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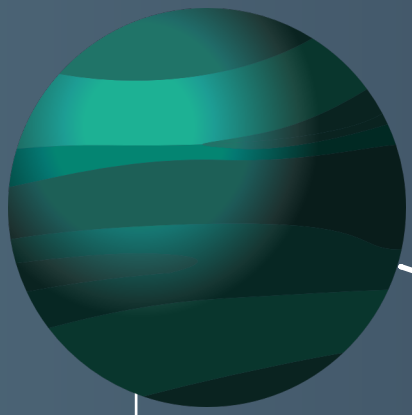
Activities Week 1 Unit 1



What is AI?

EXPLORING THE
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What is AI?

Activities Week 1 Unit 1

In today's unit we looked at what AI actually is. To continue this discussion, we have prepared the following tasks for you.

Activity 1

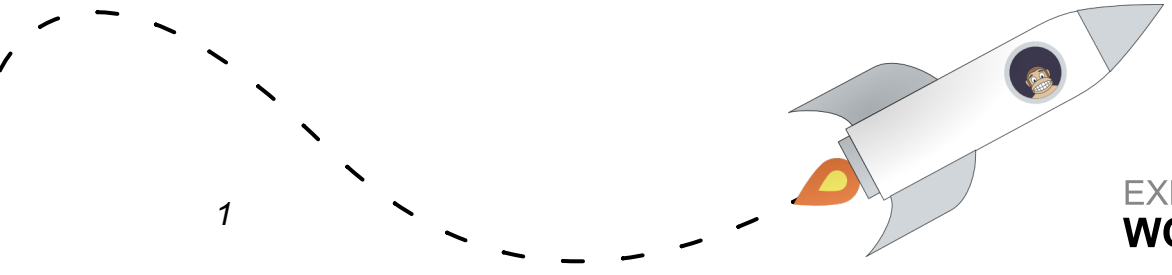
Where do you experience AI in everyday life? Take a photo or describe an example of AI on our virtual pin board in the course forum. Comment on another example: What is the role of AI in this example?

Activity 2

Discuss in the forum: How intelligent would you rate the following applications on a scale from 1 (stupid as bread) to 10 (smart as Oskar)? And why?

- **Quickdraw:** https://quickdraw.withgoogle.com
- **ClickClickClick:** https://clickclickclick.click (Turn Volume on)
- **Rock-Paper-Scissors:** https://tenso.rs/demos/rock-paper-scissors/
- **Generative Engine:** https://experiments.runwayml.com/generative_engine/

You will encounter more experiments throughout the course. But if you know any other AI experiments that you would like to share with the group, post them in the forum, too!



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Activities Week 1 Unit 2

EXPLORING THE
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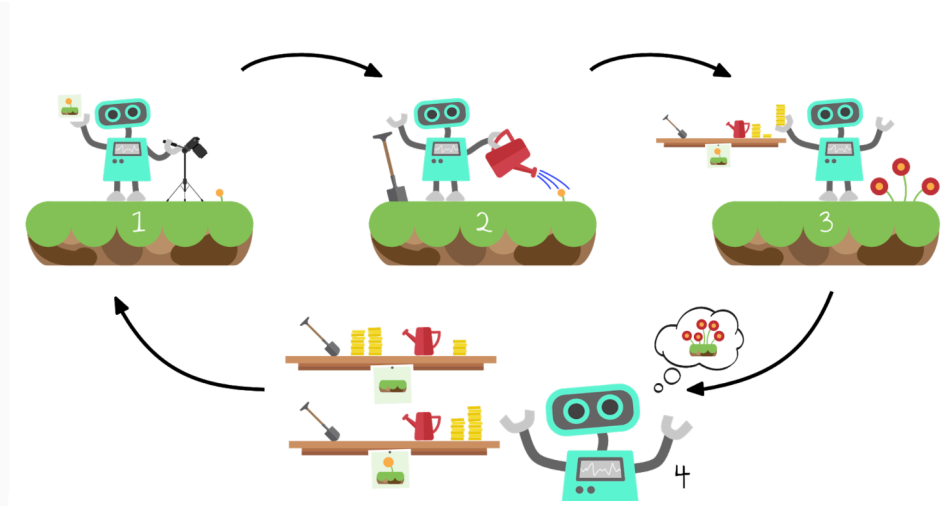
An Agent That Learns

Activities Week 1 Unit 2

Activity 1:

In order to remember things, it is helpful to write down key aspects once again in your own words. Try to note down the idea behind reinforcement learning in your own words. Also write down at least one concise example.

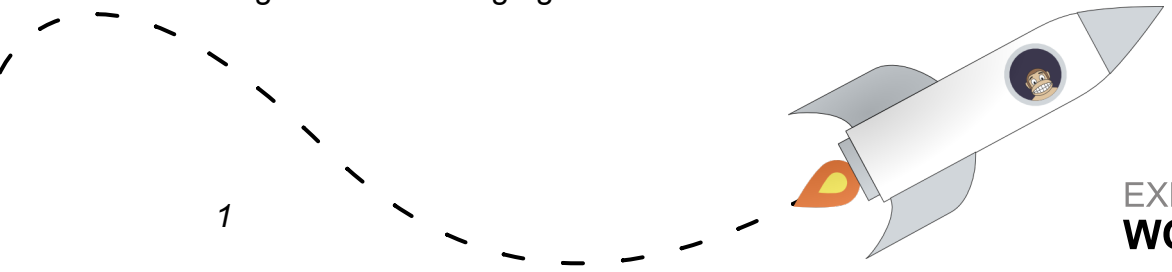


Reinforcement learning	*Description*
Examples that can be solved using reinforcement learning	

Activity 2:

The game Flappy Birds was a huge success on smartphones. At www.stefanseegerer.de/reinforcement-learning-flappybird/index.html you can watch the agent learn to play the game Flappy Birds through reinforcement learning.

1. Tap or click on the game to start the learning process. Watch the agent get better and better.
2. Set the "Show target" option to "Yes". What does the red dot mean?
3. When the agent has learned enough to fly between the tubes, change the environment from static to random while the game is running. Argue why the agent is now failing again at the tubes.



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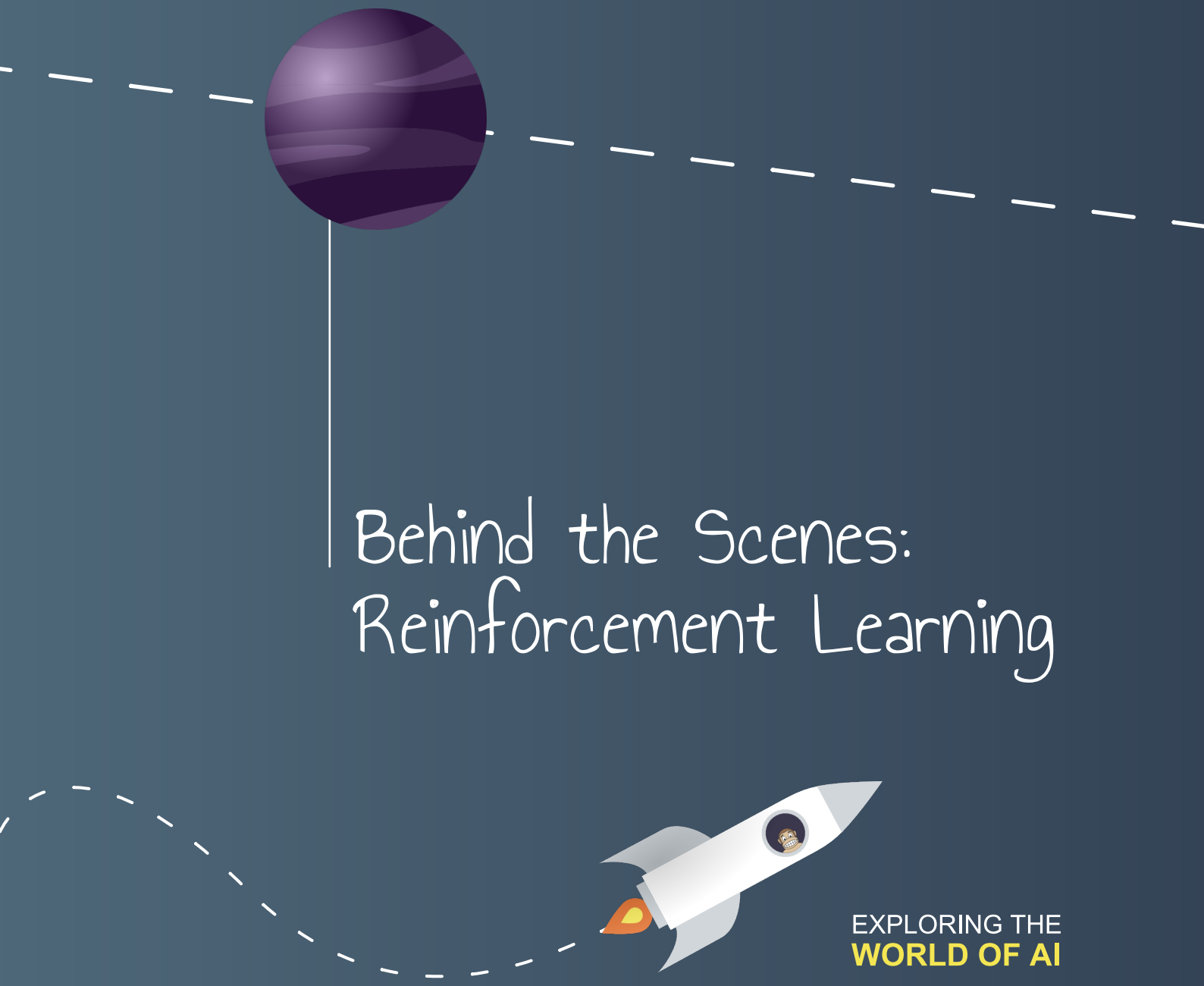
Activities Week 1 Unit 3



