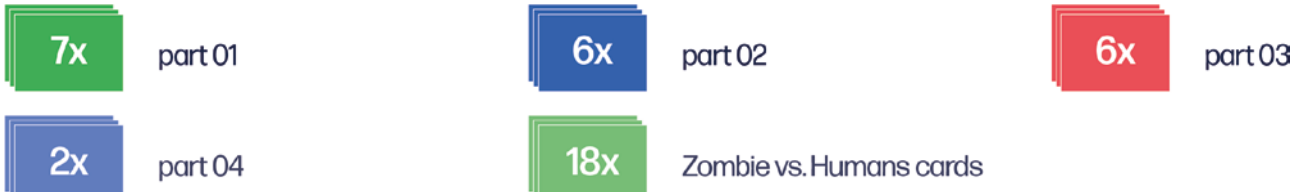
ARTIFICIAL INTELLIGENCE

Welcome to the EDUbox AI.

This EDUbox is an introduction to Artificial Intelligence (AI). The topic AI is so wide that this box only explains the basics, but it will help you to understand the future better. Good luck!

THE NECESSITIES

- ☐ A clever team
- ☐ A laptop with a Google Chrome Internet browser and a smartphone with a QR-scanner
- ☐ A internet connection



AN OVERVIEW

This EDUbox has four parts.

1. We briefly explain **the term** ‘AI’.
2. We delve deeper into AI: **how exactly does it work**?
3. **You get to work** with different types of AI.
4. If you’ve been bitten by the AI bug, you can find **extra information** here.

01
WHAT IS AI?

ARTIFICIAL INTELLIGENCE IS OMNIPRESENT

Believe it or not, we have all already come into contact with AI, including you!

It is used, for example, in:

- ☐ various apps, such as Waze or Google Maps
- ☐ social media, such as Facebook and Instagram
- ☐ search engines, such as Google, Yahoo and Bing
- ☐ streaming services, such as Netflix and Spotify
- ☐ mechatronic systems (robots, self-driving cars)
- ☐ ... and so much more

? AI is therefore used far more than you might think. Do you know any other applications that use AI?

1.1. WHAT IS ARTIFICIAL INTELLIGENCE?

That is a hard question to answer, because there is no watertight definition of AI; AI is still developing.

Broadly speaking, AI refers to **machines that can learn and operate independently.** Just like animals and people, these machines can make their own decisions.

To use AI, you first and foremost need a **computer**. A second important element of AI are **examples**. Just like us, a machine learns from the information it acquires. You feed the machine lots of examples: thousands of photos of dogs and thousands of photos of biscuits, for example. This is called training your machine.

① **Data for comparison**

② **Image selection**

③ **Simplify image**

④ **Convert pixels to values**

140	108	82	160	151	131	129	125	144	135
161	52	0	72	164	165	156	148	102	95
156	57	25	3	88	200	113	30	1	23
160	73	25	55	38	53	61	45	18	48
165	31	0	133	94	64	139	66	23	91
119	8	31	69	127	116	94	16	19	132
34	105	91	75	98	96	80	113	20	129
56	166	101	116	59	133	153	183	100	111
58	163	155	84	128	149	159	165	100	85
14	102	158	172	193	171	174	154	35	59

The machine will then analyse those examples and – with the help of mathematical formulas called **algorithms** – it will search for patterns. If you then show it a new photo of a dog or a biscuit, the machine will give you a probability based on its analyses: there is ...% probability that it is a biscuit or a dog.

ARTIFICIAL INTELLIGENTCE THEREFORE CONSISTS OF 3 ELEMENTS

A fast and powerful **computer system** equipped with the necessary software

Lots of **data**. The more data there is, the easier it is for the computer to identify patterns

Algorithms use maths to recognise patterns and apply them to new data

1.2. WHAT IS THE IMPACT OF ARTIFICIAL INTELLIGENCE?

AI is increasingly becoming a feature of our everyday lives. It is used in the social media, mobility, medicine, music... The impact this technology has on our lives should not be underestimated!

Discover here what Tom Van de Weghe has to say about the impact of AI.
Follow Tom Van de Weghe online:
medium.com/@tomvandeweghe
nws.vrt.be/EDUbox-AI

THE FOLLOWING 4 CARDS GIVE YOU SOME EXAMPLES:

- ☐ Each **take** one card.
- ☐ Quietly **read** the back of your card.
- ☐ **In turns, explain to the group** – in your own words – what it says about AI.

