Characteristics of AI-infused systems - Module 2 Individual Assignment

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1.1 Characteristics of AI infused systems

The term AI first came about in the mid 50's where the it was first used by the scientist and mathematician John McCarthy in a workshop. In this first era of AI research and speculations, most scientist looked upon AI as a locomotive of thought that might outperform human cognition in the future, however this conception was mostly restricted to arithmetic reasoning. Historically, AI as a scientific activity has since the beginning of time been a opposing trend to HCI and the CHI community. Whereas HCI focuses on improving applications and making them more user friendly, AI strongly focused and future possibilities and tolerated slow progress (Grudin, Johan, 2009, s. 1).

Following the history of AI, there are different definitions of this technology and employment, and in this section three of these will be discussed. The first one is a more recent formulation from 2010 stated by Russell and Norvig :

Definition nr.1
"AI is a subfield of computer science aimed at specifying and making computer systems that mimic human intelligence or express rational behaviour, in the sense that the task would require intelligence if executed by a human" - (S. RUSSELL, P. NORVIG, 2010.)

The second definition, is stated by the AI Magazine in 1987, and compared to the first definition by Russell and Norvig is more centered towards programs learning of themselves, rather than resembling or mimicking human intelligence.

Definition nr.2
"AI is the science of endowing programs with the ability to change themselves for the better as a result of their own experiences." - (AI Magazine Volume 8 Number 4 (1987)

The last definition, stated by IBM also relate it to the ability of computers to mimic that behaviour of the human mind. IBM was also the company that builds the chess machine that beats the world champion in chess, in two matches.

Definition nr.3
"Artificial intelligence leverages computers and machines to mimic the problem-solving and decision-making capabilities of the human mind." - (IBM 2020)

My own definition
"Artificial intelligence leverages computational technology and branches of ML and DL to simulate human reasoning and intelligence"

Grudin, Jonathan. AI and HCI - Two Fields Divided by a Common Focus (2009) goes into depth of how the field and research around AI have evolved since the mid 50's, and as a pendulum to the research of the HCI field, which has had it ups when AI had it downs.

From the get-go, AI as a practice was first employed under the ww2, when the English mathematician and scientist Alan Turing, publishes the Computing Machinery and Intelligence, where he poses the question, can machines think? Turing was also famously know for cracking the Nazi Enigma machine under the war.

An example of how the HCI field has been a prohibitor for the research of AI, was evident when Sketchpad first was developed in the early 60's, which was product that contained most of the concepts we know of today as GUI. Due to this discovery, AI and the field received less attention and thus the development and interest stagnated.

IBM is one of the present companies that are highly invested into the research around AI and was a pioneer in the space in the late 90's when they managed to design and implement a system that could beat the present world champion in chess. Furthermore, IBM has a historical perspective to AI as a

field and practice where they present a timeline of important events that has happened on that frontier. Nevertheless, they also try to frame the technology in relation to other branches that are relevant within the space, and even distinguishes between weak and strong AI. (weak AI is what is most present today, which focuses on performing specific tasks and can be found in most VUI'S such as Amazon Alexa, Apple Siri etc. Strong AI is more focused on having intelligence equal to humans, however this is only theoretically defined as of today)

I, Robot is movie from 2004 based on Isaac Asimov science-fiction novel from 1950 about a possible future where humans and robots live side aside. In the movie, humanoids, which are robots that are highly intelligent and tries to resemble humans in the way they look, are serving humanity. The plot itself starts after Chicago police officer distrust robots after he was saved by a robot in a traffic incident, where the humanoid robot chose to save him over a 12-year old girl.

The officer is put on the case of a suicide of the Alfred Lannings, who was the founder of the U.S robotics foundation. The humanoid robots all have to obey the three rules of robotics which positioned the robots as servants to humanity. The rest of the plot revolves around the breakout of some robots that starts to defy these rules.

AI in this movie is portrayed as something that that is embodied by the humanoid robots and carefully designed and coded to obey humanity. When the robots the starts to defy the rules, a more present form of strong AI is present when the robots becomes foes.

1.2 Robots and AI systems

The term Robot is drawn from an old Church Slavonic word, robota, for "servitude," "forced labor" or "drudgery."

