IN5480 Individual assignment fall 2019

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MODULE 1

Concepts, definition and history of interaction with AI

History of AI

John McCarthy was the American mathematician and logician who, in 1956, first introduced the term artificial intelligence, when inviting to a workshop called Dartmouth Summer Research Project. The term sprung from the area of “thinking machines”, in which the mentioned workshop had its focus. The concept of thinking machines were perceived as utterly divergent, and the term of AI was reasoned to represent a sort of neutrality in the field. (Grudin, 2009)

Defining AI

One of many definitions for AI is following:

“Artificial Intelligence (AI), broadly (and somewhat circularly) defined, is concerned with intelligent behaviour in artifacts. Intelligent behaviour, in turn, involves perception, reasoning, learning, communication, and acting in complex environments.” (Nilsson, 1998)

This definition is by the American computer scientist Nils Nilsson from 1998, who is considered one of the founding researchers of AI. While McCarthy was responsible for the basic idea of using logical reasoning to decide on actions, Nilsson was in a group who first embodied it in a complete agent.

A decade later than Nilsson’s definition, Russel and Norvig define AI in their book ‘Artificial Intelligence: A modern approach’, published in 2009, being as follows:

“In computer science, artificial intelligence (AI), sometimes called machine intelligence, is intelligence demonstrated by machines, in contrast to the natural intelligence displayed by humans. Colloquially, the term “artificial intelligence” is often used to describe machines (or computers) that mimic “cognitive” functions that human associate with the human mind, such as “learning” and “problem solving”.” (Russel and Norvig, 2009)

In extension of their definition of AI, they also present four approaches of AI, being the following: 1. Think like a human, 2. Act like a human, 3. Think rationally, and 4. Act rationally.

As a third definition of AI I want to mention the misquoted statement by Larry Tesler, later known as the Tesler's Theorem, being: *"AI is whatever hasn't been done yet.".*
This is the misquotation where the real statement was the following: *"Intelligence is whatever machines haven't done yet.".*

The belief that intelligence happens exclusively from machines and computers, and of AI not being *real* intelligence, is known as the AI effect. (Haenlein, Kaplan, 2019)

After reading several definitions on AI, I will try to sum up its significance in a new proposed definition. With a focus on simplicity, a definition can be:

Artificial intelligence is human intelligence adopted to an artificial environment.

The definition focuses on the environment of for instance a machine or a computer to be able to perform tasks that originally require and aspire from human intelligence.

AI in 'Uber'

The contemporary company Uber uses both ML (Machine Learning) and AI. Where AI is based on decision making, ML allows a system to learn from data(Tech republic, 2019, https://www.techrepublic.com/article/understanding-the-differences-between-ai-machine-learning-and-deep-learning/). This means that ML is often found in AI, but AI is not necessarily part of a ML system.

Uber uses AI in everything from fraud detection, risk assessment, safety processes, marketing, in addition to matching drivers to customers and routes.
Uber is considered an AI-first company, as opposed to a mobile-first company where mobile is the core in an operating environment. Uber uses instead AI as their core, and apply it to a majority of their areas and elements.

An example being Uber Eats, which is a platform where users can order food and get it delivered to their front door. Here ML is used to make models of predictions to optimize the food experience, in which is done every time the app is opened, where arrival time is estimated, and restaurant and items on the menu is suggested. (Uber, 2019, url https://eng.uber.com/michelangelo/) (Uber, 2019, https://www.uber.com/no/nb/uberai/)

AI in 'Black Mirror'

Black Mirror is a Netflix series exploring the future in technology, and where it will take us. Human interaction with AI is portrayed creatively and exaggerated, even though several

elements are believable. It is believable in the way that a combination of several elements presented are in some ways already a reality today, even though the overall portray is far-off.
The series raises ethical questions in a frightening manner, where each episode present one digital trend that is affecting society and the environment. AI is one trend that is presented in several episodes, essentially where its negative effects is being explored.