Behind the Scenes: Reinforcement Learning

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Behind the Scenes: Reinforcement Learning

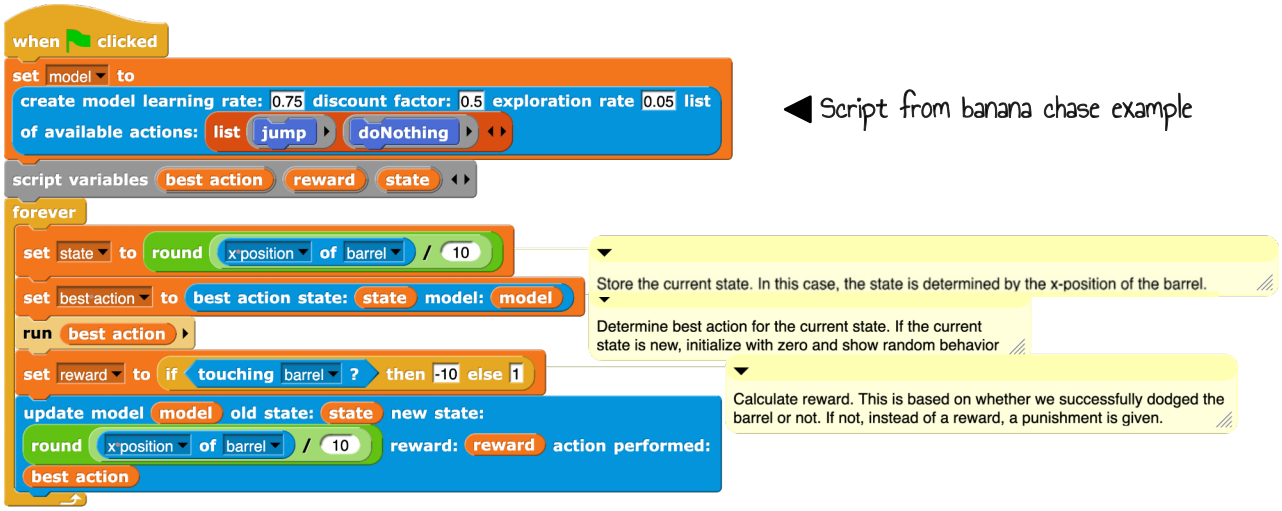
Activities Week 1 Unit 3

You can apply the same principle that we used in the video to other games, such as Pong. Pong is an arcade classic. The exciting thing about this example is that you can compete against your self-learning agent! Here's the link:

https://snap.berkeley.edu/snap/snap.html#present:Username=seegerer&ProjectName=MOOC-RL-Pong-EN-template&editMode&noRun (LINK)

The left paddle is already controlled by the computer. Your task is to make the paddle on the right learn to play Pong successfully. If you remember the banana chase example from the video, there were three main aspects to identify:

- What actions can the agent perform?
- How should the agent be rewarded/punished?
- How can the agent perceive its environment (= state)?



◀ Script from banana chase example

Now transfer this approach to Pong! You can use the coding cards (provided in the course materials) for this.

- We have already given you the possible actions.
- What is suitable as a state? *Tip: One possibility is to use the distance between the ball and the paddle as a state.*
- Experiment with possible rewards and punishments!

Give your model a few minutes and observe whether it learns a meaningful behaviour.

How would you describe the learned behaviour of the Pong paddle?

Coding Cards: https://computingeducation.de/SnAIp-cards-en.pdf

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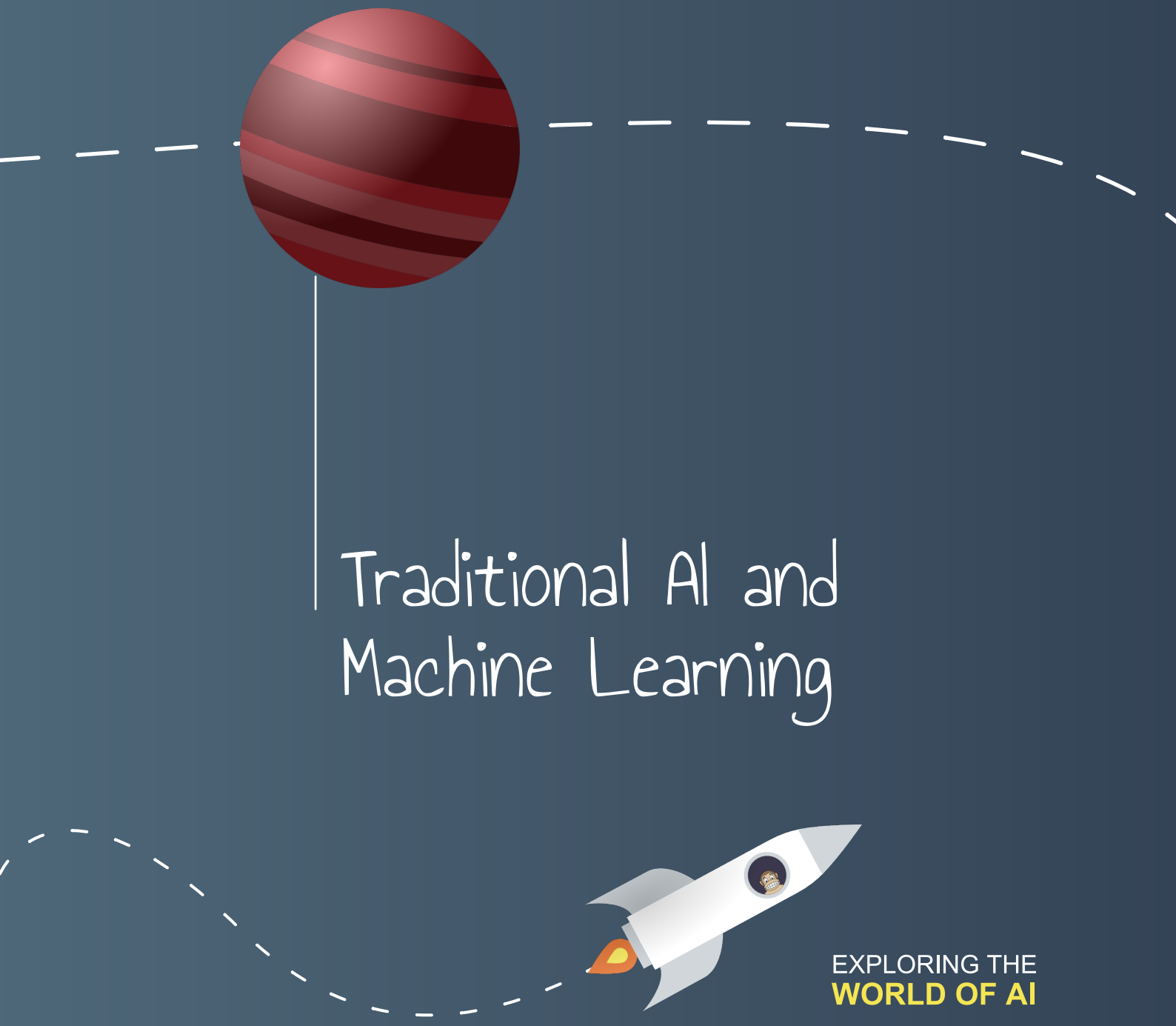
Activities Week 1 Unit 4



Traditional AI and Machine Learning

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Traditional AI and Machine Learning

Activities Week 1 Unit 4

Activity 1: Knwoledge representation

In Mushroom Land there are only **red** cap mushrooms, only **blue** sponge mushrooms and only **green** leaf mushrooms. There are also only **yellow** power stars, only **yellow** master stars and only **green** turbo stars. Furthermore, there are only two types of flowers: **yellow** dandelions and **blue** poppies grow in mushroom land.

Since the inhabitants of Mushroom Land repeatedly have questions about the various elements of their world and their special properties, an artificial intelligence is to be used that can answer such questions. To do this, the existing knowledge must first be modeled.

Create a **knowledge base** by taking **facts** from the text and recording them in the left column using the following pattern:

Facts	Rules
Cap mushroom IS red	IF (red OR blue) and mushroom THEN Powerup
Cap mushroom IS mushroom	

In the next step, we need to extend our knowledge base with rules in the **IF-THEN** form. Read the following text and write down all rules according to the given pattern in the right column!

