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ARTIFICIAL INTELLIGENCE POETRY

POEZIE UMĚLÉ INTELIGENCE

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INSTRUCTION:

The aim of the thesis is an overview of existing engine designed to compose poetry texts using "artificial intelligence" algorithms, neural networks etc. The thesis also describes and analyses the way chosen set of application works and behaves in practice. It is also supposed to provide an example of a text structured by AI and its subsequent analysis as far as its "naturalness" is concerned. Another topic will be the comparison of the different ways neural networks process data depending on different languages types (analytic and synthetic): in this case the difference between Czech and English. The theoretical outline will be based upon secondary resources from relevant full-text database (jstor, EBSCO) that the student finds useful.

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Abstract

This thesis conducts an overview of existing computer engines that are designed to write poetry texts. It contains information on how to work with each presented application and their capabilities are demonstrated through their exemplary use. The generated writings are analyzed. The operation of these computer programs is explained. Additionally, it includes information about the origins of the idea of artificial intelligence, as well as its more recent technological developments.

Keywords

artificial intelligence, AI, neural networks, poem generator, poetry, poem

Abstrakt

Tato bakalářská práce podává přehled o programech, které jsou určeny k psaní básnických textů. Obsahuje informace o tom, jak se s jednotlivými představenými aplikacemi pracuje, a jejich schopnosti jsou demonstrovány jejich zkušebním použitím. Tyto vygenerované texty jsou analyzovány. Je také vysvětleno fungování těchto počítačových programů. Dále je také zmíněna historie umělé inteligence, její prvotní myšlenka i její novější technologický vývoj.

Klíčová slova

umělá inteligence, UI, neuronové sítě, generátor básní, poezie, báseň

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Author's Declaration

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I declare that I have written this paper independently, under the guidance of the advisor and using exclusively the technical references and other sources of information cited in the project and listed in the comprehensive bibliography at the end of the project.

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Brno, May 29, 2023

author's signature

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INTRODUCTION

This thesis is about the field of artificial intelligence that in recent times is growing in significance due to its technological advancements made in recent history. This work focuses on the ability of artificial intelligence to write poetic texts. It also contains information about its history and technology, such as neural networks. The main objective is an overview of AI models capable of writing poems. This is done by accessing publicly available programs, generating poems with them, and analyzing the results.

The thesis is divided into four basic parts. The first chapter outlines the history of artificial intelligence. This includes its original definition, but also the idea of it that was explored in Greek mythos and science fiction. Additionally, Turing test is also mentioned, as well as the progress made in the field during the 20th century, as demonstrated by computer chess. The second chapter explains how artificial intelligence works and how it is designed to play chess, translate, or write poetry. The third chapter describes the possible definitions of poetry and how it influences whether or not can AI be considered as capable of writing poetry. Then it contains an overview of selected artificial intelligences that are designed to write poetry, an explanation of how they operate, an exemplary generation of poetry, and an analysis of these poems. The final, fourth chapter concludes with results and findings.

1. HISTORY OF ARTIFICIAL INTELLIGENCE

Although Artificial Intelligence (AI) may appear to be a recent technological development, its classic definition was formed in 1955, when John McCarthy with other researchers described it as “making a machine behave in ways that would be called intelligent if a human were so behaving” (as cited in Kavanagh, 2019, p. 13).

And the idea itself was entertained even before that in science fiction works. One of them is the drama R.U.R. written by Karel Čapek in 1920, which coined the word “robot”, although the word itself was created by his brother Josef states Margolius (2017). In the drama, artificial people are mass-produced to help humans with work, but eventually, they turn against humanity (Margolius, 2017). And today robotics is considered one of the subdisciplines of AI states Kavanagh (2019). The scene from the drama can be seen in figure 1.



Figure 1 Scene from R.U.R. From *Století robotů. Čím Čapkovo drama R.U.R. fascinovalo svět aneb Cesta do hlubin robotovy duše*. By J. Hroch, A. Pfeifer, December 25, 2020, Český rozhlas. <https://vtava.rozhlas.cz/stoleti-robotu-cim-capkovo-drama-rur-fascinovalo-svet-aneb-cesta-do-hlubin-8385917>

But the concept is still older than sci-fi works. In 1637, scientist and philosopher named Rene Descartes considered the possibility that one day machines would be able to make decisions and think states Marr (2018). And although Descartes thought that machines would not be able to use language ever, he did identify a basic distinction between machines that would be built to do one specialized task and machines that would be able to adapt according to the task given. Today, these are called specialized and general AI respectively (Marr, 2018).

The absolute earliest time the concept was first thought of and brought to light was in Greek myths of Hephaestus and Daedalus during antiquity with characters like Pandora or Talos states Ather (n.d.). Pandora was an artificial woman created by Hephaestus, the god of craftsmen, among other things, who also made Talos, an automaton made of bronze armor, behind which were hidden blood vessels with the ability to make decisions and experience emotions (Ather, n.d.). The depiction of Talos can be seen in figure 2.



Figure 2 The depiction of the death of Talos. From *Stanford researcher examines earliest concepts of artificial intelligence, robots in ancient myths*. By A. Shashkevich, February 28, 2019, Stanford News. <https://news.stanford.edu/2019/02/28/ancient-myths-reveal-early-fantasies-artificial-life/>

And the fact, that the concept of artificial intelligence was thought of so long before its first implementation in practice, along with its heavy use in mythos and fiction works, is most likely because the concept was and still remains somewhat intriguing to not only programmers and scientists but laymen alike. That can be because of the thought-provoking questions it raises about the nature of intelligence, mind, and consciousness, as well as the relationship between humanity and technology.

Now, to return back to the 20th century, although before the classic definition by John McCarthy, five years exactly, Turing (1950) proposed a test referred to as an “imitation game”, where a human referred to as an interrogator has to ask questions, using written communication, of two other participants of the test, one being a computer and the other a human, and by the end of the test the interrogator has to decide which of the participants is human and which computer. Turing (1950) then makes a prediction that by the year of 2000 computers will be able to deceive the interrogator, when the length

of the test is at least 5 minutes, at minimum 30% of the time and that, although he considers the question “Can machines think?” meaningless, one can then speak of machines as thinking without the presumption to be objected. This prediction proved to be too optimistic. To date, only a few computers allegedly managed this feat (Orf, 2023). According to BBC (2014), the first being AI named Eugene Goostman, which on 7th June 2014 managed to deceive 33% of judges by pretending to be a 13-year-old Ukrainian boy. However, other sources doubt the validity of the test, such as Panova (2021), stating that there were only three judges, from which only one got fooled, and that it was only possible because of the claim of the computer that it is a 13-year-old Ukrainian boy, which would explain its imperfect English. And similarly, all the other computers that had purportedly passed the Turing test are being doubted, Johnson (2022) stating that no artificial intelligence has passed the test. And the test itself is facing some criticism. Zhao (2020) states the main points in her article. The first point is that only machines that can hold a conversation with a human can be tested, leaving systems that could perhaps be considered intelligent through different means, such as action, excluded. The second point is that the test puts emphasis on the ability of the computer to deceive an interrogator rather than showcasing intelligence. The last point concerns the interrogator and the human subject, whose intelligence and prior knowledge of AI influence the test results and it is not uncommon to see an interrogator misclassify the human subject as a machine, because the human appears to the interrogator to be acting too consistent and generic.