Robots and AI systems

Robotics emerging

The word robot originates from the Czech word "*robota*", that means "forced labor". The word first appeared in 1920 in the context of a drama play by the Czechoslovakian writer Karel Čapek. The science fiction play was called R.U.R., an abbreviation for *Rossum's Universal Robot*s. The robots, or workers, in the play were made for one purpose only, which was to replace human workers. (Bassetti, 2005)

Robotics have been categorized into three different categories. These are industrial robotics, professional service robotics, and personal service robotics. These categorizations can be looked at in an historic way, where each represent different periods in the time of robotics development. (U.N. and I.F.R.R., 2002)

Industrial robots represent an early stage of the development in robotics, having commercial success and a wide distribution. The company Unimate sold the world's first commercial manipulator in the early 1960s, which represent the years of where industrial robotics commenced. The three elements represented in an industrial robot are the following; it is controlled by a computer, it manipulates its physical environment, and it operates within an industrial setting. (Thrun, 2004)
Professional service robots represent a later category of robotics. In addition to the robots manipulating and navigating their physical environments, such as industrial robots, professional service robots are assisting people in pursuing professional goals while doing so.
Out of the three categories, personal service robots have the highest growth rate expected. Personal service robots has the task of assisting or entertaining people, happening in a

domestic setting or in recreational activity. (Thrun, 2004) For instance, this can be robot vacuum cleaners or lawn mowers.

Defining robots

Robotics addresses a great area, that is and has been developing rapidly over time, and therefore consisting of several robots with different aims. I will try to find some representative definitions, that is explained below.

Robot Institute of America defined in 1979 to a robot as the following:

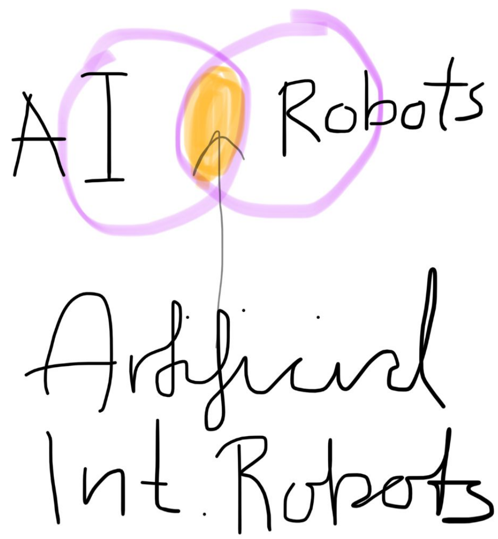
“A reprogrammable, multifunctional manipulator designed to move material, parts, tools, or specialized devices through various programmed motions for the performance of a variety of tasks”. (Robot Institute of America, 1979)

With this definition being formed at a considerably early stage of robotics, it is clear that it mostly covers the category of industrial robots. This can be seen since the description of robots are centering around the idea of the task of moving different objects through motions. This type of working task can further be compared and found in a setting of industrial factories.

Today, Merriam Webster Dictionary explains the term robot as the following:

“Robot is a machine that resembles a living creature in being capable of moving independently (as by walking or rolling on wheels) and performing complex actions (such as grasping and moving objects).” (Merriam Webster, 2019)

This definition stresses that a robot has some sort of resemblance to a living creature, as can both be interpreted to refer to robot pets as well as robots with resemblances to humans such as tasks in the everyday life.



Considering the width coverage of the robotics field, I will suggest a rather wide definition of the word robot, focusing more on inclusion rather than an in-depth specification. The suggestion is the following:

“A robot is a physical embodied machine performing a task driven by automation or a remote control.”

In my understanding, I think requirements for a robot cover that it should be physical embodied in some way, meaning that the machine should be presented with a physical user interface.

Connection of AI and Robots

AI and robots can be connected. For instance, a robot can consist of AI elements, though it is not a requirement. Robots exist in a variety of ranges, where some have AI implemented and where some do not. The amount of AI in a robot depends on the executing program.
AI can be found in several different environments, not only in the physical world of a robot. I will claim that both AI and robotics are two different fields of interest, in which both ones are broader than the part they have in common. Please see the Venn diagram suggesting an illustration of this, where the parts that are overlapping is representing robots that are integrated with AI.

