with look like the real-life things it will see later.
False positive	When the AI model outputs that something belongs to a class even though it doesn't.
Generalisation	An AI model's ability to recognise new things it hasn't seen before by using what it learned from training.
Human intelligence	The ability people have to learn, understand, be creative, solve problems and make decisions.
Neural network	A computer program that learns to recognise patterns in data by adjusting lots of values it stores each time it receives new inputs.
Sample	A single picture, word, sound or other data you give an AI model for training.
Training	A process where the AI model analyses samples so it can learn patterns in the data.
Vector	A list of numbers that a computer uses to describe something, like an image, a word or sound.

Lesson overview

Detailed lesson plans for each lesson are provided in the relevant lesson folder.

Lesson	Lesson Type	Phase 1	Phase 2	Phase 3
1	Learn it	Career overview	Understand the differences between human and artificial intelligence.	Understand that unlike AI, humans apply intelligence to new and unfamiliar problems.
		Students consider what a computer vision engineer does and what skills / knowledge they need.	Students consider 15 signs of intelligence and decide if humans or computers have an advantage.	In pairs students consider what a Roman dodecahedron might have been used for. Students identify 12 uses of image recognition.
2	Learn it	Retrieval	Use Teachable Machine.	Understand the characteristics of good samples.
		Students fill in the blanks to differentiate human and artificial intelligence.	Students make a model that can identify Gala apples and red peppers.	Students identify 4 problems in samples of broccoli and cauliflower before extending their image recognition model.
3	Learn it	Retrieval	Understand images are vectors.	Understand how AI models can learn from data.
		Students decode anagrams, identify 3 key words and write definitions of each key term.	Students encode bitmap images with 0 to indicate a white pixel and 1 to indicate a black pixel.	Students use a spreadsheet model in to recognise a square and equals sign.

4	Learn it	Retrieval	Understand what image recognition can do well.	Understand the limitations and risks of AI.
		Students categorise 6 terms into input, process or output.	Students sort 50 images of waste items into categories of plastics, cardboard, glass, metal or none.	Having read 6 limitations of AI for image recognition students rank them in order.
5	Make it	Retrieval	Make a model that can identify normal and diseased cells.	
		Students sort cards into capabilities, limitations and risks of AI.	Students use Teachable Machine to make a model that recognises two different images.	
6	Review it	Assess	Self/Peer review.	Reflect and improve.
		Students complete a multiple-choice quiz.	Student's mark each other's answers to the quiz and self-assess or peer-review work from lesson 5.	Students RAG rate themselves against a series of "I can" statements. Students improve their work or undertake extension activities.

Homework

3 activities provided.

Students watch up to a 5-minute video about the hinterland (discovering), real-world application (exploring) or consolidation (revisiting) related to the unit. Students complete a simple sheet, with all the information required to complete it included within the video.

Homework is designed to require no parental support and is independent of any lesson.

Homework	Title
1	How humans and computers “see”.
2	A day in the life of a computer vision engineer.
3	How an image becomes information.

Extension activities in the student extension workbook could also be used for homework.

Assessment

Students are graded intern, junior, associate and senior to reflect the careers-oriented approach.

Artefact

It is recommended that the Learn it workbook is used for students to record their development in learning, new knowledge and skills. They may need help with these activities in order to make progress, and therefore it is not the best work for assessment.

Instead, assess the Make it artefact workbook. This should be the best work the student can produce and will allow you to judge their independence.

 Intern	- At least one knowledge statement is achieved. - Teachable Machine has been used to make a working AI model.
 Junior	- At least two knowledge statements are achieved. - The AI model has a “None” or “Reject” class to reduce false positives.
 Associate	- At least three knowledge statements are achieved. - There is an understanding of how image recognition works. - The benefits of image recognition have been identified.
 Senior	- All four knowledge statements are achieved. - The samples chosen belong to the correct class: 12 normal, 12 diseased and 12 reject. - The risks of AI models and the potential impacts are explained. - Similarities and differences between educational models and real-world applications identified.

Tick the statements that best apply to the student when making their artefact. Award a best-fit mark of intern, junior, associate or senior.

Multiple-choice quiz

A 24-question multiple-choice quiz assesses the 4 knowledge statements and vocabulary of the unit. Award intern for 0-9 marks, junior for 10-16 marks, associate for 17-21 marks and senior for 22-24 marks.

You may choose to put the quiz into Microsoft Forms or equivalent for automatic marking.

Students should not open their Learn it workbook or Make it artefact workbook when completing the quiz.