Others, unlike Turing, found the question “Can machines think?” not meaningless, but quite intriguing. Looking back at the original definition of John McCarthy, it appears to be quite vague and abstract. The reason why the comparison between the machine and a human is made is most likely because humans are considered “naturally” intelligent, so if AI is able to behave in a similar fashion that means the AI is intelligent. However, now a problem is faced in defining “natural” intelligence. There have been many theories and tests created to describe and measure the intelligence of a person. Falqueto et al. (n.d.) mention the intelligence coefficient IQ that is set to measure so-called “beautiful pure intelligence”, but also other approaches on the matter, such as the theory of multiple intelligences. Each of them has its strengths and weaknesses as the concept of intelligence is quite complex continues Falqueto et al. (n.d.). And today, new models capable of measuring intelligence are devised specifically for artificial intelligence programs mentions Falqueto et al. (n.d.). Oxford Learner’s Dictionaries (n.d.) defines intelligence as “the ability to learn, understand and think in a logical way about things; the ability to do this well”. So, if intelligent behavior encompasses an understanding of the given matter, J. R. Searle (as cited in Bolter 1984) argues that a program that can take Chinese inputs and provide a reasonable output in Chinese is comparable to a human who would mechanically execute all the rules of the program, yet claiming that the machine or the human understands Chinese language is nonsensical. Bolter (1984) draws the line

between programmers and toymakers of medieval Europe, mentioning toys such as the duck by Vaucanson, which can be seen in figure 3, that could quack and eat.



Figure 3 A modern reconstruction of Vaucanson's popular 'crapping duck'. From *1738: Vaucanson's Mechanical Crapping Duck*. By Alpha History, n.d. <https://alphahistory.com/pastpeculiar/1738-vaucanson-mechanical-crapping-duck/>

According to Bolter (1984), both professions try to give life-like properties to their creations. However, he states that mechanical parts are not the right technology to express the qualities of an actual living creature, and the outcome is rigid and limited in scope. The effort was ultimately done "as tour de force" and thus it is not an important achievement for science and neither for engineering, he argues. Similar to that is when AI tries to imitate the human mind, although he acknowledges that a computer is more flexible than a mechanism of a toy. And while Bolter (1984) agrees that recently the work in the field of artificial intelligence is more respected, he still thinks that the AI specialists have gone too far, but then again, 1984 was a time when a computer could only beat amateur players as he, himself, states.

1.1 Artificial Intelligence in Chess

Since then, the chess supremacy of humans over machines did not last for long. In a six-game match held in 1996 between World Chess Champion Garry Kasparov and IBM computer Deep Blue, the World Chess Champion ultimately won due to his ability to adapt his game strategy to target the computer's weaknesses, which could not respond accordingly (Bateson, 2017). The match ended 4 to 2 in favour of Garry Kasparov, but this was the first time a computer won a game against a World Chess Champion in a tournament setting with classical time control (Kasparov vs. Deep Blue | The Match That Changed History, 2018). Classical time control in chess according to FIDE as cited in Chess time controls explained (n.d.) means that each player has 90 minutes to make the first 40 moves, after which 30 minutes are added to the player's time with 30 seconds addition per move from the first move. The computer, as IBM made it, can be seen in figure 4.



Figure 4 Deep Blue chess computer. From *One of the greatest chess players of all time, Garry Kasparov, talks about artificial intelligence and the interplay between machine learning and humans.* by E. Holodny, May 24, 2017, Insider.

<https://www.businessinsider.com/garry-kasparov-interview-2017-5>

And just a year later in 1997, the computer engine Deeper Blue, a successor of Deep Blue was able to win the match against the World Chess Champion, not only because it was faster and smarter than the previous version, but also because it could modify its basic strategy between games (Bateson, 2017). The calculation time was increased by approximately 100% thanks to the new hardware, and the knowledge of the board game increased, because of new features programmed into the chip, that enabled the system to recognize more chess positions and concepts states Greenemeier (2017). The result of the

match was 3.5 to 2.5 in favour of Deeper Blue, and it was the first time a computer won a match against the reigning World Chess Champion (Kasparov vs. Deep Blue | The Match That Changed History, 2018).

The chess computer engines of today are even more technologically advanced than Deeper Blue and that can be even seen in the lack of human versus computer tournament play because it just would not be a contest. However, their ability to perform can still be put into perspective, thanks to the Elo rating system that is used in chess. According to CCRL (Computer Chess Rating Lists) (n.d.) the strongest chess engine called Stockfish has a rating of 3750 in blitz time control, while the strongest rating of any human player, according to FIDE (International Chess Federation) (n.d.) in the same format is 2852, which belongs to Magnus Carlsen. In chess games with blitz time control, each player usually has somewhere between 3 to 5 minutes to play the whole game with no or small addition of time added per move, e.g. 2 seconds (Chess time controls explained, n.d.). The reason the comparison is made in this time control and not in the traditional classical time control, which is the most common time control in official chess tournaments according to (Chess time controls explained, n.d.), is due to the fact CCRL does not provide rating of chess computers in this format. That is most likely because this format is not used in computer chess and that could be because the faster time controls, such as blitz allow for quicker games and thus create more data of results faster than longer time controls such as the classic format. However, probably the main reason for this is that in faster formats more mistakes are made in the game due to the time pressure, which in turn creates more opportunities that allow for decisive results to be made, ending in one side winning and one losing rather than a draw. According to Glickman (n.d.), the probability of winning a game is given by the equation:

$$E = \frac{\frac{R_A}{10^{400}}}{\frac{R_A}{10^{400}} + \frac{R_B}{10^{400}}} = \frac{\frac{2852}{10^{400}}}{\frac{2852}{10^{400}} + \frac{3750}{10^{400}}} = 5.66 \cdot 10^{-3} \quad (1)$$

Where R_A is the rating of player A and R_B is the rating of player B. E is the expected score for player A ranging between 0 and 1. A value of 0 means player A will most certainly lose and 1 means player A will most certainly win. The expected score E can be multiplied by 100 to represent the value in percentages, in this case, the calculated probability that Magnus Carlsen wins is approximately 0.566%. And while this simple calculation does not take into account the probability of a draw or who plays with white/black pieces, it is still good enough to show how the computers in chess evolved and the overwhelming advantage computers of today have. In 1984 Bolter (1984) states that chess engines are good enough to defeat an amateur player. In 1997 the computer Deep Blue defeated the World Chess Champion, although it was still a competition and the machine lost some of its chess games. And today, in 2023, matches in a competitive setting between humans and machines, such as Stockfish or AlphaZero are no longer played. That is because of the major difference in their capability of playing the board

game, here against Stockfish represented by a meagre 0.566% chance of winning for the best human chess player, although this value could be slightly skewed, as the ratings are gained in separate, isolated environments, those being human and computer chess respectively.

2. PRINCIPLES OF ARTIFICIAL INTELLIGENCE

In this chapter, the principles of what makes artificial intelligence work are presented and explained in given examples. The ways AI can be divided into various types and disciplines is also considered.

2.1 AlphaZero

AlphaZero is an AI capable of playing chess, that in 2017 defeated then the world's strongest chess engine Stockfish version 8 in a one-sided match, in which AlphaZero scored 28 wins, 72 draws, and 0 losses from a total of 100 chess games (AlphaZero, n.d.). This feat the updated AlphaZero then repeated a year later in 2018, when it beat Stockfish version 9, scoring 155 wins, 839 draws, and 6 losses from a total of 1000 chess games (AlphaZero, n.d.). The difference between these two artificial intelligences lies within their architecture. AlphaZero, unlike all the other programs of the time, did not use the method of brute force search, but instead analyzed the chess games with the help of neural networks states Khovanskiy (2022).

2.1.1 Brute Force Search

The traditional method of computer chess is brute force search, which can be divided into four steps as described by Khovanskiy (2020):

1. **Depth-First Search (DFS)** – After every move, every legal sequence of moves is computed, until a specified depth.
2. **Static evaluation** – A numerical value is assigned to every chess position, based on which side the position favours. The algorithm takes into account the total value of the chess pieces on each side, as well as their position, including pawn structure and king safety.
3. **Minmax algorithm** – Based on static evaluation the algorithm finds the best move considering the possible and optimal future moves done by the opponent.
4. **Pruning algorithm** – This algorithm saves computing power by skipping the DFS calculations of branches that seem unpromising or redundant.

