DISCOVERY AWARD

CREST AWARDS

Machines of the future

Student pack

TEAM PROJECT

Working in teams, students are challenged to design a household product that uses machine learning.

#Machinelearning

#Artificalintelligence

#Yourhome

IN PARTNERSHIP WITH

BRITISH SCIENCE ASSOCIATION

THE ROYAL SOCIETY

# Workshop 1: Would you trust a machine?

Instructions

There are risks involved in machine learning, but it can also be very useful and enhance our lives.

Things you will think about in this workshop include: is machine learning ethical, who has ownership over what the machine does, and who would be to blame if something goes wrong?

Your task is to sort different potential machine learning jobs based on their usefulness and how much you would trust a machine to do the job.

1. Cut out the cards with the examples of things machines might do.

2. Read out the examples one by one. For each one discuss:

   • How useful or not would a machine that did this be?

   • How much would you trust a machine to do this?

3. Based on your discussion place the card on the decision chart.

4. When you have placed all the cards on the decision chart, discuss in your group:

   • Are they spread evenly around the chart?

   • Are there any patterns with the types of things that were useful and not useful?

   • Are there any patterns with the types of things that lots of people trusted and the types of things that people would not trust a machine to do?

   • For the things that people would not trust a machine to do, is there anything that would change your mind?
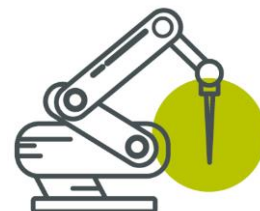
1 Buy a gift for your best friend	**6** Prepare meals for you	**11** Reply to messages from your friends
2 Post pictures of you on social media	**7** Choose your clothes for you	**12** Book an appointment for you
3 Prescribe medical treatment for you	**8** Drive a car	**13** Take photographs at your birthday party
4 Teach you a foreign language	**9** Give you driving lessons	**14** Referee a football game
5 Mark a school test	**10** Order for you in a restaurant	**15** Decorate your bedroom

Workshop 1: Would you trust a machine?

Decision chart

Place the cards on this chart to show how trustworthy or useful they are.

