Learning to Machine Learn for Primary and Secondary Education

LearnML Guidebook

A game-based learning curriculum for Artificial Intelligence and Machine Learning education and literacy

Intellectual Output 3: LearnML Guidebook

version 01

Table of Contents

Overview

Why do we need AI and ML education and literacy?

Why through games?

Have you ever wondered how social media such as Facebook and Instragram know what recommendations of new profiles or advertisements to make to us? How do video platforms such as YouTube know what videos to recommend? How self-driving cars know how to drive or how the robot vacuum cleaners know how to find their way in our house? How platforms such as Facebook recognise faces in a photograph? Artificial Intelligence (AI) and Machine Learning (ML) play a huge role in these processes.

AI and ML are already ubiquitous in everyday life in fields such as speech and image recognition, personalised information on social media and search engines, and autonomous vehicles. They have the potential to bring unprecedented benefits to society. Concerns have also been raised, though, on the potential pitfalls and dangers regarding the decisions such systems might make, the autonomy of the AI agents, and the values embedded in their design. The new generation has to develop advanced digital literacy skills, question and critically analyse and interpret data and information, recognise misinformation spread via social media platforms, emerging cultural and social biases embedded in the architecture and design of computer systems, and the ethical and political implications.

To address these challenges, the LearnML project transfers the notion of AI literacy to primary and secondary education and aims to introduce students (and teachers) to the core principles of AI and ML through a uniquely designed game-based educational toolbox. Our goal is to introduce concepts of Artificial Intelligence and Machine Learning to primary and secondary education students so that they can be able to navigate the complex digital space, effectively contribute to its design, develop into responsible citizens and insightful thinkers.

Why through games? Games can be valuable tools for teaching and learning. Beyond their motivating aspect and the engagement of the players, they can support processes and skills such as problem-solving, inquiry and exploratory learning, algorithmic thinking, experimentation, role-playing, and the construction of knowledge by the students. Over the past decades extensive research and educational practice have shaped the field of game-based learning, that is the implementation of games for learning or commercial games in teaching and learning practices. If you want to learn more about game-based learning, you can have a look at some of the first books published in this field.

Books on Game Based Learning

Gee, J. P. (2003). What video games have to teach us about learning and literacy (1st ed., Vol. 1). Palgrave Macmillan. http://doi.acm.org/10.1145/950566.950595

Prensky, M. (2001). Digital Game-based Learning. McGraw-Hill.

Unit 1 Understanding Artificial Intelligence and Machine Learning

After reading this module, you will be able to:

- Describe the terms Artificial Intelligence and Machine Learning
- Give examples of applications of Artificial Intelligence and Machine Learning
- Understand the types of Machine Learning
- Understand the meaning of deep learning, neural networks, and algorithms

What is Artificial Intelligence?

AI is the process of building intelligent machines using data. Systems learn from past learning and experiences and perform human-like tasks. AI involves complex algorithms and methods to build machines that can make decisions on their own. Machine Learning is part of AI; it is one of the ways a computer system can learn a new behaviour. ML applies to a wide range of systems in our everyday lives such as social media, search engines, online advertisements, and autonomous vehicles.

Before discussing the concept of Artificial Intelligence, we may first need to define the term "intelligence".

What is intelligence?

Intelligence is described as humans' capacity to perceive information from the environment or a context and the ability to keep, memorize and infer it. It is a mental capacity which includes several abilities. Some of them are logical understanding, emotional knowledge, reasoning, planning, creativity, critical thinking, problem-solving etc. It can be described as a cognitive process which enables humans to think and experience. It is not only a learning procedure.

Artificial is something fabricated or manufactured by humans rather than occurring naturally.

Do you have some time to watch a video about the human brain, how it works, and intelligence?

Brain and Self Intelligence | Daeyeol Lee | TEDxKFAS
https://www.youtube.com/watch?v=KyC_D3fBIU0

Scholars use the term "Artificial intelligence" to describe computers or other machines that seem to include some kind of intelligence and take up tasks usually conducted by humans such as decision-making and prediction of events. These "intelligent" machines can be characterized as systems that discern their environment and take actions to achieve the best result such as make a prediction about a future event or make the best move in a game of chess.

Several different definitions for AI have been proposed. For instance, the High-Level Expert Group (2019) on Artificial Intelligence (https://digital-strategy.ec.europa.eu/en/policies/expert-group-ai) which was set up by the European Commission proposed a definition which describes AI as:

"systems with intelligent behaviour that achieve their goals by analysing their environment and taking specific actions."

AI as a process through which a machine or a system "learns" a new behaviour is somewhat different than programming and coding. As discussed in the video below *"[…] rather than having programmers developing data processing rules by hand, as in classical programming, it is the computer that automatically learns these rules by studying a large number of examples. Thus, we could say that an automatic learning system is trained, instead of being programmed."*

A video explaining the difference between programming and training an AI system:

Inteligencia artificial en el aula con Scratch 3.0 - Presentación del Tutorial - YouTube: https://www.youtube.com/watch?v=iHzqWD5n8Ls

Applications and Examples of AI applications

AI systems can be found in many everyday life applications. We may use them without even realising that there is an AI system behind them. We can find AI systems in applications such as speech and face recognition systems, voice assistants, autonomous cars, smart homes, and more generally Internet of Things applications. For instance, you may have used a smartphone who recognizes your voice and responds to your questions or you may have noticed that Facebook asks you to review a photo of you that someone else has posted without tagging you. You may know disease mapping and prediction tools that analyse patients' data and diagnose possible diseases, or you may have heard of automated financial investing through the analysis of data from the markets. The analysis of users' previous activity and preferences in Social Media and the personalisation of the pages with relevant advertisements and recommendations as well as personalisation of search results in search engines, by analysing previous activity of the users or video, films, songs, books recommendation systems are other well-known AI applications. Some examples of AI applications are:

- Eliza https://en.wikipedia.org/wiki/ELIZA
- Deep Blue https://en.wikipedia.org/wiki/Deep_Blue_(chess_computer)
- Google Brain https://ai.google/
- Watson https://www.ibm.com/watson
- Siri https://www.apple.com/siri/
- AI for Good https://ai4good.org/
- Smart assistants (e.g. Alexa, Siri)
- Natural Language Processing (NLP) tools
- Video, films, songs, books recommendation systems
- Search engines (e.g. Google)

Activities

Task 1: We invite you to enter the word "summer" in Google Search. Are there any specific recommendations for you? Then try out the word "song". What can you find out? How do you think the search engine makes recommendations for you? Ask a friend to search for the same words on his or her computer. Do they get the same results as you did?

Task 2: Do you use any of the applications previously mentioned? What do you think are their advantages and disadvantages in your everyday life?

Task 3: You may try out some of the following Artificial Intelligence applications. Think about the data that were used for developing and training these applications. Were they images, voice, text?