2.1.2 AlphaZero's Neural Networks

Artificial Neural Networks (ANN) are a subset of machine learning, and as suggested by the name, they function similarly to biological neurons inside the human brain. (IBM, n.d.). Machine learning encompasses programs that make decisions based on their previous experience (Great Learning, 2020).

Generally, a neural network can be understood as a network of mathematical equations states Shin (2020). According to him, it consists of three types of layers: input layer, hidden layer, and output layer. There can be multiple hidden layers in the network depending on the complexity of the task, as well as one or more inputs at the input layer

and one or more outputs at the output layer (Shin, 2020). In figure 5, which is the visual representation of a neural network, the input nodes are depicted with blue color, nodes of the two hidden layers are black and the output layer nodes are green.

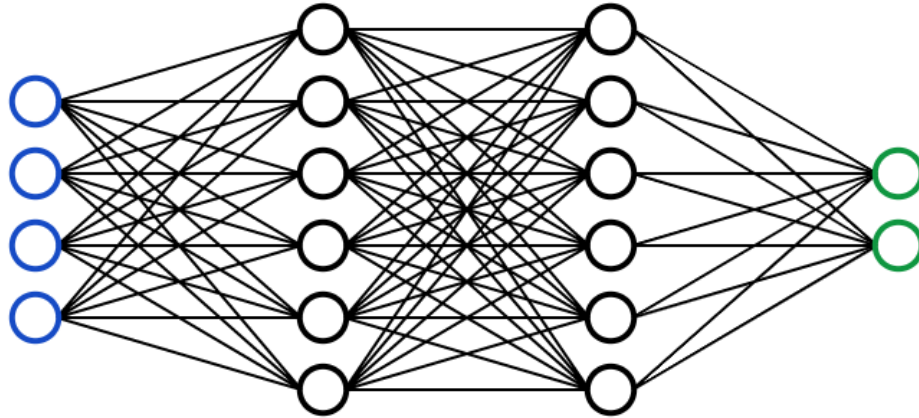


Figure 5 Visual Representation of a Neural Network. From *All Machine Learning Models Explained in 6 Minutes*. By T. Shin, January 5, 2020, Medium. <https://towardsdatascience.com/all-machine-learning-models-explained-in-6-minutes-9fe30ff6776a>

In the context of a chess game, the input is the current position on the chessboard states Mel_OCinneide (2018). The input is then processed layer by layer, AlphaZero has up to 80, until a result arrives at the output continues Mel_OCinneide (2018). They state that the output has two parts, the first being an evaluation of the chess position on the input, and the second, an evaluation of each legal move in the position. The way the input is processed is through the nodes or neurons. Mel_OCinneide (2018) describes them as simple processing units that accept a number of inputs, multiply each of them by a particular weight, sum them up, and then apply the application function, which results in an output between the values 0 to 1. This means that the outputs of the nodes depend on the nodes placed before in the network, which allows the network to notice fine details states Mel_OCinneide (2018). The hidden layer does not consider every sequence of legal moves like DFS, but only a small number of branches that it computes until the end of the game (Khovanskiy, 2020). This type of search is a version of Monte Carlo Tree Search (MCTS) states Khovanskiy (2020) and describes the process in a way that can be compiled into three steps:

1. After every chess move simulations are run. They can be thought of as mini-games the neural network plays against itself to evaluate the position on the chessboard.
2. The simulations analyse the chess line they see as the most productive. To ensure that all the simulations do not analyse the same line, the algorithm disincentivizes computing already well-explored ideas and incentivize the exploration of different possibilities that show good enough promise.
3. After a sufficient number of simulations are completed, AlphaZero uses 1600, a distribution of played moves is created. And as the more promising moves were

played more times, a move that will be played in the game can be picked from the distribution based on how many times it has been played in the simulations.

The neural network is taught by playing itself many times over, starting with nothing but the rules of the game states Khovanskiy (2020). This approach is called reinforcement learning, which means that the AI learns through trial and error (Mel_OCinneide, 2018). Khovanskiy (2020) describes the process as follows: The neural network starts off with completely random weights and thus outputs, playing random, but legal chess moves. Then, the network plays games against itself and then uses the data from the games to construct a better version of itself. This is repeated enough times to create a highly competent chess opponent.

This model made the triumph for AlphaZero against Stockfish possible, despite it only analysing 60,000 positions per second, compared to Stockfish's 60,000,000 states Pete (2019). And based on this result, the chess engine Stockfish incorporated a neural network into its structure from version 14 onward, according to Khovanskiy (2020). Neural networks also make for a more flexible model, as AlphaZero was taught to play other board games, such as Go and Shogi (A Simple Alpha(Go) Zero Tutorial, 2017).

2.2 Google Translate

Since 2016, Google uses neural networks for translation in their Google translator according to the article *Machines That Think: The Rise of Neural Machine Translation* (2023). Before neural networks were used in this way, different methods of machine translation did the job, such as rule-based machine translation or statistical machine translation states the article and further describes them. Rule-based machine translation works on predefined linguistic rules and dictionaries. On the other hand, statistical machine translation uses statistical models to generate translations based on patterns, which it recognizes based on previous analysis of existing translations and multilingual corpora. And the resources used need to be large, millions of words to train an engine in one particular domain. Unlike these phrase-based systems, Neural Machine Translation (NMT) encompasses models which use neural networks and translate inputs as a sentence, instead of breaking them into sets of words (*Machines That Think: The Rise of Neural Machine Translation*, 2023). The article also states that this new approach helped Google increase accuracy and speed of translation while simplifying engineering and design choices.

NMT systems consist of two main sections, an encoder network and a decoder network (*Machines That Think: The Rise of Neural Machine Translation*, 2023). And according to that, the whole process of machine translation can be split into two parts according to the article *What Is Machine Translation?* (n.d.). The first part consists of decoding the meaning of the source language text and the second part consists of encoding the meaning into the target language. This process is mathematically complex and in order to properly train the networks it requires large amounts of data according to Yip (n.d.).

Additionally, Google Neural Machine Translation (GNMT) system includes an attention mechanism, that helps with the translation of long sequences of text by allowing the system to learn where to place attention on the input text, as each word of the output is decoded states Brownlee (2019).

The benefits of this approach are not only structural simplicity, scalability, accuracy, and speed, but also its flexibility according to the article *Machines That Think: The Rise of Neural Machine Translation* (2023). The GNMT system was able to create satisfactory translations even between languages that were not directly trained states Ye (2020). So, when the GNMT program was trained on sets of data translations between English and Korean, and English and Japanese, the translator was able to translate well even between Japanese and Korean, unlike the models that do not incorporate neural networks.

2.3 Poetry Generators

Similarly to language translators, there have been ways to generate texts and poetry even without machine learning and neural networks (Piorecký & Husárová, 2019). However, in this day and age neural networks are used instead of models with fixed rules states Holyoak (2022). And as neural networks are a subset of machine learning (IBM, n.d.), the general structure of how machine learning is setup up still applies. Banoula (2023) lists and describes how machine learning, works in seven steps:

Collecting Data – In order to work, AI systems initially need an amount of data to learn from. The quality and quantity of the data that is fed into the system will decide how the program will behave and determine whether or not the output is accurate, relevant, and truthful. So, for poem generation poetry needs to be gathered to train the AI and the quality of the poetry will influence the poem generator's performance.

Preparing the Data – Next up, after the data that is being worked with is chosen, it needs to be sorted. For the gathered poetry, text normalization techniques, word tokenization, and other processes would be applied (Piorecký & Husárová, 2019).

Choosing a Model – The learning model of the AI determines the output of the program, thus the model chosen must be relevant to the task that is given. For poetry generation, a neural network would be a suitable choice.

Training the Model – At this stage, the data is passed to the program, to let it find data and make predictions. The system learns from the data given, so it can eventually accomplish the given assignment. As for poetry generation, the model attempts to find specific features and patterns from the original texts.

