AIAE

Artificial Intelligence - Curriculum for Adult Education

Canon of knowledge on AI – Basic and further briefings

Table of contents

AI Perceptions

- Infographic: _Perception vs Reality about Artificial Intelligence_
- Basic briefing: _AI Perceptions_

AI & Ethics

- Infographic: _What an ethical AI must do_
- Basic briefing: _AI & Ethics_

Human Machine Interaction

- Infographic: _Human Machine Interaction_
- Basic briefing: _Human Machine Interaction_

Machine Learning

- Infographic: _Machine Learning - Actual cases_
- Basic briefing: _Machine Learning_

AI & Societal challenges

- Infographic: _Artificial Intelligence - Societal challenges_
- Basic briefing: _AI & Societal challenges_

AI Technologies

- Infographic: _Six technologies that facilitate the development of AI_
- Further briefing: _AI technologies_

AIAE

Table of contents

AIAE

PERCEPTION

V E R S U S

REALITY

ABOUT ARTIFICIAL INTELLIGENCE
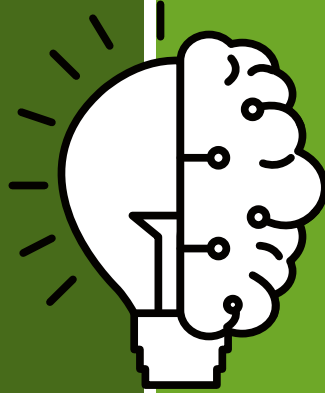
"I fear the introduction of AI in my workplace would make me lose my job"

"Wow! AI could truly represent a time-saving opportunity and a massive help in dealing with daily tasks!"

"AI is stealing my personal data!"

"AI can only correlate non-personal data to other data and match specific individuals "

"AI is completely irregulated!"

"The EU differentiates between high risk and non-high risk applications of AI. High risk applications will be carefully regulated."

"AI is going to destroy every societal system!"

"AI has its cons, but a lots of pros too! It allowed businesses to offer new innovative products and to reduce costs and increase efficiency!"

AIAE

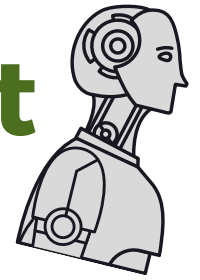# KI Curriculum project

BASIC BRIEFINGS – AI PERCEPTIONS

AI technologies have been changing our world for **over half a century**. It has been affecting **various aspects of modern life**; the way companies conduct businesses, governments and other agencies carry out their services and finally how people engage with technology.

The importance of AI in the world economy has been in an **uprising trend** and is projected to even be more influential in the near future as the disruptive technology will be further integrated in daily life. AI is expected to **reshape economies** mainly **through labour productivity improvements** as corporations will be able to use AI to automate tasks and roles, improve efficiency and save costs.

The mere economic projections are breathtaking; AI could contribute **$15.7 trillion to the global economy by 2030**; an estimated $6.6 trillion expected from increased productivity and $9.1 trillion from consumer side-effects. Greatest economic gains are projected for China (+20% GDP boost by 2030) and N. America (+14.5% GDP boost).

As AI is becoming **pervasive and integral part of our daily lives**, it sparks many concerns which are mainly ethical in nature like **personal privacy**, **biases**, **fair** and **equitable outcomes**.

Concerns about AI have often turned to perceptions influenced greatly by social media. It is difficult to distinguish what constitutes hype and what constitutes reality.

It is essential that AI stakeholders like the regulatory bodies, developers, users need to **play a public role in educating** the people.

AIAE

KI Curriculum project
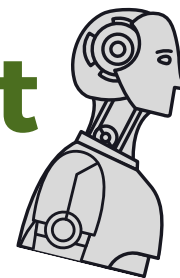
BASIC BRIEFINGS – AI PERCEPTIONS

In the following paragraphs we will take a closer look at some of the AI perceptions.

Impact on jobs and the general workplace

Job loss and the wider effects on the workplace have been a **point of debate friction**. This is certainly an individual as well as a **collective concern** and it usually comes up as the most common negative perception regarding AI technology.

Even though job automation has been around in various evolving forms since the start of the Industrial Revolution phases dating back to the **18th century**, the fear of the "robot worker" taking over jobs has never been more intense. **"Blue collar" jobs** are perceived to be at **most risk**.

Employers and the industry in general should **foster the use of AI** in a way that **augments what individuals do** in their daily tasks. This **time-saving opportunity** should have the most appeal and would negate the negative effects of job displacement.

Personal data

AI technology relies on vast **inputs of data** to train and **formulate models**. Often this data will be personal data relating for example to people's gender and age.
AI can turn "non-personal" data to "personal" though its ability to increasingly link different datasets and **match different types of information**. Thus non-personal data can be correlated to other data and matched to specific individuals.

KI Curriculum project
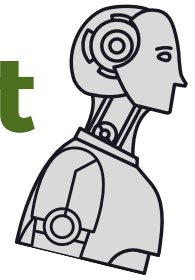
BASIC BRIEFINGS – AI PERCEPTIONS

The dominant perception by the people who are sceptical of AI technology is that **"personal" data is being used** for purposes other than the general societal benefit.

The biggest technological companies like **Google** and **Facebook** possess **massive quantities of data**. Every time you go online, your actions are being saved, analysed and integrated into highly complex models of human behaviour. Their artificial intelligence then **makes predictions** of our hobbies, interests and desires. We don't have insights into that process but its outcomes are seen as **ads** and **product recommendations**.

Emphasis should be placed by the AI industry in **making the society aware** how the **data is collected and used** and also **promoting resulting societal benefits** like healthcare analytics.

Regulation

Questions regarding regulation and accountability in the AI industry remain largely unanswered.

The public often has a **positive view** on industries that are **regulated by governments or international bodies**. For example, the **airline industry** which is amongst the most heavily regulated industries in the world is looked upon for safety issues.

People are looking to **outside bodies** to regulate the AI industry. The AI industry should embrace this as this will **promote public confidence** and **trust**.

AIAE

KI Curriculum project

BASIC BRIEFINGS – AI PERCEPTIONS
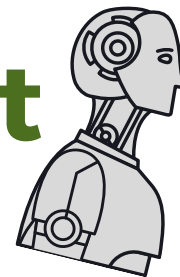
The European Union differentiates between **high-risk** and **non-high-risk applications** of AI. Only **high-risk** AI will be **carefully regulated**. Caution should be placed to **avoid over-regulation** as this might hinder innovation and prevent AI technology from realising its full potential.

Loss of control: powerful AI systems are often perceived as potential sources of **loss of control** by humans, that is the machines will take over our lives. **Public media** and the **entertainment industry** are partially to blame for this propagation of the perception.

Weapons of mass destruction: Military applications of AI technology has stirred a lot of **concerns** and **misconceptions**. As machines are starting to take the place of humans in the battlefields, people fear fully autonomous weapons, having no ethical restraints or concerns, will have no respect of human life. The wider perception is that **fully autonomous weapons** should be deemed as **weapons of mass destruction** and would have to be **treated accordingly**.

Disruptive technologies like AI often tend to **bring about exaggerated expectations** and **fears** that can **affect public confidence** and expectations. Involved stakeholders like developers, users, regulators need to put the **public trust at the centre** of the debate as any new innovation can only materialise if the majority of the users eventually accept it.

The impact of AI systems should be considered not only from an individual perspective, but also from the perspective of the **society as a whole**.

KI Curriculum project
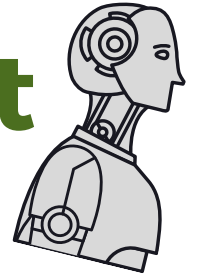
Concerns like mass unemployment, increased economic inequality and restrictions on personal freedom have been **hot topics of debate** and **perceptions** have been to **all extremes**, aided considerably by media outlets.

Businesses in all sectors view AI technology not only as the means to offer **new innovative products** but also as a way to **reduce costs** and **increase efficiency**. To this end, the importance of AI as new disruptive technology should not be discounted.

Context is key to how the public evaluates and views AI technology. Perceptions of people regarding **risks and benefits** vary according to the **application** under consideration. For example, in the context of the autonomous weapons perceptions can be extreme because of the risks.

With **major social and economic questions** at stake, such as the future of work and even wealth distribution, it is important that the public is **well informed** about the pros and cons of AI technology and also equally important to **be aware** of what is plausible or not with this technology so that perceptions are grounded **closer to reality**.

We believe that increasing public awareness is the key in separating AI hype from AI reality. The public needs to **be educated** about the benefits as well as the risks.

WHAT AN ETHICAL AI MUST DO

Ensure a genderless, unbiased AI

Serve the people and the planet

Allow the sharing of their benefits

Ban AI arms race

Establish global governance mechanisms

Be transparent
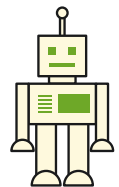
Be equipped with an ethical black-box
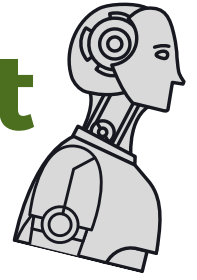
Adopt a human-in-command approach

Support fundamental freedoms and rights

Ban the attribution of responsibility to robots

AIAE

KI Curriculum project

BASIC BRIEFINGS – AI & ETHICS

In a nutshell, Artificial Intelligence (AI) is the **combination of data science and machine learning**, which provides computers with "human-like" intelligence.

AI can **make predictions, recommendations or decisions** influencing our societies and economies and is expected to revolutionise how we live and conduct business in the near future.

AI field is **constantly evolving**. It started as an ability to masterfully perform a single task (it was a big story when software defeated world chess champions). Programmes are moving towards more generally used intelligence that closely resemble the way humans solve complex challenges (like playing highly complex game Go). AI in that stage can already learn and improve itself. The 3rd stage is unimaginable at the moment. So called "superintelligence" could be **self-aware, self-conscious** and far, far **smarter than humans**.

AI is still in early stages but is already **becoming pervasive and integral part of our daily lives**, and an issue that naturally sparks many **ethical concerns** including personal privacy, biases, fair and equitable outcomes.

In the following slides we will take a closer look at the uses of AI, the economic impact, key ethical concerns and also some actual cases.

SOME OF THE USES OF AI

Some of the applications of AI are demonstrated below:

KI Curriculum project
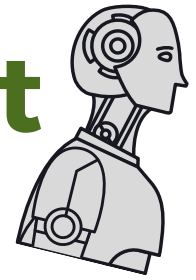
- **Healthcare** - diagnose and prevent diseases as well as in discovery of drugs and treatments
- **Financial Services** – automated trading, evaluation of credit-worthiness, detection of fraud.

Oliver: "I was surprised when I received notice a few weeks ago that my credit card was blocked. I found out my credit card data was stolen and somebody wanted to make a purchase. Software automatically prevented transaction because purchase didn't fit with my shopping patterns. Everybody knows that I don't shop on Saturday 8.00 AM as I sleep like a baby at that time."

- **Transportation** – autonomous vehicles with "virtual" drivers
- **Cybersecurity** – recognition and mitigation of cyber threats through continuous input of data
- **Web search** – search engines learn from the vast input of data gathered from users
- **Retail and consumer** – fully interactive and customised design of retail goods
- **Covid-19 fight** – thermal imaging, infections recognitions, data and simulation scenarios regarding pandemic spread

Economic impact

AI is set to be the **key source of transformation, disruption** and **competitive advantage** in today's fast changing economy.

AI is expected to **reshape economies** mainly through **labour productivity improvements** as corporations will be able to use AI to automate tasks and roles, improve efficiency and save costs.

AIAE

KI Curriculum project
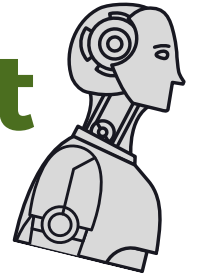
BASIC BRIEFINGS – AI & ETHICS

"4th industrial revolution" will **connect humans and machines** as never before - they will have to work as a team in order to be successful.

AI could contribute **up to $15.7 trillion to the global economy by 2030**; an estimated $6.6 trillion expected from increased productivity and $9.1 from consumer side-effects. Greatest economic gains are projected for China (+20% GDP boost by 2030) and North America (+14.5% GDP boost) AI drives enormous amounts of **private equity investments** in AI technology, a trend that is expected to continue. Technology giants like Google and Apple have acquired the most AI Start-ups since 2010. In 2020 alone companies spent around $ 50 billion for investments in AI.

Ethical Use of AI

Some of the wider concerns raised by the use of AI in our daily lives are presented below:

- AI raises concerns related to **ethics, fairness and privacy**.
- AI systems need to be **trustworthy and human-centered**.

Ingrid: "Some say I am too optimistic, when I see many opportunities that AI can bring to disadvantaged groups. For example, socially excluded people face obstacles in getting appropriate medical diagnosis and treatment. There are not enough nurses and doctors on the field. What if this job can be at least partly done by AI without additional costs? That would be a real game changer!"

AIAE

KI Curriculum project
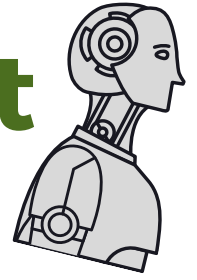
BASIC BRIEFINGS – AI & ETHICS

- AI needs to **uphold the wider International Human Rights** that provide a set of universal minimum standards. These standards create legally enforceable obligations for countries to respect, protect and fulfil human rights.
- Human rights include the right to **equality**, the right to **non-discrimination**, the right to **freedom of association** and the right to **health**.

Specific concerns related to personal data

Data held separately, meaning data that were striped of personal identifiers, were considered non-personal as they could not be linked to a specific individual.

AI systems have the processing power and capability to potentially **link different datasets** and **match different types of information** and **non-personal data to specific individuals** by **co-relating unrelated data, trends and patterns**. Thus AI can turn "non-personal" data to "personal".

The **European Union's General Protection Regulation** (GDPR) is a **mandatory law** for how organisations and companies **must use personal data** in an integrity friendly way. The use of AI to identify or re-identify data that were non-personal presents both an ethical as well as a legal issue.

Principles of Ethical AI

1. AI systems must be transparent
2. AI systems must be equipped with an ethical black-box
3. AI systems must serve people and planet

KI Curriculum project

BASIC BRIEFINGS – AI & ETHICS
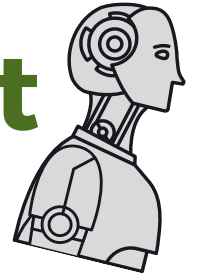
4. AI systems must adopt a human-in-command approach

5. AI systems must ensure a genderless, unbiased AI

6. AI systems must allow the sharing of their benefits

7. AI systems must secure a just transition and ensure support for fundamental freedoms and rights

8. AI systems must establish global governance mechanisms

9. AI systems must ban the attribution of responsibility to robots

10. AI systems must ban AI arms race

Ingrid: "I believe in the power of AI. But I am a proponent of a super careful approach. In many ways AI resembles nuclear energy: it is highly useful but can also be very dangerous if it isn't treated with caution or if it gets in wrong hands. We need to follow strong ethical principles so that technological progress is used for the progress of mankind. If we develop super intelligent AI that can make complex autonomous decisions, we better be sure it resembles all that is the best in people."
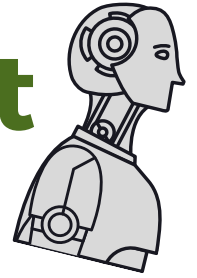
Some key ethical considerations & cases

Fair and Equitable outcome:

Since AI systems are programmed by humans, they run the risk of incomplete or not adequately representative data for training the software, thus ending-up reinforcing certain misconceptions.

KI Curriculum project

BASIC BRIEFINGS – AI & ETHICS

Example of gender inequality:

Amazon had been developing an AI system for recruiting purposes. The raw data used for training was based on 10 years of resumes mainly from men.

The result was that the software taught itself that male candidates were preferable penalising resumes that included key words referring to "women" (e.g women's chess club captain).
In the end Amazon had to deem the programme as not reliable and had to abandon it all together.

Does it introduce or increases bias:

Human bias can easily infect AI solutions, if not properly designed and programmed.
This can occur at the **data level** (meaning how data is collected, sampled or selected for use), as well at the **algorithmic/programming development level** and at the **deployment level**.

Example of AI's ability to scale up embedded prejudice:

COMPAS is a recidivism algorithm applied to prisoner populations in order to calculate the likelihood of reoffending.
The result was that in Broward county in Florida, the system incorrectly labelled African defendants as high risk at nearly twice the rate it mislabelled white defendants.

KI Curriculum project
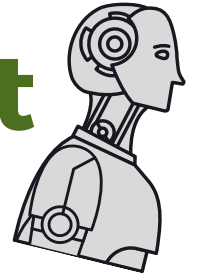
1. Autonomous car

The most widely cited case for ethical use of AI is the autonomous car. It is a car using AI as the driver in a transport system that can reduce accidents while decreasing traffic congestion, fuel consumption and CO2 emissions.

