AI & Recommender Systems

A brief study into the intelligence behind today’s technology

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# Introduction

Artificial Intelligence. The theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages. (Oxford)

The field of AI has become such a broad and all-encompassing aspect of technology, that defining what exactly AI *is* can be a challenge in itself. In this report I shall examine the different applications of AI, as well as take a deeper look into how AI factors into technology such as recommender systems.

# Applications of AI

Diagram

Description automatically generatedWhen talking about artificial intelligence, the Turing test is notoriously cited as a method of determining a machine’s “*intelligence*”. In this test, a person is isolated and allowed to engage in a conversation with a. Another person, and b. The machine in question. If the first person cannot definitively ascertain which one is the machine, it is assumed to have passed the test.

Figure 1 Classifications of AI

This test falls under the jurisdiction of *Natural Language Processing*, a single example of the many applications of AI.

AI is an umbrella term, including countless aspects such as *robotic applications*, such as physical motion, perception & navigation, as well as *cognitive applications* – e.g., reasoning, estimating and decision-making, and finally *interpretation*, which includes the aforementioned natural language processing, speech recognition and more. (Borana, 2006)

Figure 1 displays a chart breaking down the many fragments of artificial intelligence, with respect to machine learning in particular. This is a section of the second aspect of AI previously mentioned, *cognitive applications*, in which AI can use and digest provided information & statistics to allow it to understand its target.

One way or another, AI factors into every large business, and is ever-present in our day-to-day lives. Some applications of AI include:

### Video Games

A picture containing text, crossword puzzle

Description automatically generatedVideogames employ AI in numerous different ways, and a large part of the gaming industry is discovering new ways to use AI to create a unique gaming experience. One of (if not) the most common form of video game AI is Pathfinding. This is the process in which an object, be it an enemy, a current of electricity, or a homing missile, finds its way to a target, often either around several obstacles, or by calculating the shortest route out of the available options. This can be achieved by a handful of methods using the A\* algorithm (Figure 2), such as using a NavMesh (Laying out a net of polygons in a 3d space, then navigating from polygon to polygon until the object and the target are on the same space) or breaking up the game “*world*” hierarchically to find the optimal route, in a process called Hierarchical Pathfinding. (Shi, 2011)

Figure 2 A\* Algorithm (Geeks for Geeks, n.d.)

### Healthcare

AI can be coded to perform tasks such as pattern recognition, whether in images such as X-rays, or in symptoms. The inclusion of AI in medical fields can drastically increase the efficiency and productivity of medical staff, with technology far more exact than human eyes or hands. One such example that can be observed is the data collected by the equipment of Intensive Care Units (ICUs). The technology in these ICUs produces *dozens* of responses and recordings for doctors to be aware of and interpret, and proper management of this information is paramount to taking care of the patients. Thankfully, intelligent data analysis allows AI to handle this information for the physicians.

### Self-Driving Cars

A person holding a tablet in a car

Description automatically generated with medium confidenceAutonomous Vehicles are a flashy, modern example of the potential of AI. Constantly being represented in the media, a concept that once seemed like science fiction is very quickly becoming a reality. In the US, Tier 2 Self-driving systems are already in place – While these systems are far from a full “auto-pilot”, they are more of an *assisting feature,* with intelligent and adaptive *cruise control*, in which the car itself can recognize and follow lanes. Tier 3 systems, which would be more AI driven with less human input, are still under development. (Daily, 2017)

Figure 3 A conceptual self-driving car

## Strengths/Limitations

### Advantages

Of the many strengths of using AI, the most obvious is the fact that machines are not as prone to human error. Unless a piece of technology is incorrectly made, AI means that a task can be executed *precisely* how it is desired. In fields such as medicine and food safety, this clinical accuracy can literally be the difference between life and death, and so the most precise method possible is always the most desirable.

Another advantage is that AI does not tire or grow bored. While humans need breaks, rest, and stimulation, AI can perform even the most menial tasks on a theoretically infinite loop, again and again. Another related strength is that AI relies on facts and logic and therefore will not be swayed by emotions. While this can also be viewed as a downside, it is undeniable that a machine need not worry about fear of failure, or stress from pressure, etc. swaying its performance

AI also is easily reproduced; once an instance of a given problem has been solved with AI, it can be copied and transplanted with ease to solve a problem without any of the time necessary for human relaying of information.

### Disadvantages

Although artificial intelligence can potentially read and interpret vast amounts of data, a lack of common sense and intuition can lead to difficulties which could otherwise be avoided. As AI advances, there are many who criticize the ethics of high-functioning AI, whether it encroaches upon the sanctity of the human condition, and whether technology can ever truly replicate a human mind.

At the current level of AI technology, there are several barriers to making AI fully autonomous, limiting the range of possibilities to what is currently achievable.

Artificial intelligence, by its very design, is narrow-minded. Created based on a mass of information or statistical analysis, anything an AI “*creates*” or calculates is limited by the scope of its source material. AI lacks originality and creativity and can be quite repetitive when used in social or artistic situations, or any fields which may require the use of imagination.

# Recommender Systems

Look at almost any tech giant or any large-scale business. Odds are, they will have some sort of recommender system to advertise the right product to their customers. These technologies are everywhere within the internet-based industry - in fact, in October of 2009, Netflix offered 1 million dollars to anyone who could improve their recommender system’s accuracy by 10% (Johnston, 2012). Recommender Systems are a feature of AI that falls under the Natural Language Processing bracket and can be broken down into several types: Simple, content-based, and collaborative recommenders. A simple recommender is little more than an ordered list; they recommend objects based on a single metric or score. Content-based and Collaborative recommenders are described below.

## Content-Based Approach

A content-based recommender analyses information about a given object, e.g., a book’s blurb, or a recipe’s description. It then compares this information with more data drawn from other similar objects and ranks them based on their similarity to the given object. This can be based on anything, from recipes to physical products to Netflix shows, and operates off of the concept that if the customer liked the inputted object, they are likely to like other similar objects in the data set.

## Collaborative Approach

Instead of comparing the data of the object itself, collaborative recommenders work by collecting the feedback of multiple customers and combining it to find patterns between them. E.g., John likes Batman, and John likes Superman. If Mary also likes Batman, it is likely that she will also like Superman.

# Connoisseur

## Description

Connoisseur is a Wine recommender system built in Jupyter Notebook. It uses a data set of a variety of wines, and compares their descriptions written by professional wine tasters to find a number of highly rated wines similar to the user’s inputted wine *designation* (name).

## Implementation (refer to research)

The recommender system was made with Anaconda and Jupyter Notebook, using the pandas library and feature extraction add-ons to clean up and interpret the data. The creation of this program came about under the guidance of a Datacamp tutorial (Sharma, 2020).

Finding an applicable dataset for a content-based recommender system proved to be difficult, but I eventually settled on a Wine Recommender system, because wine is a popular cultural phenomenon with an abundance of opinions (and thus, reviews). While creating the recommender, I quickly came across the first hurdle; The original dataset was enormous, requiring 103gB of storage to fully parse through all of the wine descriptions and clean them for analysis. Unfortunately, I did not have access to this level of free storage, and so the problem was remedied by shortening the dataset. While unfortunately this meant that the data was less complete, it meant I was able to use this data on my machine.

While the movie system outlined in the tutorial utilizes a formula to calculate a movie’s *Weighted Rating*, my dataset was based on individual reviews of each wine instead of a collection of reviews – This meant that I had no use for the weighted rating formula and was able to proceed further without issue.

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