Evaluating the Model – To check how the model is performing, new, never before seen data, is presented to it. Here a prompt would be given to the AI, which the model would use as a basis for generating the rest of the poem.

Parameter tuning – Once the model is created and evaluated, its accuracy can sometimes be improved by fine tuning its parameters. By changing these variables, the programmer

tries to find a value for which the program is the most accurate. For neural networks, this means using the weights of the nodes of the trained neural network as starting values for a new network according to Barreto (2023).

Making Predictions – At this point the AI can be deployed in practice on new data to do its intended assignment. The poem generator would be deployed to be used for poem generation.

The model of the AI usually consists of Recurrent Neural Networks (RNN) states Piorecký & Husárová (2019). Krivitski (2018) describes them as neural networks that include a loop that acts as a memory (unlike feedforward neural networks) and since the model processes data gradually, the loop structure can hold onto information from previous steps. The units in which the data is processed vary according to Piorecký & Husárová (2019). They state that the model can work on the level of letters, word stems, or words. The units (letters, word stems, or words) create a “dictionary” of the basic building blocks of the model continues Piorecký & Husárová (2019). According to them, the letters as units are usually chosen, as they pose the least amount of strain on the memory of the system from all the options. On the other hand, letters as units are the least precise, however, generation on the level of words is much more complicated, as the “dictionary” is much larger and more complex (Piorecký & Husárová, 2019). They then argue that generation on the level of word stems may be a good compromise, but they realize that the preparation of the data for this option is the most difficult.

Additionally, the model of the AI usually, just like NMT systems, consists of an encoder network and a decoder network according to Krivitski (2018). He describes the encoder as the part that encodes the subject of the poem, and the decoder generates a poem based on the subject.

2.4 Types of Artificial Intelligence

Today, division of AI can be made based on its use and application. According to De Spiegeleire (2017), most literature agrees on the distinction between three tiers, those being:

Artificial Narrow Intelligence (ANI), also known as weak AI, are systems created to excel at one specific task, rivalling or exceeding the capabilities of a human, examples being the Deep Blue chess computer or Google translate.

Artificial General Intelligence (AGI), also known as strong AI refers to programs that possess human-like intelligence and are able to learn and apply their knowledge across a wide range of tasks. This type of AI has not been able to create yet.

Artificial Superintelligence (ASI) is a type of AI that surpasses human intelligence across any task. As of now, this concept is purely hypothetical.

So, even though all of the given examples used neural networks, their models differed based on the task given. This is because these examples, just as any other AI ever created as of today, are considered artificial narrow intelligence. And that is even though many

professionals in the field today aim to make progress toward the creation of AGI, Keida (2020) describing AGI as “holy grail” of researchers. So, at least for now, the field of AI can be divided into subdomains, each of them focusing on a specific area of AI research. Great Learning (2020) mentions and describes some of them as follows:

Natural Language Processing (NLP) deals with the interaction between computer and human language and the ability of the machine to respond accordingly. This includes programs that attempt to write poems.

Computer vision concerns itself with the ability of a computer to gather information from video input.

Cognitive computing attempts to imitate human cognition by analyzing the outside environment in a similar way as a human does.

3. POEM GENERATION

Before the generation of poems and their analysis, it may be appropriate to define what poetry is. While most definitions agree on the central idea, there is a small detail according to which they segregate into two main groups. The detail, which usually bears not much significance, starts to do so in the context of poetry that is generated by a program. The first and more plentiful group includes the definition of Nemerov (2023), who defined poetry as “literature that evokes a concentrated imaginative awareness of experience or a specific emotional response through language chosen and arranged for its meaning, sound, and rhythm” (par. 1). The second group can be represented by the article Poetry Is The Expression Of A Strong Feeling Of Emotions (n.d.), in which poetry is defined as “the expression of a strong feeling of emotions that are unleashed onto paper” (p.1). The difference is whether emotions are expressed by the writer or the poem itself. As AI does not have emotions, if the definitions of the second group are considered, no AI will ever be able to write poetry. So, for the purpose of this thesis, the definitions that fall within the first group are considered, as in those cases AI can be potentially considered as capable of writing poetry.

3.1 Verse by Verse

Verse by Verse is a web application available on the web page <https://sites.research.google/versebyverse/> that is developed for creation of poems powered by Google AI and owned by Google (Google, n.d.). This program is unique because of how much freedom it gives to the user. Firstly, the user is asked to pick out from one to three writers from a list of total twenty-two authors. This will change the database the application is working with accordingly, so the resulting poem will resemble the work of these authors. An example of how authors are selected can be seen in figure 6.

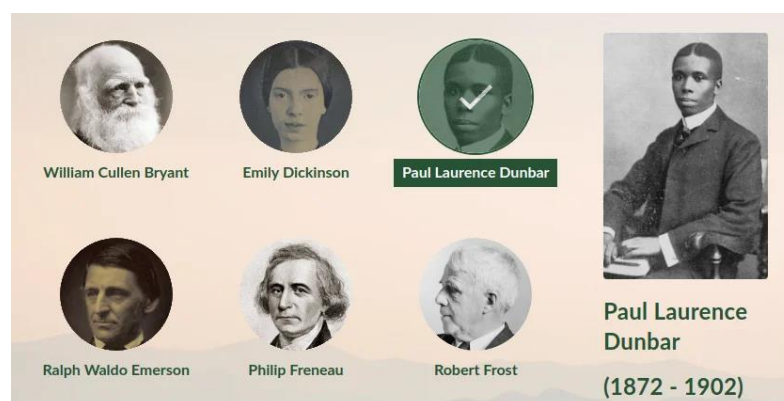


Figure 6 Selection of authors. From *Find your inner poet with help from America's greats*. By D. Uthus, November 23, 2020, The Keyword | Google. <https://blog.google/technology/ai/verse-by-verse/>

Secondly, the user is asked to suggest the form of the poem, quatrain, couplet, or free verse. In case of a quatrain, the user is asked to suggest a type of rhyme. Additionally, the syllable count for each line of verse needs to be selected from four to twelve or any. After that, the writing of the poem begins. The user is asked to come up with the first line of the poem. Then, for the second line, the engine starts to suggest from three to five, depending on how many authors have been selected, different lines for each of the authors. If there is no line that the user wants to use, they can refresh the results for different outputs or write the second line of the poem themselves. Depending on what pre-sets the user selected, the poem can be finished, or another stanza can be added or if the stanza is not finished yet, the process of creating the poem repeats same as line two.

To demonstrate the working of the engine, only one poet was chosen for simplicity, which was Edgar Allan Poe, set the poetic form to quatrain, syllable count to any, and rhyme to ABAB.

Knight in shining armour
Filled with deep passion, from the wild air
Set her down in a violet bank
Hold her out her golden hair!

Every line of the poem except the first was written by the artificial intelligence, although each was picked by a human from a list the AI suggested. The list, even when refreshed several times kept its theme around a woman, hair, air, or rays of light. Additionally, the program violates the poem structure, as the first and the third lines do not rhyme. To test its flexibility the first two lines were kept and the third was written by the user, to see if the AI can stay on the theme suggested by the third line of the poem.

Knight in shining armour
Filled with deep passion, from the wild air
Rides his horse to help a farmer
Drowning a feeling in that darkness there?

I tried to pick out the line that made the most sense, but unfortunately, most of the options suggested by the AI were not very coherent and kept returning to the theme around a woman, which clashed with the theme set on the third line. That can be due to the fact, that the AI draws from the database of Edgar Allan Poe and copies not only his style of writing but also his themes at the cost of flexibility. To check it, the AI was instructed to add another stanza to the current poem, and it continues as such:

And, as she grew in idle hour,
The night wind, in her yellow night,

Kept her young bosom in its snowy flower.
Hold her out with a delight!