- Transform sketches, scribbles and doodles into icons. AutoDraw is a drawing tool using machine learning to predict what you are drawing. It has been trained with drawings from talented artists and uses the same technology used in QuickDraw (https://quickdraw.withgoogle.com/), to guess what you're trying to draw. Right now, it can guess hundreds of drawings and we look forward to adding more over time. https://www.autodraw.com/

- Translate a piece of text from any of the EU languages into your language. The EU Council Presidency Translator is a machine translation system based on Artificial Intelligence: https://presidencymt.eu/#/
- Use visual translation services. Thing translator lets you take a photograph of an object using your camera, it recognises the object, and translates it into different languages: https://thing-translator.appspot.com/
- Discover how writers and books are interconnected. An Ocean of Books lets you explore a fantasy map based on authors and their relationships. The map was created using a machine learning technique called Uniform Manifold Approximation and Projection (UMAP): https://experiments.withgoogle.com/ocean-of-books
- Use an AI application for image, people and text recognition. Seeing AI in new languages is a free app that narrates the world around you. Mainly for supporting people with visual impairment: https://www.microsoft.com/en-us/ai/seeing-ai

Additional Resources

Watch the video discussing the significance of AI in our lives and especially in education: Teach AI | Prepare Our Students For The Future https://www.youtube.com/watch?v=ympzqGzfl0U

7 roles for Artificial Intelligence in Education https://www.thetechedvocate.org/7-roles-for-artificial-intelligence-in-education/

Artificial intelligence cracks open the black box of learning https://epale.ec.europa.eu/en/blog/artificial-intelligence-cracks-open-black-box-learning

Institute for Ethical AI in Education launches in a UK first https://edtechnology.co.uk/latest-news/institute-for-ethical-ai-in-education-launches-in-a-uk-first/

What is Machine Learning?

When does a machine learn? As we have previously discussed, learning can change the behaviour of humans or systems in order to make them perform better in the future. But how do the machines learn? Under which conditions do they learn? We can say that a machine learns when its structure, programme or data seem to change. This happens when a machine receives specific new data and responds to new circumstances.

Machine Learning is a part of Artificial Intelligence and involves the process through which a computational system learns by analysing large amounts of data: the computational system infers and makes conclusions from the data without having been programmed for this purpose. Afterwards, the machine would be able to recognize new data based on the machine's previous conclusions. The main objective of Machine Learning is to develop algorithms, computer applications and systems that have the ability to learn, and at the same time to improve their performance in their environments (Lampropoulos & Tsihrintzis, 2015). Machine Learning applications include robotics, data classification, computer games etc.

Let's simplify it! Watch the video: How machines learn
https://www.youtube.com/watch?v=R9OHn5ZF4Uo

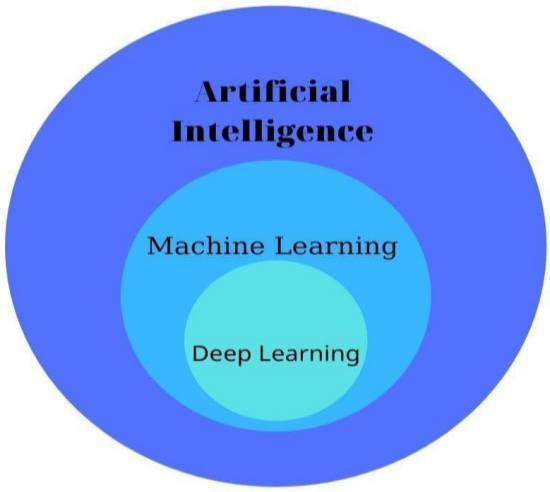

Figure 1 Machine Learning is a part of Artificial Intelligence and involves the process through which a computational system learns by analysing a large amount of data

There are different methods of Machine Learning such as supervised learning and reinforcement learning. An AI computer system can be trained by analysing examples of items belonging to different categories (e.g. images of women and images of men). Through this analysis (supervised learning) it learns to recognize new items and classify them into the respective category. Alternatively, the system can be given rewards or penalties (reinforcement learning) - a desirable behaviour is rewarded, and unwanted behaviour is penalized (e.g. an autonomous vacuum cleaner that learns how to navigate in the house and avoid the furniture).

Machine Learning, and more specifically *Supervised Learning*, uses examples of items belonging to different categories (for example images of cats, images of dogs, images of humans) and by identifying similarities and differences among the items so as to learn how to identify new items and the category they belong to. For example, for a system that identifies whether an image shows a cat or a dog, the developer, instead of coding, which would have been difficult or impossible to do, has specified the two categories (cats, dogs) and has imported in the system images of cats and images of dogs. The system analyses the images of the cats and the images of the dogs, identifies their distinguishing features, and if everything goes well (that is if there were enough images as examples) the system will be able to recognise and categorise new images. Machine Learning contains three broad categories: supervised learning, unsupervised learning and reinforcement learning.

The video below presents the difference between programming and Machine Learning giving the example of a computational system for books classification. It would be extremely difficult and complicated to programme a computational system to recognize the content of a book and classify its contents into categories. Instead of doing this, we can give some examples of books for each category (e.g. science fiction, romance, mystery) to the computational system and then let it learn to identify patterns and recognize their similarities and differences:

Inteligencia artificial en el aula con Scratch 3.0 - Presentación del Tutorial: https://www.youtube.com/watch?v=iHzqWD5n8Ls

How would you explain AI to a child? To a teen? Here is a 26' video of computer scientist Hilary Mason explaining machine learning to 5 different people: a child, a teen, a college student, a grad student and an expert: https://youtu.be/5q87K1WaoFI

AI: What is Machine Learning? https://youtu.be/OeU5m6vRyCk

See how Supervised Learning and Reinforcement Learning works in our LearnML game ArtBot: http://learnml.eu/artbot.php

Typology of Machine Learning

Some examples of methods to train an AI system are:

- Supervised Learning
- Unsupervised Learning
- Reinforcement Learning

In the LearnML project, we mainly focus on Supervised and Reinforcement learning.

What is Supervised Learning?

"Supervised learning" is using labelled or structured data so as the ability of the system to make predictions for new data improves. For instance, input could be the colour and size of a fruit and output could be the type of the fruit. Human intervention (the developer) is essential because he or she chooses which data the machine will consider in order to make decisions for the new data.

Examples:

Face recognition: when developing the system, the developers provided the system with examples of human faces. By analysing the examples and identifying their distinctive features (e.g. eyes, nose, ears) the system learns to identify new images of new faces.

E-mail spam recognition: by analysing examples of spam emails, the system learns to identify whether a new incoming email is spam or not.

What is Unsupervised Learning?

In “Unsupervised learning” human input is restricted to the system data provided but not any guidance (labels or structure) for new data is given. The training signal is the internal structure of the data. As such, the system has to work alone, discover the information and find some sort of structure and patterns underlying the data. Given the lack of labelled data, unsupervised learning seems to be more complex than supervised learning.

Examples:

Clustering and determining customers’ segments for marketing purposes, such as in recommendation systems identifying the preferences of the users.

Dimensionality reduction of random variables of a problem

What is Reinforcement Learning?

Reinforcement learning works differently. The algorithm learns to take actions that maximize its rewards (or minimize its penalties) by interacting with an environment that provides these rewards/penalties. The training signal comes in the form of rewards. This type of learning has three main components: a) the decision maker for the agent (robot, game character, etc.), b) the environment in which the agent is located and c) the actions that the agent will perform in the environment. The goal for the agent is to choose the actions that will yield the best possible result.

Reinforcement Learning is inspired by behaviourist psychology. In this case, we can imagine a baby who doesn't understand the language, but we can teach the baby through dos and don'ts. The baby starts exploring the environment through our rewards and penalties and this is the first stage of learning.

Examples:

- Self-driving cars
- Robot vacuum cleaners
- AI enemies (bots) in computer games
- Characters in computer games (bots)

To summarise, Machine Learning is distinguished in three categories, depending on the input the system receives:

- In Supervised Learning, the system learns through a training set of data and correct answers (the labels).
- In Unsupervised learning, the systems learn by analysing a dataset, with no prior categories given by the developers.
- In Reinforcement Learning, the system receives feedback from the environment which has been previously marked as positive (reward) or negative (punishment) by the developers and learns to repeat the actions that are rewarded (e.g., avoid obstacles).