01 MEDIA

01 MEDIA: GOOGLE AND FACEBOOK

AI is often used online.

1. Google can **predict your interests** by examining your search history.
2. Facebook selects the posts that appear on your Timeline. It does this using your data. On the basis of what you enjoy, which photos you have liked, who your friends are, etc. Facebook **identifies patterns.** Thanks to these patterns, Facebook can predict which things you are likely to find interesting.

NB: **Social media, such as Facebook, process and use your data: your personal data. AI is handy, but you have to relinquish some of your privacy to use it.**


LEFT REARWARD VEHICLE CAMERA
MEDIUM RANGE VEHICLE CAMERA
RIGHT REARWARD VEHICLE CAMERA

02 MOBILITY

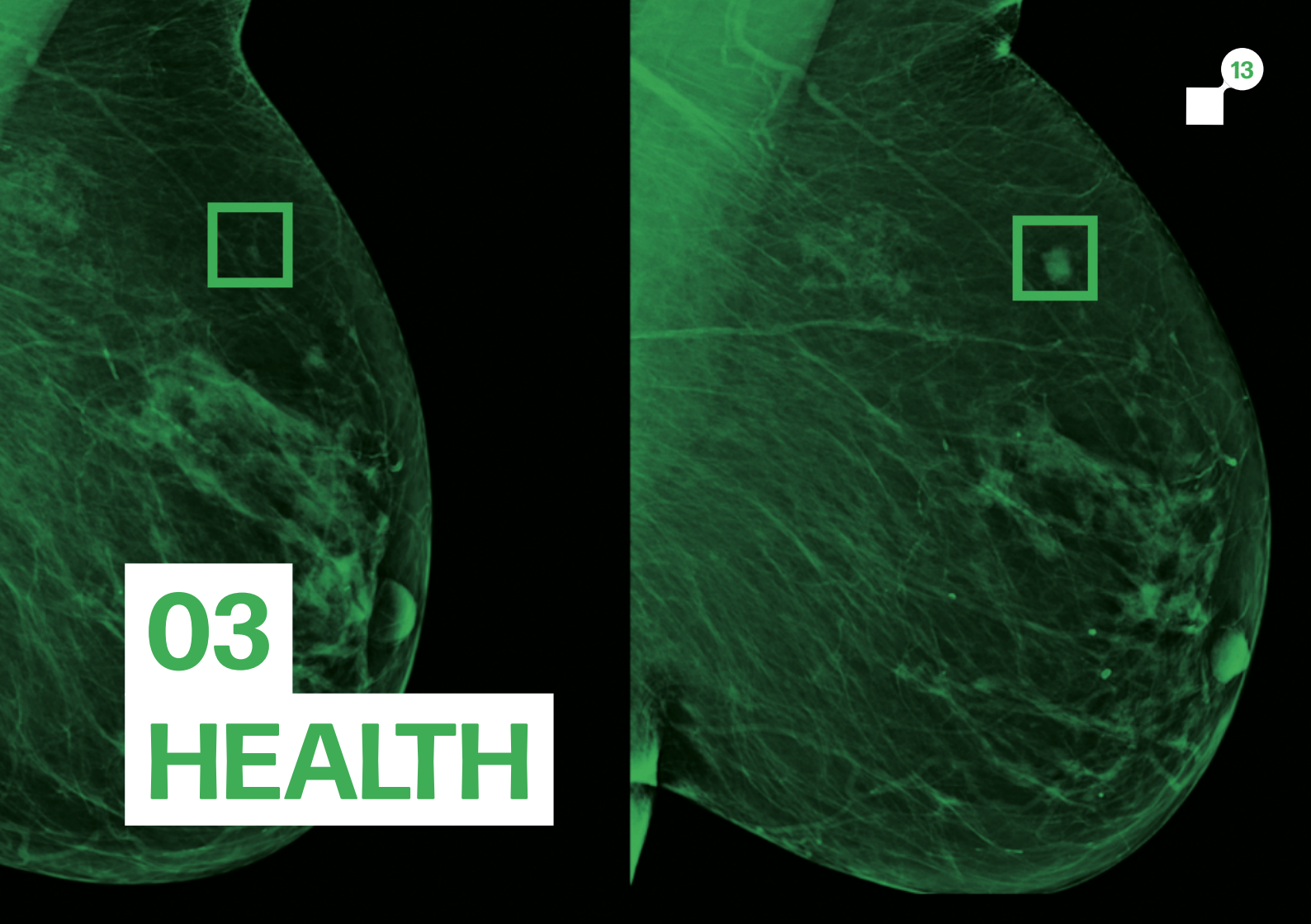
02 MOBILITY: TESLA

Tesla is well-known USA-based manufacturer of electric cars. The boss of the company is **Elon Musk.**

For many years Musk has been developing self-driving cars. These are cars that **operate autonomously,** without human intervention. This is made possible by AI.

In the near future we may no longer have to drive; our car will do everything for us. Handy, right?

NB: In group, discuss why this would be of help in traffic. Also consider a few reasons why AI could also be a traffic hazard.



03 HEALTH

03 HEALTH: BREAST CANCER

Breast cancer is the **most common cancer** among women. Despite advances in science, 500,000 women worldwide die of it every year.

Cancer detection techniques are increasingly effective, but it takes a lot of time to check every woman.