Reflection

Lesson 6 provides an opportunity for students to review the work of their peers, identify and carry out improvements to their own work. It may not be necessary for teachers to mark the artefact for every unit for every student. Instead, you could take a moderation approach instead, sampling just a few pieces of work.

It is suggested that peers highlight statements on the assessment grid in yellow and teachers highlight in green to distinguish the two markers.

Grading

Consider both the mark for the artefact and the mark for the quiz to award a best-fit judgement.

National curriculum links

These will be populated when the new National Curriculum is released.

Applications of AI

How the students can use AI to produce or enhance their work. Includes instructions for how use of AI can also be avoided.

The questions in the assessment lesson 5 can be answered with the help of AI. In particular a student may ask an LLM to explain or summarise the similarities and differences between Teachable Machine and a real-world image recognition model used for medical diagnosis such as Hologic Genius™.

Many of the extension activities also include opportunities for research which can be streamlined with the use of a large language model.

Software

PowerPoint or equivalent for students to complete the workbook and teachers to show class presentation.

Web browser to provide them with access to the online tools required for completion of this unit.

Online and unfiltered sites required

<https://teachablemachine.withgoogle.com/train/image>

The following site is used to host our homework videos for this unit:

- <https://www.tella.tv>

Extension activities

These can be used as additional activities in 7–8-week terms, for alternative homework, or for additional activities in lessons.

Extension activities are included in a separate workbook for students “Student Extension workbook.pptx”

Extension answers are included in a separate presentation for teachers “Teacher Extension answers.pptx”

Extension 1	Unknown objects of the ancient world
Activity	Examine the ancient artefact which is a bronze cog found in 1901 off the coast of the Greek island of Antikythera, dating to roughly 205-60BC. Using human intelligence of applying knowledge to new unseen problems, can students identify what it might have been used for?
Extension 2	Design an AI agent
Activity	One example of an image recognition system in schools is biometric cashless payments using fingerprints. Using human creativity think about a new hypothetical AI tool for school that does one specialised task. Describe what it does, what data it needs, how humans would use it and how it might fail.
Extension 3	Painting by numbers
Activity	An image represented in binary is shown. Fill each cell numbered 0 in black and 1 in white, revealing how numbers can represent images. The image is supposed to be a cat but looks a lot like a kitten due to the eyes. It could also be interpreted as a dog, particularly a puppy or a fox. This can lead to discussions about what features encoded in numbers correspond to each animal.
Extension 4	Recognising images from vectors
Activity	Four vectors are shown representing the features of four dogs. Four vectors are shown representing the features of four rabbits. Using this data the students should attempt to spot the patterns in the numbers in order to deduce what the four unknown animals are, either dog or rabbit. The numbers themselves do not have a pattern other than whether they are less than or greater than the next number in the same vector. This is a very simplistic way of students understanding that numbers can be used to represent features which is the basis of image recognition beyond simple black and white images.

Extension 5	Image recognition in the postal service
Activity	Identify the four problems in photographs of parcels and envelopes that may cause traditional mail sorting algorithms difficulties. They reflect on how AI image recognition systems work to identify how AI models can solve these problems.
Extension 6	Automatic number plate recognition (ANPR) at a car park
Activity	Identify the strengths, limitations and risks of automatic number plate recognition (ANPR) systems at a car park.
Extension 7	How AI is changing recycling
Activity	Read the document, “How AI is changing recycling.docx” to answer the questions.
Extension 8	Just walk out technology
Activity	Research what is meant by “Just walk out technology.” Create an informative infographic classroom poster for 11–16-year-olds.
Extension 9	Uses for AI in fruit and vegetable recognition
Activity	Describe how an AI model that identifies fruit and vegetables might be used in each of these scenarios: the farm, supermarkets, food production and packaging, delivery from farms to shops, smartphone apps, smart fridge at home, cafés and restaurants, food waste recycling.

Reading

This unit includes a folder titled, “Reading”. The files in this folder contain passages of text about scenarios related to the topic and each include five questions. These resources can be used in many ways. For example:

- Guided reading and oracy activities in terms of more than six weeks.
- Cover work.
- Work for students disapplied from the lesson.
- Alternative homework.

Guided reading is where the teacher reads the text to the students who follow along with a ruler on the line being read. To support literacy, it is important that students are both supported and challenged with text that is accessible and in places more demanding. The text has been checked that it meets these criteria and is suitable for a reading age of 11–14.

The associated questions go beyond simple comprehension using a framework that provides progression from basic understanding to deeper analytical thinking. Either moving students through increasingly demanding reading skills—retrieval, vocabulary, connection, inference and evaluation or encouraging students to identify and critique the structure of an argument or explanation.