Deep Learning

Let's simplify it! Watch the video: Deep Learning In 5 Minutes | What Is Deep Learning? | Deep Learning Explained Simply | Simplilearn https://www.youtube.com/watch?v=6M5VXKLf4D4

Neural Networks

Let's simplify it! Watch the video: Neural Network In 5 Minutes https://www.youtube.com/watch?v=bfmFfD2RIcg

Algorithms

Algorithms contain a set of rules in order to complete a task. The main goal of algorithms is solving a class of problems or performing a computation. Based on the type of the task, there are several algorithms. Algorithms involve a set of instructions for completing a task. Imagine you have to make a cake. You have to follow the instructions step by step so as to create it and be successful. An algorithm is like the recipe for completing a task.

Let's simplify it! Watch the video: What is an Algorithm? https://www.youtube.com/watch?v=e_WfC8HwVB8

Genetic Algorithms

A genetic algorithm tries to find the best solution to a given problem. The term "genetic algorithm" was inspired by Charles Darwin's theory of natural evolution. Natural selection procedure begins with the selection of the fittest individuals from a population. Their offspring will inherit their parents' characteristics to add them to the next generation. This procedure will be repeated to discover the fittest individuals of the next generation. Natural evolution can be applied to analyse a problem and

select a set of the best possible solutions. In that case, genetic algorithms follow five phases: initial population, fitness function, selection, crossover and mutation.

Let's simplify it! Watch the video: What is a Genetic Algorithm https://towardsdatascience.com/introduction-to-genetic-algorithms-including-example-code-e396e98d8bf3

For an application demonstrating genetic algorithms and neural networks try the LearnML games Evolutionary Cars and Evolutionary Flappy Birds: http://83.212.75.23/

Educational Resources

If you wish to read more about Artificial Intelligence, Machine Learning and educational activities:

Camilleri, V., Dingli, A., & Montebello, M. (2019). AI in Education A Practical Guide for Teachers and Young People. Department of AI, University of Malta http://learnml.eu/material.php

Additional Resources

AI: What is Machine Learning? https://www.youtube.com/watch?v=OeU5m6vRyCk

What is Machine Learning? https://www.youtube.com/watch?v=HcqpanDadyQ

Unit 2 Artificial Intelligence and Machine Learning in Education

Warm up!

How can you introduce AI in your lesson and why do you believe that this is important?

What skills do you believe that students are going to develop by using AI in your lesson?

After reading this section, you will be able to:

- Describe how AI and ML can be implemented in education
- Describe the terms of computational thinking and algorithmic thinking
- Explain how previous skills can help us develop and evaluate AI and ML

Over the past few years, research and applications of AI and ML in education has increased and expanded, involving technologies and fields such as educational data mining (EDM) and Intelligent Tutoring Systems (ITS). Luckin, Holmes et al (2016) paper entitled "Intelligence Unleashed: An argument for AI in Education" discusses the benefits of AI for learning through, for example, the personalisation of the learners' experience and the AI feedback.

You can read the paper here: Luckin, Rose; Holmes, Wayne; Griffiths, Mark and Forcier, Laurie B. (2016). Intelligence Unleashed: An argument for AI in Education. Pearson Education, London. http://oro.open.ac.uk/50104/1/Luckin%20et%20al.%20-%202016%20-%20Intelligence%20Unleashed.%20An%20argument%20for%20AI%20in%20Educ.pdf

In addition to the previous, the report by NESTA (see reference below) presents three categories of AI integration in schools:

a) Learner and AI: AI tools that support students' personalised needs (language learning applications, personalised learning materials etc.)

b) Teacher and AI: innovative methods through AI tools of automating tasks, such as assessment, feedback, teaching management, monitor students' assessment and personalized support to students.

c) Systems and AI: AI tools which make management decisions such as timetable organisation, course scheduling, learning diagnostics, and admission decisions.

You can read the NESTA report here: https://www.nesta.org.uk/report/education-rebooted/, https://www.nesta.org.uk/project/artificial-intelligence/

Find out more about the implementation of AI in the classroom in this video: Introduction to Artificial Intelligence in the classroom by Artur Coelho and Marjana Prifti Skenduli https://www.youtube.com/watch?v=TXWyFwwjuzw

Beyond the applications of AI and ML, it is important to consider how students can best learn about AI and ML, how it works and how to integrate AI and ML education in the Curricula. We have to consider, for example:

- How can we enhance students' learning on AI/ML?
- What is the added value of this learning?
- Which AI and ML skills will be useful for the students?
- Which tools will assist in teaching and learning about AI/ML?

- In which learning subjects can we implement AI/ML education?

We will discuss these issues in the next sections.

AI and curriculum

There are several AI tools available to teachers and education in general. There is no limitation in using AI in education and several learning subjects can involve AI tools. Generally, we can say that AI/ML can be implemented into

- Social Sciences, Humanities and Arts [Linguistics, history, philosophy…]
- STEM (Science, Technology, Engineering, Mathematics)

You can have a look at some example of AI tools below:

a) Newspaper Navigator: searching for historic newspaper photos https://news-navigator.labs.loc.gov/search/about

b) MuseNet: exploring and creating a variety of music styles. A deep neural network that can generate 4-minute musical compositions with 10 different instruments and can combine styles from country to Mozart to the Beatles. MuseNet was not explicitly programmed, but instead discovered patterns of harmony, rhythm, and style by learning to predict the next token in hundreds of thousands of MIDI files. https://openai.com/blog/musenet/

c) PhotoMath: step-by-step solutions to any math problem by using computer vision https://photomath.com/en/

d) iNaturalist: visual recognition identifying species from photographs https://www.inaturalist.org/

e) Verse by Verse: write a poem with the AI helper and discover American poets https://sites.research.google/versebyverse/

f) Bakpax: automatic grading tool that recognises handwriting https://www.bakpax.com/how-it-works/

AI related skills

Computational Thinking

Computational thinking can be described as a method of approaching a complicated problem to find a solution. In doing so, this approach breaks down the problem into smaller parts and this makes it easier to find a solution. In this way, computer machines operate since they can solve complicated problems by breaking down and analysing each phase of the problem.

Data literacy skills

In the beginning of the 21th century we live in a data-driven world. We have to collect and analyse different types of data in different databases. There are also several public datasets by scientists, researchers, journalists, as well as teachers and students who may want to present their research or work on their field. Some well known examples are data from Google Dataset Search, EU Open Data portal, Github and so on. As such, it is urgent for students to obtain data literacy skills, such as how to read data, to understand them, to analyse them and finally to create and communicate new data.

Algorithmic Thinking

Algorithmic thinking is usually situated in the context of computer science and coding. Algorithmic thinking involves the creation of a series of systematic logical steps that process a defined set of inputs and produce a defined set of outputs, in order to solve a problem. Algorithmic Thinking uses the “IF-THEN” structure in order to construct the step by step movements.

Applications of AI in Education and Algorithmic Bias

A recent study by Baker and Hawn (Baker & Hawn, 2021) examined the bias embedded in educational algorithms, their impact and causes. They discuss how algorithms “often encode the biases of their developers or the surrounding society, producing predictions or inferences that are clearly discriminatory towards specific groups.” Algorithms have been implemented in systems for dropout prediction, automated essay scoring, graduate admissions, and knowledge inference. But there are strong indications that such systems may lack generalisability across populations of students of different languages, cultures, identities, and backgrounds. Baker and Hawn cite the example of the 2020 UK GCSE and A-Level grading controversy involving formulas developed to assign predicted examination grades based on teacher predictions. The formulas and algorithms ended up assigning poorer grades to students in state-funded schools and better grades to students in smaller independent schools. They mainly discuss bias emerging from how variables are operationalized (for example the criteria used to satisfy a construct or concept) and which data sets are used to train the systems (for example, are data from rural and urban schools used?). You may watch a relevant video here:

Algorithmic Bias in Education https://youtu.be/2JSGGgNpygw This session, led by Ryan Baker and Aaron Hawn at the University of Pennsylvania, introduces participants to evidence around algorithmic bias, including understudied categories, and a proposed framework for moving from unknown to known bias and fairness to equity for educational technology.