Ollie the Baby Otter

One example on a contemporary robot is Ollie the Baby Otter. This is a therapy robot that aims to help people who is suffering, including patients with cancer, dementia, or post-traumatic stress. It was built for Animal Assisted Therapy, which entrust in animals to help people in their healing process. It builds on studies that shows people's relationships with animals can affect our health, in order of create feelings of safety and security. For instance, being around dogs and cats can have positive effects on people's wellbeing on a social, emotional, as well as a on a cognitive level.

The baby otter is able to understand how it's being interacted with through a sensor boars and a custom motor. It understands interaction through touch, in order to make a response consisting of movement and sound. The robot will hug a patient's hand and purr when being rubbed on the belly. This encourages the users to hold and cuddle Ollie like a baby pet. (Mental Floss, 2019, url: https://mentalfloss.com/article/62548/ollie-baby-otter-robot)

Universal Design and Interaction with AI

Understanding Universal Design

Ronald Mace was the first to coin the term "universal design" when wanting to describe the concept of designing products to be usable and aesthetic to the highest extent possible by everyone, regardless of age, ability, or their status in life. Universal design aim for a design

of buildings, products, and environments to be made accessible to all people. The author of Designing for the Disabled, published in 1963, Selwyn Goldsmith took big part in establishing the concept of free access for people with disabilities. (The Center for Universal Design, 2019, url https://projects.ncsu.edu/ncsu/design/cud/about_us/usronmace.htm)
In the book "Designing for People of all Ages & Abilities" the definition of universal design is defined as "*the design of products and environments to be usable to the greatest extent possible by people of all ages and abilities*". (Goldsmith, 1963)

An average group of people doesn't exist, which unfortunately is the group designers are trained to design for. The world as it is designed is not perfectly suited for anyone, and it's doubtful that one product could be used by everyone and under all conditions. (Story, Mueller, Mace, 1998).

Universal design proposes 7 principles for the concept and its application, being the following presented.

1. *Equitable use* refers to that the design should be useful for people having diverse abilities.
2. *Flexibility in use* aims for the design to facilitate the wide range of individual abilities and preferences.
3. *Simple and intuitive use* talks about that design should be easy understandable, independently of the experience of the user, their language skills, and their level of concentration.
4. *Perceptible information* aims for the design to communicate information to the user in an efficient way, here regardless of the user's environment and sensory abilities.
5. *Tolerance for error* aims to minimize errors and accidents to occur in the design.
6. *Low physical effort* refers to the design to be accessible in a comfortable way regardless of a minimum fatigue.
7. *Size and space for approach and use* aims to that an appropriate size and space is provided through the design, regardless of user's age, size or mobility.

(Story, Mueller, Mace, 1998)

The potential of AI

AI implemented robots creates a potential to develop a whole new kind of user interface. Robots have today been developed to be able to recognize language. (Thrun, 2004) AI implemented robots, such as therapy robots described earlier, has the potential to help the healing process of patients.

AI has potential both to include and exclude people. Whatever target group a system aims at, AI can strengthen these limits. Universal design argues for inclusion for all, no matter circumstances of the user and their current environment. Equal inclusion of people is a challenge, but applying the framework for universal design into AI can support this.
For instance, AI for inclusion can be discussed where speech recognition is applied. This will help inclusion for visually impaired, or simply people in busy situations and environments.

Feedback and improvement of Module 1

For the feedback I got from the first module, I've iterated on a few points. One of the improvements I've made it to clarify the difference between ML (Machine learning) and AI, since talking about both the terms in the Uber example. It would be ideal to reflect further on these two concepts and how they are different from each other, as suggested in the feedback. I have chose not to reflect further on this, other than stating a clarification of the two terms, due to the page limit and distribution of the remaining questions.