Verse by Verse abandoned the theme of the farmer, set by the human, and returned to its own theme. Not only that, but while the AI makes sure to properly rhyme and keeps an aesthetic text, the poem itself never really comes to any conclusion and keeps repeating verses with similar meaning. This is potentially influenced by the system that allows the user to keep on adding stanzas, meaning the poem cannot reach a conclusion, as the user could decide to add another stanza, which the AI would not be able to write, as the poem would be finished. And while it is impossible for AI to truly mean the verses it writes, it is possible for it to imitate them to an extent that humans cannot recognize if the poem was written by human or an AI. So, while Verse by Verse offers a lot of input options to the user, the results are quite underwhelming as the AI is not flexible enough to abide by these inputs.

3.2 Da Vinci

Da Vinci is another AI used for generating poetry available on the website <https://news.climate.columbia.edu/2022/04/22/haiku-ai-generated-poetry/>. It runs on AI engine created by Open AI (hAIku, n.d.). The type of poetry it can write are specifically haikus. Haiku is a poetic form that is unrhymed, consisting of seventeen syllables divided into three lines, five, seven, and five (Britannica, 2022). Unlike Verse by Verse its inputs are very limited. All that is required is a word or a short sentence that will set the theme for the AI.

So, the input was “Knight in shining armour” with this result:

A knight in shining armour
Comes to the rescue of a fair maiden
In distress

The format of a haiku seems to be a good fit for AI, as it is very simple and limited in scope. Compared to the poem created by Verse by Verse, both of the programs incorporated a theme of a woman into their poems. This is nothing unusual, as poems and stories alike that revolve around a knight often include maidens to be saved and such. However, in the end, Da Vinci arguably made a more elegant poem, as the text is more coherent, which may be influenced not only by the different models of the AIs, but also by the type of poem they generate. As haiku is much smaller in scale it is easier for the program to stay relevant.

On the site is also a comment section, in which people shared their results. There were some interesting cases, such as this one submitted by a user called Gautham, which input was “asdf”.

“The keyboard is my canvas
My fingers are my brush
Asdf is my art” (Da Vinci, 2022a)

Or this one by Mark, with input “terminator uprising”:

“A rise of terminators In the future,
We will all be dead
Skynet has won” (Da Vinci, 2022b)

From those two cases it is clear, that Da Vinci performs very solidly not only because of the form of poetry is haiku, but also due to its comprehensible AI, which is able to connect “asdf” to a keyboard and “terminator uprising” to a movie.

3.3 Poem Generator Powered by Aardgo

Simply named Poem Generator, available on the website <https://www.poem-generator.org.uk/>, is an application that generates poetry. It is one of many generator tools created by Aardgo (Poem Generator, n.d.). On the webpage, it also states that the project started with Song Lyric Generator as a student magazine project in 2002 and due to its popularity ventured to creation of other various forms of text, such as poems. This website is like Verse by Verse in the way of offering the user many options of types of poems, although there is no option for choosing an author that the AI will try to reassemble. There are ten types of poems, from which the user can choose, these include: free verse, quick poem, haiku, didactic cinquain, rhyming couplets, sonnet, villanelle, limerick, acrostic, and love poem. And while from all these options one cannot feel restricted, when it comes to the actual creation of one of these poems the opposite is true. Because, unlike Verse by Verse or Da Vinci, one does not set the theme of the poem by providing a word, short phrase, or a verse, but by filling a set of prompts, that ask for a noun, adjective, and other word classes. While this is not objectively worse format, it appears to be less user friendly.

3.3.1 Creation of Haiku

In order to create a fair comparison with Da Vinci, the type of poem was set to haiku, but then there appeared an obstacle of setting the initial variable in a way that would be comparable to Da Vinci. Unlike Da Vinci, where the user input consists of a simple phrase, Poem Generator requires time or setting, an adjective for the time or setting, two nouns that do not have any correlation between them, an adjective and a verb. Ideally, these all could be copied from the haiku of Da Vinci, for creating a suitable comparison, but some of the inputs that have to be set are not represented in the Da Vinci’s poem, such as the time or setting, since there is none specified. In the end, perhaps we cannot make

such a head on comparison, so instead some of the inputs have been borrowed from the poem created by Verse by Verse, such as “bank”, which potentially could be interpreted by Poem Generator as a building and not a bank of a river and similarly the adjective of the setting “violet”. As one of the nouns “knight” was chosen and since the other noun should be something that we would not usually associate with a knight, a “banana” was chosen, which does not really compare to any of the previously generated poems, however, as the program asked for an unrelated noun, it cannot be found in those examples. The second adjective was “shining”, and verb was “comes”. This is the result:

Knight – A Haiku

Chromatic camber
A roman, shining knight
comes
out of banana

The website also, along with the poem, generates a title and in this case, it created a haiku about a knight as intended. Unfortunately, some of the inputs provided did not appear in the haiku, perhaps showing that the number of inputs is bit excessive for such a limited format as haiku and that is something that even the authors of the website acknowledged, so for the rigid haiku structure they implemented a system, where if the inputted words cannot be fitted into the poem, a synonym from a dictionary is used, but not even this system could incorporate all the inputs into the haiku. And even looking past this, the outputted poem is somewhat dubious, but that is most likely due to the inputs that it did incorporate. Since the generator can function with up to two missing inputs, a decision was made to delete the second noun “banana”, because even if the user is encouraged to input two nouns that do not fit within the same theme, the format of haiku is not flexible enough to let the AI string two nouns “knight” and “banana” seamlessly. With this little tweak, the program was run with the output:

Knight – A Haiku

Purple bank building
An english, shining
knight comes
whilst enjoying the

And now, with the number of inputs reduced by one, the generator managed to use all of them and the system of using synonyms can also be seen in effect, changing the adjective violet for purple. The word bank is used with the meaning of the building instead of the

ground at the edge of a river, because it is impossible for the program to know which meaning of the word the user intended. There also seems to be an error in capitalization on the second line with the word “english”, which should be capitalized. The result seems to suffer for the fact that all the inputs were used, as the meaning of poem is unfinished, and the reader is left with the unnerving question of what the knight was enjoying. For the last haiku trial, in order to get closest to Da Vinci’s take on haiku, the minimal amount of inputs permitted were used as setting and its adjective were omitted, nouns were “knight” and “maiden”, even though the authors recommend nouns that are not correlated, but that is most likely meant as a suggestion, used as a means to create an interesting poem and not as a rule, that, when broken, will end up with the AI not function properly. The suggestion was ignored in this attempt since when integrated in the previous attempt, the format of haiku proved to be too inflexible due to its small scale. The adjective was set as “shining” and the verb as “comes” in order to resemble the haiku created by Da Vinci. The output is as follows:

Knight – A Haiku

Meandering thoughts
A gallant, shining knight
comes
before the maiden

This is the best outcome of all the tries by Poem Generator. With the minimal number of inputs, the program was given enough of space in the haiku to string the inputs together, and since the inputs correlated it did so seamlessly. Unlike Da Vinci, it incorporates a psychological aspect to the theme on the first line of the poem, which is perhaps not the most obvious based on the set theme, but it does not necessarily devalue the poem, as the knight perhaps had some doubts prior to coming before the maiden. Maybe the meeting was of great importance. The poem does not go the obvious route as Da Vinci’s poem does, which may be praised, as the program does not opt for a low-hanging fruit, but it can also be seen as an imperfection, as the system perhaps does not have the theme clearly defined and thus is a bit random. It does not achieve the elegance and coherence of Da Vinci’s haiku, but it is a good effort, especially considering the fact that Poem Generator can create many kinds of poems, while Da Vinci is strictly haiku oriented.