You may download and read the report here: Baker, R. S., & Hawn, A. (2021). Algorithmic Bias in Education. EdArXiv. https://doi.org/10.35542/osf.io/pbmvz

Unit 3 Ethical Implications and Moral Issues of Artificial Intelligence and Machine Learning

Warm up!

- Are you concerned and/or worried about AI? If yes, why?
- Have you ever heard about the ethics of AI?
- Do you use digital tools in your classroom? Do you know where students' data is stored when you use a digital tool in your classroom?
- Who is responsible if something goes wrong with students' data and privacy?

After completing this module, you will be able to:

- Describe the meaning of AI ethics
- Explain how some ethical issues may be relevant to an AI application
- Understand that Artificial Intelligence and Machine Learning can make decisions that may be biased against specific populations
- The advantages of using AI

AI applications are already being used in a wide range of domains, facilitating tasks by allowing for the process of larger amounts of data, making automated decisions and predictions. Some examples of the benefits of AI applications are the following: :

- The facilitation of decision making to create a faster and smarter decisions
- The reduction of human errors (e.g., weather forecast)
- The diagnosis of health issues
- Taking over risky tasks and therefore reducing the risk for humans (e.g. controlling wildfires in early stages)
- Any time availability of machines (any kind of online services e.g., answering phone calls, chatbots for technical support)
- Your digital assistant in any question you may have (e.g. Chatbots)

In the following videos, the benefits and challenges of AI are discussed. AI can provide huge benefits in fields such as agriculture, medicine, environmental, and humanitarian action. It is also important to set up rules and restrictions, and decide on the values and ethics that will be embedded in AI systems. :

AI for Good - Ethics in AI https://www.youtube.com/watch?v=vgUWKXVvO9Q

AI for Good https://www.youtube.com/watch?v=COQtCga6uuk

AI For Good – SDGs https://www.youtube.com/watch?v=Bpuoj1Op1kY

Ethical Issues raised by AI

Artificial Intelligence has been a game changer in humans' lives in the last decades. Scholars in the field believe that AI will improve humans' societies in every aspect of life (finances, security, health and so on). Although there are several advantages and benefits that have already been mentioned, there are several ethical issues that have been raised using AI, such as privacy protection, fairness, transparency, contestability, and accountability.

Why are ethical issues raised concerning AI?

Training data may contain biases since those are generated by humans. These biases prevent AI systems from making fair decisions since the amount of data trained by AI systems may not be enough to represent a situation fairly. AI developers may use biased data without even noticing them.

Some examples are:

AI developers in Amazon decided a year after the usage of a recruiting tool to shut it down because it was biased against women. Read the relevant article here: Amazon scrapped 'sexist AI' tool https://www.bbc.com/news/technology-45809919

Another example of AI bias involves students' assessment. Due to the restrictions of the Covid-19 pandemic, the exams in the UK were cancelled and the authorities decided to use students' data from previous results to determine students' final grades (Kolkman, 2020). Almost 40% of students were downgraded and students were discriminated against based on their social background. Read some relevant articles about the issues that emerged when an AI system was used to grade students in in the UK due to pandemic Covid-19:

Who won and who lost when A-levels meet the algorithm https://www.theguardian.com/education/2020/aug/13/who-won-and-who-lost-when-a-levels-meet-the-algorithm

British Grading Debacle Shows Pitfalls of Automating Government https://www.nytimes.com/2020/08/20/world/europe/uk-england-grading-algorithm.html

UK ditches exam results generated by biased algorithm after student protests

https://www.theverge.com/2020/8/17/21372045/uk-a-level-results-algorithm-biased-coronavirus-covid-19-pandemic-university-applications

The Global Expansion of AI Surveillance. The article explores how different countries deploy AI surveillance tools for their citizens: https://carnegieendowment.org/2019/09/17/global-expansion-of-ai-surveillance-pub-79847

As such, there are numerous initiatives, organizations, institutions, and governments which try to face the challenges of AI and set up regulatory frameworks:

Australia's Ethics Framework https://consult.industry.gov.au/strategic-policy/artificial-intelligence-ethics-framework/supporting_documents/ArtificialIntelligenceethicsframeworkdiscussionpaper.pdf

European Commission's framework for ethical use of AI https://www.europarl.europa.eu/RegData/etudes/STUD/2020/654179/EPRS_STU(2020)654179_EN.pdf

Find more information and examples of algorithmic bias and limitations of AI systems in the videos and articles below:

Ethics & AI: Equal Access and Algorithmic Bias https://www.youtube.com/watch?v=tJQSyzBUAew

Machine Learning and Human Bias https://www.youtube.com/watch?v=59bMh59JQDo

The Truth About Algorithms https://www.youtube.com/watch?v=heQzqX35c9A

Ethics & AI: Privacy & the Future of Work https://www.youtube.com/watch?v=zNxw5gJtHLc&t=1s

Gender Bias In AI https://www.youtube.com/watch?v=qpYyI9Tdtc4

Gender Shades https://www.youtube.com/watch?v=TWWsW1w-BVo

This Robot would let 5 People die | AI on Moral Questions | Sophia answers the Trolley Problem https://www.youtube.com/watch?v=8MjIU4eq__A

The ethical dilemma of self-driving cars - Patrick Lin https://www.youtube.com/watch?v=ixIoDYVfKA0

7 Revealing Ways AIs Fail Neural networks can be disastrously brittle, forgetful, and surprisingly bad at math https://spectrum.ieee.org/amp/ai-failures-2655013312?

Case Study: Attitudes towards AI

A recent survey exploring the attitudes towards technological change (Jonsson & Tena, 2021) showed that although there is a trend towards scepticism of Big Tech companies such as Facebook and Google and a preference for stronger regulations, large percentages of Europeans would:

- prefer that AI algorithms, rather than human civil servants, decide on aspects of their lives such as social welfare payments or visa approvals for working abroad,
- support the use of face recognition technology for verifying the identity of citizens
- show less concern on privacy and would be willing to share their personal data, such as health data (mostly younger people, under the age of 25)
- be willing to let their governments share their health records with companies like Google (mostly younger people, under the age of 25)

See more about this study at: Jonsson, O., & Tena, C. L. de. (2021). European Tech Insights 2021 Part II Embracing and Governing Technological Disruption. IE Center for the Governance of Change (CGC). https://docs.ie.edu/cgc/IE-CGC-European-Tech-Insights-2021-%28Part-II%29.pdf

Questions for discussion:

- What are the advantages and disadvantages of having AI systems decide on aspects of our life?
- What are the benefits and pitfalls of sharing personal data regarding, for example, our health?

Case Study: The problems of face recognition technology

Joy Buolamwini, Massachusetts Institute of Technology researcher, was trying out widely used face recognition software, when she noticed a serious glitch: some of the software couldn't detect dark-skinned faces like hers. That sparked the launch of a project that's having an outsize influence on the debate over how artificial intelligence should be deployed in the real world. She, and many others, express caution about the adoption of facial recognition by institutions such as the police and governments. Many researchers have shown that AI systems will embed the institutional biases in the data they are learning from. For instance, if AI systems are developed using images of mostly white men, the systems will work best in recognizing white men.