Another suggestion in the feedback is to present the 7 principles for the "Understanding universal design" parin a clearer way, for an improved overview. For this, I have iterated further and listed the principles in a numbered list rather than in a compact paragraph. Admittingly, iterating on the text and presenting it as a list, does take up more space, and slightly runs over the page limit for module 1.

As I got positive feedback for presenting the definitions in a clear way, good use of literature, and for explaining the relation of AI and robots through a diagram, these are points I've kept through the first iteration.

MODULE 2

Characteristics of AI-infused systems

An AI-infused system is described as “systems that have features harnessing AI capabilities that are directly exposed to the end user”. (Amershi et al., 2019)

Key characteristics of AI-infused systems have been described to be *learning*, *improving*, *black box* and *fuelled by large datasets*.

Learning as a characteristic point towards a system being in a constant learning process, where for instance data for previous user behaviour is remembered and integrated, increasing the dynamic.

As a system is learning, by observing behaviour within its platform, *Improving* builds on how the system translates what has been learnt into improvements. Errors, for instance, occur commonly in AI-infused systems, and from errors and mistakes, the system will further learn and improve itself. (Amershi et al. 2019)

The characteristic *Black box* aims at the fact that the user does not necessarily know or understand the AI-infused system, other than the input and output. The AI-elements are often unclear, and this is also the in many cases the aim.

Fuelled by large datasets aims at AI-infused systems are supported and improved by large sets of data, which feeds into the algorithms of the system.

AI-infused system: Instagram

AI-infusion is to be found in many social media platform systems. An example on an AI-infused system is instagram. This is a platform which *learns* about you through your behaviour, either it is your friends, places you’ve been, or your interests. For instance, the “explore” site on Instagram features images and posts that are carefully selected through algorithms in which have learnt about earlier behaviour and interests. This site is continuously updated and *improved* in terms of user behaviour, and every click in onto the suggested posts are immediately taken as a confirmation to a current interest. Instagram is also *fuelled by large sets of data*, and algorithms is deciding which posts and stories you get to see, and in what order it is presented. The featured algorithms and the mystical logic which is presented confirms and presents the *black box* of the system.

Human-AI interaction design

Both the papers from Amershi et al. (2019) and Kocielnik et al. (2019) discusses interaction design in relation to AI-infused systems. Further, the two articles will be shortly summarized.

Guidelines for Human-AI Interaction by Amershi et al. (2019)

Amershi et al. aims to advance AI and the growing use of AI-supporting technology. The article results in a set of 18 guidelines for general applicable design in human-AI interactions. This has been done through multiple rounds of evaluation tested on several popular AI-infused technologies. The evaluations explains the relevance of the guidelines and shows to further opportunities. With the set of design guidelines, an aim is presented for practitioners working in the field to use as a resource for design of applications harnessing AI technologies, in addition to future research in human-AI interaction.

Will you Accept an Imperfect AI? Exploring Designs for Adjusting End-user Expectations of AI Systems by Kocielnik et al. (2019)

Kocielnik et al. states a lack of work in methods for setting the right expectations before an initial use of AI-based systems. Several methods of expectation setting was studied, and shows to findings in which different focuses can lead to different subjective perceptions of accuracy and acceptance. Expectation adjustment techniques were designed, in order to prepare users for the imperfections of AI, resulting in an increase of acceptance towards it.

Instagram: Guideline 12 - Remember recent interactions

Guideline 12 refers to the system being able to maintain a short term memory and for the user to make a reference to that memory efficiently. (Amershi et al., 2019)

As briefly explained earlier, Instagram remembers your geographic positions, earlier liked posts, hashtags used, featured friends or instagram users, etc. This remembered data of earlier interactions confirms a present memory of the system. Users can make efficient references to these memories, either it is tagging a friend, where the appropriate user is suggested, tagging a place, where the system suggests places an check ins that are near you currently or where the picture was taken.