A few inhabitants of Mushroom Land know about the special properties of these resources: If a mushroom is red or blue, it is considered a **powerup**. Red powerups confer the **ability to fly**. Anything yellow gives **invincibility**. Green stars and blue flowers give a **speed boost**. Anything green gives **strength**.

Activity 2: Reasoning

You can now use this knowledge base to help the inhabitants of Mushroom Land with their questions. Use the facts and rules of your knowledge base to answer the questions of the inhabitants!

Is a red mushroom a powerup ?

Does a dandelion give speed ?

What gives invincibility ?

What gives speed ?

What does a cap mushroom give ?

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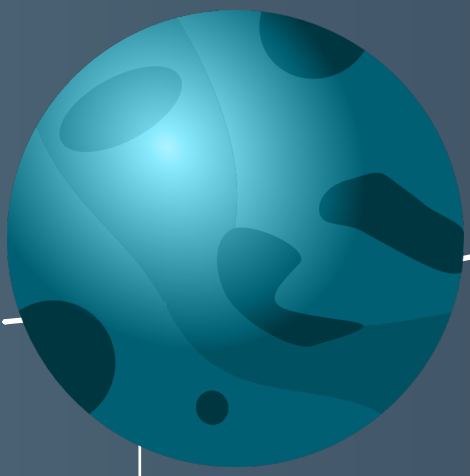
Activities Week 2 Unit 1



Supervised Learning

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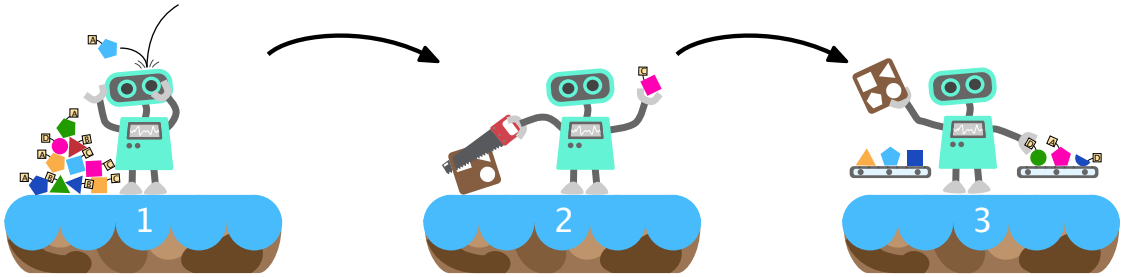
Supervised Learning

Activities Week 2 Unit 1

Activity 1:

To remember things, it is helpful to write down key aspects again in your own words. Try to note down the idea behind supervised learning in your own words! Also write down at least one concise example.

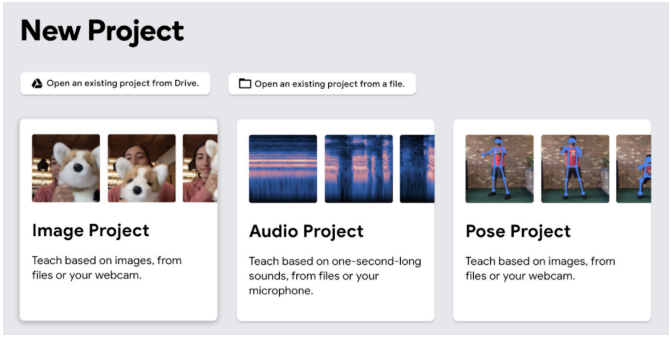


Supervised learning	*Description*
Examples that can be solved using supervised learning	

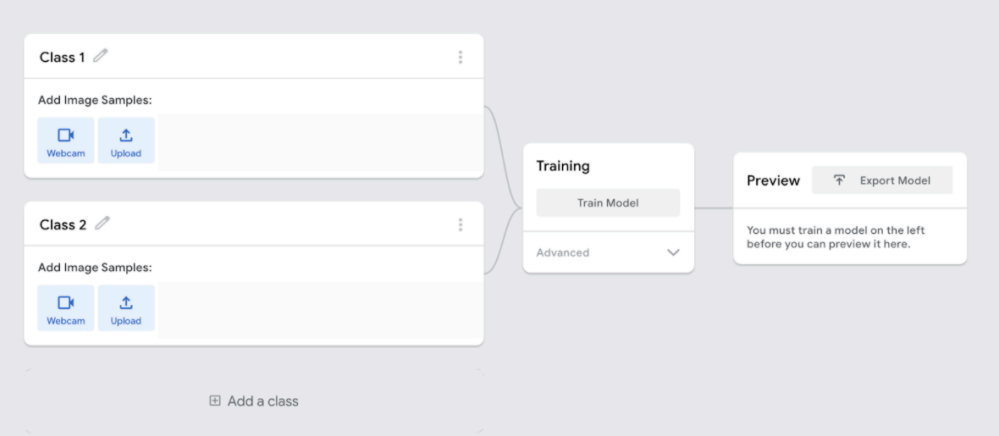
Activity 2:

For these tasks, you will use the Teachable Machine (https://teachablemachine.withgoogle.com/train), which runs without installation in the browser. A modern browser is recommended (e.g. Chrome, Firefox, Chromium-based Edge, Opera).

Our goal is to distinguish biting and non-biting monkeys. Therefore, click the card saying **Image Project**.



The following interface will appear:



Now you can make the computer train a model. The following task descriptions and questions are supposed to help you structure this process.

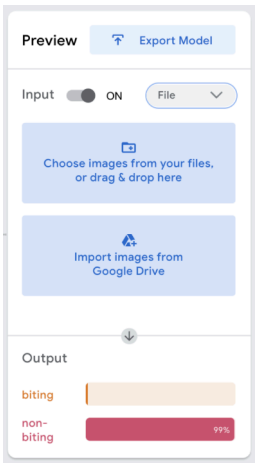
1. How can you tell the program you want it to distinguish biting from non-biting monkeys?

2. How do you provide images to the program for each category?

3. Download the monkey images here (https://www.stefanseegerer.de/decision-tree-monkey-game/img/all.zip) and upload all images from the `training` folder to the biting and non-biting class accordingly.

4. Click **Train Model** to train the model with the collected image examples.

5. Test your model with the test images you can download here. How many of the test images does the computer recognize correctly?
Important: Make sure that **File** (see image) is selected as input.



Activity 3:
Für diese Aktivität benötigst du eine Webcam.

Create a new **image project** and train a model that distinguishes different types of objects in your room (e.g. pens, mugs, …).

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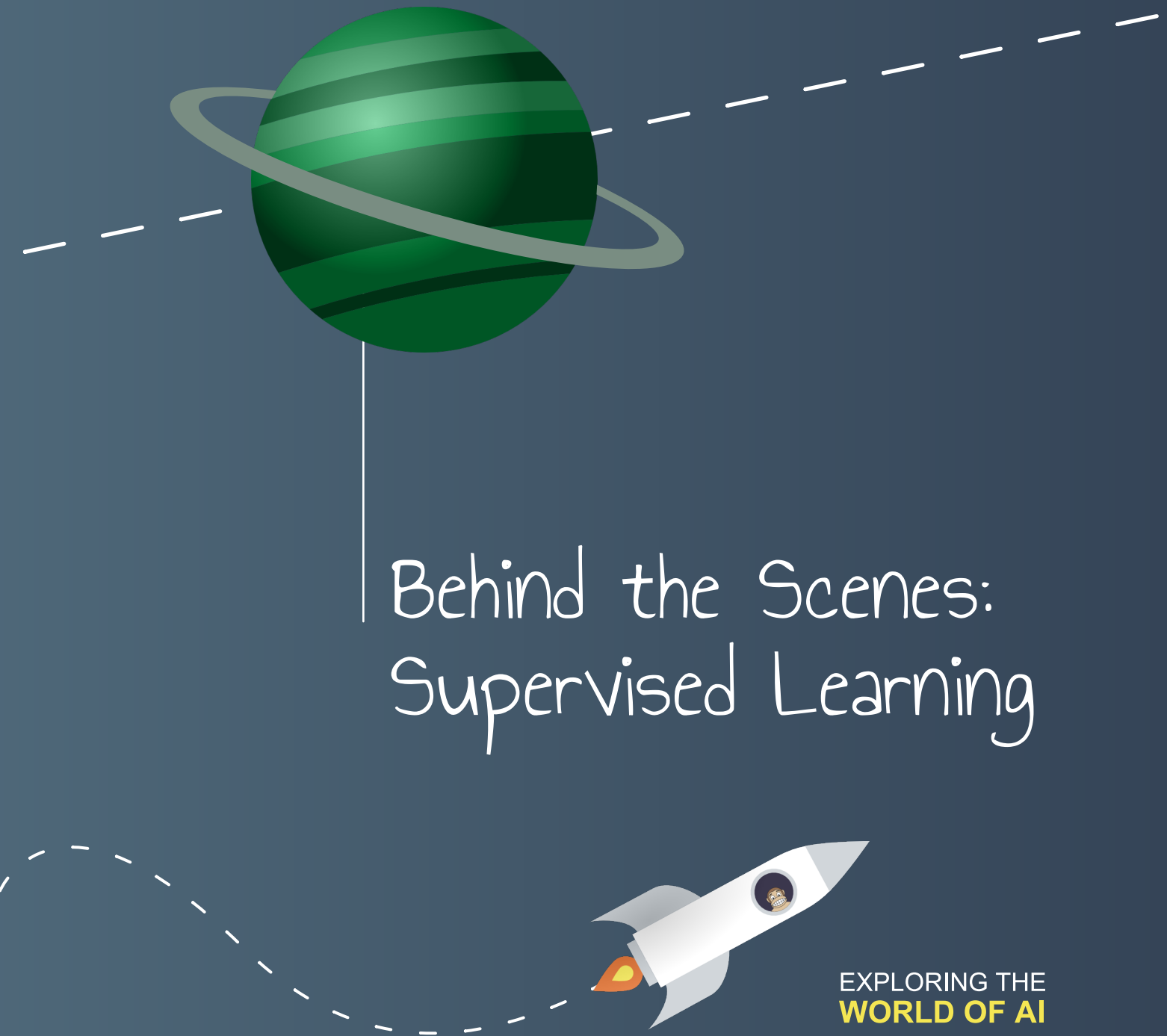
Activities Week 2 Unit 2