AI can offer a solution to this problem. If you feed computers a lot of data about tumours, **computers can learn to recognise tumours.**

This will allow cancer to be detected much faster and women to be treated much sooner.

NB: AI can reveal things that are undetectable by the human eye, but we still have to be vigilant. The system may have been improperly trained. By only being fed the scans of white people, for example.

04 MUSIC

04 MUSIC: JEF NEVE

Can a machine use AI to compose a new piece of music? A Pano report put it to the test.

The machine was **first fed with data:** Jef Neve, a famous concert pianist, played various versions of a piece of music. These were recorded and uploaded into a computer programme.

Using its mathematical algorithms, the computer analysed that data. It was then able to compose a new piece of music **based on the patterns** in Jef's data.

Watch the film clip here
vrt.be/vrtnws/nl/2018/09/19/in-beeld-artificiele-intelligentie-in-vlaanderen/

NB: What about jobs? Can you think of jobs that will disappear because of AI?

02 THE PRINCIPLES OF AI

2.1. I THINK, YOU THINK, IT THINKS

How exactly does AI work? We are now going to examine that more closely.

AI is an umbrella term: many things are covered by the heading ‘AI’.

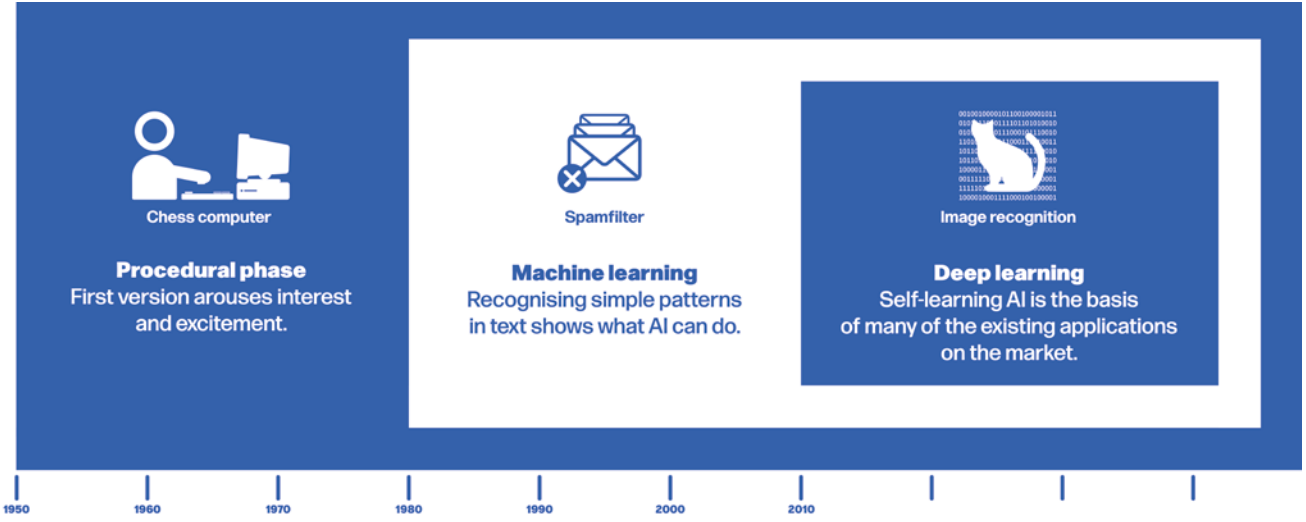
Scientists have been working on AI for quite some time. It was first discussed in the **195s.** Since then AI has come a long way.