Dilemma: image you own a self-driving car. One day while driving along, an unfortunate set of events causes the car to head towards a crowd of 10 people crossing the road. The only way to avoid killing 10 people is to steering into a wall and killing the driver. One way to approach this is to act in a way that minimises the loss of life, that is killing one is better than killing 10.

Future implications: fewer people would choose to buy self-driving cars if they are programmed to sacrifice the owner and consequently more people are likely to die because ordinary cars are involved in so many more accidents.

Result: a Catch-22 situation where people are in favour of cars that sacrifices the occupant to save other lives, as long as they do not have to drive one themselves.
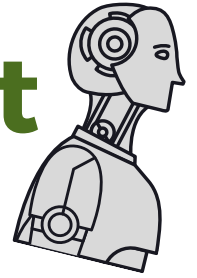
Oliver: "Abovementioned dilemma is a bit tricky. I have never met a similar situation in my 35 years on the road. Neither did my friends (if they did, they must be dead already). They say 90 % of accidents are caused by human error. I am sure AI can provide better scanning of the driving conditions and has zero problems with alcohol and fatigue, normal speed and fast response. All these can drastically lower the number of accidents. I am sceptical towards AI at my work, but I liked its potential for safer driving."

2. Predpol

Predpol is an algorithm designed to predict when and where crimes will take place, with the aim of helping to reduce human bias in policing. In 2016, The Human Rights Data Analysis Group found out that the software could lead the police to unfairly target certain neighbourhoods.

3. Gender recognition

Law enforcement agencies increasingly use facial recognition software. This is another potential source of both gender and race bias. Recently, researchers at the Massachusetts Institute of Technology have concluded that 3 of the latest gender-recognition AIs from IBM, Microsoft and the Chinese company Megvii could identify a person's gender from a photograph 99% of the time for white men, but this number dropped to a mere 35% for dark-skinned women thus increasing the risk of false identification of women and minorities.

KI Curriculum project
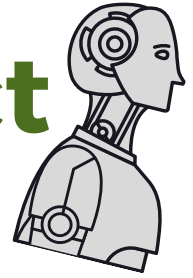
4. Autonomous military weapons

Machines are starting to take the place of humans in the battlefields. Some robotic experts have predicted that fully autonomous weapons -with the ability to select and engage targets without human intervention - could be developed within the next 20 to 30 years.
Experts have been debating the benefits and risks of fully autonomous weapons. The evaluation perspectives include military utility, cost, politics and ethics of delegating life-and-death decisions to a machine.

The primary concern of Human Rights Watch and IHRC is the impact fully autonomous weapons would have on the protection of civilians during times of war. There is also danger to use autonomous weapons in terrorist attacks. Fully autonomous weapons could be deemed as weapons of mass destruction and would have to be treated accordingly.

Conclusion – Challenges & Concerns

• The impact of AI systems should be considered not only from an individual perspective, but also from the perspective of the society as a whole.
• The main risks related to the use of AI concern the application of rules designed to protect fundamental rights (including personal data and privacy protection and non-discrimination) as well as safety and liability-related issues.
• Finding the appropriate balance between AI and ethics will be crucial in order for societies and economies to fully benefit from it.

HUMAN MACHINE INTERACTION

Human–Computer or Human-Machine Interaction (HCI/HMI) refers to the communication and interaction between a human person and a machine or a computer. It aims at creating user friendly software that people want to use, are able to use and find effective to use.

INTERACTIVE PRODUCTS MUST BE

Memorable and easy to learn

Effective to use

Enjoyable from the user's perspective

Safe for users, the environment and others
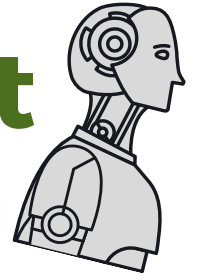
EMERGING TRENDS

VIRTUAL REALITY

AUGMENTED REALITY

MIXED REALITY

AIAE

KI Curriculum project

BASIC BRIEFINGS – HUMAN MACHINE INTERACTION

Introduction

According to Britannica "Human-computer interaction (HCI) is concerned with **designing effective interaction between users and computers** and the **construction of interfaces** that support this interaction. HCI occurs at an interface that includes both software and hardware".
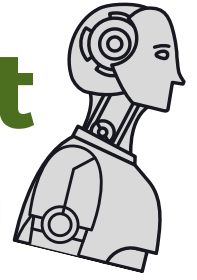
Human–Computer or Human-Machine Interaction (HCI/HMI) refers to the **communication and interaction between a human person and a machine or a computer.** It aims to **create user friendly software** that people want to use, are able to use and find effective to use. 1st interactions were limited to experts in computer programming. Nowadays researchers are studying how to use people's brain to communicate or even integrate with machines.

With computer systems and technology in general, undertaking important tasks of our everyday personal and business lives, the sensors and interfaces that allow humans to interact with machines, are becoming increasingly important.

Ingrid: "At present moment a lot of human - machine interaction is done at work. But in the very near future, the majority of communication will happen inside our home. So-called "smart homes" will connect numerous devices and adjust them to our needs and habits. Imagine evening when you come home from a tough working day. Door will recognise your face and open automatically. Virtual assistant will scan your mood and turn on the relaxing music. Lights will become slightly dimmed. System will start to pour hot water in the bath and the fridge will warm bottle of red wine to 15 degrees. Well, you got the point now :)"

At the same time, operating all these machines must be straightforward and intuitive for users and/or operators.

How are devices controlled

The field of HMI is at the **intersection of the computer and behavioural sciences** and has evolved from our desktops and laptops, to mobile screens and handheld devices.

Most devices can be controlled in two ways:

1. **Directly**: users/operators issue "commands" to the machine:
- Users/operators may touch a tablet's screen, make a selection on their web browser, select an option on a touch screen or issue a verbal command to their smartphone or other digital assistant.
2. **Indirectly**: machines automatically identify what people want:
- A chatbot provides "live" support to buyers on a website, replying automatically to customer questions and improving their knowledge. Customer support of the biggest technological companies is becoming more and more non-personal. Your initial request will be met by chatbot. Only after all preset solutions are written off, you will be directed to the live agent.
- A navigation system proposes an alternative route when a turn is missed by the driver,
- A smartwatch automatically stops recording a running activity when the user pauses his activity.

KI Curriculum project
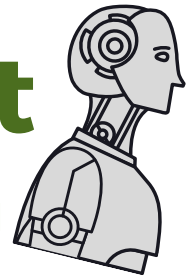
The goals of human-machine interaction

The goals of Human-Machine Interaction are to **develop usable, safe and functional systems**.

The process entails understanding the factors that determine **how people use technology** and utilising tools and techniques to enable the development of suitable systems.

The usability element relates to ensuring that interactive products/interfaces are:

- Memorable and easy to learn,
- Effective to use,
- Enjoyable from the user's perspective,
- Safe for users, the environment and others.

Oliver: "Relationship between Humans and robots is a theme in numerous movies and series. Blade Runner 2049 points out that robots can be more humane and emphatic than people. In Westworld people can live their fantasies in amusement park which is populated by android robots. Movie "Her" explores the complexity of love between human and virtual assistant."

The evolution of human machine interaction

A perceptual user interface is an interface that allows users to interact with computers or machines without having to use **a keyboard and/or a mouse**.

KI Curriculum project
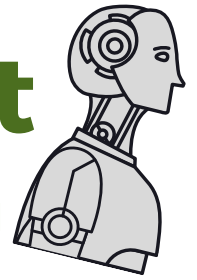
BASIC BRIEFINGS – HUMAN MACHINE INTERACTION

Voice activation and gesture control are considered **perceptual user interfaces**.

Gesture recognition is a user interface that allows a computer or a machine to **interpret human motions as commands**. It is based on Computer Vision (CV) technology.

Voice recognition enables a machine or a computer to **recognise spoken language and carry voice commands**. Voice recognition uses Natural Language Processing (NLP) technology.

Both interfaces can be used as alternatives to touch control, allowing users to communicate with a computer or machine without the use of hands.

Oliver: "I own an Apple smartphone so I often meet its virtual assistant Siri. Siri is a voice-controlled personal assistant who helps to interact with smartphone and other devices. I ask her simple questions like "what's the weather forecast" or "where is my laptop". She also reads my messages and e-mails and checks the results of my favourite football club. Sometimes we make jokes. I said "Siri I'm sad", and she replied "It's OK to cry if you want. My glass surface is tear resistant".

AIAE

KI Curriculum project
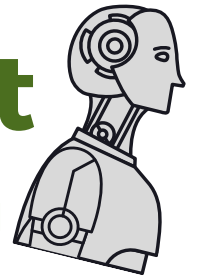
Emerging trends

Virtual Reality is a **fully immersive technology**, which tricks humans into thinking they are in a different environment from the real world by creating a **computer-generated representation of an object** or objects.

Augmented Reality is a technology that overlays digital information on real-world elements, **producing a composite view**.

Mixed Reality brings together **real and digital world elements** allowing users to **manipulate physical and virtual items** and environments.

Virtual, Augmented and Mixed reality cannot only be used for games and fun.

Combining VR/AR/MR with Human–Machine Interaction (HMI) technologies can help people **control machines or computers remotely**, **practice and acquire advanced skills** and competences in a virtual environment and experience new things.

Ingrid: "Virtual reality might just get a big boost from lockdowns. It enabled virtual tours in museums, augmented travel to exotic destinations or realistic display of planned home renovations. Virtual reality is already used in development of complex skills like battlefield behaviour, flight simulations, surgeries or practices in team sports. It is effective in treating post-traumatic stress as it enables a safe environment where patients face their fears and phobias."

KI Curriculum project
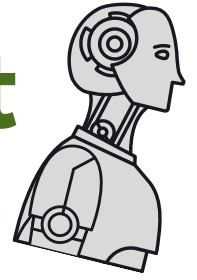
BASIC BRIEFINGS – HUMAN MACHINE INTERACTION

Challenges

Depending on the industry, there are numerous challenges that must be taken into consideration.

Human capabilities and limitations, must be taken into account in the design and development of **human centric interfaces and sensors**.

Operating a machine must not be complex or require a high learning curve.

The communication between humans and machines, the so called **user experience** must be **smooth** and **limit the possibilities of mistakes** or accidents.

The 1979 "Three Miles island" accident, the worst nuclear accident in US history was attributed to mechanical failures, the failure of plant operators to recognise the situation, inadequate training and inappropriate human-computer interaction design.

In the words Don Norman, the inventor of the phrase user experience, "The control room and computer interfaces at Three Mile Island could not have been more confusing if they had tried."

MACHINE LEARNING

ACTUAL CASES

Machine learning is considered a branch of artificial intelligence (AI) focused on building applications with the ability to learn from experience.

FACEBOOK

By keeping track of uses' behaviour (friends, groups, interests), platforms like Facebook recommend people we may know or with whom we can be associated

PINTEREST

By identifying patterns and visual similarities, Pinterest keeps users engaged, by recommending relevant pins to users, even pins they may have never searched or pinned

EMAIL AND SPAM FILTERING

E-mail service providers filter spam and other malicious e-mails by identifying coding patterns and/or senders' behaviours and characteristics.
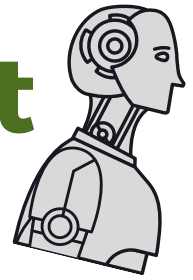
CAR NAVIGATION

To predict traffic, Google Maps uses machine learning to combine and analyse historical traffic patterns and live traffic conditions.

AIAE

KI Curriculum project

BASIC BRIEFINGS – MACHINE LEARNING

Introduction & main aim

Machine learning is considered a branch of artificial intelligence (AI) focused on **building applications** with the ability to **learn from experience**.

By **analysing massive data and patterns**, machines automatically learn and **improve their accuracy** over time, **without being programmed** to do so. At Haverford College in Pennsylvania, machine learning was used to extract insights from data of failed and successful experiments of producing crystals with chemical reactions. After sorting the data, the machine learning algorithm was able to predict crystals in 89 percent of the cases, which is better than the predictions of the researchers, who did so in 78 percent of the cases, based on their knowledge and experience. (Source: Human + Machine, Daugherty and Wilson)

Machine Learning Definition:

• Back in 1959, Professor Arthur Samuel, a pioneer in the field of machine learning defined it as the "field of study that gives computers the ability to learn without being explicitly programmed".

Primary aim:
• **To provide machines with independent learning techniques** and allowing them to learn, **with minimum human intervention** or assistance (programming) and adjust actions accordingly.
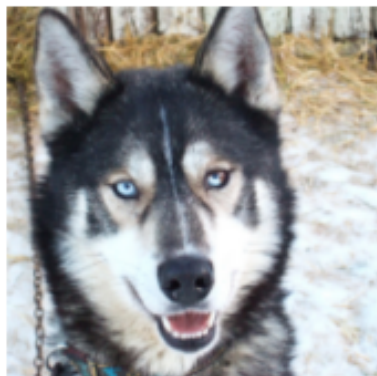
KI Curriculum project
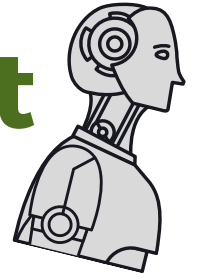
BASIC BRIEFINGS – MACHINE LEARNING

Oliver: "I've heard of an example when AI was used to differentiate between dogs and wolves in multiple photographs. Mostly, it has worked very well, but then it labeled a husky as a wolf. When inventors researched why the husky was interpreted as a wolf, they found out that AI learned to differentiate the two animals based on the background. If the animal was on snow it interpreted it as a wolf, when it was on grass it was interpreted as a dog. This shows that humans still have to supervise the decisions done by AI, especially when making important conclusions or predictions. Can you imagine it would differentiate between people based on this kind of algorithm?"

(a) Husky classified as wolf   (b) Explanation

(Source: https://hackernoon.com/dogs-wolves-data-science-and-why-machines-must-learn-like-humans-do-41c43bc7f982)

Differences from traditional programming

Traditional programming:

· In the traditional computer programming setting, a programme executed on a computer, **uses input data and a set of rules** in order to generate an output.

KI Curriculum project
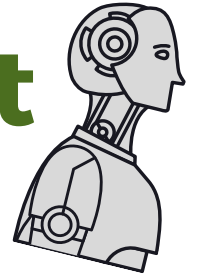
BASIC BRIEFINGS – MACHINE LEARNING

· The **process is manual**, meaning that a **programmer creates the logic** and the rules of the programme by writing a programme (hard code).

The dataset is a **subset of a bigger dataset** and serves to give the algorithm an idea of the problem, solution, and data points.

The algorithm **establishes a cause and effect relationship** between the variables in the dataset.

At the end of the training, the algorithm has an idea of how the data works and the relationship between the input and the output.

The solution is deployed with the bigger dataset and follows the same approach and continues to learn after deployment.

It is often referred to as task oriented learning.
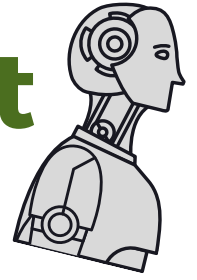
Machine learning – Unsupervised Learning

Un-supervised Learning

It is the opposite of supervised learning, requiring no data labels.

· Data = Information

· **Labeled vs Un-Labeled data**
  • Labeled data: Comes with a label which defines what it is.
  • Unlabeled data: Comes without a label.

KI Curriculum project

BASIC BRIEFINGS – MACHINE LEARNING

Algorithms are fed with massive amounts of data and are additionally provided with the tools to understand the properties of the data.

The ability of intelligent algorithms to **evaluate and make sense of "un-labeled" terabytes of data**, makes un-supervised learning applicable for numerous business applications.

Un-supervised learning is more about **identifying patterns and relationships in large volumes of data** that humans would miss, rather than automating decision making and predictions.

Machine learning – Reinforcement Learning

Reinforcement Learning

A "behavioural" machine learning technique that focuses on **training an algorithm mimicking the trial-and-error approach** from which human beings learn from experience.

The algorithm improves upon itself through an **iterative process** during which the algorithm evaluates a situation, takes an action, and receives feedback from the environment after each decision.

Based on the psychological concept of conditioning, **positive feedback is considered favourable** and is "reinforced" as a reward for the right choice, while negative feedback is considered punishment for making a mistake, the wrong choice.

KI Curriculum project
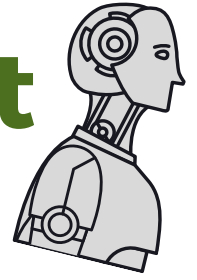
BASIC BRIEFINGS – MACHINE LEARNING

Oliver: "I have figured out some AI learns in a similar way as my dog Lin. He is still a puppy, so we are just learning the command "sit". Whenever he sits at my command, I instantly give him a treat. Being a fast learner, Lin already knows that he will be rewarded after he sits, so he does that more often. The same goes for AI, but in this case the inventors don't have to spend money on treats, lucky them."

Actual cases – Social networking

As of the 4th quarter of 2020 Facebook alone had roughly 2.8 billion monthly active users (https://www.statista.com/statistics/264810/number-of-monthly-active-facebook-users-worldwide/)

Most of us find social media fun and engaging, as they teach us new skills (LinkedIn learning), provide us with news of our preference and support us expand our professional network or reconnect with old friends and relatives.