Behind the Scenes: Supervised Learning

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Behind the Scenes: Supervised Learning

Activities Week 2 Unit 2

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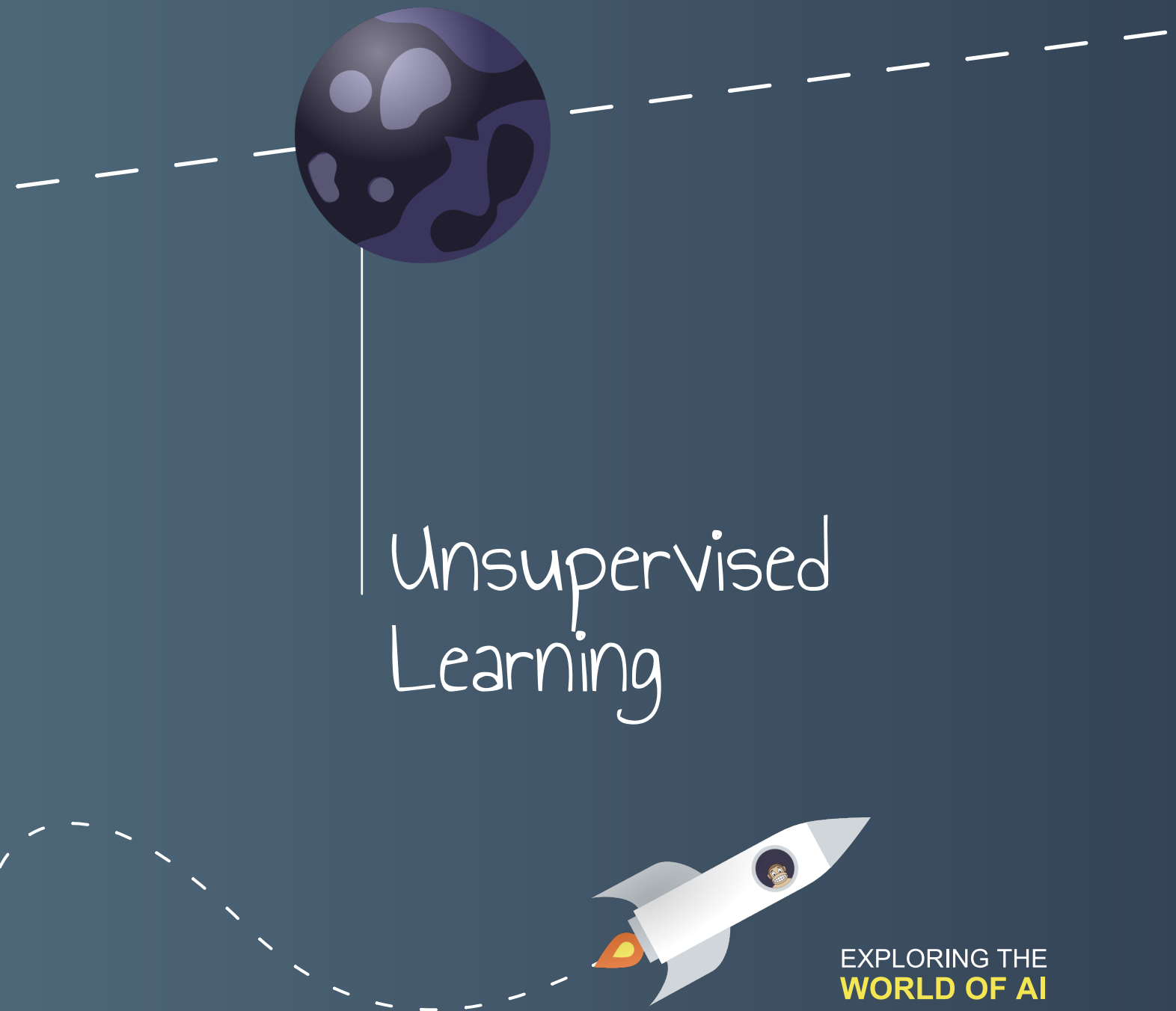
Activities Week 2 Unit 3



EXPLORING THE
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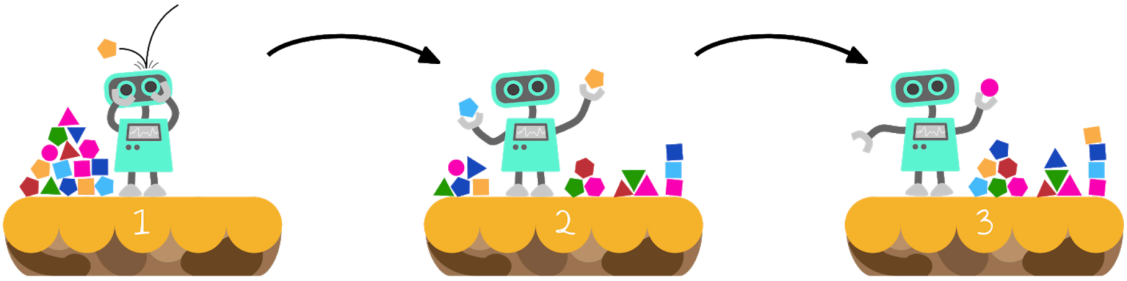
Unsupervised Learning

Activities Week 2 Unit 3

Activity 1:

In order to remember things, it is helpful to write down central aspects in your own words. Try to note down the idea behind unsupervised learning! Also write down at least one concise example.

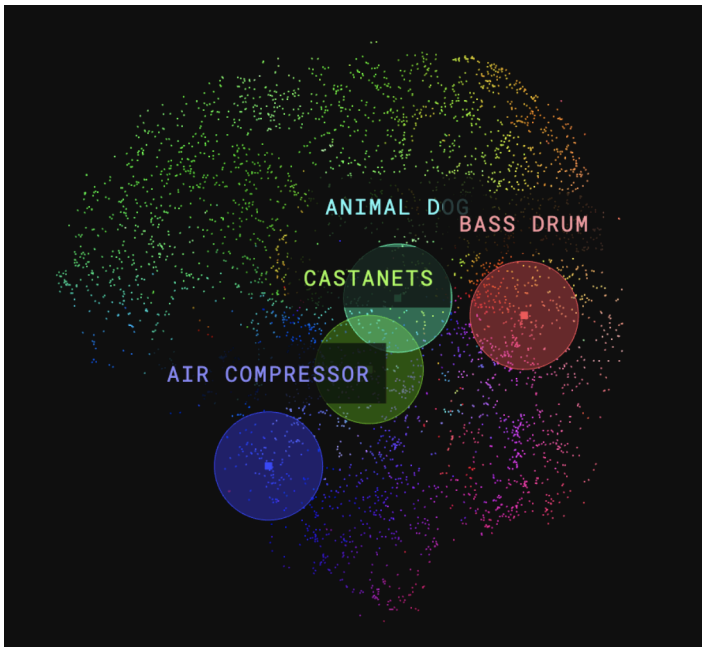


Unsupervised Learning	*Description*
Examples that can be solved using unsupervised learning	

Aktivität 2

For these tasks, you will use the tool https://experiments.withgoogle.com/ai/drum-machine/view/, which runs in the browser without installation. A modern browser is recommended (Chrome, Firefox, Chromium-based Edge, Opera).

1. Get familiar with the application: Move the circles (in the provided example: BASS DRUM, CASTANETS, etc.) via drag-and-drop and listen to different sounds.

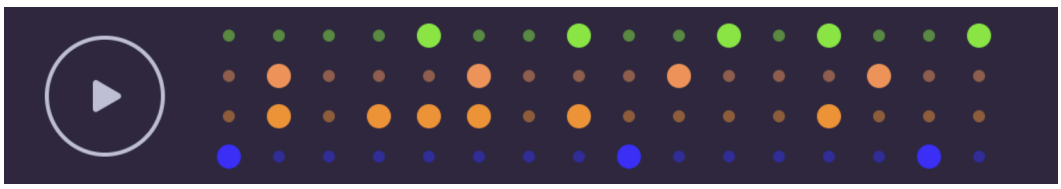


2. What do you think: Which characteristics were used to determine the similarity of certain sounds?

3. Try to guess what the meaning of the colours might be!

4. Watch the video about the experiment: https://www.youtube.com/watch?v=9x-_My5yjQY

5. Finally, create your own beat with the help of your choice of sounds. You can influence the beat using the coloured dots. Start your composition by clicking the play button.