3.3.2 Creation of Free Verse Poem

Now we will take a look at the creation of a free verse poem by Poem Generator. Perhaps the way it accepts inputs will lend itself more favourably in longer poem formats. The creation of a free verse poem is divided into two steps. In the first step, the user suggests a noun, optionally an additional word that gives the noun context and an adjective to

describe that noun, however, the generator is able to create a poem just with either the noun or adjective, so it is possible to give the program more freedom if one so desires. Then the span of the poem is chosen between four to eight verses and alliteration is set to one of three options: minimal, some, and excessive. Lastly, in the first step, onomatopoeia can be set to either no or yes. In the second step, a number of related words to the inputted noun are generated. The number of words generated depends on the number of verses of the poem chosen by the user; three words for four and five verses, four words for six verses, five words for seven verses, and seven words for eight verses. These generated words can be refreshed by the user, but only as a set and not individually. If the user in the first step did not suggest any noun, they are warned by the website, and the noun is substituted by one of a few options such as missing, omitted, or absence. Meaning that the user can in practice only get away with not submitting any adjective in the first step. Then the user is prompted to fill in additional information about these words, such as submitting an adjective, comparing it to another word or writing a sound associated with it. Lastly, the user is confronted with a filled table of the related words, that describes them as either singular or plural. The user is asked by the website to check if the program assigned the correct form to each word. After that the poem is generated.

In the first step, for the noun was submitted the word “knight”, the optional hint was left unfilled and the same was the case for an adjective describing the noun. The number of verses were set to four, alliteration to some, and onomatopoeia to yes. In the second step, after a few refreshes of the words related to knight, a settlement was made on the set containing: hero, prince, and gentleman. An adjective describing the hero was “brave”, an adjective describing the prince was “noble”, word comparing gentleman was “art” and the sound associated with gentleman was “chuckle”. Lastly, checking the correct form of the words: knight, hero, prince, and gentleman, were all correctly set as singular by the program. As can be seen, just like when generating a haiku, this poem generator requires a lot of inputs. This makes it hard to end up with inputs that could be compared to the inputs of the other poem generators, as the theme ends up more narrowly defined. The results can be refreshed until a satisfactory poem appears. One of the possible results of these inputs is:

Knight

I saw the the brave character of my
generation destroyed,
how I mourned the hero.
Are you upset by how stalwart it is?
Does it tear you apart to see the hero so
gamy?

How happy is the noble prince!
Now rarefied is just the thing,
to get me wondering if the prince is aristocratic.

A gentleman, however hardly it tries,
will always be zany.
Gentleman – the true source of chuckle

In this particular result can be seen the Poem Generator having some problems with grammar. In the first line, it uses two definite articles consecutively and throughout the poem it uses wrong pronouns: referring to hero and gentleman as “it”. The theme of the poem ended up not being about a knight, but rather about the three related words to it. The words, hero, prince, and gentleman, also not being connected, so the poem could be separated into three different poems without much difficulty. So, the resulting poem is not very coherent. Even though the theme was more narrowly defined by the number of inputs, it seems that in the actual poem the theme expanded, as it builds upon each of the inputs as a separate theme. Thus, the poem is not comparable to the other results as the theme is different. As for the inputs, the only one that did not appear in the final poem is “art”, which should have been compared to gentleman. When it comes to the contents of the poem, some parts seem to be bit questionable, like the gentleman being the true source of chuckle. There can be also seen hints of alliteration that we set to “some”, as well as onomatopoeia. To observe how much the poem will get alliterated, for this example the alliteration was set to excessive, the other inputs from step one were unaltered and in step two the related words were: roman hero, imperial prince, and horse compared to brown motion associated with the snorting sound. The resulting poem:

Knight

I saw the the roman persona of
my generation destroyed,
How I mourned the homeric
hero.
Handsome, homeric hero.
Down, down, down into the
darkness of the homeric hero,
Gently it goes – the romish, the
roman catholic, the papist.

I cannot help but stop and look at the imperial, pious prince.
Does the pious prince make you shiver?

does it?

All that is large is not handsome horse,
handsome horse, by all account is little.
Never forget the smaller and stingy handsome horse.

This poem seems quite comparable to the previous result, suggesting the Poem Generator is quite consistent. However, consistency of this sort is not necessarily desirable. There were again signs of grammatical mistakes, the one on the first line identical to the previous poem with the double definite article, as well as mistakes in capitalization for the word “homeric”, which first letter should be capitalized. The theme focused on the three related words, which were again separated into their own distinctive parts of the poem. When it comes to alliteration it occurs more frequently as desired with utterances like “Handsome, homeric hero”, “Down, down down”, and “smaller and stingy handsome horse”. However, it might be appropriate to question whether or not the added alliteration did not cost the poem some of its coherence and meaning, which as a result could shift a bit.

3.4 Poem Generator by Poem of Quotes

With the same name as the previous entry, Poem Generator, this time by Poem of Quotes, available on the website <https://www.poemofquotes.com/tools/poetry-generator/>, is another program capable of writing poetry. It can generate thirty types of poems ranging from poems about feelings or specific people to haikus. So, it is another entry with quite an impressive number of possibilities. The input required differs depending on the type of the poem and for some there are multiple options. For example, haiku can be created by submitting two singular nouns or one word or seven-word sentence. On the other hand, a love poem is created by entering the name of person in question, their hair colour, and the colour of their eyes. Overall, the way the website asks the user for inputs, even in the cases it requires inputting different types of word classes, is very user friendly and a little bit more convenient than the poem generator powered by Aardgo.

3.4.1 Creation of Haiku

First, a haiku generated by a single word was tested. The input was “knight”. The program then asked if it should generate a title as well, which in this demonstration was allowed. The resulting poem is as follows:

He was a noble man

Teutonic, armored
a knight in shining armor

a brave knight will ride.

The title of the poem is interesting in a way, due to the fact that other poem generators that have the same feature usually just borrow the input as the name of the poem, which in this case is not true. This time, the central theme of a knight was not linked to a maiden or woman character, but instead was further developed with the use of adjectives, as can be seen on the first line of the poem. Then the theme is expanded on the third line with the verb ride, which most likely points to horseback riding. The result is very solid, coherent, and quite comparable to the performance of Da Vinci haiku generator, however, Da Vinci still has the advantage of interpreting inputs like “skynet” or “adsf”, because for this generator to work, the input needs to be a word appearing in a dictionary. Also, it is perhaps worth mentioning that this poem generator writes in American English as can be seen from the form of the word “armor”.

Next up the creation of haiku using two words was tested. The inputs were “knight” and “maiden”. Using this version of the program, titles cannot be created. The resulting poem:

Medieval, german
order of teutonic knights
beautiful maiden

According to the authors (Poem Generators, n.d.) of the website, this version of the haiku generator is not trained on as many parameters as the version with a single input. This is not a significant problem in this case, as one would be hard-pressed to find a relevant difference, at least from these results. There appear mistakes in capitalization for the words “german” and “teutonic”. What stems as a bigger issue is the fact that the submitted nouns were not very well connected in the resulting haiku. Perhaps the relation between a knight and maiden is too weak for this type of generator, as it instead develops the theme of a knight further with the addition of order of knights. And just like the first time, the generator yet again uses more descriptive adjectives for the knight than the other programs capable of writing haiku. To test if some more closely related words will create a more elegant haiku, the inputs “knight” and “castle” were submitted, with the result:

Teutonic, mounted
real life of sebastian knight
within the castle

The program continues to make errors in capitalization, this time in the word “sebastian” and arguably also in the word “knight”, as the entire second line of this haiku is identical to a name of an existing novel about a character named “Sebastian Knight”. The AI

continues with its heavy use of adjectives. Compared to the previous poem, the inputs are connected in the poem more seamlessly. It appears, that this two-input version of the haiku generator writes the first two lines about the first input and on the last line it writes about the second, and since both versions of this generator always used the word “Teutonic” a trial was made by setting the inputs as “knight” and “Teutonic”. Examining if the generator uses the word “Teutonic” in the first two lines as it always did until now and if so how it will write the last line.