Machine Learning plays a crucial role in **developing user-friendly social media** websites and applications.

- **Facebook**: By keeping track of uses' behaviour (friends, groups, interests), platforms like Facebook recommend people we may know or with whom we can be associated.
- **Pinterest**: By identifying patterns and visual similarities, Pinterest keeps users engaged, by recommending relevant pins to users, even pins they may have never searched or pinned.

AIAE

KI Curriculum project
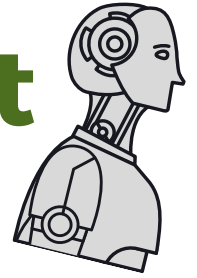
BASIC BRIEFINGS – MACHINE LEARNING

Ingrid: "When I bought my apartment, most of it had to be renewed. With the help of Pinterest, I have come up with so many good ideas on which furniture to buy and how to decorate all rooms. After creating the board "Apartment" and pinning some posts I liked, the application started suggesting some great ideas, which were exactly what I wanted, but would never remember them on my own. Thanks to AI, I didn't need an interior designer, since I was able to renovate the apartment with the help of an application."

Actual cases – Email

Email and Spam Filtering

There are 293.6 billion e-mails sent and received every day and 4 billion e-mail users around the world (https://review42.com/resources/how-many-emails-are-sent-per-day/).

The following are some of the areas where Machine Learning techniques can support in optimising :

· E-mail service providers filter spam and other malicious e-mails by **identifying coding patterns** and/or senders' behaviours and characteristics.

· Marketing companies **optimise their campaigns** by generating appropriate e-mail content, targeting the right users using **predictive analytics** and tracking the **performance of campaigns**.

· Users become more efficient by **using filters** and **categorising e-mails**.

KI Curriculum project

BASIC BRIEFINGS – MACHINE LEARNING
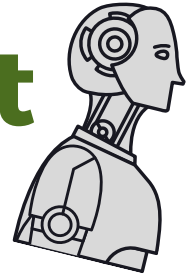
Actual cases – Car Navigation

Machine Learning – Helping drivers globally reach their destination

According to Google, every day, over 1 billion kilometers are driven with Google Maps in more than 220 countries and territories around the world (https://blog.google/products/maps/google-maps-101-how-ai-helps-predict-traffic-and-determine-routes/).

Live traffic, powered by Google Maps users around the world **aggregate location data** and support Google **predict traffic conditions** on roads all over the world.

To predict traffic, Google Maps uses machine learning to **combine and analyse historical traffic patterns** and **live traffic conditions**.

To select routes, Google Maps uses **predictive analytics** combined with factors, like road quality, the size and directness of a road, data from governments and real-time feedback from users. Google Maps automatically reroutes drivers using its knowledge about nearby road conditions and incidents.

Challenges

- **Avoiding biased views**: We must ensure that the biased views of programmers and business analysts are not "learned" by the systems they will develop.
- **Fair & Ethical decision making**: We must ensure that we can verify that the decisions, automatically made by machine learning systems, are ethical and fair.

KI Curriculum project

BASIC BRIEFINGS – MACHINE LEARNING
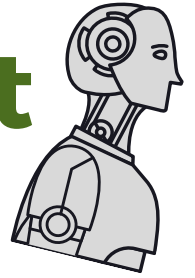
- **Transparency**: Transparency must be inherent in decisions made by machines and algorithms and those affected must be able to understand them.
- **Safety**: We must ensure that decisions made by machines and algorithms are safe.
- **Quality of data**: We must ensure that algorithms are provided with the right data.

Opportunities

- Machines are designed and programmed by humans, we therefore have the opportunity to engrain the above in all programmes, audit and constantly improve them over time.

Sources

https://www.intel.com/content/www/us/en/artificial-intelligence/posts/the-challenges-and-opportunities-of-explainable-ai.html
https://www.kaspersky.com/blog/machine-learning-nine-challenges/23553/

ARTIFICIAL INTELLIGENCE

SOCIETAL CHALLENGES

LABOUR JOBS AUTOMATION

This integration affects not only blue collar jobs but also many traditional white collar sectors, whose traditional role is already partly taken by artificial intelligence.

BIASES

Human bias can easily affect AI solutions if not properly designed. This can occur at the data level as well at the algorithmic/programming development level and at the deployment level. Subsequently AI may reflect and amplify cultural assumptions and inequalities.

CIVIL AND PERSONAL RIGHTS

AI systems are often deployed by governmental agencies and private corporations in ways that challenge civil rights and raise numerous privacy and accountability concerns. For example, AI applications in the Healthcare sector and the handling of sensitive information.

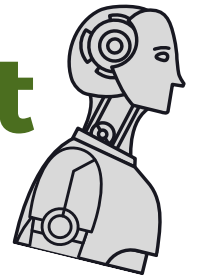## Societal applications

EPIDEMICS	AGRICULTURE	GLOBAL HUNGER

HEALTHCARE	EDUCATION	CLEAN ENERGY

AIAE

KI Curriculum project

BASIC BRIEFINGS –AI & SOCIETAL CHALLENGES

Ethical use of AI

Some of the wider concerns raised by the use of AI in our daily lives are presented below:

- AI raises concerns related to **ethics, fairness and privacy**.
- AI systems need to be **trustworthy and human-centered**.

AI needs to **uphold the wider International Human Rights** that provide a set of universal minimum standards. These standards create **legally enforceable obligations** for countries to respect, protect and fulfil human rights.

Human rights include the right to equality, the right to non-discrimination, the right to freedom of association and the right to health.

Oliver: "Majority of my friends visualise AI as a hyper intelligent humanoid robot. Some agree robots should obey 3 famous Asimov laws 1) "A robot may not injure a human being or, through inaction, allow a human being to come to harm." 2) "A robot must obey orders given to it by human beings except where such orders would conflict with the First Law." 3) "A robot must protect its own existence, as long as such protection does not conflict with the First or Second Law."

I am more sceptical. Should use of robots then be prohibited in wars? Are robots really just slaves to humans? How should humans treat intelligent machines that might someday have consciousness and emotions?"

AIAE

KI Curriculum project

BASIC BRIEFINGS –AI & SOCIETAL CHALLENGES
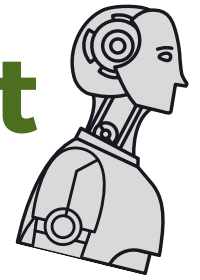
Societal Concerns

1. Labour jobs automation

One of the prime concerns about AI is probably the general fear of the prospect of **mass job loss due to automation**. For example, the adoption of robots to handle automation.

AI is already changing the **balance of the workplace environment**; hiring, the gig economy (a labour market characterised by the prevalence of short-term contracts as opposed to permanent jobs) are just two of the areas that have already been integrated to some degree by management to be handled by AI technologies. This integration affects not only **blue collar jobs** but also many traditional **white collar sectors**. Imagine jobs like physicists, plant operators, translators, market research analysts, radiologists, recruitment specialists… Their traditional role is already at least **partly taken by artificial intelligence**.

Ingrid: "Imagine the world without jobs. Some experts say it's possible because the majority of tasks will be done better by AI. There are at least two pressing issues: where to get the money and how to spend our time. Some say money will be paid by the governments who will collect taxes from companies that employ robots. Work is crucial for shaping personality, finding meaning and forming relationships. We could spend more time with family or finding new ways to contribute to society. Both solutions were piloted during covid lockdowns and some people were unhappy with that lifestyle."

KI Curriculum project
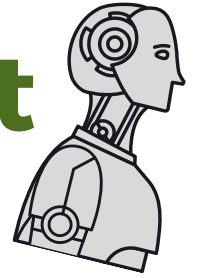
BASIC BRIEFINGS –AI & SOCIETAL CHALLENGES

Concerns: AI has the capacity to intensify the surveillance, tracking and evaluation of workers. AI assisted forms of management may shift owner power under the disguise of technology.

Source: AI Now 2017 Report

2. Biases

At the optimal theoretical level, AI systems can be used to augment human judgement and reduce both conscious and unconscious biases. In practice though, **human bias can easily infect AI solutions**, if not properly designed and programmed.

This can occur at the **data level** (meaning how data is collected, sampled or selected for use), as well at the **algorithmic/programming development level** and at the **deployment level**. Subsequently AI may reflect and amplify cultural assumptions and inequalities.

Possible remedy: Since AI systems involve studying and predicting the behaviour of often the most diverse population, a more diverse universe of AI designers should be aimed for to mitigate bias. Currently designers of AI systems tend to be well- compensated, highly educated males.

AIAE

KI Curriculum project
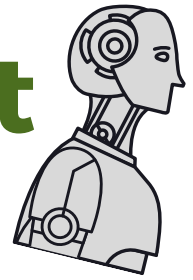
BASIC BRIEFINGS –AI & SOCIETAL CHALLENGES

Ingrid: "Many think recruitment processes are done unfairly. Would AI be of any help? It can certainly read a lot of CVs in a short time. It can follow the same criteria when comparing candidates. It can objectively evaluate if candidates match standards. It can provide assessment of competencies with psychological tests. It can ask powerful questions that are adjusted to the answers of participants. It can also provide a detailed online check of candidates. However I highly suspect that the final decision will still be made by humans."

Source: AI Now 2017 Report

3. Civil and personal Rights

AI systems are often deployed by **governmental agencies and private corporations** in ways that **challenge civil rights** and **raise numerous privacy and accountability concerns**.

For example, AI applications in the Healthcare sector have raised considerable concerns regarding the **handling of sensitive information**. AI training algorithms require large amounts of data which means an increase in data collection both in scale and granularity. Without the proper safeguards, these can create risks that threaten and expose already vulnerable populations.

Source: AI Now 2017 Report

AIAE

KI Curriculum project
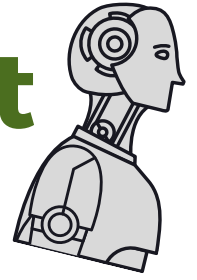
BASIC BRIEFINGS –AI & SOCIETAL CHALLENGES

AI Societal applications

- **Epidemics:** AI technology can make it easier in gathering large data sets that can be used to build models quickly enough – a critical element in epidemics modelling. Subsequently, these models are utilised in providing predictive analytics out in the field to health care workers and other relevant professionals.

- **Agriculture**: AI is widely used in agriculture from sensors on livestock and watering of plants to even crop – picking robots. Given the global population increase, AI is expected to play a crucial role in farming, increasing efficiency and eliminating risks.

- **Global Hunger**: The global hunger crisis is partly due to the fact that people in some parts of the world, especially the so called "developed" world, tend to waste a lot of food. AI technology could be utilised so that it can be determined how much food people should buy at supermarkets or takeout orders so that waste is minimised.

Oliver: "I like to have a choice in my fridge. I will be very unhappy if AI decides I need to eat healthier food. Excellent ice creams, juicy steaks and rich sauces are then off limits. Sometimes I prefer to eat fresh bread - even though I have a few slices of older toasts. And I am also very picky about some brands. Will AI know all that? And if it knows, will it allow me to continue with my shopping habits?"

AIAE

KI Curriculum project
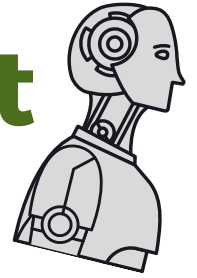
BASIC BRIEFINGS – AI & SOCIETAL CHALLENGES

- **Energy sector - Clean Energy:** AI technology can impact the energy sector by bringing clean energy solutions to cities and villages that otherwise would not be recommended. AI can also help tremendously in fighting climate change. It can improve energy efficiency, forecast energy supply and demand, help to avoid waste, monitor environmental hazards or even create new materials.
- **Better Education**: AI technology can provide precise educational content through personalised suggestions on topics to focus on better results and enhanced learning. Applicable areas could be educational platforms, environmental initiatives.
- **Health Care cost**: More targeted drugs can be developed so that clinicians can practice personalised medicine resulting in not only better care but also lower overall cost.

Source: Forbes Technology Council

Conclusion

The impact of AI systems should be considered not only from an individual perspective, but also from the perspective of the society as a whole.

The main risks related to the use of AI concern the **application of rules designed to protect fundamental rights** (including personal data and privacy protection and non-discrimination) as well as **safety and liability-related issues**.

Finding the appropriate balance between AI uses and their societal effects will be crucial in order for societies and economies to fully benefit from it.

AIAE

SIX TECHNOLOGIES
THAT FACILITATE
THE DEVELOPMENT OF AI

OBJECT OR IMAGE RECOGNITION

Object recognition enables computers to identify specific objects, people, places and activities in images or videos by using computer algorithms and machine learning techniques

FACE RECOGNITION

The capability of a machine or robot to recognise a human face through the use of biometrics and other technology, to match facial features from an image or a video.

VOICE RECOGNITION

It is a computer technology, that enables computers to identify and authenticate a speaker through the use of specialised application/software.

SPEECH RECOGNITION

It is the capability provided by technology to computer devices, to process human speech and understand words spoken by humans.

NAVIGATION

Today's navigation systems have been facilitated by innovations in location technology, the development of digital maps and the increased accuracy of global positioning systems (GPS).

OBJECT MANIPULATION

The capability to better interact with their surrounding environment by performing human actions such as touching, pushing or grasping.

AIAE

KI Curriculum project
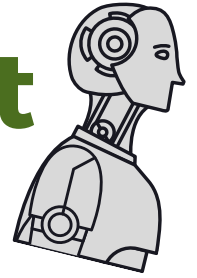
FURTHER BRIEFINGS – AI TECHNOLOGIES

In a nutshell, Artificial Intelligence (AI) is the **combination of data science and machine learning**, which provides computers with "human-like" intelligence. Machine learning is an activity where the intelligence system learns how to do a specific task without being explicitly programmed how to do it. Its intelligence relies on the analysis of previous data.

Ingrid: "Let's imagine a very busy intersection with numerous traffic lights for pedestrians, cars and trams. We want to reduce traffic jams by synchronising traffic lights and adapting lights sequences to the hourly traffic flow. If we collect data about past traffic patterns, AI system can "learn" what is the optimal traffic arrangement for each hour of the day."

Oliver: "I am somewhat concerned about AI being smarter than humans. I read something about supercomputers like dr. Watson from IBM and artificial intelligence being used in fighting covid-19. Then I saw a statement from 2012 that the best AI is still outsmarted by rats. I immediately felt better."

AI is expected to influence our societies and economies and revolutionise and improve how we live and conduct business.

AI is becoming pervasive and integral part of our daily lives.

AIAE

KI Curriculum project
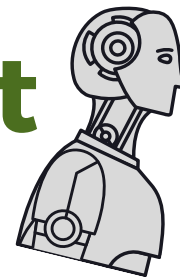
FURTHER BRIEFINGS – AI TECHNOLOGIES

Ingrid: "My colleague Anita told me the most incredible story where AI was involved. She was deeply depressed due to some tough life challenges. She was thinking about harming herself but didn't tell anyone. Then Facebook started to recommend mental health articles and offered contacts of local mental health professionals and emergency numbers for psychological help. She decided to contact one of those numbers and since then she is climbing out of depression."

In the following pages we will look into six of the many technologies that facilitate the development of AI.

Object or Image recognition

Object recognition enables computers to identify specific objects, people, places and activities in images or videos. It uses computer algorithms and machine learning techniques to accomplish that goal.
It is directly related to computer vision, which is what makes computers identify and recognise images - just like humans do.
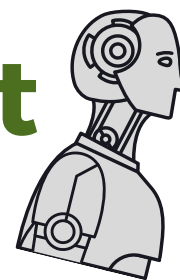
Goal:

The goal of object recognition is to **support computers and robots imitate the natural ability of humans to instantaneously, identify objects, people, animals or places and their characteristics**, by simply looking at an image or a video.

Three basic steps facilitate object recognition – classification, detection and segmentation.

KI Curriculum project
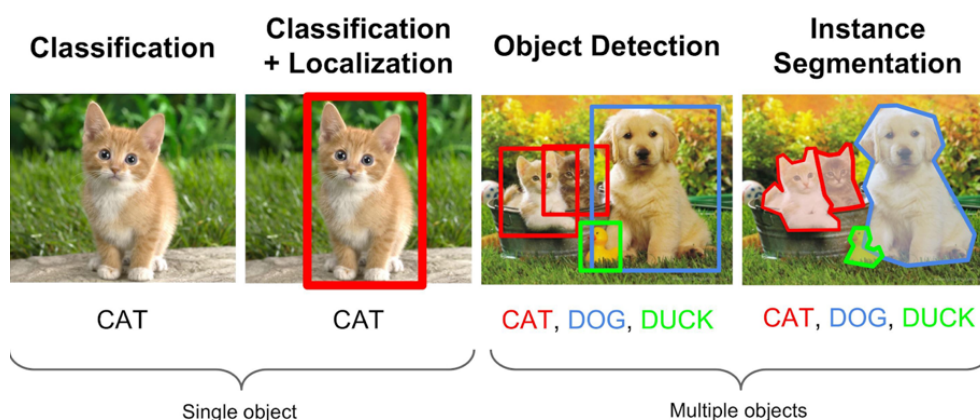
Classification and localisation

The first step is classification where an image is identified, with a high level of confidence, of what it is. Classification determines which objects are present in an image or video and combined with localisation, the exact position of the object in the image or video is determined.