AI has undergone many evolutions and experienced both golden and darker days. We are currently living in a period in which AI is rapidly expanding.

In the beginning, shortly after World War II, AI was like an Ikea instruction booklet for the assembly of a bed: first do step 1, then step 2, and so on. This is called the **procedural phase.** At a certain point, however, the pioneers were confronted by the limitations of this method and interest in AI diminished.

In the 1980s AI entered a **second phase**: **machine learning.** Machines became more powerful and it became possible to teach them.

Since 2010 AI has been in its **third phase**: **deep learning.**



2.2. HOW DOES A MACHINE LEARN?

From the 1980s on, machines were able to learn. They were trained to identify connections in data.

There are three types of learning:

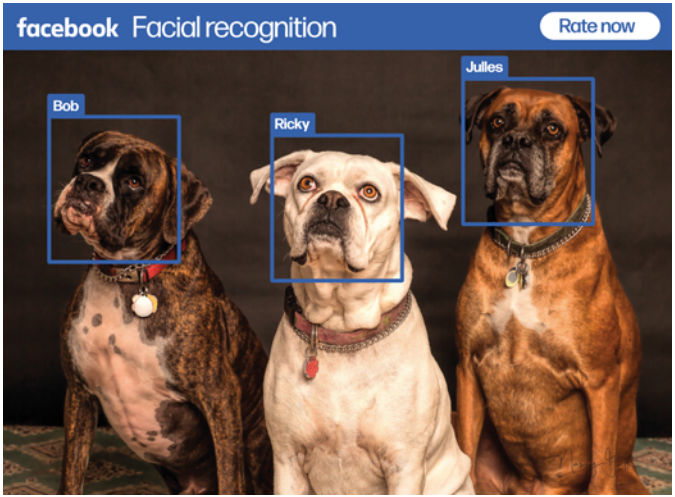
2.2.1. supervised learning
2.2.2. unsupervised learning
2.2.3. reinforcement learning

The 'learning' happens in the **'black box'** , as illustrated in the diagram below. Data is fed into a machine (= input). All sorts of calculations are made. And finally you get a result: the output.

2.2.1. SUPERVISED LEARNING

This is **'controlled learning'.** in which you tell the computer what the examples are. You feed in thousands of photos of a dog, for instance, and say 'this is a dog.' You feed in thousands of photos of a biscuit and say 'this is a biscuit.' In this way, the computer gradually learns to recognise dogs and biscuits. You are working with 'labelled data'.

An example of this that you may already have used is **facial recognition.** Every time you tag your friends Laura and Mo on Facebook, your Facebook is learning: this is Laura and this is Mo. After a while, based on this data, the algorithm is then able to recognise Laura and Mo with a high degree of probability. **But the system is never completely reliable.**

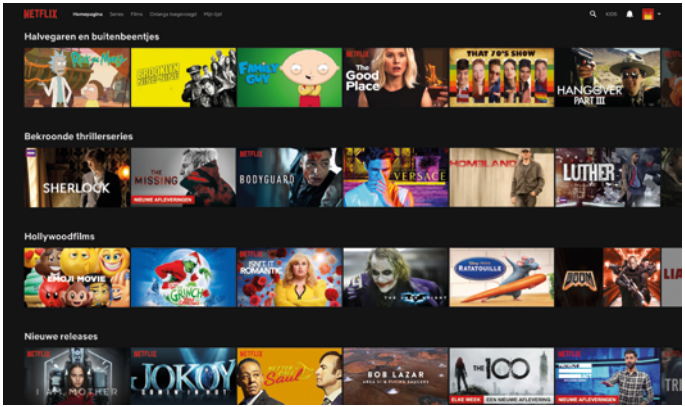


2.2.2. UNSUPERVISED LEARNING

With unsupervised learning the input is no longer labelled. The machine learns in an **'uncontrolled'** way and has to self-organise the data it acquires. The algorithms therefore have to learn how **to group or to segment** datasets.