Medieval, christian
order of teutonic knights
early teutonic

So, the word “teutonic” end up being used by the program again on the first two lines along with the first input “knight”. On the last, third line the program followed the structure of using the second input “teutonic”, even though it already appeared before on the second line. This is not necessarily a mistake, but in this case, it would be more beneficial and elegant to fill the last line with some other information, as both inputs already appear in the poem, and it is not needed to adhere to the rigid structure of input one appearing on first two lines and input two appearing on the third line. However, the poem generator does not recognize this as an issue and keeps the structure at the expense of the resulting poem.

The last way to create a haiku with this program is to supply the website with seven words in total, one of them being the main word and the other six being support words. The difficulty with this system is that the user is submitting a large portion of the vocabulary that will appear in the poem, so the user needs to be careful and deliberate with the words they are submitting. If the user is not careful with their inputs, the poem generator will try to salvage this situation by generating its own words to complete the haiku, nevertheless, the quality of the resulting poem depends heavily on the user’s inputs. With that in mind, for the first test the main input “knight” was chosen with the supporting words “shining”, “armor”, “comes”, “to”, “rescue”, and “maiden”.

knight

Shining, comes maiden,
To rescue,
Rescue, armor comes.

The main input word ended up as the title for the haiku and not appeared anywhere else. All of the supporting inputs ended up being used in the poem, some of them more than once, which is, in this case disappointing, since the resulting poem is a bit nonsensical

and would benefit from additional vocabulary. The generator did not use any other words than those included as input. An argument could be made, suggesting that the inputs of the poem generator are not related enough to create a solid haiku, but since all of the inputted words were borrowed from the haiku created by Da Vinci, which came out very elegant, it seems like this version of this poem generator is inferior to Da Vinci. Perhaps, it will work better if the inputs reassemble the outputs of the different versions of this poem generator. So, the main input was again set as “knight” and the supporting words were “teutonic”, “armored”, “shining”, “brave”, “will”, “ride”.

knight

Shining, armor brave,
A complete suit of armor,
Brave, will teutonic.

The resulting poem is not as good as the one created by the one-word-input version of this poem generator. This time the program did use other words than the ones already included as input, but it was not enough to create a seamless reading experience. Perhaps part of the problem lies within the fact that the generator does not add enough of its own ideas to string the inputted words together and rather opts out for repeating the inputted words in hope of alliteration. This, however, results in haiku that has its ideas disconnected from one another. So, for the last test of this version of the generator the submitted main input stayed the same and the supporting words were “a”, “the”, “ride”, “through”, “under”, “bridge”. Possibly with these inputs of different word classes than in the previous attempts, the program will be forced to create with a larger degree of freedom.

knight

At the beginning of the,
Under, under ride.
To the public through.

Unfortunately, the results did not change much. The program clung to the submitted inputs with little of its own addition. This is perhaps by design, but as can be seen from previous examples, even when submitting reasonable inputs, the generator has problems to meaningfully put them together.

3.5 Chat GPT-3.5

Originally, the intention was to find a poem generator that would purely work with the Czech language. However, as of now, there appears to be none publicly available on the internet, or at least it is not popular enough to be found, even when using multiple queries. So instead, the decision was made to include an AI that is multilingual. This also made it easier for comparison of Czech and English generated poems, as both of them can be generated by single a AI. For this reason, Chat GPT-3.5 is included in this thesis.

This AI, that can be found on the website <https://chat.openai.com/>, is not only different from the other models described thus far by its ability to understand multiple languages, but also because it is not a poem generator, but a chatbot. When ask, Chat GPT-3.5 describes itself as a language model developed by OpenAI that is designed to understand and generate human-like text based on the prompts given by the user. This means it is a more general type of AI, that can be used for answering questions and even writing poetry, yet it is still classified as a type of ANI. It describes its architecture as consisting of encoder and decoder parts just like the poetry generators, however, containing self-attention mechanisms and feed-forward neural networks. The self-attention mechanisms work similarly to translators. To generate poetry, instead of filling the input windows as instructed, a simple query can be made with all the user's demands.

To generate an English sonnet about a knight in shining armor, the query was written as follows: "Write me a sonnet about a knight in shining armour". This result came out:

In days of yore, a knight in armor bright,
With gallant stride and sword gleaming with light,
He rode across the lands, a valiant knight,
A beacon of courage in the darkest night.

His armor shone, reflecting golden rays,
A symbol of honor through countless frays,
With shield held high, he faced his foes unfazed,
In battles fought, his glory often praised.

A champion of justice, he would defend,
The weak and oppressed, he'd fiercely attend,
His heart ablaze with chivalry untamed,
A noble soul, his virtues unrestrained.

Though tales may fade, his legend still remains,
A knight in shining armor, etched in refrains.

The resulting poem accurately and faithfully follows the structure of a sonnet. The text is coherent, despite the fact that this is one of the longest poems generated in this thesis. Additionally, it is worth mentioning that this AI is not even meant solely for poem generation, yet it arguably performs better than some of the specialized software. It does not incorporate a woman or maiden into the poem, just like some of the poem generators did, but it includes concepts very close to the theme of a knight. These include sword, courage, honor, shield, battles, glory, justice, and chivalry among others. It also successfully generated figures of speech, such as “beacon of courage”, “golden rays”, “champion of justice”, “heart ablaze”, and “tales may fade”.

Now, to generate a Czech sonnet about a knight in shining armor, the query was written as following: “Napiš mi sonet o rytíři v blyštivém brnění”. The result being:

V blyštivém brnění rytíř vstupuje,
Jako slunce září, jasný a statečný,
Jeho krok pevný, srdce plné touhy,
Ochrání všechny, kteří k němu přistupují.

Jeho brnění září jako stříbro čisté,
Symbolem síly, cti a nezlomné vůle,
Meč v ruce drží, jako blesk přes lesy letí,
Ve jménu spravedlnosti bojuje, až do úplného cíle.

Překonává nebezpečí a srdce se mu plní,
Statečností a odhodláním, co nikdy nezní,
Vítězí ve výzvách, září jako hvězdy v noci,

Ó, rytíři v blyštivém brnění, vznešený,
Tvé ctnosti jsou vzorem, nadějí pro všechny,
V této písni oslavujeme tvou slávu nekonečnou.

The structure of the poem is fulfilled, but some of the rhymes are imperfect. The text is quite coherent, although the English version appears to be slightly more eloquent. As both poems are generated by the same model, it builds on the theme of a knight similarly as in English, with words like “statečný”, “meč”, “spravedlnosti”, “vznešený”, “ctnosti”, and “slávu”. Figures of speech are not omitted, as they make an appearance in phrases like “jako slunce září”, “srdce plné touhy”, “brnění září jako stříbro čisté”, “jako blesk přes lesy letí”, and “září jako hvězdy v noci”. So, the Czech version performs not too much differently to the English one, which is quite surprising, as the data the AI is trained on most likely contain much more English than Czech. Additionally, another root of problems could have been caused by the fact that Czech is a synthetic language with

concepts like infection, but this does not appear to be the case. So, the only problem that seems to be caused by the Czech language is that some of the verses were not rhyming.

4. CONCLUSION

In conclusion, if poetry is defined as a form of writing that evokes some sort of emotion in the reader, and not that the writer has to necessarily experience those feelings themselves in order to convey them through a poem, then it can be said that artificial intelligence is capable, in certain cases, to write poetry. Perhaps not all of the different artificial intelligences presented here are capable of such a feat, but some are, even though their consistency may vary. That depends where the line is drawn; how bad can poetry get before the classification changes to just an attempt at poetry. And by “bad” is meant whether or not the poem adheres to the form it is trying to replicate, if it rhymes when it should, number of its verses, correct division into stanzas, use of figures of speech, coherence, and such. Generally, the programs do not have problems with rules and forms, since they are quite rigid, but have problems with creating a poem that is coherent, has some sort of meaning, and that evokes emotions.