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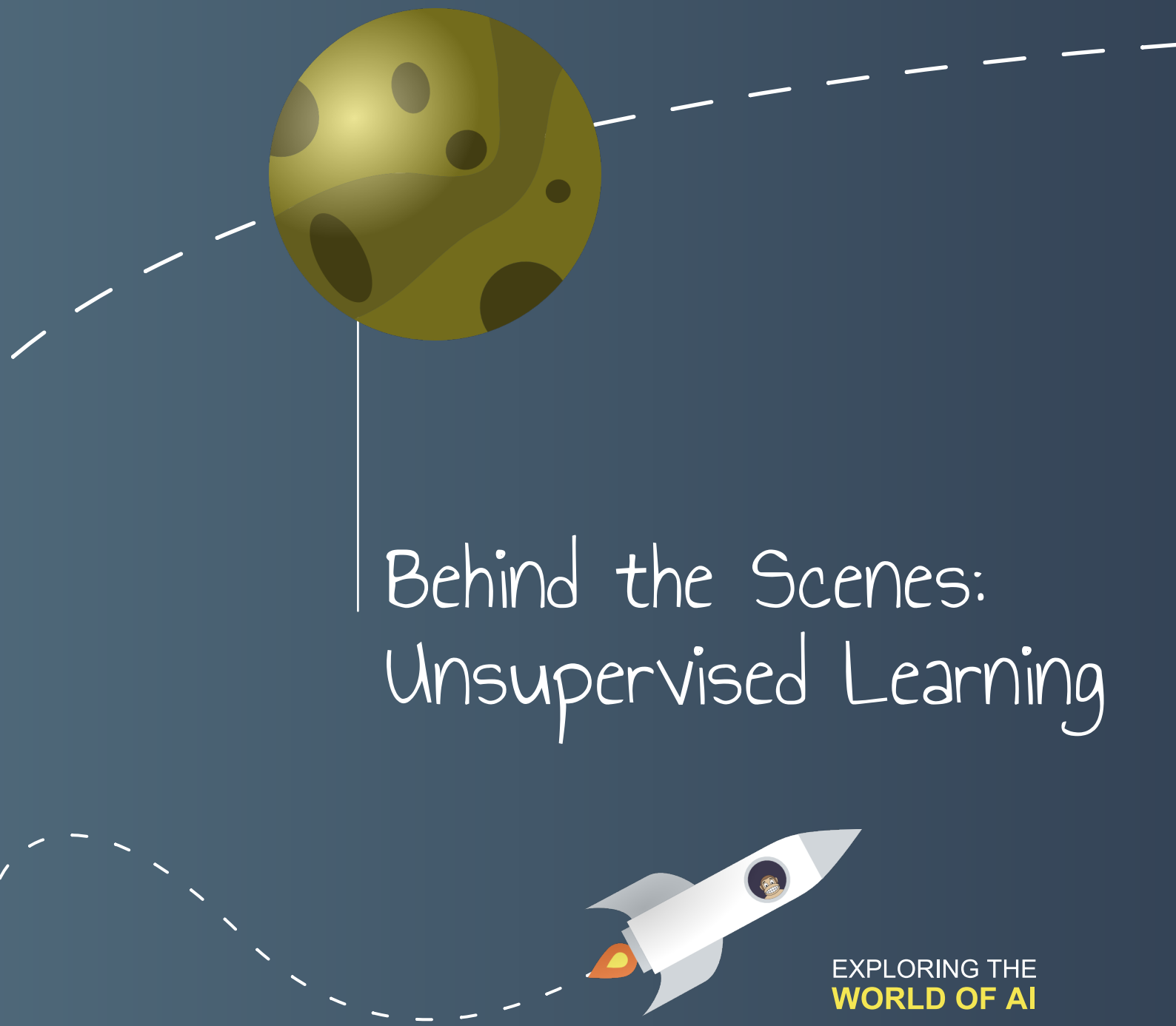
Activities Week 2 Unit 3



Behind the Scenes: Unsupervised Learning

EXPLORING THE
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Behind the Scenes: Unsupervised Learning

Activities Week 2 Unit 4

Now try to improve the algorithm.

Possible ideas for this are:

- Running the procedure in multiple iterations to reduce the influence of outliers.
- Reduce the step size of the prototypes over time.

Improve your algorithm as much as possible so that the dig teams are perfectly placed!

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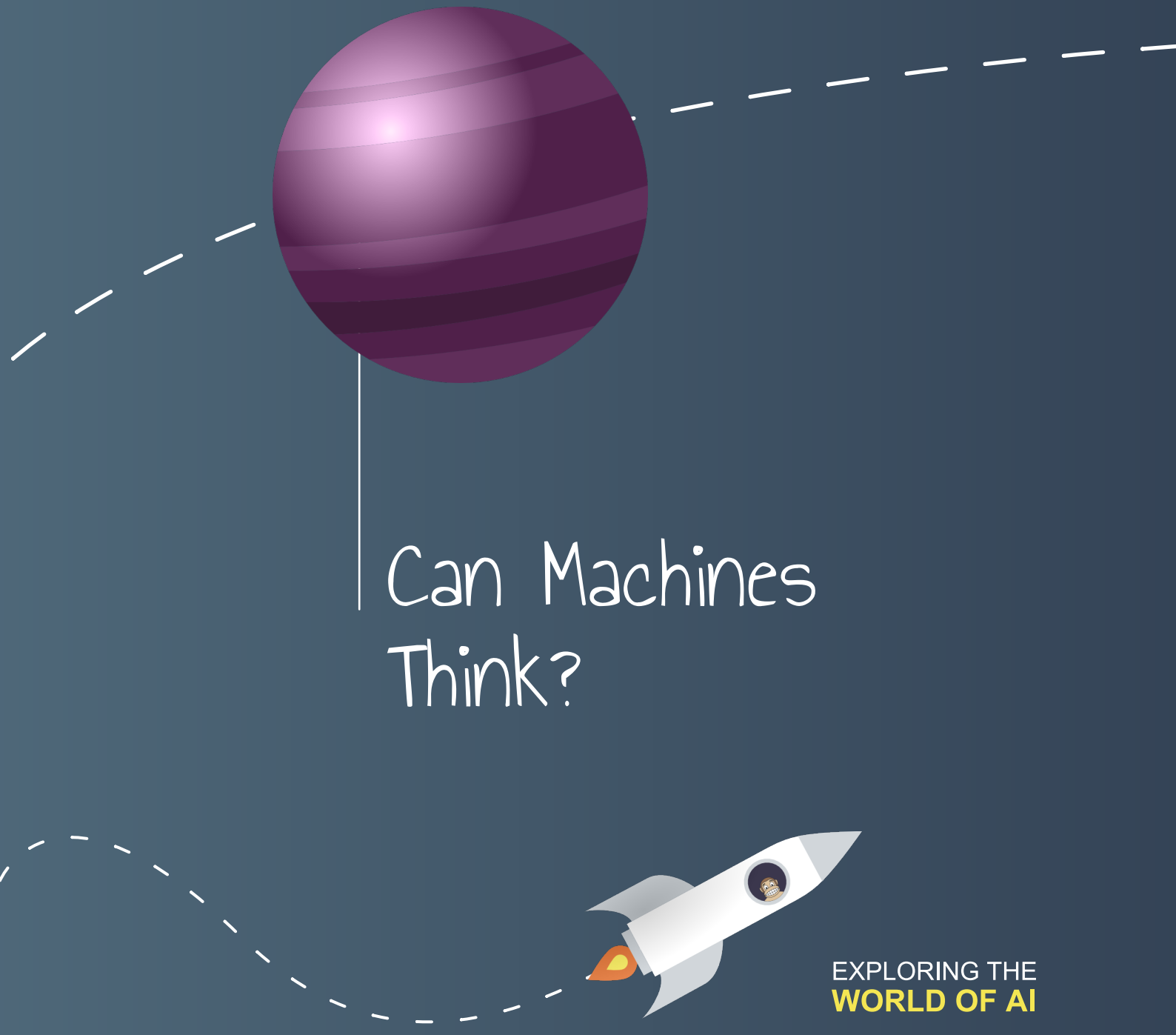
Activities Week 3 Unit 1



EXPLORING THE
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Can Machines Think?

Activities Week 3 Unit 1

Activity 1:

Go to https://www.pandorabots.com/mitsuku/ and hit the button Just chat to chat with Kuki (former Mitsuku). Try to ask different questions. Find three questions to which Kuki's answers convince you and three questions that show that she is not truly intelligent.

Aktivität 2 (Englisch):

In some cases, computers already manage to successfully trick us. The NYT has prepared a quiz. Try it and guess, if the text presented to you is written by a human or a computer. Be prepared, it's not that easy!

This way: https://www.nytimes.com/interactive/2015/03/08/opinion/sunday/algorithm-human-quiz.html

Aktivität 3:

On the next page you will find five questions that were asked to Mitsuku and the chatbot Midge, who also participated in the Loebner Prize contest. The judges score each answer from the chatbots independently with 0 to 2 points.