The machine searches for data sets with shared attributes and proposes groups accordingly.

Netflix, Amazon and Bol.com. are examples of such an application. The computer divides the products into groups. It can then recommend certain groups of products to you, based on your viewing and/or purchasing pattern.



2.2.3. REINFORCEMENT LEARNING

The final form of machine learning is reinforcement learning. Reinforcement learning is like a new video game that you learn to play by having your avatar operate within the game and **make the occasional mistake.**

That is also how a computer works. The machine enters an environment in which all sorts of things are happening and changing. The machine learns what to do by making mistakes, for which it is 'punished', or doing the right thing, for which it is 'rewarded'. By trial and error (by simply trying) the algorithm thus discovers which strategies deliver the best results.

Supervised

The data is labelled and the algorithms thus learn to predict the result.

Unsupervised

The data is not labelled and the algorithms learn how to structure by grouping.

Reinforcement

By trial and error, the machine learns which action is the best.

2.3. NEURAL NETWORKS: A NEW MACHINE LEARNING TECHNIQUE

Deep learning = machine learning + neurale netwerken

Machine learning is growing rapidly nowadays, thanks to a new computing technique: the artificial neural network. When this is employed in multiple layers, we call it 'deep learning'. This technology facilitates many new applications, in which even the most complex operations can be calculated and analysed.

We humans can easily tell the difference between a dog and a biscuit because our brains instinctively make a few rapid assessments. For example: What does it smell like? What colour is it? Does it make any noise? A computer has no instinct. It has to be taught to do this.

Think, for example, of self-driving cars. Driving involves lots of actions and interactions: monitoring your surroundings, changing gear, braking, accelerating, recognising traffic signals and signs, looking into your mirrors... Driving is a combination of all of these different tasks. A self-driving car needs a separate algorithm for each of them. It is the **combination of these** that makes it possible for the car to drive itself.

2.4 AI: NOT ONLY ADVANTAGES BUT ALSO DISADVANTAGES

The previous examples showed that AI can have a positive impact on your life: improved health, great music, no stress getting your driver's license, search engines that offer videos and information to suit your taste... Sounds like a dream, doesn't it?

AI is indeed fantastic. But it is not all a bed of roses. AI also has some disadvantages.

The two most important of these have to do with:

- ☐ prejudices
- ☐ ethics

2.4.1. Prejudices in AI

AAI uses statistics. The AI-system analyses data, searches for patterns, calculates, and makes a prediction. The outcome is not a given. This is not necessarily a problem, as long as we human beings continue to monitor AI closely and do not rely on it unthinkingly.

Imagine, for instance, that an AI system analyses your data and, based on that data, predicts that you are probably a huge fan of something, when that is not at all true. AI is very useful, but we can't leave it up to its own devices; we have to monitor it closely. What happens when your AI system has been trained with incorrect examples?

This robot passport checker, for instance, was not trained with photos of Asiatic people. **nws.vrt.be/2mBn1yt**

99% dog
1% biscuit

1% dog
99% biscuit

2.4.2. Ethics in AI

AI is made possible by mathematics. But not everything can be calculated. Human life is much more than just maths and numbers; values and norms also play an essential role. And they are not easily fed into a computer.

For example: You are travelling by car. You notice too late that a pregnant woman and her young child have stepped onto the pedestrian crossing. To avoid hitting them, you will have to swerve. But if you do, you will hit a concrete wall and get fatally injured. As of yet, AI is unable to cope with such difficult ethical dilemmas.

? Which choice do you make? Discuss this in group.