Read more about this story and Buolamwini's initiative in this Associated Press article: https://apnews.com/article/north-america-ap-top-news-artificial-intelligence-ma-state-wire-technology-24fd8e9bc6bf485c8aff1e46ebde9ec1

Questions for discussion:

- Can you imagine situations where a biased AI face recognition system could cause problems?
- How would you develop a face recognition software? What issues would you consider? How would you use it?

Unit 4 Digital Games for Artificial Intelligence and Machine Learning education and Literacy

Warm up!

- Have you ever learnt anything from a digital game?
- Do you remember which game it was and what did you learn?

After reading this module, you will be able to:

- Use games to leverage AI and ML education
- Use and reuse educational material based on games and AI/ML

LearnML project provides teachers with a game toolbox which will introduce the concepts of AI and ML to primary and secondary students. In addition, we have selected a number of games and applications that might help teachers and students explore AI and ML concepts in the classroom.

Let's play the LearnML games!

Artbot

http://learnml.eu/artbot.php

ArtBot is a game for players of all ages which teaches the basics of Artificial Intelligence. Your quest is to find and retrieve stolen art objects. You train your AI helper to recognise and locate the objects hidden in a maze of dungeons, and see how supervised and reinforcement learning works.

The game introduces players to core principles and concepts of Artificial Intelligence. Players' quest is to find and retrieve valuable art objects that have been stolen and hidden. Through the first part of the game, the process of supervised learning is introduced; players train their AI helper to recognise specific art objects (i.e. paintings and sculptures). They classify a set of training data, experiment with different parameters, and then see how well the helper was trained by observing how it classifies a set of testing data. This is where the players teach their helper to recognise which objects they are looking for in their quest.

During the second part of the game, the players and their AI helper need to navigate through a series of dungeons, locate, and collect the stolen art objects. In this part, the players are introduced to the processes of reinforcement learning; they guide their helper by indicating what type of objects to look for and which ones to avoid (e.g. traps), by assigning rewards to the right objects. The AI helper tries to find its path based on the parameters set by the players, such as the exploration and exploitation rates. The players watch the process, they can pause or accelerate it, and think what the optimal settings would be for helping the AI find as many objects as possible.

The game was designed by a team of educators, game developers and AI experts with the aim to support AI literacy of primary and secondary education students. Beyond the technical aspects of AI, our goal was to trigger the critical thinking of players on the aspects, factors and bias that may shape the architecture and behaviour of AI agents and systems. The game guides the player through a set of actions but also provides opportunities for exploration, experimentation and reflection; players are encouraged to construct their knowledge by observing the outcomes of their actions, evaluate the results, make and test their hypotheses.

Through the design of the game we tried to avoid common stereotypes and address students' misconceptions of AI, such as the anthropomorphic nature of AI systems - the AI helper is an unidentified artifact rather than a robot. Players, though, do have the option to choose and modify their own avatar for the AI helper. By setting the game in the context of cultural heritage (art objects) our aim was to address the application of AI systems in multiple different areas, beyond computing and programming, such as archaeology, art and transportation.

LearnML Artbot Game Preview (video) https://www.youtube.com/watch?v=ZGnAHGQ63i4

Evolutionary Flappy Bird

http://83.212.75.23/

This game demonstrates the operation of an evolutionary algorithm to create an intelligent agent that can play the well-known Flappy Bird game. It also allows this agent to be used for competitive play with the player.

General idea

A population of 30 "birds", each equipped with a "brain" based on a neural network, tries to beat the game Flappy Bird, moving on the randomly created track from pipes and gaps, as far as possible. In each generation of the population and for each frame of the application, the birds take as input the distance they have from the next pipe, the height where the next pipe is, the height where they are, the position of the gap from which they must pass as well as the speed of the pipes (if moving). With this input, they decide whether, in the current frame, they will choose to climb or whether they will be left to gravity. If a bird hits the ground or on a pipe, it is killed. The parameters of the "brains" of birds are, in the first frame of the first generation, initialized randomly.

In each frame, some birds do better (survive longer, travel longer distances). When all the birds are killed, a new generation of the population is created consisting of the characteristics of the best cars of the previous one, slightly mutated for diversity. The purpose of the application is to create a general bird that will be able to play the game without any problem.

Handling

The player has the following control options (top to bottom):

Play Mode:

With the Human Play option, the player plays without competition against the track.

With the AI Play option, the population of agents plays, while at the same time it is trained according to the standards of an evolutionary algorithm (see previous paragraph).

By selecting Human vs AI, the player faces the trained agent from the AI play scenario. Prerequisite for this is to have been clicked on

somewhere in AI play, the "Freeze weights" button (see below).

Game Difficulty: With the Impossible option, some pipes move up and down.

Freeze Weights: If, at some point during AI Play, the user is satisfied with the performance of the trained agent, he can press this button to save the "brain" of the best bird. So he can deal with it himself in the Human vs AI script (see Play Mode).

Frame Speed: Controls the speed of the game, in all play modes.

Evolutionary Cars

http://83.212.75.23/

This game demonstrates the operation of an evolutionary algorithm to create "cars" that can be automatically directed to an unknown closed track.

General idea

A population of 100 cars, each equipped with a "brain" based on a neural network, is trying to set off on an unknown track. In each generation of the population and for each frame of the application, the cars receive as input the distance they have from the walls, based on 6 sensors at the front. With this input, they decide the angle of rotation (counterclockwise, clockwise, degrees) as well as the speed (negative or positive) at which they should move. If a car hits a wall, it is killed. The parameters of the "brains" of cars are, in the first frame of the first generation, initialized randomly.

In each frame, some cars do better (survive longer, travel longer distances). The best of them is colored green and the field of view of its sensors can be seen.

When all the cars are killed, a new generation of the population is created consisting of the characteristics of the best cars of the previous one, slightly mutated for diversity. The purpose of the application is to create a general car that can be launched on the track without any problems.

Handling

The player has the following control options (top to bottom):

Car Speed: Accelerates cars (accelerates the algorithm as a whole)

Load New Track: Used to test the current car population in a new and unknown scenario, or in case the current track is very difficult for the population)

Mutation Rate: Each "car" has a "brain", in the form of a neural network. Each neural network has a number of parameters to model the problem to be solved. The mutation rate determines the percentage of the parameters of the specific "brain" that must be "transferred" before being transferred to a next generation car.

Lifespan: The life time of cars, in frames. If, e.g. we have it at 25, the car will be "killed" after 25 frames, no matter how well it does or if it hit a wall. This reflects our "patience" with each generation of the population and indirectly affects the frequency of generational change.

Sight Range: The field of vision of cars. It affects how far the 6 sensors look and, consequently, how timely each car decides on its course.

Next Generation: It forces the change of generation of the population. It is necessary to apply any changes we have made to the Mutation rate, Lifespan and Sight Range values.

Reset Vehicles: Starts from the beginning the population and the algorithm in general.

You can find below the LearnML Games:

Artbot	http://learnml.eu/games.php
Evolutionary Flappy Bird	http://83.212.75.23/
Evolutionary Cars	http://83.212.75.23/
Minecraft learns ML	http://learnml.eu/games.php
Super Meat Bot	http://learnml.eu/games.php

Let's experiment with games and applications about AI/ML!