Trust-worthy

Not useful

Useful

Not trust-worthy
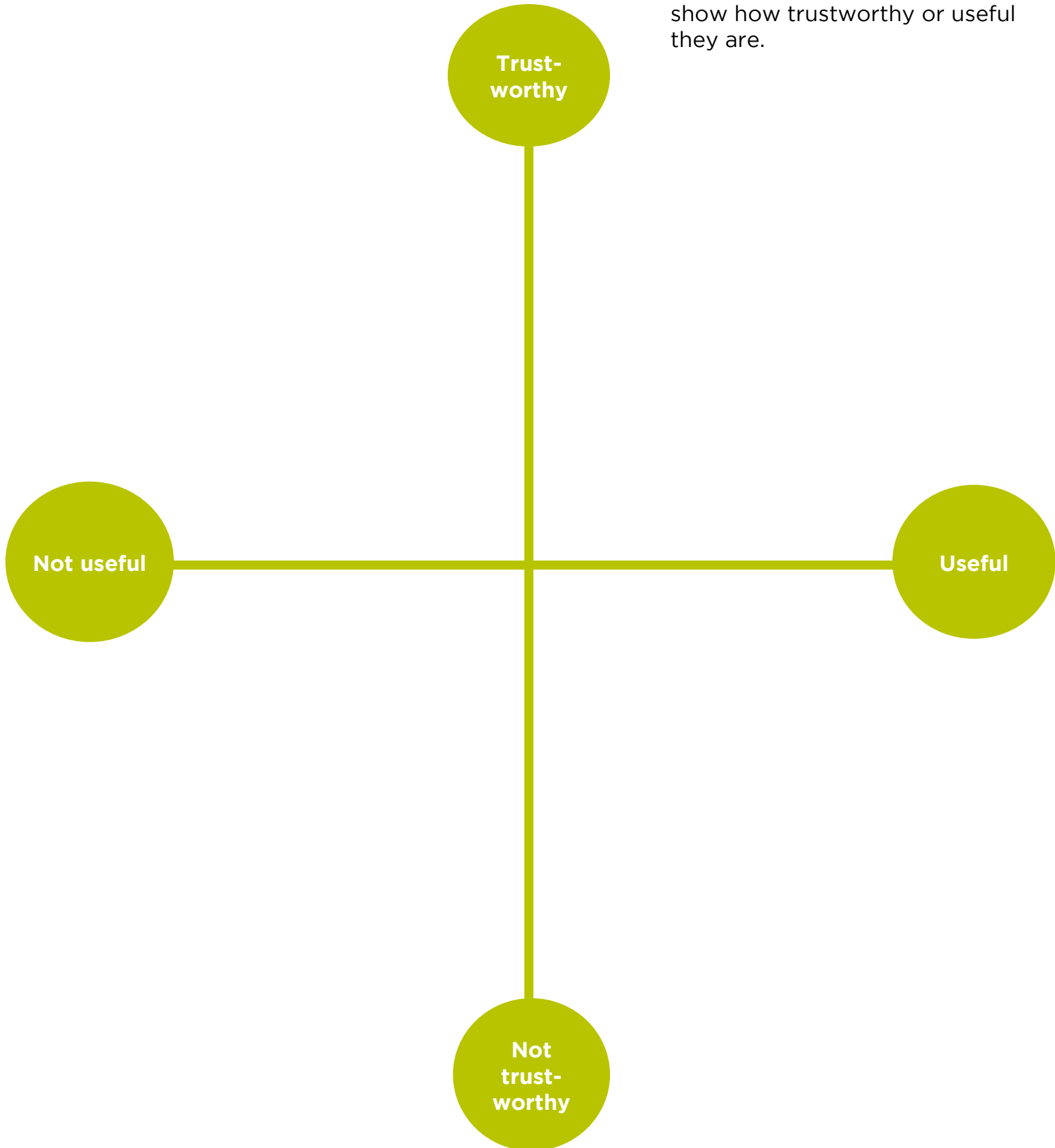
Workshop 2: Machine learning now

Instructions

Machine learning is already part of our lives. In this workshop you will learn about real examples of machine learning in everyday life.

There are three examples of machine learning. Your challenge is to put the stages of machine learning in order.

Case study 1 : Netflix

Cut out the Netflix picture and sentence cards. Match the pictures with the sentences to show how Netflix or other streaming services use machine learning to predict what you might like to watch.

Case study 2 : AI (Artificial Intelligence) duet

Read the article or watch the video. Sort the cards into the correct order or place in the spaces on the sheet you are given to show the elements of machine learning.

Article www.theverge.com/2017/2/16/14641462/google-ai-duet-experiment-music-art-software
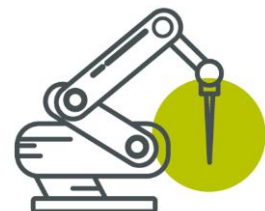
Video www.youtube.com/watch?v=0ZE1bfPtvZo

Case study 3 : Factory production

Read the article or watch the video. Sort the cards into the correct order or place on the sheet you are given to show the elements of machine learning.

Article www.autodesk.com/redshift/machine-learning-robotics/

Video www.youtube.com/watch?v=yC4J840LSRM

1. At the beginning, the machine has no idea what you might want to watch. You choose a film. It stores information about the choices you make, the content of the films and the choices other people make. **(Input)**

2. When you select a film, the machine tracks what you watched and looks for similar films or films other people have watched to make recommendations. **(Algorithm)**

3. Netflix suggests films you might like to watch. **(Output)**

4. You can either choose to watch the recommended films or ignore them. **(Test)**

5. If you choose to watch the recommended films, it shows the system is working and Netflix will continue to suggest these kinds of films to you. **(Feedback)**

Workshop 2: Machine learning now

Basic flowchart – to be used with case studies 2 and 3
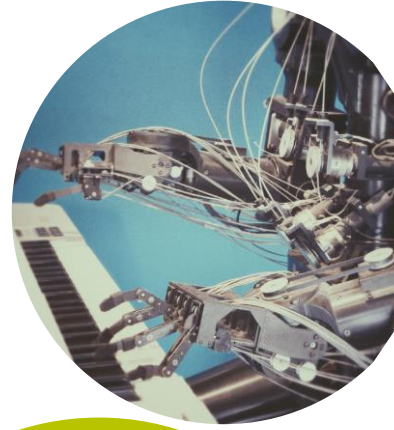
1. Data (input):

What is the content of the data?