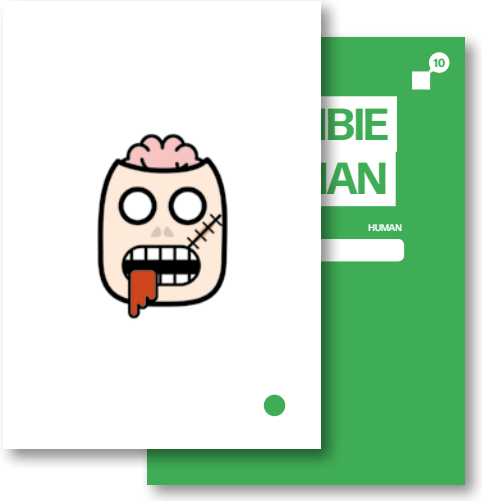
Ethics in AI clarified by imec
nws.vrt.be/EDUbox-AI

03 EXERCISES

As you have read, there are various forms of AI. In these exercises, in order not to make things too complex, we focus on a commonly used method: supervised learning. Apply this method to a Zombie Apocalypse. In these exercises we use facial recognition.

Take the green cards in your hand and play a game of ‘Humans vs Zombies’ in group.

Good luck! Mind your brains don’t get eaten!



TO THE EXERCISES

- ☐ Look at the green cards
- ☐ Perform the four tasks on the following pages

The various tasks are listed below:

3.1. Human intelligence
3.2. Procedural AI
3.3. Supervised learning
3.4. Neural networks

OEFENING 3.1. HUMAN INTELLIGENCE

In this first task you distinguish between zombies and humans using your own intelligence.

- ☐ Take the 6 green cards that are marked with a triangle.
- ☐ Look at the cards.
- ☐ Discuss with your groupmates which cards belong with the 'zombies' and which with the 'humans'.
- ☐ On this basis, divide the cards into two piles.

zombies	humans

Note: **Not all zombies look 100% zombie, some have retained human characteristics.**

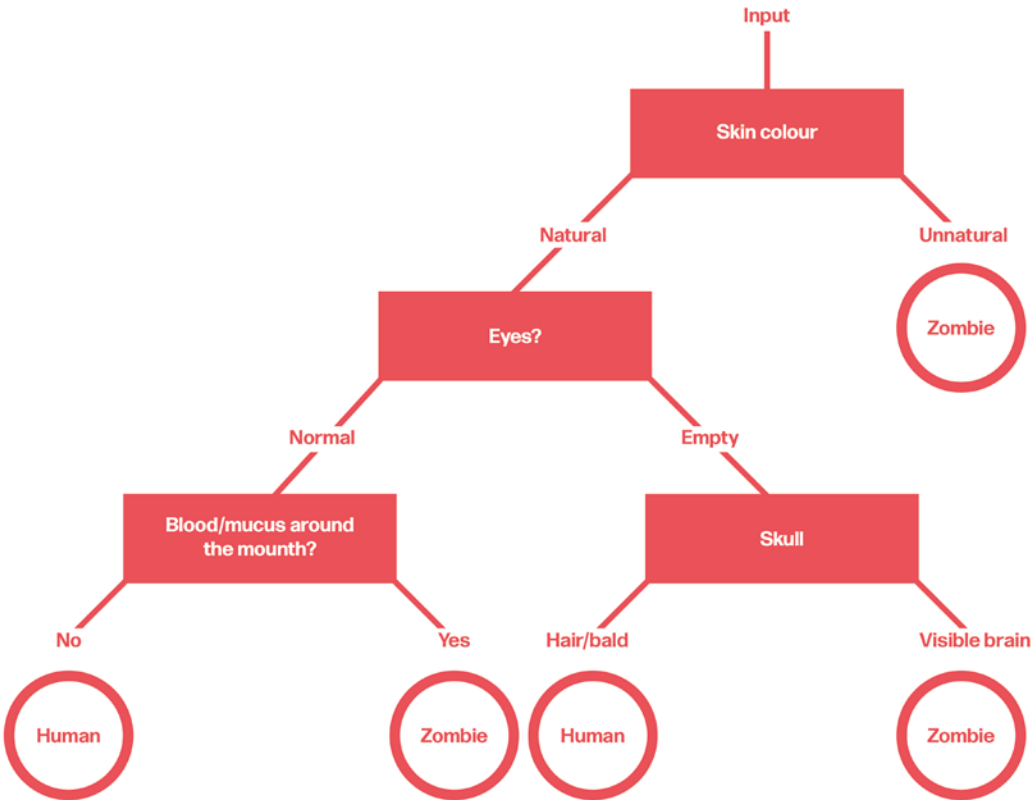
EXERCISE 3.2. PROCEDURAL AI

In this second task you use procedural AI to distinguish between zombies and humans. To do this you have to follow a particular procedure.