The robot institute of America has defined in 1979 robots as:

"A re-programmable, multifunctional manipulator designed to move materials, parts, tools, or specialized devices through various programmed motions for the performance of a variety of tasks"

Merriam Webster's collegiate dictionary (1993), defines a robot as a :

"An automatic device that performs functions normally ascribed to humans or a machine in the form of a human."

Based on my own conception of what a robot is i have made a definition of my own:

"A robot is a machine that have features defined important for the robot's use purpose, where the input and output can be programmed or constrained by humans"

Is a Robot different from an AI?

Comparing AI to Robots is not an apple vs oranges comparison as the former is a means to be deployed in the latter. While AI is a concept of autonomy and aims in high degree to mimic human intelligence and even behaviour, robots are machines designed at performing specific tasks for specific purposes, as of today.

A similarity between the two is that they both can operate autonomously, where a robot can function fine without being autonomous, an AI kind of loose its purpose if it were to not function autonomously. Looking at the definition made of AI :

Artificial intelligence leverages computational technology and branches of ML and DL to simulate human reasoning and intelligence

vs

A robot is a machine that have features defined important for the robot's use purpose, where the input and output can be programmed or constrained by humans

An important distinction is that AI is a concept of intelligence while a robot is a concept of an automated machine that can accomplish task related to the domain in which it is spawned.

Boston dynamics is a company that are highly involved in the development of robots and have a dog-like robot called 'Spot'. This robot have multipurpose use in that is can function as platform for extentions of capabilities, parts can be added as the engineer best likes. Additionally, the robot has a form of animalistic behaviour in that the movement of the robot highly resembles the movement of e.g a dog or four legged animal.

1.3 Universal Design and AI systems

Universal Design (UD) is an approach to design that increases the potential for developing a better quality of life for a wide range of individuals. It is a design process that enables and empowers a diverse population by improving human performance, health and wellness, and social participation (Steinfeld and Maisel, 2012).

The definition to Steinfeld and Maisel have a broad view for what UD is and its reach. However, in short it can be explained as a design principle that is established to design for diversity, be it people that are impaired or come from different cultures.

UD and AI could e.g merge together to make systems that are even more personalized for the persons that are users of the systems of even products. More specifically, having a systems that learn what type of perceptions are most efficient for the user, could utilize those and ditch or reduce the other so the experience are tailored to the specific user.

WCAG 2.1 defines the concept of "understanding" and "understand". These terms can be discussed from different angels when looking at machines. E.g, a machine can understand its input based on software running in the microchip in the head of the robot of machine. However, this understanding is based on electrical signals passing through different NOR/OR/AND transistors in the CPU, which in result gives and output of 0 or 1. This calculation then results in an output that similarly is digital. Understanding in terms of humans, are more related to making sense of something and reasoning reflecting on past experiences and what is present in the environment.

1.4 Guideline for Human-AI interaction

Chosen microsoft guideline:

13. Learn from user behavior

This principle leads to how the system or interface adapts and learns the users behaviour and routines. This principle is highly relevant for AI systems where there is a necessity that its understanding of the user becomes richer and more thought as the system is used, e.g making a wearable glass gadget for visually impaired people, that utilizes AI software to give more definite feedback guidance to the user.

Ben Schniderman's fifth principle of the eight golden rules for designing interfaces;

5.Offer simple error handling

is somewhat in the same alley as the one from Microsoft. This principle imply that the system should be designed to handle errors, and in an easy and understandable fashion so the user understands it - also, this is important in order for the user to have trust and confidence in using the system. Relating this to the one human AI-interaction, it is inevitable that an AI system does not commit errors, and in these situations it is important to display or present this to the user in a way that is not confusing or misguiding.

1.5 Key characteristics of AI-infused systems

AI-infused systems are as mentioned those systems who harness AI capabilities like continuously learning and improving based on data inputted to the system - and expose this directly to the end user of the system. Moreover, an AI-infused system can also be described in terms of what type of "tier" of AI it is. Following Noessel (2017)[1], there are three types of "tiers" within AI: (1). Artificial Super Intelligence, (2). Artificial General Intelligence, (3). Artificial Narrow Intelligence. This paper will focus on the last tier, (3). Artificial Narrow Intelligence, which can be briefly described as AI that is encapsulated in a specific system or environment to streamline and enhance the specific task(s) that are products of these.