Detection

The second step is detection which combines classification and localisation to determine what objects are in the image or video and specify their exact location.

Segmentation

The third and final step, segmentation, identifies the objects for each pixel in the image, resulting in a very precise, pixel by pixel, map of the image. Image segmentation separates an image into areas, outlining those areas that can be potentially used for further processing.

KI Curriculum project
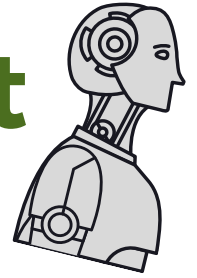
FURTHER BRIEFINGS – AI TECHNOLOGIES

Ingrid: "Let's start with pets. In classification and localisation AI recognises one cat in the picture and draws its boundary. In detection this is repeated for all the other meaningful objects in the picture (in our case all objects are pets, rubber duck included). Segmentation is much more accurate as it doesn't just draw the square around the object, but identifies which pixel belongs to which animal."

Object recognition is a complex process as it is aimed to provide computers and robots with the ability to address numerous issues and **recognise with a high level of precision different scenes, shapes, colours and illuminations**.

Oliver: "My house lies next to a busy railroad. I still vividly remember workers walking in heat, inspecting the tracks. When I was a kid, I sold them lemonade. Nowadays I don't see them anymore. Rail company built a train that is equipped with cameras. It goes up and down and photographs every cm of the track. Computers analyse photos and detect broken clamps with object recognition software. Now my kids can't sell lemonade anymore. Obviously times are changing."

Machine learning vs Deep learning:

Understanding the difference between machine and deep learning is crucial as it affects all areas of Artificial Intelligence.

KI Curriculum project
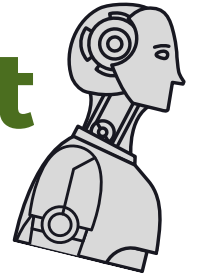
FURTHER BRIEFINGS – AI TECHNOLOGIES

In machine learning, algorithms **analyse and learn from large amounts of data**, and **apply what they learn** to make decisions. Deep learning is a technique that teaches machines **to learn by examples**. Computers continually analyse data with a **logic structure** similar to how humans draw conclusions. They use algorithms called "artificial neural network".

How this works in object recognition:

Machine learning scenario – the process begins with a collection of images (or videos), and the selection of relevant object features by using an algorithm that can differentiate them.

Deep learning scenario – deep learning models are used in order for the computer or robot to automatically learn a object's inherent features in order to uniquely identify that object.

Deep learning offers a high level of accuracy but will require a large amount of data to make accurate predictions.

Use cases

The following cases can help us understand how object recognition is used in our daily social and business lives.

Automobile Industry

Object recognition has supported the car industry **improve security**, by introducing parking sensors and city safety features, all the way to the evolution of **self-driving cars** and **autonomous vehicles**.

AIAE

KI Curriculum project
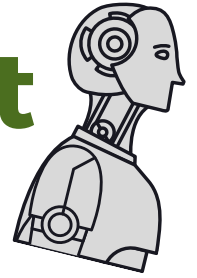
FURTHER BRIEFINGS – AI TECHNOLOGIES

Reducing road accidents and the human casualties they cause, enforcing traffic rules and optimising traffic, especially in large cities, are some of the reasons using self-driving cars and autonomous vehicles.

Healthcare Industry

Advancements in object recognition is supporting healthcare professionals **optimise the treatment** offered to patients.

From the use of **computer tomography** (CT or CAT scan), **magnetic resonance imaging** (MRI) and **X-Rays**, for accurate medical diagnosis purposes to the use of robots to perform **advanced microsurgical procedures** or to **detect irregularities** in the human body, object recognition is revolutionising the healthcare industry.

Early diagnosis of rare diseases and telemedicine can be further enhanced by advancements in object recognition and computer vision.

Ingrid: "I have highly problematic skin so I have to visit dermatologists often. They always say I should carefully monitor some of my moles. This task is easier nowadays as I downloaded an app that takes serial photographs of my moles and tracks its progress in time. I am waiting for the moment when AI can scan my whole skin and make a highly accurate diagnosis against skin cancer."

AIAE

KI Curriculum project
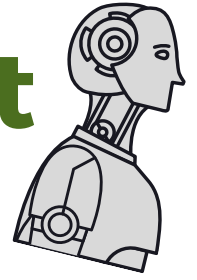
FURTHER BRIEFINGS – AI TECHNOLOGIES

Manufacturing

The manufacturing sector is also being revolutionised by object recognition.

In quality management and control, object recognition can **reduce errors of manual processes** by identifying faulty parts on an assembly line, sorting inventory and concluding orders and even facilitate the full automation of assembly lines, where products come in different sizes, colours and types.

Retail

Cashier-less automatic check out points, store inventory management, shelf replacement and inventory optimisation are some of the areas where object recognition can support retailers **enhance customer satisfaction** and **increase sales**.

Oliver: "Our company is producing technology for the textile industry. One of our clients experienced a big increase in sales during lockdowns when shops went online. It put big mirrors in exhibition windows. Mirror consisted of multiple cameras that detected different body parts of potential customers. Customers used QR code to open the store's e-shop. E-shop provided recommendations based on the correct size and available models. Customers could turn in front of the mirror and check how clothing fits. My wife told me that the mirror makes her look thinner. Maybe that's why she spends so much money in that shop."

KI Curriculum project
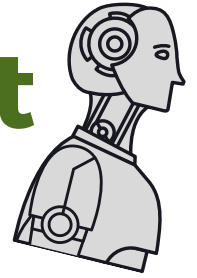
FURTHER BRIEFINGS – AI TECHNOLOGIES

Object recognition can also support **theft prevention** and **security.**

Object recognition relates directly to computer vision.

Overcoming issues related to the surrounding environment such as lighting, weather and illumination conditions and the scenery where an object is positioned, is considered crucial.

Providing "lifelong" vision learning to machines and robots and enabling them to distinguish between the same object being placed in a different environment or under different weather conditions is equally important.

Face recognition

The capability of a machine or robot to **recognise a human face** through the use of **biometrics** and other technology, to match facial features from an image or a video.

Goal

The main goal of face recognition is to **identify and/or verify the identity of individuals**, using their district facial characteristics by searching in photos, videos and in a real-time environment.

The main use of face recognition is in **biometric security.**

KI Curriculum project
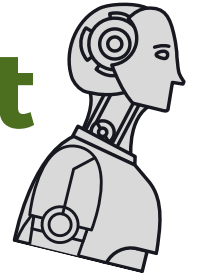
FURTHER BRIEFINGS – AI TECHNOLOGIES

Oliver: "I have heard that reliability of face recognition is improving, but is not completely accurate yet. For that reason, I am wondering if my face can be mistaken for someone else's, perhaps even a criminal, when I for e.g. cross the border. Aside from that, face recognition data is already being collected in many places, but no one has ever asked me for my consent. Actually, most countries have no specific legislation or rules that regulate the use of facial recognition technology. What happens if my data is stolen or abused with deep - fake technology?"

Process

Most of us know face recognition through our interaction with the unlocking feature on our mobile phones, tablets where our device identifies us as a person authorised to access the device and restricts access to unauthorised persons.
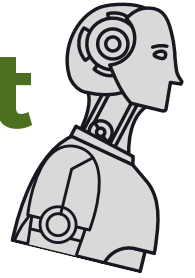
In the following pages we will discuss how face technology systems function.

Face detection

The process begins with a **camera locating and detecting a face**, alone, when unlocking a device or checking in at the airport, or in a crowd in surveillance and law enforcement systems.

KI Curriculum project

Face analysis

The device then captures and analyses the image, in order to match the image with photos, held in its database or public photos. Key face characteristics factors include the distance between your eyes and the distance from forehead to chin. The software identifies facial landmarks that are key to distinguishing your face. Distances from the centroid of the face to all 68 facial landmarks create your facial signature.

Ingrid: "If you ask my youngest sister, face recognition is the most useful AI tool in the world! She is constantly taking photos and then uses various filters in Instagram and Snapchat that provide a unique face look. When I am talking with her in Zoom, she often uses face filters. Technology works so well that sometimes I can't even recognise her."

Converting a captured image into data

The third step involves **transforming a captured face image into digital data** and essentially **converting a face into a mathematical formula**, the so called "faceprint". In the same way we have unique thumbprints, we also have unique faceprints.
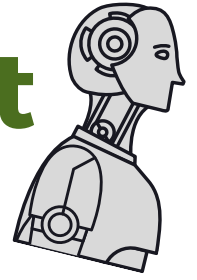
Match determination

The process is concluded with the **comparison** of the "faceprint" **against the database of the face recognition system** and **determining a match** where the captured faceprint matches an image in the system's database.

Use cases

Beyond supporting us to gain access to our mobile phones and tablets, facial recognition works side by side with numerous applications to make our lives easier. Some examples are presented below:

Device Security

The combination of the cameras available in most mobile phones, tablets and computers, and face recognition software, not only supports us to **unlock our devices**, it also offers **powerful protection of our sensitive data** as it reduces the chances of **unauthorised access** by hackers or cybercriminals.

Law enforcement

From comparing mugshots of suspects with global databases of criminals to the use of street cameras and smartphones, face recognition transforms law enforcement and supports officers in forensic investigations, in identifying offenders and in solving crimes.

KI Curriculum project
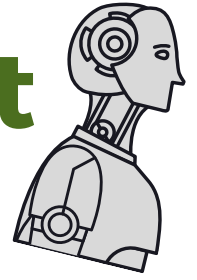
FURTHER BRIEFINGS – AI TECHNOLOGIES

Airports

Checking in at the airport and taking the flight to your next destination is gradually made easier with the increased use of biometric passports and face recognition check points, which allow airports and airlines to decrease long lines and wait time and improve security.

Finding missing persons

Ingrid: "Face recognition technology can be very useful in real-life situations. It supports authorities to find missing children and other victims of human trafficking. Simply by adding the picture of a missing individual to a global database, law enforcement agencies will become alerted once face recognition identifies an individual at an airport, a retail store or a public area. Isn't that just great?"

Finding the appropriate balance between ethics and the use of face recognition by government agencies and other entities around the world, will be crucial in order for societies and economies to fully benefit from it.

Issues like the **loss of privacy and anonymity**, who can process facial data, and having your identity mistaken with a criminal are some of the areas that must be properly addressed at the technology level and continuously monitored by authorities at the regulatory and legislative level, in order for facial recognition to work and be widely adapted and accepted.

AIAE

KI Curriculum project

FURTHER BRIEFINGS – AI TECHNOLOGIES
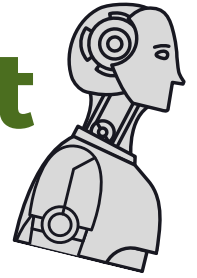
Voice Recognition (Verification)

A computer technology, that **enables computers to identify and authenticate a speaker** through the use of specialised application/software.

The process is supported by **evaluating an individual's unique voice biometrics** such as the frequency and flow of pitch, and natural accent.

Goal

Voice and speech recognition are two distinct technologies that usually work side by side.

Voice recognition, is mainly used as a biometric tool, to **recognise and verify the identity of the person speaking** and granting access to a device.

Speech recognition, on the other hand, **recognises words spoken by the speaker** and types or acts upon words spoken.

Ingrid: "There are some very interesting researches going on in the area of voice recognition. In 2019 worldwide spread of coronavirus occurred, a respiratory disease, which also leads to changes in people's voice. Team of researchers developed an artificial intelligence technology that can detect specific voice patterns in infected people and serve as a preliminary test before carrying out more precise tests, especially beneficial in asymptomatic cases."

AIAE

KI Curriculum project
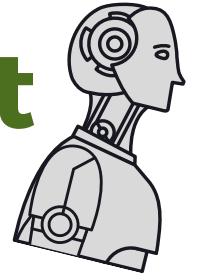
FURTHER BRIEFINGS – AI TECHNOLOGIES

Process

Voice recognition software **records a sample of a person's speech** and **digitises it** in order to **create a unique voice print**.

The voice recognition process works as below:

- The user speaks a word in a microphone which is **converted into a digital signal**, computers can read. An Analog to Digital Converter (ADC) facilitates the process.
- The speaker's unique "voice template" is created by **dividing words into discrete segments**, comprising several tones.
- This template, is used by the computer to **compare and match the input voice with the voice of the speaker** in order to identify the user.

Humans have a unique vocal tract, which means a unique voice imprint, which the computer can use for authentication purposes.
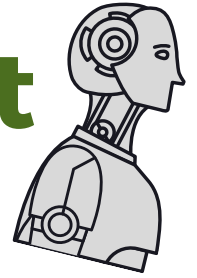The ability of a system to understand a user improves over time.

Use cases

While not as accurate as other biometric methods, voice recognition is mainly used in biometric authentication, using **script-dependent or script-independent voice verification**.

The following are the main approaches used:

AIAE

KI Curriculum project

FURTHER BRIEFINGS – AI TECHNOLOGIES

Script dependent voice verification – A person speaks a specific passphrase, usually a small number of words or a short phrase, previously registered by the voice recognition application.
The person cannot say anything he or she would like to authenticate, but will be asked to speak a predetermined phrase.

Script independent voice verification – An approach where **the user can say anything**, enabling authentication to quickly happen in the background during their normal interaction with the application.

Oliver: "There is a machine only authorised people, including me, are allowed to use at my workplace. It used to be locked in a room and only people with the key could enter. The problem was, we were always searching for the key, before we could enter the room. One day, my colleague came up with an idea to use voice recognition to start the machine instead of putting it in a separate room and always searching for the key. At the beginning, we have used script dependent voice verification, with the password that was changing every second week. That became too confusing, so we have swapped to script independent voice verification. This is more simple and quite fun, since you can say anything you like and the machine starts. There is no more need for key hunt, which is also terrific."

Other uses of voice recognition are:

- verifying and authenticating the identity of customers **calling support centres**,
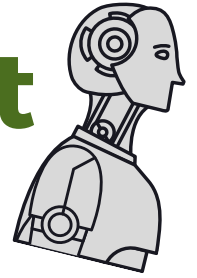
- improving customer service by **personalising the interaction** with service agents,
- enhancing security by **combining voice recognition with unique customer information** like the date of birth,
- an approach called **two-factor authentication**,
- **release valuable time** from customer service agents.

Where it is used:

Voice recognition is used in various business sectors like banking and financial services, telecommunications and healthcare.

The physical health or psychological state of an individual can cause a change in a person's speech and lead to a **mismatch** between the stored template and the person's current voice sample.

**Background noise, weather conditions** and the quality of the input device used by the speaker, can also **affect the performance** of the system and lead to a mismatch.

SPEECH RECOGNITION
What is Speech Recognition

Speech recognition, also known as Automatic Speech Recognition (ASR), is the capability provided by technology to computer devices, to **process human speech** and **understand words** spoken by humans.

KI Curriculum project
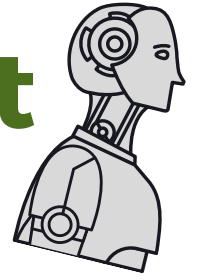
FURTHER BRIEFINGS – AI TECHNOLOGIES

"Audrey" was the first speech recognition system, developed by Bell Labs in 1952 and could understand only digits.

"Shoebox" was developed by IBM in 1962, IBM and could understand 16 words spoken in English. In 2017 Google's machine learning algorithms had a 95% word accuracy rate for English language, which is the threshold for human accuracy.

Source: https://www.vox.com/2017/5/31/15720118/google-understand-language-speech-equivalent-humans-code-conference-mary-meeker

Goal

To use technology in order to **convert words and phrases spoken by humans into electrical signals** that can be provided as **input** to computers and other intelligent devices **for manipulation or processing**.

Process

Although in today's digital age we consider speech recognition a simple task, it is one of the most complex areas of computing.

Speech recognition is a **multidisciplinary process** which involves a combination of the linguistics, mathematics, and computing disciplines.

The following steps take place when converting speech to digital form:

AIAE

KI Curriculum project
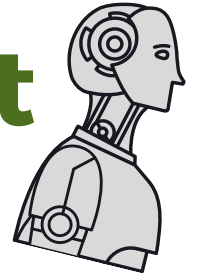
FURTHER BRIEFINGS – AI TECHNOLOGIES

- An **analog-to-digital converter** (ADC) converts human voice (analog waves) into digital data the computer can understand.
- The **signal is divided into short segments**, matched to known "phonemes", which are the smallest elements of a spoken language.
- The programme **evaluates and identifies phonemes** in the context of the other phonemes known to it.
- Finally, the program **determines what the user was saying and either presents an output** in text or executes a command.