Title	Link/URL	Description	Price	Language	Target Age	Other Comments
While True: Learn()	https://luden.io/wtl/	This game aims to familiarise players with concepts and processes of Machine Learning. Players take up the role of a machine learning specialist who uses visual programming to complete the clients' projects. It includes elements such as neural networks, actual machine learning techniques, and machine learning related problems such as self driving cars.	10-20€ depending on the edition	English, Russian, German, Hungarian, Korean, Greek, Portuguese - Brazil, Simplified Chinese, Polish, French, Italian, Spanish - Spain, Czech, Japanese, Spanish - Latin America, Traditional Chinese, Turkish	9+	Internet and installation required Provided via Steam for Windows, Mac, and Linux. Also provided DRM-Free for Windows, Mac, and Linux. A free Steam account is required (https://store.steampowered.com/) It has been used by schools, universities, teachers, and students.
Human Resource Machine	http://tomorrowcorporation.com/humanresourcemachine	Human Resource Machine is a puzzle game. Players are required to solve problems through programming. Concepts relevant to AI such as automation and optimisation are introduced. In each level, players have to automate work by programming the	14.99 USD	English	13+	Installation required

		employees of an office environment.				
Evolution Simulator	https://www.openprocessing.org/sketch/377698	Evolutionary algorithms Description over YouTube: https://www.youtube.com/watch?v=GOFws_hhZs8	Free	English	13+	Browser based, internet required No installation needed
MarI/O	https://pastebin.com/ZZmSNaHX	Learning about Evolutionary algorithms and Neural Networks "Artificial Neuroevolution in Super Mario: YouTube: https://www.youtube.com/watch?v=qv6UVOQ0F44 Machine Learning for Video Games"	Free	English	13+	Browser based, internet required This isn't really a game; this is code for an AI that can be put in an emulator. Users would need to be fairly advanced to paste the code and play with it.
Machine Learning for Kids	https://machinelearningforkids.co.uk/	Learn How Machine Learning works How training works How labeling works Difference between supervised and unsupervised learning how to implement machine learning in games/tools Machine Learning for Kids introduces machine learning by providing hands-on experiences for training machine learning systems and building things with them. It provides an easy-to-use guided	Free	English, Czech, Chinese, Taiwanese, Japanese, German, Greek, French, Italian, Korean, Dutch, Portuguese, Russian, Spanish, Swedish, Turkish, Sinhalese	13+	Browser based, internet required.

		environment for training machine learning models to recognise text, numbers, images, or sounds. Machine Learning for Kids adds models to educational coding platforms Scratch and App Inventor, and helps children to create projects and build games with the machine learning models they train.				
AI Machine Learning Education Tools	https://education.minecraft.net/hour-of-code	The game integrates a coding interface with Minecraft. Players, by programming a robot to predict forest fires, are introduced to basic coding concepts and learn about artificial intelligence (AI) and its potential for protecting the environment. A lesson plan and supporting material for educators are also provided	Free	English	All ages	Installation required
The Moral Machine	http://moralmachine.mit.edu/	Ethical and social implications of AI The players are asked to choose the lesser evil when facing an impending car crash. This platform is mainly situated in the field	Free	English, Arabic, German, Spanish, French, Portuguese, Russian, Chinese, Japanese, and Korean	16+	Browser based, internet required

		of ethical decision making. It aims to address the diversity of human perspectives in face of a moral dilemma and the implications on machine intelligence designed to make similar moral decisions (e.g. self-driving cars)				
Universal Papersclips	https://www.decisionproblem.com/paperclips/	Not quite a game for teaching AI concepts but rather for triggering discussion on the role and potential of AI in society. Based on the philosophical thought experiment "paperclip maximiser" about artificial intelligence design and machine ethics, this is a clicker game where the player takes up the role of an AI machine making paperclips. After several upgrades such as the possibility to "interpret and understand human language" or buy "autonomous aerial brand ambassadors" the game ends when 100% of the universe is explored and all	Free	English	9+	Browser based, internet required

		matter is turned to paperclips.				
Tynker: Coding for Kids	https://www.tynker.com/	Platform including applications and games, separated by age group, for children as young as 5. Children can create games through block programming, and share their artifacts	Free	English	5+	Registration required No installation required Browser based, internet needed.
Cognimates	http://cognimates.me/	Models, Machine Learning Offers a set of Scratch extensions to provide access to speech generation, speech recognition, text categorization, object recognition, and robot control Application Programming Interfaces (APIs).	Free	English, Czech, Turkish (Dutch, French, German, Spanish, Chinese	5-18	Browser based, internet required
eCraft2Learn	https://ecraft2learn.github.io/ai/	Machine Learning, Neural Nets, Using visual and sesory data, using existing AI models A set of extensions to the Snap! programming language to enable children (and non-expert programmers) to build AI programs. The blocks are available as projects with	Free	English. Page has a Google Translate Option to translate into any language	5-18	Registration required (for using the API) Browser based, internet required GPU - Microphone and Camera for Speech and Image recognition modules

		examples of using the blocks as well as libraries to download and then import into Snap! or Snap4Arduino.				
TensorFlow Playground	https://playground.tensorflow.org	Neural Networks, Classifications. Learn what influences how a neural network interprets the data. It allows K-12 students to explore neural networks and backpropagation learning via an interactive graphical tool	Free	English	7+	Browser based, internet required.
Bug Brain	http://www.biologic.com.au/bugbrain/	Neural Networks, Nodes, Neurons, Building up learning. How to build up a neural network using neurons and nodes. Bug Brain is a game where children can experiment with the neurons and nodes that make up a brain. They build a brain for a Lady Bug to help it feed and survive. Not specifically aiming at learning AI and ML, Bug Brain features rendered graphics, challenging puzzles and the opportunity	Free	English	7+	Installation required

		to learn about neural networks (free).				
Mitsuku	https://www.pandorabots.com/mitsuku/	Explore the limitations and possibilities of semantic evaluation. Learn about how computers analyse language. What they do differntly from humans and how to address this. conversational AI chatbot	free	English	all	Browser based, internet required
Semi-Conductor	https://semiconductor.withgoogle.com/	Be a naesto! Conduct an AI orchestra trhough your browser, with your body.	free	English	all	Requires web camera Browser based, internet required
Shadow Art	https://shadowart.withgoogle.com/	Try puppet theatre with your hands, with the help of AI	free	English, Chinese, Korean, Japanese, Portuguese, Thai Malay, Indonesian	all	Browser based, internet required Only Chrome (Windows, Mac, Android) or Safari (Mac, iOs) Requires web camera Better works with a clear darker background
Thing Translator	https://thing-translator.appspot.com/	Take a picture of something to hear how to say it in a different language.	free	English, Spanish	all	Mind the objects on your background. You might confuse the AI. Works best with clear background. Web camera required

						Browser based, internet required
Teachable Machine	https://teachablemachine.withgoogle.com/	Train a computer to recognize your own images, sounds, & poses. A fast, easy way to create machine learning models for your sites, apps, and more – no expertise or coding required.	free	English	all	Browser based, internet required
Eliza Talking	https://www.masswerk.at/eliza/	Chatbot Conversational models Understanding models of conversation, limitations of conversation with robots,	Free	English	All	Browser based, internet required
AI for Oceans	https://code.org/oceans	Computer science is about so much more than coding! Learn about artificial intelligence (AI), machine learning, training data, and bias, while exploring ethical issues and how AI can be used to address world problems. Enjoy Code.org's first step in a new journey to teach more about AI. When you use the AI for Oceans activity you are training real machine learning models.	free	multiple	All	Browser based, internet required

Roomba Quest	https://st33d.itch.io/roomba-quest	A machine that learns new things. The internet of things. As a trigger for discussion. An adventure game about a roomba. As the roomba vacuums the house, it reads books, it learns more about itself, and decides to upload its consciousness on the internet. It meets other intelligent appliances that agree to take it into the Internet of Things.	free - optional donation	English	16+	Browser based, internet required