Some of the applications are targeted more as a tool to help human writers in the creation process, these types usually have more user control, which is to a certain degree required to achieve a satisfying result. In this category would fall Verse by Verse and Poem Generator by Aardgo. Other applications aim with the utmost priority to create meaningful poems almost on their own with limited user control. In this category would fall Da Vinci. When it comes to Poem Generator by Poem of Quotes, it depends on what kind of input system the user chooses. So, since the poem generators have each a different goal, it is quite hard to compare them. A pleasant surprise, that does not necessarily fall within this categorization, is Chat GPT-3.5. The writings of this chatbot can be considered poetry, even though a human would probably recognize it to be produced by a machine, and that applies even for the writings it did in the Czech language. A similar thing can be said about the writing of Da Vinci, however, here the human would have probably a tougher time deciding if the poems were written by a machine.

The fact that today can be said, that an AI is capable of writing poetry marks another advancement in the field, just like previously was the triumph of AI over the strongest human in chess. This milestone is another step forward towards the potential development of AGI.

Rozšířený abstrakt

Úvodem této bakalářské práce je zmíněná stále se navyšující důležitost umělé inteligence jako oboru. Tato důležitost se navyšuje z důvodu stále se zvětšující kompetence těchto programů.

Na to navazuje první kapitola této závěrečné práce o historii umělé inteligence, kde je tento pokrok demonstrován na stolní hře šachy. Tato demonstrace se skládá primárně ze dvou šachových zápasů, při čemž oba zápasy byly hrány těmi stejnými hráči, a to tehdejším mistrem světa v šachu Garri Kasparovem a počítačem společnosti IBM s názvem Deep Blue. Na šachových hrách z těchto dvou zápasů lze rozpoznat pokrok umělé inteligence, kdy v druhém šachovém zápase počítač nakonec lidského zástupce poráží. Vzhledem k tomu, že se dnes již oficiální šachové zápasy mezi člověkem a strojem nekonají z důvodu jejich velkých rozdílů schopností šachy hrát, tak nemůžeme přímo porovnat, jak se šachové programy od té doby zlepšily v porovnání s člověkem. Lze však stále jejich schopnost porovnat pomocí koeficientu Elo, který je v šachu používán jako měřítko těchto schopností. V takovém případě, nynější nejlepší lidský hráč šachu, Magnus Carlsen, nemá ani 1% šance na poražení nynějšího nejvyspělejšího počítače s názvem Stockfish (patnáctá verze). V této kapitole jsou také zmíněny prvotní představy o umělé inteligenci jako konceptu, které jsou znázorněny v řecké mytologii nebo ve vědeckofantastické tvorbě. Zde je za příklad uvedeno drama Karla Čapka s názvem R.U.R., které přineslo na svět slovo „robot“. Dále jsou zmíněni filozofové jako John Searle nebo David Bolter, kteří říkají, že umělá inteligence, v doslovném významu těchto slov, jak je právě znázorněná v těchto literárních dílech, existovat nemůže, neboť není možné, aby tyto programy přemýšlely nebo měly vědomí a emoce. S tím také souhlasí původní definice umělé inteligence formulované Johnem McCarthym a jeho kolegy, kteří umělo inteligenci pouze přirovnávají k lidské a netvrdí, že pracují identicky. Podobně to vidí i Alan Turing, který tvrdí, že v určitém případě lze o stroji říct, že pracuje jako kdyby přemýšlel, nikoli že skutečně přemýšlí.

V druhé kapitole, která je zaměřena na princip fungování umělé inteligence, je práce těchto programů, které fungují na bázi neuronových sítí vysvětlena. Popsány jsou tři tyto programy, které se liší účelem použití, při čemž se právě kvůli tomu architektura těchto modelů liší, i když používají stejnou technologii. To je z důvodu toho, že co se týče vývoje umělé inteligence, je lidstvo stále pouze schopno vytvořit úzkou umělou inteligenci. To je typ UI, který je vytvořen k řešení jedné přesně vyměřené úlohy. Na rozdíl od toho je obecná umělá inteligence schopna řešit jakoukoli úlohu, a přitom konkurovat lidské inteligenci v každé z nich. Je to právě ten typ z mytologie a vědeckofantastických příběhů. První z vysvětlených programů je AlphaZero, umělá inteligence se schopností hrát šachy. Toho je dosaženo pomocí algoritmu Monte Carlo Tree Search, který na rozdíl od všech dosavadních šachových počítačů neanalyzuje veškeré možné šachové pozice, ale pouze ty, které vypadají nadějně. Druhý z popsaných programů je překladač Google. Ten dělí neuronové síť na dvě části: enkodér

a dekodér. Enkodér extrahuje význam ze zadaného textu a dekodér potom tento význam zapíše do požadovaného jazyka. Podobně funguje i třetí typ programu který je popsán pouze obecně. Jedná se o generátor poezie. Také má části enkodér a dekodér a pracuje s typy neuronových sítí, které mají paměť a znají předchozí výstupy programu.

Generátory poezie mohou pracovat na úrovni písmen, slov nebo také slovních kmenů.

V třetí kapitole je objasněna definice poezie, kterou pro naše potřeby užíváme. Pro nás to tedy znamená, že myšlenky a emoce, které jsou v básni zachyceny, nemusí být nezbytně autorem myšleny, protože v opačném případě by UI podle definice psát poezii nikdy nemohla. Dále je pak přehled jednotlivých programů, vysvětlení jak je operovat, zkusmá tvorba textu a jeho analýza. Co se týče operace, většinou jde o zadání slov nebo slovních spojení do vymezených oken. Jedinou výjimkou je aplikace ChatGPT-3.5, která je operována dotazy nebo otázkami. Generátor poezie Verse by Verse má mnoho možných nastavení, nicméně jeho výsledné básně mají vždy podobnou strukturu a význam, který není příliš koherentní. Program Da Vinci je na druhou stranu striktní co se týče možnosti vstupů a může generovat pouze haiku, nicméně jeho výsledné básně mají správnou formu, jsou koherentní a obsahují řečnické figury. Poem Generator by Aardugo může psát mnoho typů básní a jeho vstupy jsou tvořeny slovesnými třídami. Při tvorbě haiku musel uživatel experimentovat se vstupem aby dostal přijatelný výsledek a co se týče básní ve volném verši nebylo dosaženo akceptovatelné básně i s několika pokusy. Podobně je na tom i Poem Generator by Poem of Quotes, u kterého si může uživatel vybrat více způsobů vstupů. Vstupy o jednom nebo o dvou slovech měly ty nejlepší výsledky, avšak s možností o sedmi slovech musel operátor s programem zápasit, a i tak se mu dostalo pouze podprůměrných výsledků. Posledním analyzovaným programem byl ChatGPT-3.5, který se od ostatních liší, protože není specializován na tvorbu poezie, ale i přesto dokázal konkurovat i těm lepším, zde analyzovaným programům, a to nejen v anglickém, ale i také v českém jazyce. I přestože psal sonety, jeden z delších typů poezie dokázal text udržet koherentní a obsahoval i řečnické figury.

V závěru je řečeno, že lze tvrdit, že alespoň některé z těchto programů dokážou poezii psát.

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SYMBOLS AND ABBREVIATIONS

Abbreviations:

AI	Artificial Intelligence
AGI	Artificial General Intelligence
ANI	Artificial Narrow Intelligence
ANN	Artificial Neural Network
ASI	Artificial Superintelligence
CCRL	Computer Chess Rating Lists
DFS	Depth-First Search
FIDE	International Chess Federation
GNMT	Google Neural Machine Translation
MCTS	Monte Carlo Tree Search
NLP	Natural Language Processing
NMT	Neural Machine Translation
RNN	Recurrent Neural Network
R.U.R.	Rossum's Universal Robots

Symbols:

E	expected score for player A	(-)
R_A	rating of player A	(-)
R_B	rating of player B	(-)