Ingrid: "Lately, I have had many international online workshops on the topic of AI. Sometimes it is difficult for people, who are not fluent in English, to understand the training content. For that reason, I have decided to use the tool on the training online platform, which recognises the words of the speaker and writes them as subtitles instantly. When I am speaking, others are listening and moreover, they are able to read the words I say simultaneously. This is an amazing tool, which enables participants to follow the training more easily despite the language barriers."

Use cases

From turning the lights or the heat on in a smart home, to virtual assistants typing documents or answering questions speech recognition is becoming part of our daily lives.

AIAE

KI Curriculum project
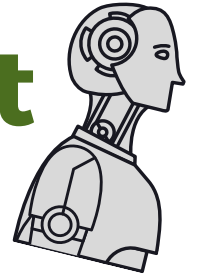
FURTHER BRIEFINGS – AI TECHNOLOGIES

Virtual assistants, the most commonly used applications and devices, can be found on our phones, tablets and laptops.

Depending on the platform we use, we are familiar with either Google Assistant, Microsoft's Cortana, Apple's Siri and Amazon's Alexa. "Alexa" is also widely known for its skills and ability to interact with humans for various daily tasks.

Speech recognition is expanding into many industries and combined with artificial intelligence and speech verification is revolutionising industries like:

- **Banking**: by **reducing the need for interaction** with customer agents and **speeding the execution of specific transactions**, speech recognition is expected to enhance customer service and release resources for sophisticated work. With the help of a virtual assistant Aida, SEB, a major swedish bank, interacts with millions of customers. Aida can answer many frequently asked questions, but in about 30% of cases, it turns the caller over to a human customer-service representative. By monitoring that interaction, the virtual assistant learns how to resolve similar problems in the future, so it can handle them on its own the next time.

Source: https://hbr.org/2018/07/collaborative-intelligence-humans-and-ai-are-joining-forces

- **Healthcare**: having continuous access to a virtual assistant that can **search massive data of previous cases** and provide accurate feedback in a split second, can make the difference between life and death,

AIAE

KI Curriculum project
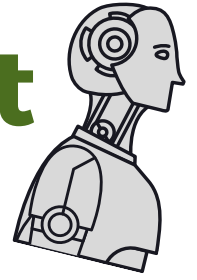
FURTHER BRIEFINGS – AI TECHNOLOGIES

- **Education**: speech recognition can provide the **independence learners with disabilities** seek in learning or writing and tools for researchers and learners.

Oliver: "I was so surprised when my blind nephew sent me a text message for the first time. With the speech recognition on his phone, his words were easily transferred into text. When I saw him the next day, he told me he uses this technology also in school, when he has to write an essay or do the homework. This gave me an idea of how I can use speech recognition at my workplace. Instead of taking off gloves every single time I wanted to make notes about the functionality of a certain component on my tablet, I now use speech recognition to do the transcription for me. This makes things so much easier."

- **Workplace in general**: By automating routine functions like dictating a document for typing, recording accurate minutes, scheduling a meeting, printing or automatically translating a document, speech recognition can increase efficiency.

The performance of speech recognition systems is to be evaluated on two criteria, **speed and accuracy**, the so-called **word error rate** (WER).

Speech recognition systems require **clean audio** that can be recognised and sufficient processing power in order **to run the algorithms required** to process the audio.
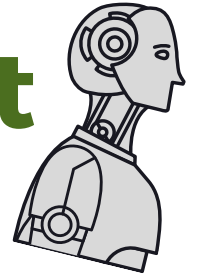
Accuracy may decrease depending on a number of factors like background noise, large numbers of people simultaneously speaking, hardware problems and issues relating to accent, expressions, idioms and the local use of a language.

NAVIGATION
Brief history:

Early navigation relied on simple **observation techniques** such as following landmarks, staying close to the shore and following hungry birds.

Navigation evolved to star charts, a technique replaced by cartography and the use of a compass utilising the earth's magnetic poles.

Today's navigation systems, embedded in vehicles, mobile phones and watches, have been facilitated by innovations in location technology, the **development of digital maps** and the increased **accuracy of global positioning systems** (GPS).

Navigation systems have advanced in almost all transportation areas, land, sea and air.

The purpose of this lesson is to cover developments in automobile navigation systems and how artificial intelligence is expected to further revolutionise the automobile industry.

AIAE

KI Curriculum project
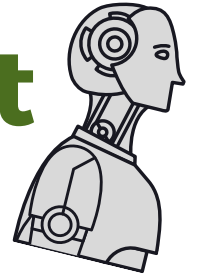
Automobile Navigation:

The history of aiding drivers reach their destination using a faster, more efficient and safer route dates back to 1930 with "Iter Avo", a device that came with a set of rolled paper maps that could roll across a display.

Fast forward to today, advancements in technology coupled with the evolution of the internet, the cloud and mobile phones, are **redesigning the automobile navigation landscape**.

Most new mid-range cars have in-car navigation systems while drivers may opt to use their own or co-driver's smartphone, using Google maps or another app they are familiar with, to reach their destination.

Autonomous cars

The efforts to develop autonomous cars dates back to the **late 1960s**.

Stanford Professor John McCarthy, one of the founding fathers of artificial intelligence, referred in his article "Computer – Controlled Cars", to an automatic driver, or a chauffeur, capable to navigate the streets via a television camera input using the same visual input available to the human driver.

McCarthy also envisioned users entering their destination in order to prompt the car to drive them there and other commands to allow users change the destination, make stops, reduce speed, or speed up.

KI Curriculum project
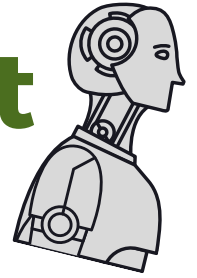
FURTHER BRIEFINGS – AI TECHNOLOGIES

Today, companies like Waymo, owned by Google's parent company Alphabet, Tesla and most "mainstream" manufacturers are working on introducing driverless or autonomous cars.

How autonomous cars work

Autonomous cars rely on a **combination of hardware, software and sensors** to function properly.

Sensors create a map of the car's surroundings and monitor the exact position of the car, nearby vehicles and other objects.

Ingrid: "My car is smart. Last month I was driving on the lonely road and spilled a hot coffee on my skirt. I screamed, started to clean the skirt and then my car suddenly stopped. I saw a deer crossing the road 1 meter from my car! Obviously sensors detected an obstacle and activated brakes so I didn't collide with an animal. Oh, did I mention that my smart car can also park autonomously in the crowded city?"

Video cameras monitor traffic lights, read road signs, track the direction of other vehicles, and **lookout for pedestrians**.

Light detection and **ranging sensors** (LiDAR), **measure distances**, detect road edges, and **identify road lane markings**, while sensors located in the wheels detect curbs and other vehicles when parking.

The information from all these sensors is processed by sophisticated software controlling acceleration, breaking, and steering.

KI Curriculum project
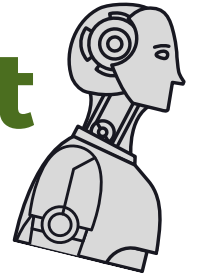
FURTHER BRIEFINGS – AI TECHNOLOGIES

Rules in a number of algorithms, make decisions based on scenarios and combined with external connectivity with digital maps and a GPS system, support the car to navigate, avoid obstacles and follow traffic rules.

Levels of car automation

There are six levels of car automation:

- **Level 0**: A car driven by a human driver **without any assistance**.
- **Level 1**: **Assisted driving**, with the driver having to constantly drive by himself and be aware, i.e. Adaptive Cruise Control (ACC).
- **Level 2**: **Partly autonomous driving**, with the car driving by itself and the driver having to constantly monitor.
- **Level 3**: **Highly autonomous driving**, meaning the car is driving on its own and the driver must only intervene when required by a situation.
- **Level 4**: **Fully autonomous driving**, meaning a car driving completely on its own.
- **Level 5**: **Driverless autonomous driving**. At this ultimate level, a car is able to drive, even without a driver, and manage all conditions it will encounter.

AIAE

KI Curriculum project
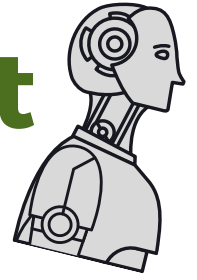
FURTHER BRIEFINGS – AI TECHNOLOGIES

Ingrid: "Level 5 of autonomous driving will drastically change the cities and society. Car ownership will fall as it will be much easier to borrow one when needed. Less parking spots will be needed and that will free space for pedestrians, cyclists and green areas. Many jobs in the delivery sector will come under threat. Areas out of the city centre will become more attractive as it will be much easier to reach all services that are clustered in the urban places. Autonomous cars will dramatically increase mobility and wellbeing of older and disabled people."

Challenges

A number of challenges must be addressed in order for autonomous cars to become widely available:

- **Weather conditions**: Autonomous cars should be able to work in all sorts of weather conditions, from sunny and clear, to cloudy and rainy or stormy weather.
- **Traffic conditions**: Autonomous cars must drive in various traffic conditions, drive with other autonomous cars by their side, as well as with humans.

Oliver: "I don't worry about the safety of autonomous cars. But I have some concerns regarding the driving experience. Will autonomous cars prevent my daughter's motion sickness? Will driving still be a fun and enjoyable activity? Will all cars offer the same feeling in the driver's seat as they will be guided by software (I like to accelerate fast for example)? And last but not least: who will pay the potential traffic fines if the car drives autonomously?"

AIAE

KI Curriculum project
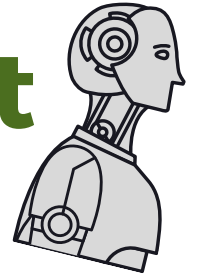
FURTHER BRIEFINGS – AI TECHNOLOGIES

- **Road network:** The road network can be unpredictable and often vary from place to place. Where roads are smooth, marked and highways are broad, challenges are less. Where roads have deteriorated, potholes are frequent and signals are unclear, challenges are more.
- **Accident Liability:** Defining who is liable in a car accident is key. If we are moving towards fully autonomous cars, who will be liable in case of a weird incident?
- **Artificial vs Emotional Intelligence**: Anticipating the emotions and possible reactions of humans and making judgment calls is also a challenge.

OBJECT MANIPULATION

Introduction:

The question of how computers manipulate objects can be answered by defining the capability of robots to **better interact with their surrounding environment**, not only by identifying an object through observation, but **by performing actions humans perform** such as touching, pushing or grasping.

In the case of humans, cognitive skills combined with what we learn from previous interactions with similar objects and observing others, are used in order to quickly learn how to touch a hot plate, change a fragile light bulb, hold an infant without causing an injury, treat an elderly person and even more advanced skills like supporting a surgeon or performing a surgery.

KI Curriculum project
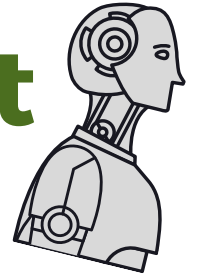
FURTHER BRIEFINGS – AI TECHNOLOGIES

Human experience allows humans to adjust the force or pressure applied in each case or when handling an object, with a different shape than the one we are already familiar with, for a example a paper vs a plastic bag.

Ingrid: "Touch is one of the most demanding senses for replication in AI machines. Human finger is a super sensitive tool as it contains more than 400 touch sensors per square centimeter of skin. Key component in sensitive object manipulation is "smart skin" - special material equipped with touch sensors that resemble human hands. Recent breakthroughs in nanomaterials lead to ultra sensitive and flexible smart skin that can be used not only in object manipulation, but also in making realistic feelings in the fingers of prosthetic arms."

Dexterity:

Human dexterity, the **manipulation skills** acquired during our childhood and further enhanced through life, with activities such as playing musical instruments, practicing sports and playing games, are crucial in object manipulation.

Oliver: "Did someone mention musical instruments? I was surprised that robots can play guitar, piano, drums and even mix music. All together, as a band. Here is the video: https://www.youtube.com/watch?v=bAdqazixuRY
However, they don't look as charismatic as some of my favourite rock members, so I wouldn't visit their concert."

AIAE

KI Curriculum project
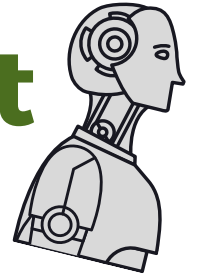
FURTHER BRIEFINGS – AI TECHNOLOGIES

In the case of artificial intelligence, teaching a robot to play chess or a video game may prove simple by **applying large datasets or scenarios** and allowing an AI system to **learn at an accelerated rate**. Teaching robots real-life tasks, related to dexterity, is much more challenging.

Dexterity **cannot be easily achieved** in a laboratory as in order to develop the **ability to manipulate the abundance of objects** that exist in our world, robots and the artificial intelligence systems that support them, must **be able to continuously learn**, **adapt their perception** to the numerous objects in the environment and **control how to use objects** they have not previously come across. Adding to the equation that each object, human or not, should be treated differently, further adds to the complexity.

Robots and Cobots

From packaging in the manufacturing sector, to warehouse automation, and check in agents in hotels or airport gates, artificial intelligence and robotics, are **revolutionising societies and economies**.

Some robots may use artificial intelligence, **in combination with sensors and actuators**, while others may simply **follow routine** and repetitive, labour **intensive instructions,** requiring no advanced skills.

KI Curriculum project
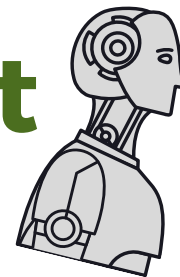
FURTHER BRIEFINGS – AI TECHNOLOGIES

The emergence of cobots, collaborative robots, which unlike traditional robots, which work separately from humans to autonomously perform specific pre-determined tasks are specifically designed to collaborate in close proximity with human workers and support them complete a task, is a new trend.

Oliver: "We welcomed 2 new coworkers. We call them Stan and Olio. Some tasks were immediately taken by them. To be honest, those tasks were also the most boring, repetitive and unpopular. They are productive, don't get tired and have excellent concentration. Some of us had to learn basic programming because Stan and Olio don't have the capability of speech recognition and articulation. I checked the manual if they can make coffee but I guess they haven't invented that yet. Maybe that will be possible with deep learning…"

Challenges

The use of robots, cobots and artificial intelligence, is becoming increasingly attractive for adaption in a number of business sectors and by organisations of all sizes.

Efficiency gains, **increased productivity** and the ability to easily penetrate new markets and **develop new products**.

At the same time, there are still challenges that need to be addressed, including **safety, ethics, intellectual property** and **reskilling of workers** in order to support a smooth transition to the artificial intelligence age.

KI Curriculum project
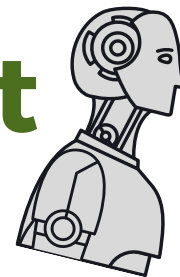
FURTHER BRIEFINGS – AI TECHNOLOGIES

Ingrid: "Our educational institution is unable to train enough home care workers. Maybe we need to hire different employees, elder care robots. Robots can cook basic food, bring water and take care of medicines. They can talk, entertain, sing or even dance. They can assist in bathing, transporting and shopping. If needed, they can call for help. And they never lose energy or patience."

AIAE

HOW ARTIFICIAL INTELLIGENCE CAN ENHANCE EDUCATION

AI AND TEACHING

AI can bring **efficiency, personalisation, automate assessment and evaluation** and provide teaching staff with a better understanding of students' individual needs, allowing educational institutions to continuously **adapt and streamline the learning process**.

AI AND LEARNING

AI combined with applications like virtual and augmented reality, can provide students with **individualised collaborative learning environments,** continuous assessments, **recommendations** and **learning by chatbots or robots**.
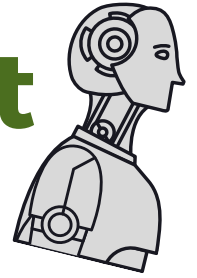
AI ENHANCED INTELLIGENT TUTORING SYSTEMS (ITS)

It can provide the **personalised learning and coaching approach** only a human tutor can offer.
In the area of adult learning, integrating an ITS into an eLearning platform, can provide **personalised real-time support and guidance**.

AIAE

KI Curriculum project

FURTHER BRIEFINGS – AI IN EDUCATION

Introduction

Similarly to all other aspects of our social and business lives Artificial Intelligence (AI) is expected to radically transform the educational sector and how we learn.

In a recent IDC survey in 509 US institutions, commissioned by Microsoft:

- **99.4%** of respondents said **AI will be instrumental** to their institution's competitiveness in the next three years,
- **15% called AI a "game-changer"**,
- **54% of higher education institutions** in the US have started to experiment with AI,
- **38% have adopted AI** as a **core part** of their business strategy.

https://educationblog.microsoft.com/en-us/2020/03/new-report-shows-big-opportunities-to-transform-higher-education-through-ai/?utm_source=MIT&utm_medium=InArticle

Primary, Secondary & Tertiary education

Artificial Intelligence (AI) can work **side by side with teachers, professors and institutions** in order to **bring the best outcome** for students and learners.