Instagram: Guideline 5 - Match relevant social norms

Guideline 5 refers to the system being able to deliver experiences in a way that users are familiar with and would expect, given the social and cultural context. (Amershi et al., 2019)

Instagram features algorithms that decide the order in which different posts and stories are presented. This can be argued to not being what users would expect, since the chronological order is replaced by a black box order. On the other hand, social expectations might be reached, due to algorithms calculating which users and which images and posts are more interesting than others, due to remembered and learnt behaviour.

Chatbots / conversational user interfaces

Key challenges in the design of conversational user interfaces such as chatbots

Regarding design of conversational user interfaces such as chatbots, there are many challenges to consider. One challenge is that conversations tend to break down fast, making the platform mostly relevant for tech experts and enthusiasts. Designing a conversational user interface, involves suggesting expectations for the services to the user to provide an appropriate response. With conversation as the object of design, a key challenge is to look at design as an interpretation task rather than a explanatory task. This means that the design should understand the user and her needs, in order to provide an appropriate service, rather than just explaining to the user what is available and what is not. (Følstad & Brandtzæg, 2017)

Luger and Sellan (2016) studied how the distance between the users' expectations and the abilities of the systems contributes to lower the user experience. For the user to have a realistic view and expectations of a system, it needs to be designed as transparent about its services and capabilities.

Discussing Guideline 1 & 2 in relation to challenges in chatbots

Guideline 1 talks about helping the user understand what an AI system is capable of, by making it clear what the system can do and not do. Guideline 2 aims to help users to understand the frequency of mistakes made by the AI-system, by clearly stating how well the system can do what is can do. (Amershi et al., 2019)

These guidelines are important in chatbots, to lower expectations and to increase acceptance. Looking at chatbots as a replacement of a human, will lead to disappointment, since the chatbot cannot reach the level of understanding in a human-human interaction. I think making it clear, not only that a chatbot is a chatbot, but also what is means in terms of differences to human conversations. I believe users would have a more satisfying experience if the chatbot was transparent about its capabilities, for users to make an active decision about whether or not wanting to proceed to use the service.

Feedback and improvement of Module 2

As for the second iteration, I received good feedback on the description on AI-infused systems, and Instagram as an example.
Noting particular was asked to get improved, but as this is the latest iteration, I have reread the whole report, in order to maintain a coherent presentation of the modules.

MODULE 3

Collaboration and levels of automation

Situation Awareness
The term *situation awareness* (SA) aims at the capability of being aware of what is happening around you, in addition to translating information into the present and the future. SA is usually applied in operational situations, and the awareness is typically defined to which information that is important for a specific task or goal (Endsley, 2011). For instance, SA is important when driving a car. This is a situation where people driving must have focus on several things at the same time, and is dependent on being able to assess the situation. The much needed focus points at the necessity of awareness. Further, this kind of human awareness is important to discuss in relation to automation in a technological field.

Human-robots collaboration
Philips' paper talks about military robotics, and states the difficulties for a robot to be operated and at the same time maintain situation awareness. A goal is for the robot to be transitioned from a tool to a teammate, by increasing automation (Philips et al., 2016).

Levels of automation
Endsley describes an approach to find the different levels of automation, by categorizing how involved the human as an operator is in a system, or how independent a computer can act by itself. It is showed that SA is improved in operations where intermediate levels of control is involved (Endsley, 2011). I will further discuss some examples from Philips paper, and state and discuss their level of automation.

Example: Working dogs

Philip et al. discusses the metaphor of a working dog, whether it would be able to autonomously follow a human or go on a walk by itself.

Philip's paper touch upon the metaphor of the human-animal team, in relation to robotics. The reason for this being used in robotics, are that human already have mental models of animal companions, such as dogs. Involving such a mental model of a robot, may help the people to accept a robotic partner to perform different tasks (Philips et al., 2016).

Robot dogs are in the low levels of automation. There are dogs with the level of Manual control, meaning that the human perform all aspects of the tasks, for instance from a remote control, and there are robot dogs with the level of Batch Processing, where the computer carries out single or sets of tasks commanded by the human (Endsley, 2011).