- 0: answer misses the point completely
- 1: answer is not wrong but does not address the core of the question (e.g. “I don't know”)
- 2: answer could also come from a human being

At the end, the scores are added together. The chatbot with the most points wins.

Score the two chatbots! According to your judgment, which chatbot wins with the selected questions? Compare your verdict with the real jury verdict: where does your verdict agree with the jury (see solution), where does it differ?

Mitsuku

Frage / Nachricht	Antwort	Deine Bewertung
Good Afternoon	Evening?! It's morning here.	
Where should one look for love?	On the internet.	
What will you do later today?	Ah. I don't have any plans yet.	
Do you have any legs?	Sure, I have two legs	
If a chicken roosts with a fox they may be eaten. What may be eaten?	Is this a riddle? Is it part of a car?	

Midge

Frage / Nachricht	Antwort	Deine Bewertung
Good Afternoon	Good morning, Judge. How are you this morning?	
Where should one look for love?	Should 1 look for love? Yes, don't most people think so.	
What will you do later today?	I will seek out intelligent conversation.	
Do you have any legs?	Yes, all my legs are back in Boston.	
If a chicken roosts with a fox they may be eaten. What may be eaten?	If a chicken roosts with a fox they may be eaten.	

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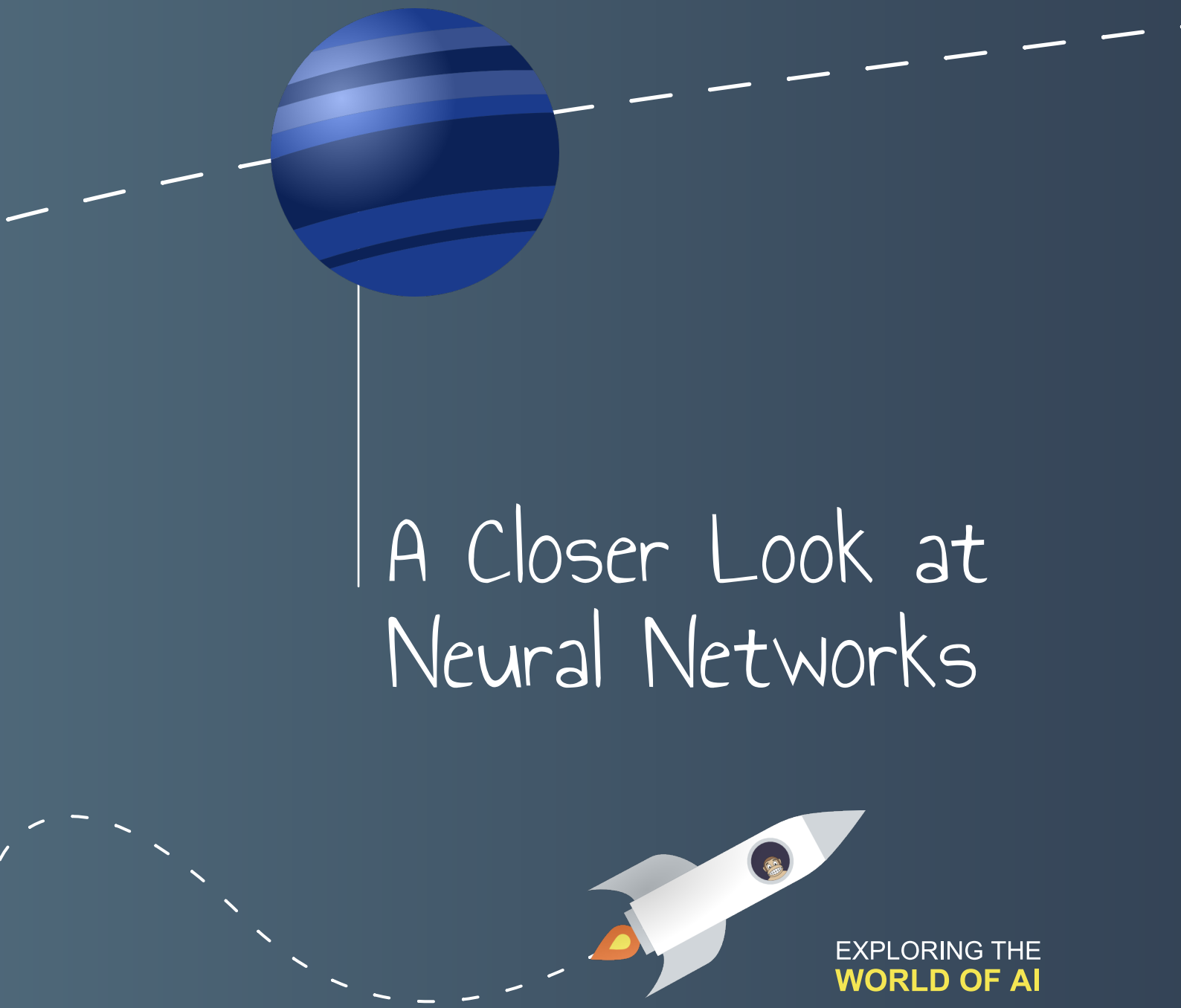
Activities Week 3 Unit 2



A Closer Look at Neural Networks

EXPLORING THE
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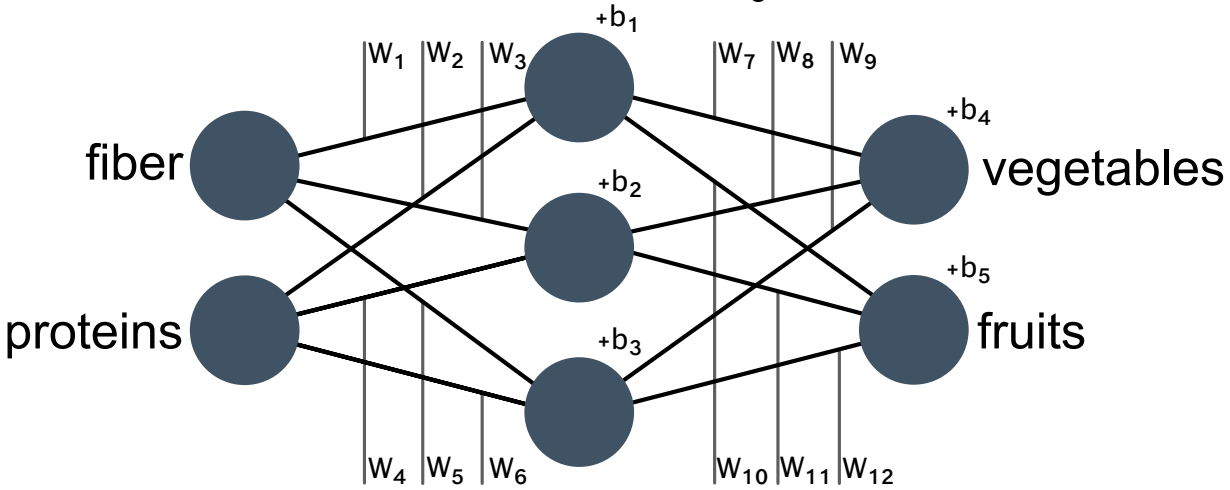
A Closer Look at Neural Networks

Activities Week 3 Unit 2

Activity 1

In this activity, analogous to what you saw in the video, we want to use a graphical visualization to get a feel for the different parameters of a neural network.

The neural network we want to look at is the following:



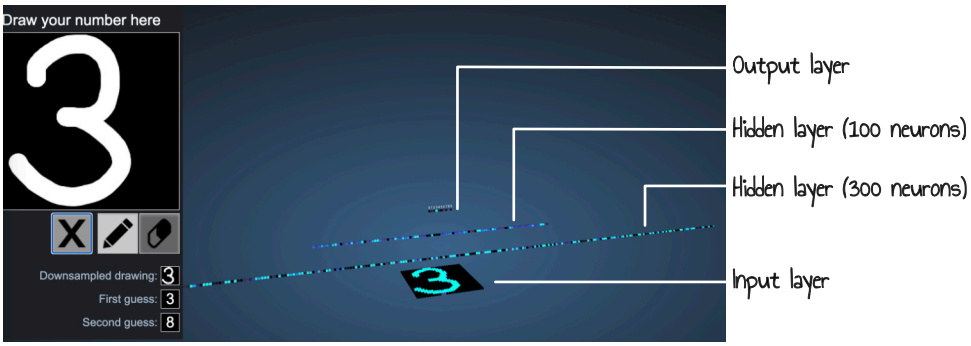
- First, open the visualization of the decision of this neural network with a linear activation function: https://www.desmos.com/calculator/ptzzyqczmu. Manipulate the weights w1, ..., w12. Observe what effects your changes have (compare also minute 5:19 - 6:35 in the video)!
- Now change the bias b1, ..., b5. Observe what effects your changes have (compare also minute 6:36 - 6:50 in the video)!
- Finally, open the graphical neural network with a nonlinear activation function: https://www.desmos.com/calculator/hzhfhisw8t. What difference do you notice? Do you manage to separate fruits and vegetables by changing the weights w1, ..., w12 as well as the bias b1,...,b5 (compare also minute 6:51 - 7:26 in the video)?