E.g. pictures of bees and threes from the video you watched at the beginning

Where does the data come from?

Place card here

2. Algorithm

What does the machine or system do with the data?

E.g. 'Look' for patterns in all the photos of threes and all the photos of bees

Place card here

3. Output

What output does the machine produce?

E.g. Sorts each photo into either bee or three

Place card here

4. Test

How does the machine know how well it has done?

E.g. Checks if the picture has been correctly sorted by comparing its response to the responses given by a human/humans.
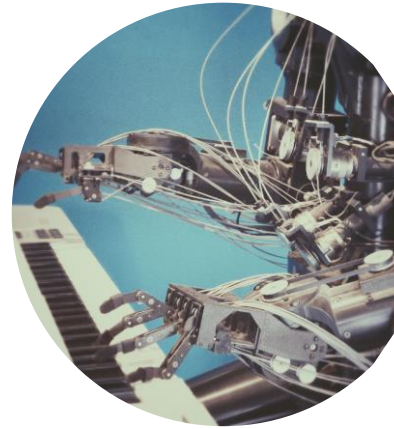
Place card here

5. Feedback

How does the machine use the results to improve its performance?

E.g. 'Remembers' which answers were correct and incorrect and uses this to improve pattern recognition and identify future pictures more accurately

Place card here

Workshop 2: Machine learning now

Flow diagram – to be used with case studies 2 and 3

1.

Place card here

1. Data (input):

What is the content of the data?

E.g. pictures of bees and threes from the video you watched at the beginning

Where does the data come from?

5.

Place card here

2.

Place card here

2. Algorithm

What does the machine or system do with the data?

E.g. 'Look' for patterns in all the photos of threes and all the photos of bees

5. Feedback

How does the machine use the results to improve its performance?

E.g. 'Remembers' which answers were correct and incorrect and uses this to improve pattern recognition and identify future pictures more accurately

3.

Place card here

3. Output

What output does the machine produce?

E.g. Sorts each photo into either bee or three

4. Test

How does the machine know how well it has done?

E.g. Checks if the picture has been correctly sorted by comparing its response to the responses given by a human/humans.

4.

Place card here

Case study 2: **AI duet** (to be used with the basic flowchart OR flow diagram)	The machine plays a tune back to the user.	It looks for patterns in what rhythms and melodies people like and play. It uses this information to compose a tune to play back to the user.
The machine rates its own performance based on how long people listen to the tune and how highly they rate it.	The user plays a tune. The machine stores information about which tunes people like and the tunes they have been playing.	The user listens to the tune and gives it a rating to show how much they like it.

Case study 3: **Factory production** (to be used with the basic flowchart OR flow diagram)	The machine builds the model using the pieces available.	Using the stored information, the machine chooses the quickest method given the blocks available.
The machine records how long it took to make the model and the method it used. It compares this to previous attempts.	The more models it makes, the more information it stores. It uses this information to make better choices about the method and blocks to use next time.	Pictures of blocks. The machine uses a camera to 'see' the blocks available. It stores information about different building methods.

Workshop 3: Teach a machine

Instructions

In this workshop you will experiment with machine learning using a range of different AI powered tools.