- ☐ Take the 6 green cards that are marked with a circle.
- ☐ Look at the cards.
- ☐ Use the tree structure on the next page to place the cards in the right group.
- ☐ Make two groups: 'zombies' or 'humans'.

zombies	humans

Note: As you use the tree structure, you will notice that not all the cards fit readily into a group. This is a disadvantage of procedural AI: it is not a flexible system. If the system is confronted with something new, it doesn't know how it should react.


Input
Skin colour
Natural
Unnatural
Zombie
Eyes?
Normal
Empty
Blood/mucus around the mouth?
Skull
No
Yes
Hair/bald
Visible brain
Human
Zombie
Human
Zombie

EXERCISE 3.3. MACHINE LEARNING: SUPERVISED LEARNING

In this task the computer learns via labelled data. Showing it images of zombies teaches it to recognise zombies. Showing it images of humans teaches it to recognise humans, until eventually it is able to do this independently.

- ☐ For this exercise, use the 6 green cards that are marked with the triangle and the 2 green cards that are marked with a hexagon.
- ☐ Select 1 person in the group to function as the computer.
- ☐ Show the computer 4 examples of humans and 4 examples of zombies.
- ☐ Divide the cards into two groups (zombies or humans) and place them in front of the computer.
- ☐ Now show the computer a new card from the pile.
- ☐ Let the computer decide to which group the card belongs.

zombies	humans

Note: The computer calculates the probability of an image being a zombie on the basis of the characteristics it has leant. It therefore searches for the best match.

EXERCISE 3.4. NEURAL NETWORKS

For this exercise each group will need a computer

- ☐ Surf to the EDUbox AI website and click on our AI Machine.
- ☐ Using cards, teach the machine what zombies and humans look like.
- ☐ The machine has now learnt what zombies and humans look like.
- ☐ Show the computer a new card. Based on its previous information, the computer will calculate the probability of that image being human or zombie.

Is it correct? Can this system decide who gets to enter and who is excluded during a zombie apocalypse? What happens if you train the computer using flawed or incorrect examples?

EDUBox AI Machine
Teach the machine the difference between human and zombie.
nws.vrt.be/EDUbox-AI

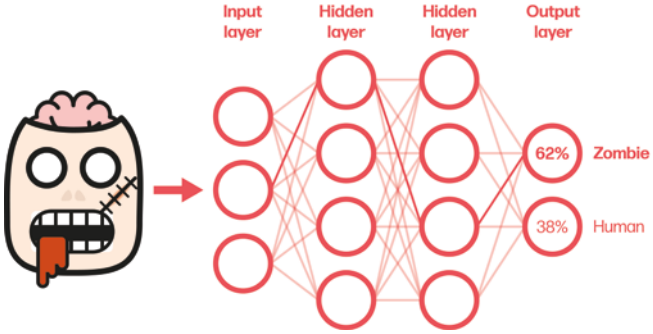
The online machine from exercise 3.4 can also solve other problems. Here are some examples:

- ☐ Boy or girl?
- ☐ Long hair or short hair?
- ☐ Straight cucumber or curved cucumber?
- ☐ ...

3.5. NEURAL NETWORKS, WHAT ARE THEY?

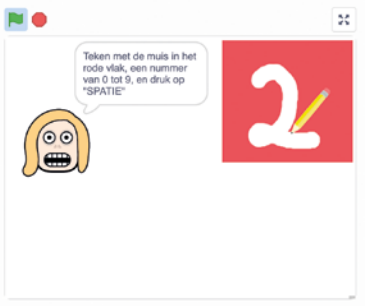
Neural networks are relatively recent. But that is no reason not to understand them. Viathe video below we briefly explain how a neural network arrives at its final decisions.

How do neural networks work?
Discover the answer in this clearly explained neural network video.
nws.vrt.be/EDUbox-AI



AND NOW YOU!

There are also tools with which you can teach a neural network numbers. You can try this out yourself with Scratch.