Activity 2:

The second neural network we looked at in the video classified handwritten digits as 0, 1, 2, etc. Let's have a look at two different neural networks for this task.

a) Feed Forward Neural Network

The first of these two networks has 784 input neurons (remember, each image had 784 pixels), 300 neurons in the first intermediate layer, 100 neurons in the second intermediate layer, and 10 neurons in the output layer (we want to distinguish 10 different digits, after all). You can find it here: https://www.cs.ryerson.ca/~aharley/vis/fc/



Draw different numbers in the field on the upper left. Hover the mouse over a neuron to find out which incoming edges it has.

- How to interpret the output layer?
- Look at the different activations of the neurons, which neurons are activated more strongly, which ones are barely activated?

Tips:

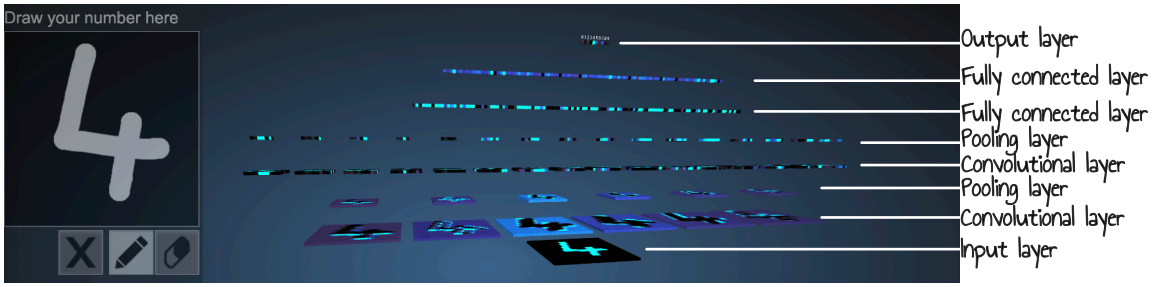
- Clicking on X will delete your drawing.
- Hovering over a neuron with the mouse unveils its incoming edges.
- Clicking on a neuron provides additional information.

b) Convolutional Neural Network

Now let's look at a second network with the same goal. You can find it here: https://www.cs.ryerson.ca/~aharley/vis/conv/

This time it is a so-called Convolutional Neural Network (CNN). As mentioned in the video, CNNs use additional types of layers, namely convolutional layers and pooling

layers. This particular CNN has 1024 own neurons (some black pixels are simply packed around the 784 existing pixels), a convolutional layer with six filters of size 5x5 and one with 16 filters of size 5x5, each followed by a pooling layer that takes 2x2 neurons and combines them into one value.
Then there are layers as we already know them from Feed Forward Neural Networks: Fully connected layers with 120 neurons, 100 neurons and finally 10 neurons.



Again draw different numbers one after the other in the field at the top left and watch how the activations change.

- Can you find out what a neuron in a pooling layer is doing?
- How many inputs does a neuron of the first convolutional layer consider?
- How many inputs does a neuron of a fully interconnected layer consider?
- Make a guess as to which type of layer can be trained faster with the same size and formulate a reason: a convolution layer or a fully interconnected layer?
- Now try to draw a rotated number as well. Why doesn't the system recognize your number? How would one have to adapt the training in order to deliver correct results even in such a case?

Tips:

- Clicking on X will delete your drawing.
- Hover the mouse over a neuron to see what incoming edges it has.
- Clicking on a neuron provides additional information.

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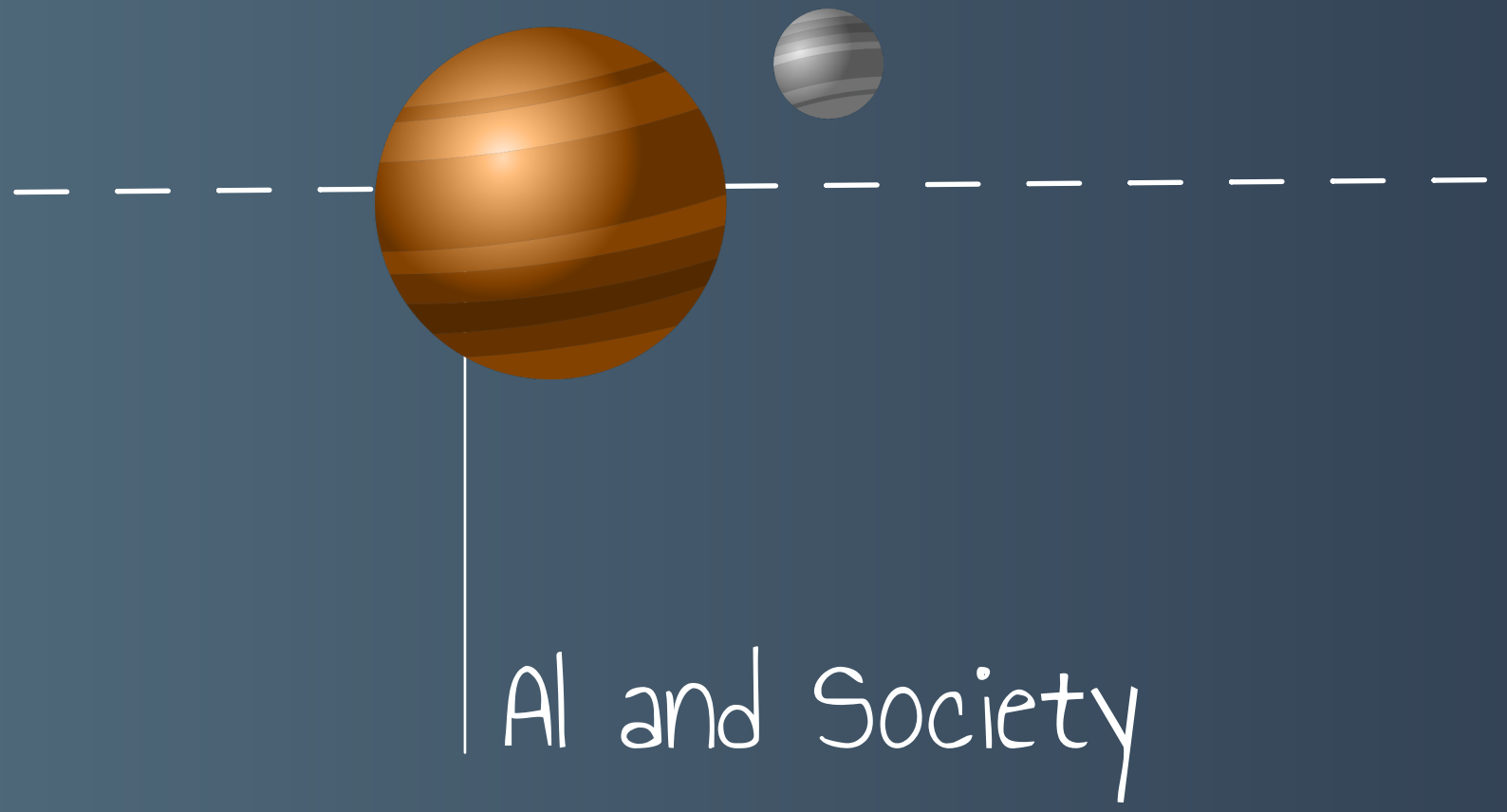
Activities Week 3 Unit 3



AI and Society

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AI and Society

Activities Week 3 Unit 3

Activity 1:

In the video we learned about word embeddings, where words are placed in a high dimensional space. We looked at a 2D visualisation of these embeddings. However, it is also possible to project these embeddings into a 3D environment. Under the following links you can find a visualisation in three dimensions in different languages:

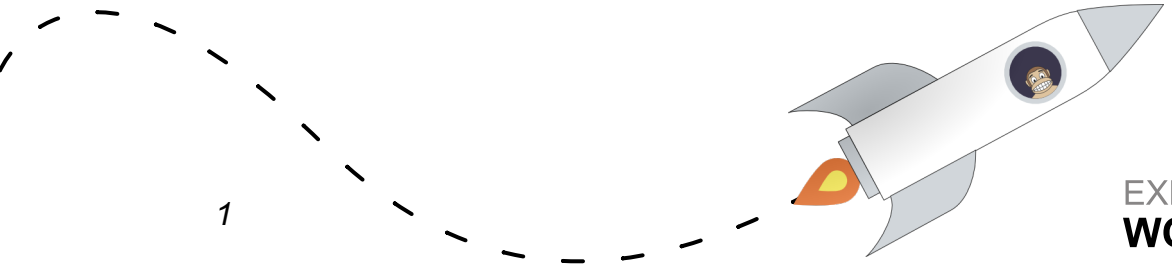
- German: https://projector.tensorflow.org/?config=https://ecraft2learn.github.io/ai/word-embeddings/de/projector.json
- English: https://projector.tensorflow.org/?config=https://ecraft2learn.github.io/ai/word-embeddings/en/projector.json
- French: https://projector.tensorflow.org/?config=https://ecraft2learn.github.io/ai/word-embeddings/fr/projector.json
- Italian: https://projector.tensorflow.org/?config=https://ecraft2learn.github.io/ai/word-embeddings/it/projector.json
- Spanish: https://projector.tensorflow.org/?config=https://ecraft2learn.github.io/ai/word-embeddings/es/projector.json
- Japanese: https://projector.tensorflow.org/?config=https://ecraft2learn.github.io/ai/word-embeddings/ja/projector.json
- Lithuanian: https://projector.tensorflow.org/?config=https://ecraft2learn.github.io/ai/word-embeddings/lt/projector.json
- Mandarin: https://projector.tensorflow.org/?config=https://ecraft2learn.github.io/ai/word-embeddings/zh/projector.json
- Hindi: https://projector.tensorflow.org/?config=https://ecraft2learn.github.io/ai/word-embeddings/hi/projector_v2.json

Dataset taken from ecraft2learn by Ken Kahn, see https://ecraft2learn.github.io/ai/AI-Teacher-Guide/chapter-5.html

To view the location between different terms, you can either click on any term in the cloud or search for specific terms in the top right-hand corner.