On the **side of teaching**, AI can bring efficiency, personalisation, automate assessment and evaluation and provide teaching staff with a **better understanding of students' individual needs**, allowing educational institutions to **continuously adapt and streamline the learning process**.

AIAE

KI Curriculum project

FURTHER BRIEFINGS – AI IN EDUCATION
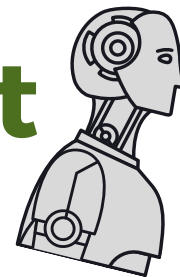
On the **side of learning**, AI combined with applications like virtual and augmented reality, can provide students with **individualised collaborative learning environments**, **continuous assessments**, recommendations and learning by chatbots or robots.

The school of the future will allow teachers and educational institutions to **streamline admissions, optimise lesson scheduling, identify learning trends** and allocate resources accordingly, **provide customised tutoring** and even perform early diagnosis of learning disabilities.

Ingrid: "It is very inspiring for me that some schools are already incorporating AI tools in their curriculum. One example is the Third Space Learning, which enables students to learn Math at their own pace. Combined with the teacher support in the classroom, the app can help boost student's confidence by providing individualised feedback and just the right selection of exercises, focusing on the areas where a specific student lacks knowledge. At the same time, Eva can practice integrals, whilst Alex is focusing more on derivatives. That saves time and energy of the teacher so they can later work on complex new content together."

AI in professional learning & reskilling

For many experts the answer to job displacement, as a result of artificial intelligence and/or other technology applications, is reskilling.

KI Curriculum project

FURTHER BRIEFINGS – AI IN EDUCATION
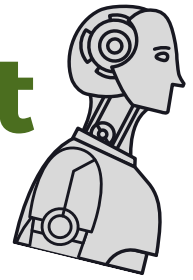
Artificial Intelligence applications can support professionals to **acquire the skills required**.

AI enhanced Intelligent Tutoring Systems (ITS)

- An AI enhanced ITS can provide the **personalised learning** and coaching approach only a human tutor can offer.
- The primary objective of an ITS is not simply to identify if a response is incorrect but to **anticipate why it was incorrectly answered** and **provide learning guidance**.
- In the area of adult learning, integrating an ITS into an eLearning platform, can provide **personalised real-time support and guidance**.
- An ITS can also **complement the work of human teachers/trainers** in preparing their lessons or when delivering them.

Oliver: "When I started working I had a wonderful mentor, who has taught me many technical skills. But what I've appreciated the most was our rapport. He helped me to connect with other colleagues, explained the expectations he and others have from me, shared with me interesting stories that form organisational values and culture, offered support when I was in doubt or made a mistake. He is still a good friend of mine. Can we expect that from an AI tutor?"

AI & Personalised Learning

- As all courses, professional courses follow the **one-size-fits-all approach**, a setting where a trainer delivers the course and the responsibility is on the learner to learn, improve and support her/himself and her/his company achieve its objectives.

AIAE

KI Curriculum project
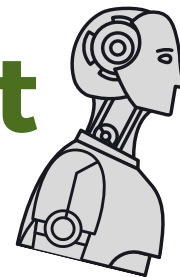
FURTHER BRIEFINGS – AI IN EDUCATION

- The traditional approach does not take into consideration human nature and the fact that individuals have **different learning and teaching approaches**.
- By evaluating historical data from other users and/or courses users themselves attended, AI can **bring the changes required** and advance at a slower pace where a learner lacks the knowledge or at an expedited pace where the opposite applies.
- In a similar manner, learners can receive **tailor-made curricula and learning material designed to help them succeed** in their role.

AI Standards for children

In the "Platform for Shaping the Future of Technology Governance: Artificial Intelligence and Machine Learning", a project coordinated by the World Economic Forum where UNICEF and other prestigious organisations participate, three strategic pillars are identified in order to reap the benefits of AI and protect those more vulnerable:

- **Educate**: Develop frameworks and toolkits to educate and inspire children, adolescents, parents and guardians around the responsible use of AI.
- **Empower**: Empower children and young people with AI skills to create their own technology to improve the state of the world with an emphasis on underrepresented voices.
- **Protect**: Protect and expand children's human rights and civil liberties when encountering AI in their homes, schools and public places.

Source: https://www.weforum.org/projects/generation-ai

KI Curriculum project
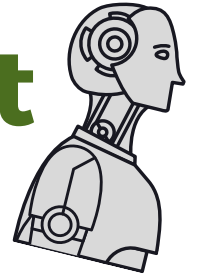
FURTHER BRIEFINGS – AI IN EDUCATION

Ingrid: "It is not only that youngsters benefit from AI, it is also the opposite. There are many kids that actively contribute to the field of AI. Neil Deshmukh, 17-years-old, created two AI apps. One helps farmers with detecting and diagnosing variations of crop disease, whilst the other helps blind people or low-vision people to "see" by audibly describing photographs. Riya Karumanchi developed a SmartCane, a stick for blind people that can sense wet surfaces and obstacles, and alarms the user by vibrating, when she was only 14. There are many more young people, who will definitely move milestones when it comes to AI."

Source: https://time.com/collection/davos-2020/5765632/young-inventors-changing-the-world/

Opportunities & Challenges

According to UNSECO AI can improve learning outcomes by helping education systems use data to **improve educational equity and quality** in the developing world and **support sustainable development**.

Beyond the opportunities, the following challenges and policy implications are identified in introducing AI in education and preparing students for an AI future:

- **Developing** a **comprehensive view of public policy** on AI for sustainable development,
- **Ensuring inclusion and equity** for AI in education,
- **Preparing teachers** for an AI-powered education,

AIAE

KI Curriculum project

FURTHER BRIEFINGS – AI IN EDUCATION
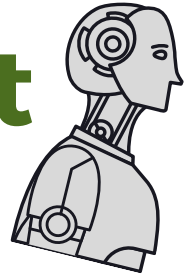
- **Developing quality** and **inclusive data systems**,
- **Enhancing research** on AI in education,
- **Dealing with ethics and transparency** in data collection, use and dissemination.

Source: https://unesdoc.unesco.org/ark:/48223/pf0000366994

AIAE

ARTIFICIAL INTELLIGENCE

IN FINANCE

Asset Management

Risk Management ⚠️

Traditionally, risk models assume that **markets behave in linear relationships** (a typical one is weight-height: on average higher people weigh more).
With the help of AI **multiple factors are tested together** (like in example of high dimensional data) and a **better, more holistic risk model** is developed.

Alpha generation

Alpha generation in investment management means that we are able to **"beat the market"**, but there is an **overwhelming amount of data** available. With the evolution of software and hardware many financial experts try to **systematically organise and analyse this "big data"**.

Banking

Virtual assistant

Banks traditional customer service model has **limited economies** and is **rigid to adapt**. Banks are shifting to the so called Virtual Assistant model which can be more **timely, cost effective** and can cope with the **inflating volume of queries**.

Debt underwriting

Banks have always relied on historical credit data to determine **credit worthiness, repayment ability and overall lending risk**.
AI credit scoring provides a **more individualised credit score assessment**.

Fraud detection

Banks are increasingly turning to AI to **combat financial crime.**
Machine learning algorithms can **handle the task of sifting** through huge amounts of data points to **detect fraudulent instances**.

Algorithmic trading

Algorithmic trading is defined as algorithms that **automate parts or the whole of the trading process** (pre-trade, execution, post-trade). Programme **monitors price of stocks** and **places buy or sell order** when a predetermined threshold is met.

Insurance

Core operations

Automation using robots are increasingly used to **handle high-volume workflow**. This highly **increases speed of process** and also **efficiency**. AI has also been used as an **assistance to insurance brokers** who sell insurance on behalf of a client.

Virtual assistants

As for banks, the traditional customer service model in the insurance industry has **limited economies** and is **rigid to adapt**. With the use of virtual assistants, insurance companies can **improve customer profiling, simplify** and **speed up processes**.

AIAE

KI Curriculum project
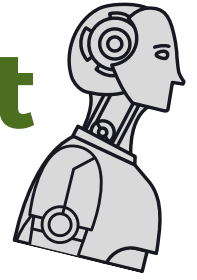
FURTHER BRIEFINGS – AI AND FINANCIAL SECTOR

Introduction

The financial services sector is no exception of the industries affected by the disruptive technology of AI. Fintech, a combination of finance and technology, has been mostly developed with an emphasis on AI.

The benefits of using AI in financial services include **productivity gains, efficiency, minimisation of errors** and **detection of fraud**. The success of AI is linked to its inherent capabilities of being **highly efficient in repetitive tasks**, **automation and pattern identification** in the so called "high dimensional data" and "big data".

Ingrid: "If we try to prognose future success of the company, many elements matter: financial liquidity, strength of competitors, GDP growth, quality of products, key employees, market potential… We can think of 100, maybe 1000 elements that matter. People can visualise the relation between two maybe three elements (if there is GDP growth, we can expect higher financial liquidity). High dimensional data analysis takes into account much more than three elements. It looks for patterns among many, many elements, that are impossible to analyse with ordinary software or common mind. When patterns are discovered, right decisions and actions can be taken."

AI deployment in the financial sector has stirred many debate topics relating mostly around **regulation, data protection** pertaining to the use of "big data" especially what is considered as personal data and security.

AIAE

KI Curriculum project
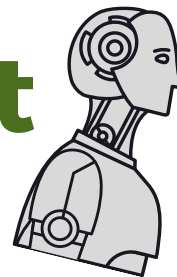
FURTHER BRIEFINGS – AI AND FINANCIAL SECTOR

There are legal and financial implications as well as reputational risks for organisations that take lightly or may abuse AI to their advantage.

**Asset Management application**

Risk Management
- Traditionally, risk models assume that markets behave in **linear relationships** (typical linear relationship is weight - height: on average higher people weigh more). , that is normal distribution is used for **regression analysis models**. For example stock prices are affected by factors like profitability, debt-to-equity ratio, market liquidity and general macroeconomic conditions. With the help of AI these factors are tested together (like in example of high dimensional data) and a better, more holistic risk model is developed. and followed in order to evaluate overall risk.
- Using machine learning and AI, statistical methods have been developed to address the **non-linear nature of data** and **challenge the traditional risk-factor regression analysis**.

Benefits: complex risks can be modelled enabling stress testing beyond the conventional business scenarios.

Alpha generation
- Alpha generation in investment management means that we are able to **"beat the market"**. In alpha generation our investments bring more profit than those from average investors (of course we can compare just investments with a similar level of risk).   a benchmark –usually a stock index – while assuming a similar amount of risk compared to the benchmark. Performance fees by asset managers are highly correlated to alpha generation.

AIAE

KI Curriculum project
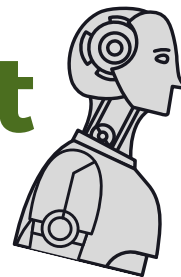
FURTHER BRIEFINGS – AI AND FINANCIAL SECTOR

- There is an **overwhelming amount of data available** when we talk about investment opportunities. With the evolution of software and hardware many financial experts try to **systematically organise and analyse this "big data"**.
- AI is used to **establish hypothesis** and **formulate models** in analysing "big data".

Oliver: "I don't have much luck with money. Whenever I earn something extra, I make some stupid decision and loose it all. I bought bitcoins when the price was high, then panicked when value fell and sold them for much less. A friend of mine who knows something about the business warned me that you can't predict the future from past performance. However, proponents of AI in finance disagree. They analyse big data with artificial intelligence to get a better idea of what might happen with stocks, bonds and yes, cryptocurrencies."

Benefits: Automation of research functions which are too costly and labour intensive can help **identify relevant information** which are useful in alpha generation and the determination of what creates value for a company.

Banking applications

AI is expected to be a game changer in the banking industry. There are numerous applications under development which could **shave down cost** and **provide numerous new channels** for sales.

KI Curriculum project
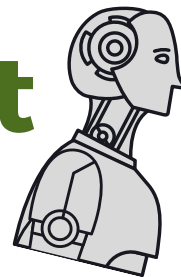
FURTHER BRIEFINGS – AI AND FINANCIAL SECTOR

Following is a list of some of the applications:

Virtual assistant

Banks traditional customer service model has limited economies and is rigid to adapt. Banks are shifting to the so called Virtual Assistant model which can be **more timely, cost effective** and can **cope with the inflating volume of queries**.

Oliver: "I like my personal banker. He is a good friend of mine and he goes the extra mile to find the best solutions for me. I can reach him whenever I need and he is highly responsive. When he went on holiday I had an opportunity to meet the bank's virtual assistant. Yes, he knew a lot, but he was distant, too rational and didn't genuinely care about me. I needed a short term loan at that time but I didn't dare to negotiate with a virtual assistant or bank's artificial intelligence."

Benefits: reduced costs, enhanced customer experience, improved relationship building, adaptability of the system to expand and also include new channels of service.

Debt underwriting

Banks have always relied on historical credit data to determine credit worthiness, repayment ability and overall lending risk. This conventional model is also associated with unforeseen risks, diminishing margins and slow decisions.

KI Curriculum project
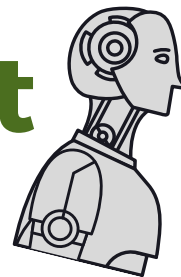
FURTHER BRIEFINGS – AI AND FINANCIAL SECTOR

Fintechs use AI mathematical models to handle big data. AI credit scoring, unlike the traditional credit scoring which focusses on credit history, is more sensitive to real-time indicators for the borrower under evaluation such as the potential ability to earn. Thus, it provides a more individualised credit score assessment.

One notable benefit is **providing credit for individuals or corporations with no credit history** but who also possess an enhanced ability to earn. Under the traditional credit scoring model, these individuals would have been probably denied credit, resulting in an unrealised economic opportunity.

Ingrid: "Oliver was maybe too harsh towards artificial intelligence when he was thinking about loan. His history of unfortunate investments proves he could use good advice. Chatbots can help in managing personal finance. Software can warn Oliver if investment opportunity doesn't suit his risk profile or long-term financial goals. AI can support Oliver in making more rational, long-term decisions instead of impulsive or panic reactions that usually don't end well for the wallet."

Fraud detection

Banks are increasingly turning to AI to **combat financial crime**. Machine learning algorithms can handle the task of **sifting through huge amounts of data points** to **detect fraudulent instances**.

Benefits: efficient and cost effective, scalable, improves with increasing number of data set.

KI Curriculum project
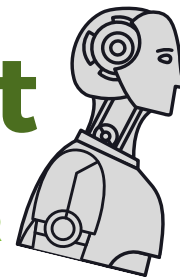
Algorithmic trading

Algorithmic trading is defined as algorithms that **automate parts or the whole of the trading process** (pre-trade, execution, post-trade). AI has been used in algorithmic trading for over a decade now by financial institutions like hedge funds. Algorithmic trading can **respond immediately to small changes in price**. Programme monitors price of stocks and places buy or sell order when a predetermined threshold is met.

Benefits: faster execution, better pricing, diminishing trading errors.

Insurance applications

Insurance is a traditional, heavily regulated industry. It is widely divided into Life and Non-Life insurance products. Following is a list of some of the AI applications in the insurance industry.

Core operations

Automation using robots are increasingly used to **handle high-volume workflow**. This highly increases **speed of process** and also **efficiency**. AI has also been used as an **assistance to insurance brokers** who sell insurance on behalf of a client. in insurance broking functions. Brokers are not anticipated to be replaced by AI functions but rather are expected to take a more analytical and risk advisory role.

Virtual assistants

Like the case for banks, the traditional customer service model in the insurance industry has limited economies and is rigid to adapt. With the use of virtual assistants, insurance companies can **improve customer profiling, simplify** and **speed up processes**.

KI Curriculum project
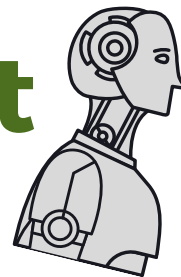
FURTHER BRIEFINGS – AI AND FINANCIAL SECTOR

Challenges & Concerns

AI technology has brought about considerable benefits to the financial services industry but there are also some notable concerns that cannot be discounted. As it is often the case, some of these issues are actual and some are perceived.

These issues are not industry specific but rather are the general concerns relating to the wider use of AI technology.

- **Complexity**: This could result to systematic crashes
- **Lack of transparency**: This could result to incorrect conclusions and also to difficulty in attributing performance breakdown
- **Data issues**: Data integrity and quality are always concerns. Bad data quality can result to the notorious "garbage in, garbage out". The need for large amount of data is also a concern especially the perceived association of "Big Data" regarding privacy issues etc.

Conclusion

AI in the financial services industry is an emerging field with many exciting and breakthrough applications. It is expected to shape the face of the industry in the future in all of its sectors – asset management, banking and insurance- through automation, cost cutting and also non-conventional forecasting.

AI's advantages lie in its **automation in conducting repetitive actions** as well as its ability and capacity to **identify patterns in data**, a feature of high importance in forecasting modelling.