1. Open Quick Draw: quickdraw.withgoogle.com/

1. Launch the experiment and spend 5 minutes exploring what it can do.

1. Choose another one of the tools below and do the same.
   • Teachable Machine: teachablemachine.withgoogle.com/
   • Teachable Machine (demo version): teachablemachine.withgoogle.com/v1
   • Shadow Art: shadowart.withgoogle.com/
   • Imaginary Soundscape: www.imaginarysoundscape.net/
   • Giorgio Cam: experiments.withgoogle.com/giorgio-cam

4. In your group, for each tool discuss the questions below.
   • What does the tool do?
   • What type of data does the tool use (images, audio, text)?
   • What is the tool programmed to do?
   • How do you provide data to the tool?
   • How does the tool use the data you provide?
   • How does the tool improve over time?
   • What data does it have?

Planning guide

Your challenge: Design a household product that uses machine learning

Get started

Start by brainstorming ideas. Think about some of the different elements of home life that machine learning could help with.

- **Chores:** What repetitive tasks do you or your family do around the house? Is there a way a machine could learn to do that task? Could it be automated?

- **Security:** What security issues do you have in your neighbourhood? Is there a way that data could be used to help?

- **Communication:** Machine learning is already being used in home communication tools, to help people control their heating and security features remotely, to interact with entertainment devices like the TV or playing music. What other ways could machine learning streamline and improve communication with household devices?

Still stuck for ideas? Take a look at some of these ideas for inspiration:

- Systems that make recommendations, suggesting products or services that you might like. Like Amazon making book recommendations based on your previous choices, or Spotify suggesting songs you might like based on what you have already listened to.

- Systems that organise, such as spam filters or search engines. This often works by looking for patterns e.g. words or phrases. When you search for something online the search engine does not only look for the words you input, but it may also look for words that are associated with the words you typed in.

- Voice recognition and response such as virtual personal assistants. Like Alexa or Google Home answering questions, setting alarms or carrying out tasks, using loads of data from other people asking the same things, these assistants can improve their ability to successfully identify what is being of them and complete it in an appropriate way.

TIP!

*Your product needs to **learn rules from examples or experience**. Think about whether your idea is really using machine learning.*

https://royalsociety.org/topics-policy/projects/machine-learning/what-is-machine-learning-infographic/

Idea development

Research and develop your concept

Start by researching your ideas. Look into what similar products already exist and how they work.

- Where do they get their data from? What limitations are there?
- What output does your tool produce?
- Does your tool use supervised or unsupervised machine learning?
- Do you teach your tool using training data? Where does this data come from?
- How does your tool assess its performance?
- What are the ethical considerations of your product. What is the worst thing that could happen?
- How will your tool continue to improve once the product is on the market?
- Where will you source live data from and how will this be used to provide feedback for the algorithm (set of rules that your machine follows)?

Design your product

You will need to make decisions about the physical designs of your product. Think about whether your idea could be integrated into a tool already in use, or whether it would be an entirely new product.

- Would it be an app on a smartphone, or part of a fridge or a washing machine, or would it be something totally separate?
- Who is your product aimed at? How will it be useful for them?
- What is the physical format of your product?
- What will you do to ensure that your tool will be safe and that people trust it?
- How will you make your design both fit for purpose **and** attractive to consumers?
- How is the machine learning integrated? Will your product collect data?
- What is the reasoning behind your design?

Marketing

Have a look at what already exists, think about what makes your product unique.

- Decide on a target audience
- How will you reach them?
- How will you convince them they need this product?
- Write a 2 minute elevator pitch to explain and sell the idea of your product.

Presentation

Create a presentation on your idea using the poster making materials provided. Your presentation should be 5 minutes long, and every team member should get a chance to speak.

Team roles

Project Manager

Makes sure the whole team and the project is on track

Software Lead

The creative minds behind your program - responsible for creating a flowchart for your product, like the ones from the 'Machine Learning Now' workshop.

Research Lead

Responsible for thinking about where and how to source the voluminous sets of data you will need. Research support for other team members.

Risk Lead

Responsible for thinking about the risk vs. utility of your product and how to manage that. How will you help people trust your product? You need to identify the risks involved and ensure that your machine learning tool will be safe and unbiased.

Design Lead

Responsible for the physical design of the product.

Marketing Lead

Responsible for developing a marketing plan and thinking about who this tool would be useful for, how and why.

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