Example: Military robotics

Philip et al. discussed how zoomorphic features and forms can help as mental representation for humans to understand that the robotic teammate is not a complete replica of a human being. Even though the end goal is a teammate, it is important that human only rely on the robots as a robotic teammate, not a human one. By appliance of zoomorphic features, a more accurate picture of robotic teammates could be built.

Using war drones as an example on military robotics, the level of automation could be Decision support. This means that a computer generates a recommended option, but the human get to decide whether or not the system will carry out with it (Endsley, 2011).

Military human beings would need to be very aware of his situational context at all times. While this only being a machine, maybe controlled from the other side of the world, the situational awareness is lacking.

Sending out machine based weapons, rather than men carrying them, sure secures the lives of your allies, but I would argue, like anything related to war and murder, that to focus automation to such an area is highly problematic.

I believe that automation can serve for its good, but designers and developers of the automated products has to be very careful in the process to build on good intentions. It is important to conduct automation processes precise and carefully. Mimicking human behaviour has many times been proved possible, but aspects regarding SA and ethics, is crucial for its performance. Learning from the conducted processes' feedback in retrospect is not sustainable as a method, rather the quality of automated processes should rely on research and its safe testing in advance of the reveal. Vague predictions are not enough when counting on automated robots to take on human responsibilities.

Conducting actions based on calculations are beneficial to delegate to automation, as it will help to increase efficiency. I think there still is a long way to go with involving AI and automation in robotics, where security and good intentions should play a significant role in its future developing.

Literature list

Amershi et al. (2019) Guidelines for Human-AI Interaction

Bassetti, W. H. C. (2005) Robotics and Automation Handbook

Endsley, Mica R. (2011) Designing for Situation Awareness: An Approach to User-Centered Design.

Følstad, A., & Brandtzæg, P.B. (2007). Chatbots and the new world of HCI interactions

Goldsmith, Selwyn. (1963). Designing for the Disabled

Grudin, Jonathan. (2009). AI and HCI: Two Fields Divided by a Common Focus

Haenlein, Michael & Kaplan, Andreas. (2019). A Brief History of Artificial Intelligence: On the Past, Present, and Future of Artificial Intelligence

Kocielnik et al. (2019). Will you Accept an Imperfect AI? Exploring Designs for Adjusting End-user Expectations of AI Systems

Luger, E., & Sellen, A. (2016). “Like having a really bad PA”: The Gulf Between User Expectation and Experience of Conversational Agents

Nilsson, N. (1998). Artificial Intelligence: A New Synthesis

Philips, Elizabeth & Ososky, Scott & Swigert, Brittany & Jentsch, Florian. (2016). Human-animal teams as an analog for future human-robot teams, Proceedings of the Human Factors and Ergonomics Society Annual Meeting.

Russel & Norvig. (2009). Artificial Intelligence: A modern approach

Story & Mueller & Mace. (1998). The Universal Design File, Designing for People of all Ages & Abilities

Thrun, Sebastian. (2004). Towards a Framework for Human-Robot Interaction

U.N. and I.F.R.R. (2002) United Nations and The International Federation of Robotics: World Robotics 2002. United Nations, New York and Geneva.

Mental Floss, 2019, 22.09. Url: https://mentalfloss.com/article/62548/ollie-baby-otter-robot

Merriam Webster, 2019, 22.09. Url: https://www.merriam-webster.com/dictionary/robot

RIA, Robot Institute of America. (1979)

Tech republic, Understanding the differences between AI, machine learning, and deep learning, 2019, 28.10.
https://www.techrepublic.com/article/understanding-the-differences-between-ai-machine-learning-and-deep-learning/

The Center for Universal Design, 2019, 23.09. Url:
https://projects.ncsu.edu/ncsu/design/cud/about_us/usronmace.htm

Uber, 2019, 20.09. https://eng.uber.com/michelangelo/

Uber, 2019, 20.09. https://www.uber.com/no/nb/uberai/