Educational Material

Explore some more educational material that may help the introduction of AI and ML in the classroom:

Title	Link	Topics	Age Group	Description
How Normal Am I?	https://www.hownormalami.eu/	Face Recognition AI Ethics	13-16	Experience how "Artificial Intelligence" judges your face. This is an art project developed in the framework of the European Union funded research project SHERPA (Shaping the Ethical Dimensions of Smart Information Systems https://www.project-sherpa.eu/). It shows how face detection algorithms can be used to judge you. Access to your camera is necessary, but no personal data is collected. No personal data is sent to their server in any way. All the face detection algorithms will run on your own computer, in the browser. Read the Terms and Conditions before agreeing. Find more similar projects and creations by the artist Tijmen Schep and explore what it could be like to live in a world full of 'Smart Information Systems' driven by Big data and "AI" at https://www.sherpapieces.eu/overview/
AI + Ethics Curriculum for Middle School	https://www.media.mit.edu/projects/ai-ethics-for-middle-school/overview/	AI Ethics Elements of AI	13-16	This project, by the MIT Media Lab, seeks to develop an open source curriculum for middle school students on the topic of artificial intelligence. Through a series of lessons and activities, students learn

				technical concepts—such as how to train a simple classifier—and the ethical implications those technical concepts entail, such as algorithmic bias.
Teaching Artificial Intelligences for K-12	http://teachingaifork12.org/	Elements of AI AI Ethics	5-17 Teachers	There are a variety of AI resources available on the Internet and it can often be a little overwhelming as you try to find the best resources for your students. This portal has a carefully designed search feature to pinpoint resources to specifically connect with the needs of you and your students. To find resources that fit your students' needs, choose from any of the menus. You can choose more than one option on any menu.
Do you know AI or AI knows you better? Thinking Ethics of AI (version with multilingual subtitles)	https://youtu.be/im0XTC91qMI	Elements of AI AI Ethics	13-17	Developed by UNESCO How is AI changing our world? Why should each of us care about it? What would be our future with AI? Four experts talk about ethical questions of AI such as self-driving cars, job loss, data bias, gender issues, minority populations, human vulnerability, international cooperation and lessons from the Frankenstein story.
UNESCO Artificial Intelligence In Focus	https://en.unesco.org/artificial-intelligence	AI Ethics	Teachers	Rapid technological advancements in Artificial Intelligence (AI), as well as other advancing technologies such as robotics, cloud computing, and the Internet of Things, are transforming disciplines, economies, and industries, and challenging ideas about what it means to be human. AI has enormous potential for social good if it develops

				in a way that benefits humanity, respects global norms and standards, and is anchored in peace and development. Documents, videos, stories, ideas and initiatives in the context of a humanistic approach to AI, presented by UNESCO.
Deep Fake Text to Speech	https://vo.codes/	Elements of AI Speech Synthesis Deep Fakes AI Ethics	6-17	Say stuff with your favorite characters. Users may write any text in the text field, and hear their favourite characters say this text. There is a huge selection of fictional and real characters such as Darth Vader, SpongeBob, Sylvester Stalone, and Barack Obama. Students may discuss the moral implications of the distribution of deep fake audio and videos. Would they want their voice and name to be used in such applications? What measures should be taken to avoid fraud?
I am A.I. explaining artificial intelligence	https://www.i-am.ai/			A platform with resources for teaching and learning about Artificial Intelligence. Including un-plugged and online activities and games. Artificial Intelligence is the most exciting technology of our time. But how exactly does it work? In which areas is it used? And what are its limitations? Join us in the launch of I AM A.I. to explore these questions together.
I am A.I. – Gradient Descent game	https://www.i-am.ai/gradient-descent.html	Game Neural Networks		Find the treasure hidden in the deepest point of the ocean floor by lowering a probe from your research ship. Use the arrow buttons to move the ship and the

				circle button to send the probe. After you find it, read on and discover how AIs learn through the same strategies you developed to win.
AI Basics for Schools	https://www.europeanschoolnetacademy.eu/courses/course-v1:CodeWeek+AI+2021/course/	Course Elements of AI AI Benefits AI Challenges	Teachers	Join this free online course by the European Schoolnet Academy. The course has concluded, but its content remains available for perusal. You can access the modules by enrolling in the course, but it is no longer possible to receive the course badge or the course certificate.
Minecraft Education Edition UNIT 9: AI	https://education.minecraft.net/en-us/lessons/unit-9-ai	Lesson plan Minecraft Education Computer Science Coding Elements of AI	8-18	Students will explore the concept of artificial intelligence or AI. If you have access to Minecraft Education edition, try this lesson plan and resources for teaching students the basic elements of AI and coding intelligent agents. Included are a classroom presentation, educator guide, student workbook, and an overview Video

Educational Scenarios (Lesson Plans)

Primary Education

Project for the World Environment Day

Author: Dora Troupi
Subject: Geography
Class: 9 years old
Duration: 2 teaching hours

Materials:
Painting Images of Creatures Living in Water
Images of Other Objects Code.org - AI for Oceans # 2
https://studio.code.org/s/oceans/stage/1/puzzle/2

Learning Objectives:

- Define the term of the computing machine
- Become familiar with the concept of artificial intelligence.
- Become familiar with the concept of machine learning.
- Understand how the data we provide to computer systems determine what the computer systems learn.
- Discuss ethical dilemmas from the misuse of the computing machine

Procedure
1st teaching hour (45 min)
Starting with (5 min): Through discussion, we give the definition of the computing machine.
Activity (35 min): We present to the children how “AI for Oceans works”. We can watch the video of the 1st stage of the AI of Oceans https://studio.code.org/s/oceans/stage/1/puzzle/1
In pairs, we ask students to complete the 2nd stage of the game in which they teach the AI for Oceans machine to separate the fish from the other objects. Each group discusses how they made the AI for Oceans machine learn and what the results seem to be. Each group justifies why they made these choices and explains the criteria of their choices. We show students photos of creatures living in the water and photos of other objects outside oceans. We ask them to categorize them according to what should be in the water and what not.
We move on to the 3rd stage of the game (AI for Oceans). After completing it, they are asked to compare the categorization they had done before and what they had done using the AI Oceans’ machine.
We continue in the 4th stage asking the students to categorize only the first 8 objects. Why does the machine still not categorize correctly?
Conclusions (5 min): Discuss and think about what we learnt today about how AI for Ocean machines works.

2nd teaching hour (40 min)

Ethical dilemmas: We start with the 6th stage of the AI for Oceans’ game. Students select a specific species of fish to detect through "Artificial Intelligence". They select the first ten items, perform the identification. What is wrong? We ask the following question: If our model has learned to detect

creatures that live in the water and have a specific colour or shape, what problem could arise for the rest?
In the 8th stage, we observe all the words that we can train our machine to learn. We ask questions and write notes: Can we define any words with objective criteria? Can some words be defined by different criteria? We categorize the words into two columns.
Can the model learn all the words? Would it be useful? Justify our thoughts.
All groups choose the same word e.g. “fun” and move on to the AI for Oceans machine. We compare the results of each group.
What do we observe?
Are the same fish for everyone based on the word “fish”?
Finally, we watch the 3 videos of the game, which explain what AI and machine learning are, and how they work.