AIAE

KI Curriculum project
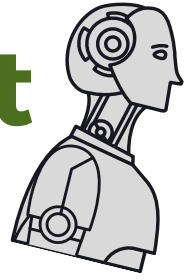
FURTHER BRIEFINGS – AI AND FINANCIAL SECTOR

AI's weaknesses lie in its **complexity, opacity** of its core operation and **the quality and integrity of the data** used for training the models.

There are legal and financial implications as well as reputational risks for organisations that take lightly or may abuse AI to their advantage.

Sources

"The new physics of financial services. How artificial intelligence is transforming the financial ecosystem" World Economic Forum and Deloitte

"Artificial Intelligence Applications in Financial Services" Marsh, Guy Carpenter, Mercer, Oliver Wyman

"Artificial Intelligence in Asset Management" CFA Institute Research Foundation

ARTIFICIAL INTELLIGENCE

IN THE HEALTHCARE SYSTEM

HEALTHCARE APPLICATIONS

Research

It is widely estimated that it takes 10+ years for a drug to be developed from research to the patient.
AI technology with its **vast data handling capabilities and the cognitive features of pattern identification** is used in an attempt to **speed up the process** and also **cut costs**.

Diagnosis

The capability of AI technology to **handle huge amounts of data** coupled with the powerful learning algorithms has made tremendous advancements in the diagnostic field. AI driven software has a **variety of diagnostic applications**, for example it is used in **spotting signs of disease in X-ray imaging**.

Health monitoring

AI technology can be used to **keep track of a patient's health** and in doing so they also encourage a healthier lifestyle. AI is also used to **increase the ability of healthcare professionals to understand the needs** and provide feedback to their patients.

Early detection

AI is used to **detect many diseases in an early stage**. **In cancer detection**, AI technology not only enables early detection but also **improves on the yielded false results of tests** (eg. Mammograms for breast cancer detection).

Training

Simulations have been an integral part of training for high-tech sectors.
AI training software has the **ability to draw instantly on a large number of scenarios** and also **build a training case** based on previous strengths and weaknesses.

Treatment

AI technology can **help doctors and healthcare clinicians take a more inclusive and all-round approach to disease treatment** and also **facilitate the long-term care management** by the patient himself.

⚠️ CHALLENGES & CONCERNS ⚠️

AI's weaknesses lie in its **complexity, opacity of its core operation** and the quality and integrity of the data used for training the models, as well as **quality of the data, data integrity, personal data** use creating **conflicting privacy issues** and also **data security.**
Furthermore, there are **legal, regulatory and financial concerns** regarding AI technology use.

AIAE

KI Curriculum project
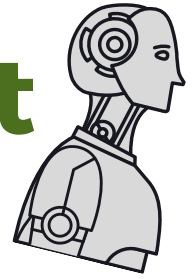
FURTHER BRIEFINGS – AI AND HEALTHCARE

Introduction

The healthcare sector is no exception of the industries affected by the disruptive technology of AI. AI technology has been mainstream in **transforming the healthcare eco-system**; drug research, diagnosis, early prevention, patient monitoring and well-being are only a small sample of the spectrum of AI applications. AI has the potential to enhance human and machine capability for **the benefit of the patient**.

The benefits of AI technology in healthcare are not confined to the conventional metrics of productivity gains, cost cutting, efficiency and minimisation of errors. The healthcare industry thrives on technological innovation and AI technology has been pivotal. AI was first used in medicine **in the 1970s for diagnosis** and **treatments recommendations for glaucoma** and infectious disease. Nowadays, it is expected that AI implementations in healthcare can help **save 128 billion euros in costs until 2026**.

(**Source**: https://www.frontiersin.org/articles/10.3389/fdgth2020.00006/full)

AI technology use in the healthcare sector does not come without challenges. These include actionable data due to privacy concerns, regulation and sizable financial and organisation investments.

KI Curriculum project
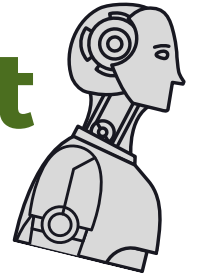
FURTHER BRIEFINGS – AI AND HEALTHCARE

AI Healthcare applications

Early detection
Early detection is of immense importance in medicine and healthcare in general. AI is used to **detect many diseases in an early stage**. In cancer detection, AI technology not only enables early detection but also improves on the **yielded false results of tests** (eg. Mammograms for breast cancer detection).

Consumer wearables use AI technology to help oversee and monitor early stage diseases like diabetes and cardiovascular disease.

Diagnosis
The capability of AI technology to handle huge amounts of data coupled with the powerful learning algorithms has made tremendous advancements in the diagnostic field. AI driven software has a variety of diagnostic applications, for example it is used in **spotting signs of disease in X-ray imaging**. With the help of an AI-enabled assistant that receives imaging scans and automatically analyses them for various clinical findings it has studied, radiologists can take the assistant's report into consideration when making diagnosis.

Source: https://builtin.com/artificial-intelligence/artificial-ntelligence-healthcare

Treatment
AI technology can help doctors and healthcare clinicians take **a more inclusive and all-round approach to disease treatment** and also facilitate the **long-term care management** by the patient himself.

AIAE

KI Curriculum project
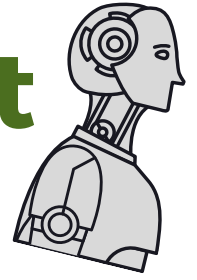
FURTHER BRIEFINGS – AI AND HEALTHCARE

The use of robotics in treatment has been around for many decades now. The range of applications vary from simple procedures to assisting **highly complex surgical procedures** to even **fully autonomous operations**.

Ingrid: "Did you know that IBM's Watson diagnoses heart disease better than cardiologists? The United Kingdom's National Health Service uses chatbots to provide medical advice? A smartphone app can detect skin cancer with an expert accuracy? I'm wondering why people are still so retained from using AI in healthcare."

Source: https://hbr.org/2019/10/ai-can-outperform-doctors-so-why-dont-patients-trust-it

Research

Medical research is a long and extremely costly process. It is widely estimated that it takes 10+ years for a drug to be developed from research to the patient. AI technology with its **vast data handling capabilities** and the cognitive features of pattern identification is used in an attempt to **speed up the process** and also **cut costs**. Pfizer, one of the pharmaceutical companies that developed COVID-19 vaccine in less than 2 years, used AI software to **analyse signals in its 44.000 person study**, consisting of millions of data points.

Source: https://www.fastcompany.com/90611856/pfizer-ceo-reasons-for-fast-covid-19-vaccine-development

KI Curriculum project

FURTHER BRIEFINGS – AI AND HEALTHCARE
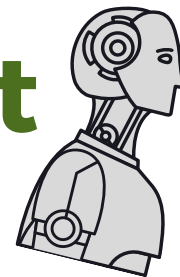
Training

Simulations have been an integral part of training for high-tech sectors. For example, in aviation simulation training is used extensively to **cut down on costs** and also **train on risky procedures** in an insulated environment. This is also the case for medicine. AI training software has the ability to draw instantly on a large number of scenarios and also build a training case based on previous strengths and weaknesses.

Oliver: "When scrolling through the news I noticed an interesting article about surgeons practicing spinal surgery in a virtual reality environment and it had worked pretty well. They have received feedback on what was done correctly and what needs to be improved. Better to practice with the help of AI than on my spine."

Health monitoring

AI technology can be used to **keep track of a patient's health** and in doing so they also encourage a healthier lifestyle. AI is also used to increase the ability of healthcare professionals to **understand the needs** and **provide feedback to their patients**.

Challenges & Concerns

AI technology has the potential of significant socioeconomic effect. Like the case with any disruptive technology, there are concerns and challenges to be overcome in order to realise its full potential. Again it is the case that some of these issues are not industry specific but rather are the general concerns relating to the wider use of AI technology.

KI Curriculum project
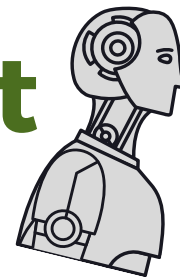
- **Data**: Quality of the data, data integrity, personal data use creating conflicting privacy issues and also data security have been concerns about AI technology and are often topics of debate.

Oliver: "In 2020 an AI company leaked over 2.5 millions medical records with names, medical diagnosis, note and payment records. All data became publicly visible online. Can you imagine what harm this could cause to the people, whose data was revealed?"

- **Regulatory issues**: Questions regarding regulation and accountability in the AI industry remain largely unanswered. Caution should be placed to avoid over-regulation as this might hinder innovation.

- **Operational and financial issues**: The healthcare industry will have to make considerable financial investments in organisational infrastructure to adopt AI applications.

Conclusion

AI in the healthcare services is a technology with many exciting and breakthrough applications. It is expected to shape all aspects of the sector ranging from research, diagnosis, treatment, patient well-being and follow-up and prevention.

As it is the case for any technology, AI needs to be **financially and operationally viable** in order to be adopted and its future development and investment in the technology depends on actual high quality, cost-efficient measurable deliverable outcomes.

KI Curriculum project
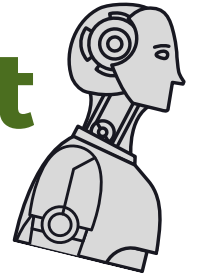
FURTHER BRIEFINGS – AI AND HEALTHCARE

AI's advantages lie in its automation in conducting complex actions as well as its capability to identify patterns and also its handling of huge amounts of data.

AI's weaknesses lie in its complexity, opacity of its core operation and the quality and integrity of the data used for training the models.

There are legal, regulatory and financial concerns regarding AI technology use.

Sources

"The socio-economic impact of AI in healthcare" Oct 2020. Deloitte, Commissioned by MedTech Europe
"AI in Healthcare: Keys to a Smarter Future". General Electric Company

https://www.pwc.com/gx/en/industries/healthcare/publications/ai-robotics-new-health/transforming-healthcare.html

ARTIFICIAL INTELLIGENCE

IN JUSTICE

Using artificial intelligence (AI) responsibly and in compliance with the European Convention on Human Rights and the Convention on the Protection of Personal Data, lies at the core of the "Ethical Principles on the Use of AI in the Administration of Justice", published by The European Commission for the efficiency of justice (CEPEJ).

The Principles also aim at enhancing the ability to improve the predictability of law, the consistency of court decisions as well as to prevent discrimination.

ETHICAL PRINCIPLES OF USING AI IN COURTS

PRINCIPLE OF RESPECT FOR FUNDAMENTAL RIGHTS

Ensure that the design and implementation of artificial intelligence tools and services are compatible with fundamental rights.

PRINCIPLE OF NON-DISCRIMINATION

Specifically prevent the development or intensification of any discrimination between individuals or groups of individuals.

PRINCIPLE OF QUALITY AND SECURITY

With regard to the processing of judicial decisions and data, use certified sources and intangible data with models elaborated in a multi-disciplinary manner, in a secure technological environment.

PRINCIPLE OF TRANSPARENCY, IMPARTIALITY AND FAIRNESS

Specifically prevent the development or intensification of any discrimination between individuals or groups of individuals.
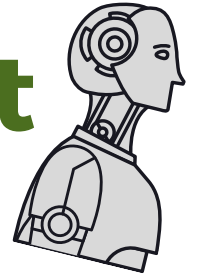
PRINCIPLE "UNDER USER CONTROL"

Preclude a prescriptive approach and ensure that users are informed actors and in control of the choices made.

AIAE

KI Curriculum project

FURTHER BRIEFINGS – AI IN JUSTICE

Introduction

In simple terms, administering justice means delivering justice in an individual case.

Delivering justice is a complex task and varies significantly depending on the type of each case, civil, criminal, family, employment, as well as the nature of the offense or the dispute between the parties.

The entire legal system, lawyers, judges, prosecutors, plaintiffs, defendants, even law enforcement officials, depend on **finding and analysing information** in order to **defend their case** and **serve justice**.

Efficiencies and improvements brought by artificial intelligence can support the legal system, improve how justice is served and also solve the delays courts experience which subsequently leads to the perception, "justice delayed is justice denied"!

AI in court

From simply organising information to the so called predictive justice, AI is gradually entering court rooms around the world.

- **Organising information**

AI can support with **identifying patterns** and **searching documents and files** that relate to the case. Lawyers use approximately 30 % of their time for routine work, reviewing the documents, investigating facts, doing case administration and management. AI is capable of doing that in a fraction of the time, while lawyers can focus on more demanding tasks.

KI Curriculum project
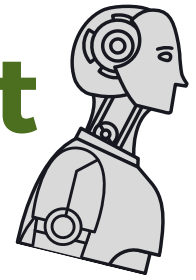
- **Providing advise**

Utilising AI applications that will not only search for information, but will also **provide answers** to questions that users can evaluate and decide how to act upon, could also be of added value. Many AI applications are able to search for information, but applications that provide possible answers to specific questions take a step further. With their help, users are able to evaluate AI's suggestion and decide how to act upon accordingly.

- **Predictive justice**

Predictive justice or more accurately **forecasting**, can be achieved using artificial intelligence, advanced search engines and extremely precise criteria and algorithms which are provided with large amounts of data and statistics. It can be used as a **decision support tool**.

Ingrid: "My friend who is a lawyer uses Lex Machina, a famous predictive justice AI technology, when he needs to prepare for a demanding legal case. He told me it helps him prepare a strategic approach, since it provides him with information on similar cases in the past, together with custom insights into all activity that led to a court's grant or denial of that motion. Looks like the applications serves him well, as he's becoming more known in the public. Aside from that, he finally has time for a coffee with me during his lunch break."

Using AI & technology in courts

The use of Artificial Intelligence in courts has been widely discussed in Europe.

KI Curriculum project
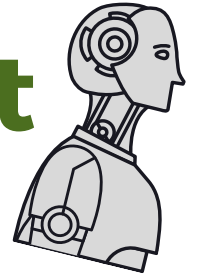
FURTHER BRIEFINGS – AI IN JUSTICE

Using artificial intelligence (AI) responsibly and in compliance with the **European Convention on Human Rights** and the **Convention on the Protection of Personal Data**, lies at the core of the "Ethical Principles on the Use of AI in the Administration of Justice", published by The European Commission for the efficiency of justice (CEPEJ).

The Principles also aim to enhance the ability to **improve the predictability of law**, the **consistency of court decisions** as well as to **prevent discrimination**.

Ingrid: "Hopefully, AI will be able to diminish corruption and discrimination in courts. With quality data input, it can make objective suggestions regarding a certain case. Perhaps findings discovered by AI, which has access to an enormous amount of data, will be more fair and less dependent on the subjectiveness of the judge. Maybe it can even produce an innovative solution to the case, the judge wouldn't come up on his own? Of course, we have to take into account the problem of the input data AI technologies receive. How can we make sure they are given the right data to work on?"

According to the Global Judicial Integrity Network, which also evaluates the use of AI in justice, while Artificial Intelligence brings a great potential for improvement, challenges related to **ethical principles**, **transparency, accountability** and **impartiality** must be carefully taken into consideration.

KI Curriculum project
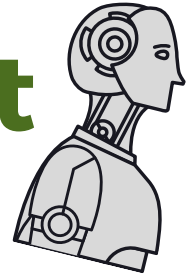
Ethical principles of using AI in courts

1. Principle of **respect for fundamental rights**: ensure that the design and implementation of artificial intelligence tools and services are compatible with fundamental rights.
2. Principle of **non-discrimination**: specifically prevent the development or intensification of any discrimination between individuals or groups of individuals.
3. Principle of **quality and security**: with regard to the processing of judicial decisions and data, use certified sources and intangible data with models elaborated in a multi-disciplinary manner, in a secure technological environment.
4. Principle of **transparency, impartiality and fairness**: make data processing methods accessible and understandable, authorise external audits.
5. Principle **"under user control"**: preclude a prescriptive approach and ensure that users are informed actors and in control of the choices made.

Oliver: "Let's imagine I'm arrested for a crime based on the AI face recognition tool. Officers come to my home, arrest me in front of my daughters and my wife. They take me to the police department, where I'm held overnight. Next afternoon a detective shows me a photo of a man shoplifting. I instantly see the difference between me and the robber, who is clearly not me. I hardly escape being convicted of a crime I didn't commit based on the AI mistake. Sounds like science-fiction? Unfortunately not, this has actually happened to Mr. Williams and probably to some other people, who are serving their sentence due to poor judgement. Who takes the responsibility, if AI makes a mistake?"

AIAE

KI Curriculum project
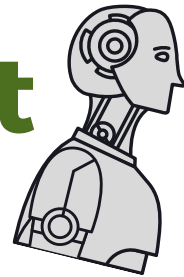
Source:

European ethical Charter on the use of Artificial Intelligence in judicial systems and their environment.

ARTIFICIAL INTELLIGENCE

IN MANUFACTURING

MANUFACTURING APPLICATIONS

Production

AI is used primarily for factory automation with the **introduction of robots** which made it possible to **meet a higher demand**.
Robots are **more efficient** in areas like the **assembly line with speed and error eliminations** being the obvious advantages.