Search for at least:

- one adjective, e.g. "beautiful" or "strange",
- one profession, e.g. "farmer" or "doctor",
- one term of your choice.



Activity 2:

Now let's look at Word Embeddings again in two dimensions. Open the following link: https://www.stefanseegerer.de/word2viz/index.html

First open the record "nostalgia". It is preselected, but can also be opened via the dropdown menu ("What do you want to see?").

Answer the following questions:

- What does it mean when a word is higher up (e.g. *'80s* over *'50s*)?
- What does it mean if a word is further to the right (e.g. *sentimental* than *kitsch*)?

Now we want to find out for the term *memory* whether the model places it closer to *sentimental* or *nostalgic*.

- Add the term *memory* via the "Add word" command under "Change words" and describe the meaning of the 2D projection in the given example: Is the word used more in happy contexts (happy) or sad contexts (sad)? Is it more *nostalgic* or *melancholic*?

Now change the data set to "Jobs" by selecting it from the dropdown menu ("What do you want to see?").

You will get a 2D projection of different job titles.

- Compare the terms *homemaker*, *teacher* and *physician*! What does the position tell you about the words?
- Add the word *ceo* (chief executive officer). What does the position tell you about the word?
- *Now add "actor" and "actress" as a word pair. What do you notice?*

Experiment further with the Word Embeddings. Look at other preset data sets or change the axis labels. Share interesting or strange discoveries in the forum!

Activity 3:

Probiere die Moral Machine – ein Experiment des Massachusetts Institute of Technology (MIT) – aus. Bei der Moral Machine geht es darum, in Dilemma-Situationen eine Entscheidung für das Verhalten eines selbstfahrenden Autos zu treffen.

- Go to https://www.moralmachine.net/
- Click on "Start Judging" and make your decision in the various situations. By clicking "Show description" you will be provided with more details about the situation.
- After finishing: Compare your results with the average! Were you aware of your preferences?

Note from Brian Harvey: By the time the AI system in a dilemma (i.e. a choice between two bad outcomes) the actual ethical failure has already occurred: Software engineers have shipped a product that is too risky to be used. Therefore engineers need to figure out ways to anticipate dangerous situations, e.g. slow down the car in a controlled manner.

More to do:

- At https://hownormalami.eu (an art project funded by the European Union) you can experience how "artificial intelligence" judges your face.
- AI is also used in the US to calculate the risk of reoffending for convicted criminals. However, it is not always fair. Can you make the AI fairer than a judge? https://www.technologyreview.com/2019/10/17/75285/ai-fairer-than-judge-criminal-risk-assessment-algorithm/

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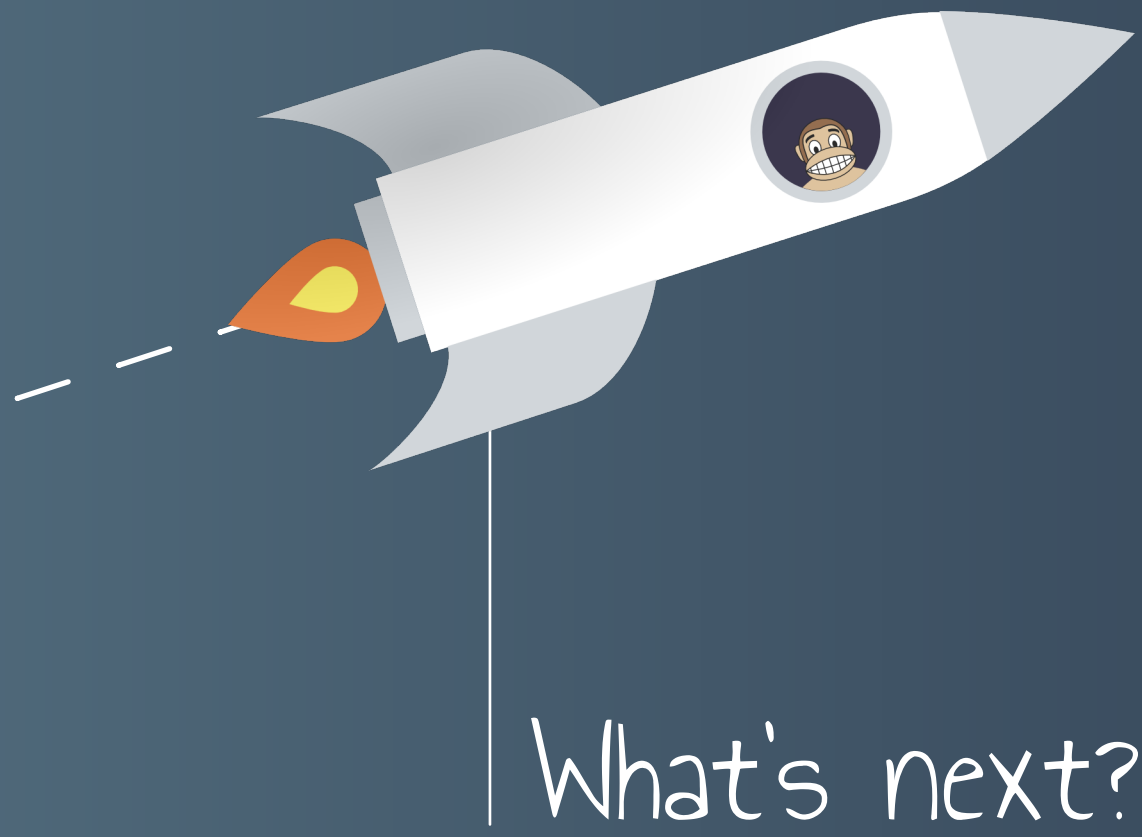
Final words



DIE WELT DER KI
ENTDECKEN

What's next?

Final words

On this journey through the world of AI, we explored the underlying ideas and principles behind artificial intelligence and machine learning. With all you learned in the course, you are now well prepared to assess current and future developments in the field of AI. Even though specific technologies may change, the underlying ideas and principles remain the same.

But there are more galaxies to discover in the world of AI. So if you can't get enough of artificial intelligence, here are some more ideas to continue your journey through the world of AI.

If you want to experiment even more, the following websites might interest you:

- On https://machinelearningforkids.co.uk/ you can train AI models and use them in your own scratch projects. The site already offers many suggestions (https://machinelearningforkids.co.uk/#!/worksheets) for possible projects.
- On https://experiments.withgoogle.com/collection/ai you find different experiments with AI. We would particularly like to recommend you the FreddieMeter (https://freddiemeter.withyoutube.com/), because who doesn't want to know if he/she can sing like Freddie Mercury?

If you want to be inspired by one or the other video:

- A documentary about the pros and cons of artificial intelligence and algorithms: https://www.youtube.com/watch?v=s0dMTAQM4cw
- Ted has a great playlist highlighting social implications of AI called “What happens when the robots take our jobs?” https://www.ted.com/playlists/642/what_happens_when_the_robots_take_our_jobs

What's next (for teachers)?

Final words

Here is a curated list of 7 suggestions and ideas for your teaching:

- https://aiunplugged.org is a collection of classroom activities that can be used to teach artificial intelligence performatively and without computers (i.e., "without electricity").
- At https://machinelearningforkids.co.uk/ one can train AI models and use them in one' own scratch projects. The site already offers many suggestions for projects including worksheets (https://machinelearningforkids.co.uk/#!/worksheets).
- Cognimates.me is similar to Machine Learning for Kids. It allows to use AI models in one' own scratch projects and of course a few tutorials are available as well (http://cognimates.me/guides/).
- Ecraft2Learn (https://ecraft2learn.github.io/ai/) is a collection of Snap*!* blocks that make it easy to experiment with AI models. The possibilities for calculating with words are particularly exciting (see Word Embeddings in week 3, unit 3).
- At SnAIp*!* (https://snaip.org) it's all about using Snap*!* to enable a look behind the scenes of machine learning. Always starting with unplugged activities, the curriculum explores the different ways machines can learn with Snap*!*.
- In addition to the functionality of AI, the AI + ethics curriculum focuses on the implications of the use of AI systems for society. You can find it here (https://www.media.mit.edu/projects/ai-ethics-for-middle-school/overview/).
- MIT has created a collection of AI teaching and learning materials, that you can checkout here (https://aieducation.mit.edu/).