Training ArtBot

Author: Eirini Varianiti
Subjects: History, Art
Duration: 3 teaching hours
Class: 11 - 12 years old

Learning outcomes:

- Understand the process of supervised learning. Students become familiar with the terms: testing dataset, classification, labelling, image recognition, decision trees
- Understanding the process of reinforcement learning: students are introduced to the concepts of rewards and penalties, understand the process of reinforcement learning: students are introduced to the concepts of rewards and penalties, learning duration, learning rate, exploration, exploitation, pathfinding.
- Students seek to learn about the term “Renaissance” to learn its main representatives and to understand its significance for the subsequent evolution of Europe.
- Students study the main representatives of the Renaissance, learn about the colours, styles and themes that dominate their works and try to classify them.

Educational scenario

- Introduction (1 teaching hour)
    - Students are asked to briefly write down some applications of machine learning in everyday life (padlet) and participate in the class discussion.
- Gameplay (2 teaching hours)
    - The teacher introduces students to the game (ArtBot). Students choose the appearance of the “ArtBot” and begin the phase of training data and testing data (supervised learning). The teacher observes and helps students to understand the process. He/She motivates them to test and pay attention to the decision tree.
    - Students move on to the next stage of the game (reinforcement learning). The teacher helps them in the levels that are difficult to pass, suggesting to experiment with the parameters in order to understand under which conditions the “Artbot” achieves the goal.
- Reflection - Evaluation (1 teaching hour)
    - Students express their impressions, complete the questionnaires and write a short guide.
- Teachers will need a brief guide to the game.
- Students will need to complete three online questionnaires and a game guide.
    - The first questionnaire will be completed before the game starts and will include questions related to their knowledge and beliefs about the concepts of machine learning and artificial intelligence.

- The second questionnaire will be completed after the gameplay so the students can observe how much their initial answers are different from the beginning.
- Finally they will complete a game evaluation questionnaire.

Fake Account or Not

Author: Chris Mirtsiotis
Course: Informatics, IT: Social Media and Internet Security
Ages: 10-11 years old
Time frame: 8 teaching hours

Short description: Students become familiar with the concept of "Fake Account" in social media. The aim of the project is to learn how they can train a system to detect fake accounts based on data that will be “fed” to the model.

Teaching procedure:
Introduction: What does the term "Fake Account" mean? Searching for features of these accounts. (1 teaching hour)

Introduction to the platform www.machinelearningforkids.co.uk - we study ready-made templates of fake accounts (1 teaching hour)
Creating a Training Set and a Testing Set with students based on the characteristics and criteria they have chosen: training the model based on the data, together with students and then testing a new data set (training set) and discuss the results with the students (3 teaching hours)
We discuss with the students problems in machine decisions and then we think about ethical dilemmas in terms of fake accounts (1 teaching hour)

Secondary Education

Creation of Relations with Minecraft (Hour Of Code 2020 | Minecraft: Education Edition)

Author: Eleni Georgiou
Age: 11-16 years old
Duration: 40 minutes
Learning outcomes: The aim of the course is for students to understand how they will give instructions to the agent to react in an environment in order to learn the benefits of working together to achieve a common goal. Students will also experience the meaning of empathy and compassion for their neighbours in the game. Students will understand the meaning of reinforcement learning and how the agent can learn from penalties and rewards.

Teaching Procedure

General introduction to the class (5 minutes): Presentation of the script, of the two groups but also of goal to be achieved
Install Minecraft: Education Edition from https://aka.ms/HourofCode2020
Starting the Minecraft game (25 minutes):

- Students give instructions to the agent who will indicate the steps required to solve a specific problem in the village.
- Students give instructions to the agent in order to achieve the best results (how their agent worked in relation to cooperation, mutual aid, protection from enemies)
- In each mission that is completed, the friendship tree grows in the centre of the village.

- End of the gameplay

Evaluation of students' results (10 minutes)
Students are asked to present whether their actions of agents have specific results and their goal was finally achieved or not.
Students will express their feelings about how they worked and how they participated in the game.
Students will express their feelings about the notion of prejudice and its consequences for each individual and society of the village.
The game could be connected with the lesson of Linguistics and Philosophy, through which students will understand the importance and benefits of diversity, humans' engagement to society, cooperation, mutual aid and justice

Ethical dilemmas

Author: Zefi Skalkogianni
Subject: Linguistics, Literature
Duration: 40 min
Age: 14-15

Learning Goal: Students discuss ethical dilemmas and argue in favour of their choice
Learning outcomes:

- Students will practice their critical thinking based on their arguments
- Students will reflect on the impact of technology on the world
- Students will form attitudes and values after their gameplay and they evaluate their choices during gameplay

Teaching methods:
Discussion, problem-solving, cooperative learning
Game: https://www.moralmachine.net

Teaching procedure:
The ethical dilemmas of everyday life - a general discussion about how students understand the ethical dilemmas (5 min)

Game presentation and instructions:
The students are divided into 2 groups and depending on the dilemma presented to them in the game, they are given time and each group must observe it, discuss and decide as a group what choice did they come up with (5 min)
Students process the dilemmas one by one and the selection and argumentation of each group begin. Each group will have 1 minute to argue for each image. (20 min)

Final stage 10 min
Choices:

- One group tries to evaluate the other group's choices
- There is a general discussion among the students about the dilemmas on which they did not agree (debate)

Geometric shapes (schemas)

Author: George Noulas

Course: Geometry
Ages: 11-12
Duration: 45 minutes

Learning outcomes:

Students "train" the computer to recognize the basic Geometric shapes.
• Students understand how the computer works.
• Students realize the importance of providing the “right” data.
• Students perceive a different way of learning

Material

Websites
https://machinelearningforkids.co.uk
https://machinelearningforkids.co.uk/scratch3/

Teaching procedure:
The students are divided into groups and access the website. They briefly describe the project, the "training" dataset and then how to test the model.
Each group creates their own shapes and "trains" the computer to recognize them.
When they have completed their tasks, they test the machine and discuss how well they have "trained" the machine.
Each group tries to evaluate and test the model designed by the another group
Each group discusses the data which was given to the model and their results.

Get to Our School Fast!

Author: Georgia Tzortzou
Subjects: Mathematics, Critical Thinking, Data Collection
Ages: 12-14
Duration: 2 to 4 teaching hours

Educational Approach:
Discuss with students how they come to school in the morning (car, school, bicycle, on foot). Artificial Intelligence will help us choose how we can go to school finding the best solution on a daily basis.

Materials:
The game environment that will be used is:
Machine Learning For Kids https://machinelearningforkids.co.uk

Teaching Steps:

1. We start with the general question: what are the possible options that students choose to come to school
2. Then we will mention that we will deal with quantitatively distinct variables, such as:
    - the age of the students
    - the distance of their home from the school
    - or the neighbour classmates that can help us come to school

    - Computer-guided application
    - Definition of variables
    - Initial values of variables (critical thinking)
3. Game Test Mode
4. Results Discussion (utility, organization, speed)
5. Conclusions: Discussion (do we need to use artificial intelligence in our lives?)

Educational Objectives
Become familiar with the concept of artificial intelligence, machine learning and how it works, use critical thinking for the best way of moving in proportion to their mathematical variables and values.

Machine Learning: training a computer

An educational practice about Machine Learning that was implemented in a High School in Greece and was published at the STEAMonEdu conference "STE(A)M educators and education".

The purpose of this educational practice is to give the students the opportunity to know about Artificial Intelligence and Machine Learning, examine how a machine can learn by humans and the role of data and patterns in this training.

Designed and implemented by Computer Science Teacher: Αλέξανδρος Παρουσίνας / Alexandros Parousinas

Middle/junior high school, Age Range 12-15

https://steamonedu.eu/platform/node/269

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