Amerish (2017) [2] defined a set of 18 important guidelines which are good practices and heuristics to follow when designing AI infused systems now and in the future. These were distilled from a set of over 150 guidelines that has been developed over the last 20 years. -> notably guidelines 1 and 2, defined: Make clear what the system can do and Make clear how well the system can do what it can do were the two guidelines that in their earlier definition was most often confused with one another or misinterpreted. Mention worthy is that these 18 guidelines were refined and altered when in exploration phase of applying these to product features such as: E-commerce, Mobile navigation, Music recommender, Activity trackers.

Kocielnik (2019) [3] investigated how expectations of performance and behaviour related to an AI infused scheduling assistant, could be altered before use to set realistic expectations to the user and ultimately enhance user experience and satisfaction. Learning output from this research is how setting the degree of accuracy of the AI system can contribute to better match of expectations and ultimately better user experience and satisfaction. Moreover, this accuracy that is investigated and described can in Kocielnik eyes be either weighted towards a High Recall model or a High Precision model.

These models can be describing simply – the High Precision model focuses on preventing interpreting true of false, while the High recall model focuses on preventing interpreting false of true. the research revealed that a High Recall model of accuracy, greatly increase user satisfaction and acceptance of the systems when seen in relation to Scheduling assistant. Discussing his findings, he also expects this to be valid for other AI – infused systems as chat/email response suggestions, sharing memories in some applications, assistant in context analysis. Basing this rationale on that there is a higher cost for the user of correcting a false positive contra a false negative – in that the prior model would result in more interventions from the user of falsely created appointments, compared to the user taking action of creating appointment that was not detected. The users nonetheless have expectations to such systems and will be disappointed if these are not fulfilled or adjusted for before use.

Zimmerman (2020)[4] et al. have investigated and developed a framework for how HCI an UX designer can conceptualize and envision human interaction with AI based on four different levels for system output of an AI system. These are based on the two challenges they have defined when designing such systems, which are: AI's capabilities and AI's output complexity. Addressing the first challenge, AI capabilities are separated into Fixed and Evolving systems, where the former are systems were the capabilities are explored and defined from the design phase to the deployment. Evolving systems however are partly defined in these phases but continue to evolve after deployment based on user input and activity, and thus poses another challenge to designers in that they are inhibited to predict the behaviour and output of the system. Output complexity is based on what output the system might output in relation to

the input from the user, where an input leading to two possible outputs is lowest degree of complexity and infinite possible outputs are the highest degree. With infinite possible outputs error handling becomes impossible to simulate, hence also difficult to consider when designing for such systems. The authors main concern and message is that the type of AI system developed needs to be considered in terms of its level of complexity, to understand how such system might be designed. In correlation to that, what challenges the level of complexity might pose for the user experience and the interaction between system and end user.

To better grasp what the key characteristics of AI infused system are, culminating the different findings and research areas from the authors above can help give definitions to this. An AI infused system is one where the behaviour and output will differ based on the type of input is given, and one input might produce one, more or infinite possible outputs. Also, such a system is not necessarily fixed as one defined product with defined capabilities when it's deployed, but can be considered as a planted seed where the width, hight and longevity of the plant is only defined by its DNA (algorithm). Furthermore, such a system has unexploited complexity when it comes to UX and human interaction, where common HCI principles as; the affordance of system capabilities, error handling and informative feedback - becomes extremely important to consider in the design and development phase.

Identify one AI-infused system

One AI infused system that has gathered enormous amount of heat and adoption in the last couple of years, is the Chinese social media platform TikTok. TikTok is based on a concept where creators can make short videos and share them with others on the platform. These videos can also be affiliated with a song, thus, the more a video gets played the more the song will be exposed. The videos can also be liked and shared to others on other on the TikTok network or other social media platforms. Creators do also have accounts which can be followed and shared.

The presence of AI is first evident after installing the app, where an algorithm based on a deep learning model is predicting what videos are most interesting for you and display these videos on your video feed. Initially, these videos are based on your parameters such as age and location. The longer the app is used the more trained the deep learning and thus the AI becomes to predict what content is most relevant to you, and thus more precise in terms of the videos that are shown on your feed. This mechanism is similar to that of a music recommender algorithm. The input to the AI model is based on parameters as: what videos you like, how long you watch each of the videos, whom you are subscribed to, the song affiliated to the video. The output of the AI model is scoped to the videos that are showed on your feed, and what videos will appear in the future.