Safety

AI technology can **help cut down on accidents in the workplace** as robots are not prone to fatigue or distraction. In addition, the **use of more advanced sensory equipment** integrated into the working environment by the use of AI brings about **additional safety guards increasing protection of human lives** at the workplace.

Direct automation

The use of AI technology has enabled **the integration of the manufacturing processes**. Generated information are recorded and analysed by AI technology and corrective action can be taken automatically to **ensure seamless production process**.

Supply chain

The **precise and secure delivery of goods** is a vital supply chain function.
That's why manufacturing companies have been increasingly adopting AI technology to handle tasks such as: **equipment maintenance and delivery and demand management**.

Lower operational costs

AI technology often requires an enormous capital investment. Studies have shown that the return of investment is low at the beginning but **increases significantly in the longer term**.

Enhanced efficiency

AI technology **enables the collection, analysis and processing of vast amounts of data** which can be used for advanced analytics. AI modelling use of this data can result in **pattern recognition and trend predictions** enabling forecasts.

Customer service

Although customer service is not considered as critical for the manufacturing sector as it is for other industries, AI solutions are used to **analyse customer behaviour** in order **to identify patterns and predict future outcomes**.

Quality control and efficient maintenance

AI enables the **predictive maintenance of machinery and equipment**. Sensors are used to track operating performance so that machines are trained to predict malfunctions but also enhancing product quality control.

AIAE

KI Curriculum project
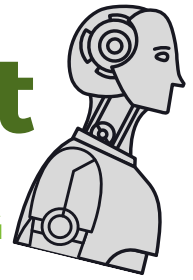
FURTHER BRIEFINGS – AI IN MANUFACTURING

Introduction

Deloitte is prognosing that about 50% of the biggest 500 US companies will be **replaced** in the next 10 years from that list by ambitious companies that will **embrace digital transformation**. The manufacturing sector is no exception to the industries affected by the disruptive technology of AI. AI has been used throughout the manufacturing value chain including **production, testing and engineering**.

The benefits of using AI in manufacturing primarily involve **productivity gains** as a direct impact from a**utomating processes and augmenting existing labour tasks**. Additionally, the notable enhanced ability and capacity for the **production of personalised, higher quality consumer products** is expected to **increase product variety** and **consumer demand**. It's a bit paradoxical: AI is increasing automation and also increasing customisation.

AI deployment in the manufacturing sector has created many debate topics and concerns, pivotal being the concern that automation will eliminate jobs. This concern is present in most sectoral applications of AI like in Financial Services or Healthcare but it is given particular attention in manufacturing because of the so called "robot workers".
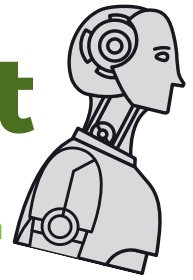
AI manufacturing applications

Production
- AI is used primarily for **factory automation** with the introduction of robots. As a result production capabilities can be expanded making it possible to **meet demand**.

- Robots are more efficient in areas like the **assembly line** with **speed** and **error eliminations** being the obvious advantages.

Direct automation

- The use of AI technology has enabled the integration of the manufacturing processes. Generated information are recorded and analysed by AI technology and **corrective action** can be taken automatically to ensure **seamless production process**.

Ingrid: "Have you heard about the industry 4.0? Maybe we should start at the beginning. In the 1st breakthrough we used water and steam power for mechanical work. 2nd was about electricity and mass assembly. The 3rd revolution brought computers and mobile phones. Now we are at the zenith of the 4th revolution. It is all about hyper connections between computers and machines. AI in smart companies will collect data, analyse, learn, make decisions, optimise production and lead to higher efficiency. If you are a business owner, that's a very exciting time to be alive!"

Supply chain

- Manufacturing companies have been using AI technology for **logistic applications** of the supply chain process. These include **equipment maintenance** and **delivery** and **demand management**. The precise and secure delivery of goods is a vital supply chain function and manufacturing companies have been increasingly adopting AI technology to handle the task.

AIAE

KI Curriculum project
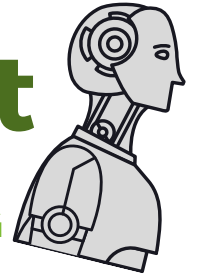
FURTHER BRIEFINGS – AI IN MANUFACTURING

Safety

- AI technology can help **cut down on accidents** in the workplace as robots are not prone to **fatigue or distraction**. In addition, the use of **more advanced sensory equipment** integrated into the working environment by the use of AI brings about additional safety guards increasing protection of human lives at the workplace.

Ingrid: "When Uber's self-driving car killed a pedestrian in 2018, news spread across the world. But when AI helps to promote safety nobody writes about that. So I will. AI can check if protective equipment is used by personnel. It can suggest maintenance if the condition of equipment is unsatisfactory. Sensors can identify safety hazards before it's too late. And when accidents do happen, AI is like a C.S.I. detective: it finds cues very fast and with high accuracy."

Lower operational costs

- AI technology does not come cheap and often requires an enormous capital investment. It is definitely not a short-term alternative and its benefits should be forecasted with a long time horizon. To this effect studies have shown that the **return of AI capital investment** (the so-called ROI –return on investment) is **low at the beginning** but increases significantly in the **longer term** as economies of scale and time kick-in. AI is also becoming cheaper as it is used by more and more organisations.
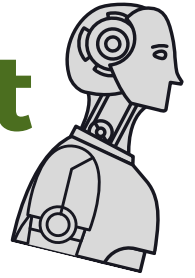
AIAE

KI Curriculum project

Enhanced efficiency

- AI technology enables the **collection, analysis** and **processing of vast amounts of data** which can be used for **advanced analytics**. AI modelling use of this data can result in pattern recognition and trend predictions enabling **forecasts** which can include a variety of attributes like time, economic sectors and geographical markets.

Customer service

- Although customer service is not considered as critical for the manufacturing sector as it is for other industries (healthcare, banking, other financial services), AI solutions are used to **analyse customer behaviour** in order to **identify patterns** and **predict future outcomes**. Observing and learning from customer behaviour, enables manufacturing to better **meet** and **anticipate customer needs**.

Oliver: "I always envied employees in R&D. I thought they live in another world - world of creativity, autonomy and job safety. But even they can't escape from AI. AI is changing the way products in our company are designed. Designers enter info about technology, functions, materials, customer demands and budget. AI responds with all possible design options and helps to choose the best one. So AI is getting more creative and autonomous. I don't know about engineers, but AI has a safe job in R&D."

KI Curriculum project
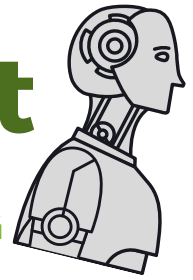
Quality control and efficient maintenance

- AI technology enables the **predictive maintenance of machinery and equipment**. Sensors are used to track operating performance and other useful input data so that machines are trained to **predict malfunctions** eliminating downtimes but also enhancing product quality control.

Challenges & Concerns

AI technology has brought about enormous measurable benefits to the manufacturing sector but there are also some notable challenges and concerns.

Some of these concerns are not industry specific but rather are the general concerns relating to the wider use of AI technology like system complexity which could result to systematic crashes.

Robots eliminating human jobs is probably the most sector specific concern and debate. It might be the case that a great part of manual labour processes will be automated and jobs will be lost but AI is also expected to bring about **new employment opportunities**.

Oliver: "Numbers are not looking great. World Economic Forum expects automation will replace 85 million jobs by 2025. Even a bigger number of workers will have to be retrained as their skills will become obsolete. Study from MIT professor Acemoglu shows that each robot replaces about 3,3 workers nationally. Of course new jobs will arise, but will it be enough if machines are getting cheaper and smarter?"

KI Curriculum project
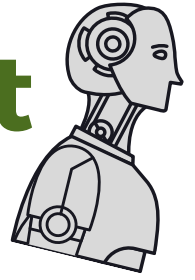
Conclusion

AI technology is a **game changer** for any involved industry and the manufacturing sector is no exception. It holds the future key for success in the sector. The manufacturing sector has always been welcoming to new technologies as it is a sector that thrives on innovation.

AI is becoming **more accessible** for companies and as the technology matures, adoption **costs tend to lower**. Often an enormous amount of capital investment is required for utilising AI technology but the benefits should be viewed in the long-term. The ROI –return on investment- is low at the beginning but increases significantly in the longer term as economies of scale and time kick-in.

AI adoption enables manufacturing companies to **analyse enormous amounts of data**, make rapid decisions, **optimise manufacturing processes**, enhance quality control, **minimise operational costs** and develop new exciting products.

ARTIFICIAL INTELLIGENCE

IN TRANSPORTATION

4%
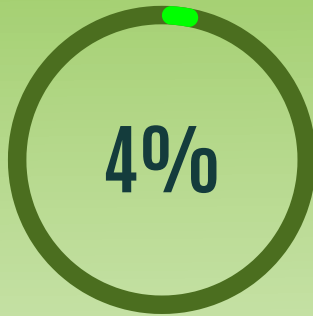
Percentage of greenhouse gas emissions that AI usage could reduce worldwide in 2030, equivalent to **2.4 gigatonne of carbon dioxide emissions**, according to PwC and Microsoft.

Source: https://www.computerweekly.com/news/252461751/AI-can-help-to-reduce-carbon-footprint-and-manage-environmental-issues

Artificial Intelligence provides the capability to gather and analyse massive amounts of data that can lead to modelling predictions and better decision making.

Artificial Intelligence will lead to more efficient capacity planning and resource optimisation, something that will lead to less greenhouse gas emissions, less air pollution, less noise and better utilisation of the infrastructure which has serious impacts on ecosystems.

ROAD TRANSPORTATION

- AI in combination with sensors, cameras, and radar can **enable self-driving cars** to become our new reality.
- **Traffic management systems** based on AI can predict, monitor and curb daily traffic problems and decrease road congestion.
- By analysing data and monitoring their fleet, companies can implement **driver behaviour monitoring** in order to improve safety.
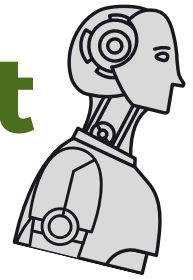
MARITIME TRANSPORTATION
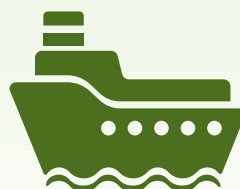
Some of the area through which AI can bring benefits are:
- **Predictive analytics**: by using a combination data from ports, trucks and ships.
- **Maintenance/Performance optimisation**: AI systems can support ship owners undertake predictive maintenance
- **Ship navigation**: by combining the internet-of-things (IoT), machine learning and cloud computing, AI can optimise route planning and voyage execution.

AVIATION TRANSPORTATION

The following are some areas where AI is redefining the airline industry:
- **Virtual Assistants**: AI powered chatbots respond to flight related inquiries and enhance customer experience.
- **Smart Logistics**: AI can automate airline operations, such as crew management, air safety, etc.

Emission reduction: SkyBreath, an AI platform, promises to reduce emissions by 50% by 2030, by collecting data and suggesting changes to reduce emissions.

AIAE

KI Curriculum project

FURTHER BRIEFINGS – AI IN TRANSPORTATION

Introduction

Artificial Intelligence can have a profound impact on the transportation sector and enable its radical transformation.

Road, air, sea and train transportation can **become safer for passengers** and **greener for the environment** with the use of Artificial Intelligence. AI usage could **reduce worldwide greenhouse gas emissions** by 4 % in 2030, equivalent to 2.4 gigatonne of carbon dioxide emissions, according to PwC and Microsoft.

Source: https://www.computerweekly.com/news/252461751/AI-can-help-to-reduce-carbon-footprint-and-manage-environmental-issues

 Ingrid: "Hopefully, we will be able to take a better care of our environment in the future. With the support of AI, people can monitor pollution and other contributions to climate change. With the route and traffic optimisation, eco-driving algorithms, autonomous ride-sharing services and connected electric vehicles our planet won't suffer as much as it does today."

Artificial Intelligence provides the capability to **gather and analyse massive amounts of data** that can lead to **modelling predictions** and better decision making.

Artificial Intelligence will lead to **more efficient capacity planning** and **resource optimisation**, something that will lead to less greenhouse gas emissions, less air pollution, less noise and better utilisation of the infrastructure which has serious impacts on ecosystems.

KI Curriculum project
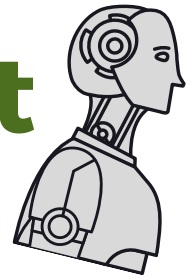
AI in road transportation

- **Self-driving Vehicles**

AI in combination with sensors, cameras, and radar can enable self-driving cars to become our new reality.

- **Traffic Management**

Traffic management systems based on artificial intelligence can predict, monitor and curb daily traffic problems and decrease road congestion by diverting traffic during peak hours.

- **Smart fleet and logistics**

By analysing data and monitoring their fleet, companies can implement driver behaviour monitoring in order to improve safety, optimise routes in order to increase productivity, improve customer service and decrease costs.

Ingrid: "In Dubai, AI techniques are used to monitor the behaviour of taxi drivers. They are monitoring drivers' performance, contributing to safety. In case of repeated violations, such as sudden parking, unnecessary use of brakes and excessive speed, AI alerts or directs the drivers. It can even subject them to the rehabilitation courses if they're constantly violating the rules. The collected data is sent to the monitoring centre for analysis, reporting 99,98 % accuracy rate of the images related to the driver's behaviour on the road. I wonder if a taxi drive in Dubai is less like a rollercoaster, as it is in my hometown."

AI in the maritime industry

The maritime shipping industry is a trillion-dollar industry that transports 90% of the goods people interact with on a daily basis.

KI Curriculum project
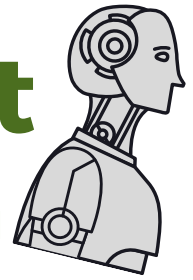
FURTHER BRIEFINGS – AI IN TRANSPORTATION

The following are some of the area through which Artificial Intelligence can bring benefits to ship owners, the economy and the environment:

- **Predictive analytics**: By using a combination of historical and real time data from various sources, ports, trucks, ships, an AI system can make accurate predictions on shipping times.
- **Maintenance/Performance optimisation**: AI systems can support ship owners undertake predictive maintenance, identify vessels that have reached milestones and even identify malfunctioning equipment.
- **Ship navigation**: By combining the internet-of-things (IoT), machine learning and cloud computing, ship crew can receive continuous advice on the environment, weather, potential hazards and ship performance, AI can optimise route planning and voyage execution.

AI in the aviation industry

According to Adina Vălean, EU Commissioner for Transport, European aviation faces growing pressure to reduce its environmental impact and capacity bottlenecks while artificial intelligence can bring sophisticated changes to accommodate sustainable traffic and passenger growth.

https://www.futuretravelexperience.com/2020/03/new-fly-ai-report-focuses-on-potential-of-artificial-intelligence-in-aviation/

The following are some areas where AI is redefining the airline industry:

- **Virtual Assistants**: AI powered chatbots respond to flight related inquiries and enhance customer experience.

AIAE

KI Curriculum project
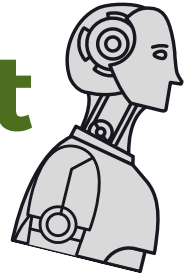
FURTHER BRIEFINGS – AI IN TRANSPORTATION

Oliver: "When I traveled to France for a nice family vacation our flight was delayed. In the past, I haven't received any explanation why the delay occurred, but this time the airline surprised me. Soon after the delay was declared, I received an apology on my email, explaining the reason for the delay. They were able to respond in such a quick manner, since the message was produced by AI. Anyway, this didn't bother me, quite the opposite, it was easier to wait for the plane, since we knew what was going on. I'm going to choose the same airline when I travel again."

- **Smart Logistics**: AI can automate airline operations, such as crew management, air safety and airplane maintenance, etc.
- **Emission reduction**: SkyBreath, an AI platform, promises to reduce emissions by 50% by 2030, by collecting data from the aircraft's black box and suggesting actionable changes to reduce emissions en route.
- **Predicting plane ticket prices with AI**: In Europe, hundreds of thousands of passengers fly to multiple destinations every day. In order to be competitive, airlines have to set a reasonable price to attract the passengers, taking in consideration that prices are changing on a daily basis. With AI model prices of plane tickets can be predicted up to 90 days before each given flight with 70 - 80 % accuracy.

AIAE

KI Curriculum project
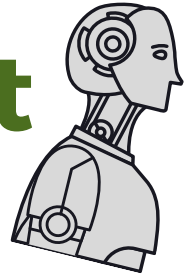
FURTHER BRIEFINGS – AI IN TRANSPORTATION

Opportunities & Challenges

Artificial Intelligence presents a great number of opportunities for the aviation industry.

Increased safety, efficiency, capacity and resource optimisation are factors that can be facilitated by Artificial Intelligence and redefine the whole sector.

Cybersecurity, privacy, the absence of common standards, collaboration frameworks, trust in the sharing of data and the ethical use of data and a common regulatory framework, are only some of the challenges the industry must address prior to reaping the full benefits artificial intelligence can bring.