Scratch tool for numbers

- ☐ To start, click on the green flag.
- ☐ Use your mouse to write a number on the red square.
- ☐ Press 'SPACE'.
- ☐ The computer recognises your number.
- ☐ If you want to know how it works, take a look at the code.

nws.vrt.be/EDUbox-AI

Outro video by Loutfi Belghamidi

In this video Loutfi gives you some tips and tricks.

nws.vrt.be/EDUbox-AI

Pinterest

Instagram

Medium

Facebook

Looking for more fun examples?
Follow EDUbox on the abovementioned social media channels.

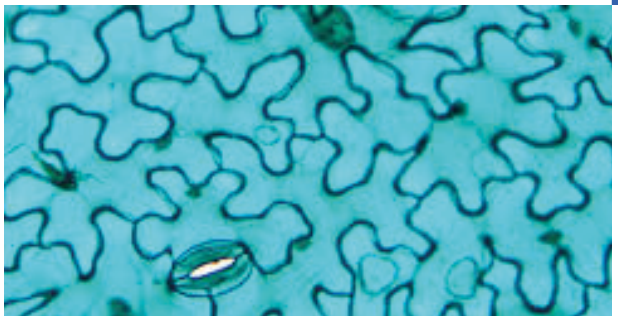
04 WANT TO KNOW MORE

This EDUbox only gives you a brief introduction to AI. If you have now been bitten by the AI bug, you can find out more about it vai the links below..

1. **Your job taken over by artifficial intelligence?**
   From the automated influencing of US elections to self-driving cars: a new AI application makes the media every day. In this report Pano investigates to wat extent AI threat to our job security.
   vrt.be/vrtnws/nl/2018/09/19/pano-uw-job-overgenomen-door-artificiele-intelligentie

2. KIKS: additional work in the classroom?

KIKS is about artificial intelligence, climate change and stomata. Stomata are the tiny orifices or slits in the epidermis of leaves. In the KIKS project you build a neural network that counts stomata, you also learn about the link with climate change.
www.aiopschool.be
KIKS is a Smart EDUCAtion @ Schools project by Sint Bavo secondary school, Ghent University and Dwengo vzw, together with other partners.



3. VRT NWS KLAAR AI

KLAAR is a VRT NWS project. KLAAR is the Dutch word for clear. KLAAR provides youngsters with weekly news videos, editorial comment and contextualisation tailored to their needs. KLAAR ensures that complicated and sensitive topics are explained clearly. The project archive includes a file about Artificial Intelligence.
onderwijs.hetarchief.be/collecties/1268281

4. Films and documentaries

AI also appeals to artists' imaginations. In recent years, many films – such as The Matrix trilogy and Ex Machina – have been made about it. The documentary AlphaGo is about the Google AI computer programme that managed to defeat the world champion of the game Go. Renowned British mathematician Alan Turing is also a popular subject. The documentary Codebreaker, for example, is about his insights into AI. The acclaimed film The Imitation Game is based on Turing's life.

CITIZEN SCIENCE AND ARTIFICIAL INTELLIGENCE: CITIZENS WHO HELP TO TRAIN NEURAL NETWORKS

As you have now come to understand, neural networks learn by example. You feed a neural network a lot of examples, while telling the computer what you are feeding it. You feed it images of zombies, for example, and tell it 'these are zombies' and images of humans and tell it 'these are humans'. This process of labelling data is called 'data annotation'. Thanks to such annotated examples, the computer learns to distinguish between humans and zombies. It is naturally very important here that the examples are clear and correct.

Find out more about citizen science in Flanders at **www.scivil.be**

5. Eye for diabetes

Eye for diabetes is a citizen science project that wants to enlist your help in the inspection of photos of the retina for signs of diabetic retinopathy (DR). DR is a complication of diabetes that can cause visual impairment or blindness. The photos in which you identify signs of DR will be used to 'train' a computer programme to detect the characteristics of DR on the retina automatically. The programme will thus help ophthalmologists to make a faster and more efficient diagnosis. **oogvoordiabetes.be**

6. Burgerpraat

Data can also be spoken language. Humans are experts at this. We intuitively adjust our communication style to suit our conversation partner. You talk to your parents differently than to your sweetheart. And if your (girl) friend uses a cool expression, you will probably use it next time you meet. The citizen science project *¿Burgerpraat!* enlists the help of Flemings to teach computers this skill **www.burgerpraat.be**.