1.6 Human AI-interaction Design

Amerish (2017) [2] work on guidelines for Human AI-interaction have revealed a set of 18 guidelines that are important to consider when designing interaction and UI for AI infused systems. Evident in this research is a proposal for how such guidelines can be extracted, the different number of iterations necessary in doing so, general argumentation and explanation in shaping these guidelines, and placement of these guidelines based on four different levels of interaction. (Initially, During Interaction, When Wrong, Over Time).

Kocielnik [3] work was more aimed at investigating whether real users ever will be satisfied in using a croquet AI system and test this hypothesis by testing three different UI implementations in a Scheduling assistance AI program. Evident in the research is that expectation adjustment design positively impacts the user experience of a system.

Amerish (2017) [2] two first guidelines, *Make clear what the system can do* and *Make clear how well the system can do what it can do*, the UI of the app have some inefficiencies. Firstly, the UI of the app does not in any regard reveal how the AI algorithm operates when selecting videos, as this happens automatically behind the scenes. Moreover, there are no metrics, illustration, or controls where the user can learn or have an conscious influence of/to the accuracy and precision of the algorithm.

TikTok's output in the videos the app decides to show on your video feed, are also highly different based on the input the app is feed in terms of the user attention or activity. E.g, watching a shuffle dance and a diy (do-it-yourself) video does not necessarily create the same output. Nonetheless, one can't think of it as one input generates one output, but one input is supplying and enriching the model the app uses to calculate its output. (It could be interesting to see what influence a clarification in terms of adjuster or controller of the AI's accuracy and precision, could have to the user experience of the system, in regard to Kocielnik (2019))

The lack of transparency and clarification in terms of the A1's capabilities are also evident in TikTok, also relevant to the previous remark of the user being to adjust and control the precision and accuracy of the algorithm. Despite this might go on the expense of the user experience of the app, in that it is based on the AI operating fluently, behind the scenes unnoticeable to the user's eye.

Bender 2021 [5] investigates what possible challenges that come by using large language models for AI systems. He points to these huge models bringing large implications in terms of financial and CO2 spending's. Also looking at the beneficial sides of such models, these might be exclusively reserved to a certain group of the population, more precisely those who are English speaking. What these data models are constituent of is also a problematic topic addressed in this article. Bender reflects on how a large model that contains data from the whole of the internet could be representable for the whole world population. However, this again might bring in liabilities and consequences in terms of unfair representation in the data set in that people are using the internet to very different degrees world over. Instead of consuming giant amount of data from the vast internet landscape, Bender reflects over that a higher degree of due diligence is necessary when picking out the data sets, to better compose data sets that are more just and representable for its domain.

1.7 Chatbots conversational user interfaces

In contrast to other more conventional interfaces that are most often graphical or tangible, Chatbots are significantly different in that they are dynamic in form of how they operate and behave as means of interaction. There is an evident complexity in terms of its output but also in term of the affordance it signifies to the user. The complexity is two folded, as it's constituent of both the input to the model as well as the output to the user. Furthermore, most chatbots are substitutes to a human servicer and operator, thus the one of the challenges intertwined in this equation is the chatbot ability to simulate this role without sacrificing proper user experience. In the name of the Turing test, a simulation to the degree of what a human can perform has yet to be seen, and thus there is need for a mediation the service of a huma operator and that of a machine.

The first guideline, GL1: *Make clear what the system can do*, is relevant when designing for human chatbot interaction in that such systems sometimes lack good affordance in terms of what the system can offer for the user. An important improvement is to enhance visibility/transparency of the system. In the initial interaction with the chatbot the systems should express what role it serves, what it can do, and this in the preferable perception for the system. Also, constraints are also important to offered to the user, so that the users' actions are not deviating from what purpose and functionality the chatbot serves.

The second guideline, GL2: *Make clear how well the system can do what it can do*, correlates to how informative the system is of its proficiency and accuracy in calculating output to the user. Adherence to this principle could e.g be achieved by providing better informative feedback upon user input, simpler error handling and easy reversal of actions. Nonetheless, Kocielnik work on expectation adjustment of AI infused systems can also provide positively results in relation to this guideline, as have been shown in his research.

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