

COMP 6721 Applied Artificial Intelligence (Summer 2023)

Assignment #1: Overview and History of AI

Solutions

Question 1 Google these events on the history of AI and sort them in chronological order, indicating the year that they occurred if you can. Feel free to browse the Web and read here and there about AI.

1) Alan Turing develops the *Turing Test*.

- year 1950
- source: https://en.wikipedia.org/wiki/Turing_test

2) The term “Artificial Intelligence” is first used.

- year 1956
- source: https://en.wikipedia.org/wiki/Artificial_intelligence

3) While at the Cornell Aeronautical Laboratory, Frank Rosenblatt develops the *perceptron*, the first artificial neuron, that will set the stage for the development of networks of artificial neurons, a.k.a. neural networks.

- year 1957
- source: <https://blogs.umass.edu/brain-wars/files/2016/03/rosenblatt-1957.pdf>

4) Joseph Weizenbaum develops *Eliza*, the first chatbot. It is based on a set of re-write rules written by hand.

- year 1966
- source: <https://en.wikipedia.org/wiki/ELIZA>

5) Marvin Minsky & Seymour Papert publish a book that shows the limits of perceptrons and argue for more work in symbolic computation (aka Good-Old-Fashioned AI, GOF AI). The book is often cited as the main reason for the abandoning research on neural networks.

- year 1969
- source: [https://en.wikipedia.org/wiki/Perceptrons_\(book\)](https://en.wikipedia.org/wiki/Perceptrons_(book))

- 6) The Lighthill and the ALPAC reports that showed little progress in AI, kills research funding and leads to the first *AI Winter*.
- *early 1970's*
 - *source: https://en.wikipedia.org/wiki/AI_winter*
- 7) For his PhD project, Terry Winograd, develops a system called SHRDLU, that understands English instructions. SHRDLU is based on hand-written rules.
- *year 1970*
 - *source: <http://hci.stanford.edu/~winograd/shrdlu/>*
- 8) The robot Shakey¹, programmed in LISP, resulted in the development of the A* search algorithm.
- *year 1972*
 - *source: https://en.wikipedia.org/wiki/Shakey_the_robot*
- 9) Alain Colmerauer, who was professor at the University of Montreal for a few years, develops Prolog; a programming language based on logics that is very popular in AI to write rule-based systems.
- *year 1972*
 - *source: https://en.wikipedia.org/wiki/Alain_Colmerauer*
- 10) Marvin Minsky develops the Frames to reason with world-knowledge. Years later, frames turned out to be the basis of object-oriented programming.
- *year 1974*
 - *source: [https://en.wikipedia.org/wiki/Frame_\(artificial_intelligence\)](https://en.wikipedia.org/wiki/Frame_(artificial_intelligence))*
- 11) The expert system MYCIN is developed to recognise bacterial infections and recommend antibiotics. Its recommendations are often better than those of human experts. It is based on a knowledge base of ≈ 600 hand-written rules (written in Lisp) and developed in collaboration with medical doctors.
- *year 1975*
 - *source: <https://en.wikipedia.org/wiki/Mycin>*
- 12) The METEO rule-based machine translation system, developed at the University of Montreal, is deployed at Environment Canada to translate weather forecasts from English to French.

¹Guess why it was called this way? ;-)

- *year 1975*
 - *source: https://en.wikipedia.org/wiki/METE0_System*
- 13) Expert systems, such as MYCIN, and other types of systems made of hand-written rules are considered too expensive to maintain and to adapt to new domains. The industry drops research in such systems. It is the 2nd *AI Winter*.
- *late 1980's – early 1990's*
 - *source: https://en.wikipedia.org/wiki/AI_winter*
- 14) Corinna Cortes and Vladimir Vapnik develop an approach to machine learning called soft margin *Support Vector Machines* (SVM), which quickly becomes one of the most popular machine learning algorithm.
- *1993*
 - *source: https://en.wikipedia.org/wiki/Support-vector_machine*
- 15) After finishing his PhD on handwriting recognition, Yann Lecun makes public the MNIST dataset. The dataset contains 70,000 images of handwritten digits and becomes the benchmark to evaluate machine learning.
- *year 1998*
 - *source: https://en.wikipedia.org/wiki/List_of_datasets_for_machine_learning_research*
- 16) Google launches its Google Translate service based on *Statistical Machine Translation*. Translation rules are found automatically based on a statistical analysis of parallel texts in different languages.
- *year 2006*
 - *source: https://en.wikipedia.org/wiki/Google_Translate*
- 17) Netflix initiates a competition in machine learning to beat its own film recommendation system. It provides a data set of about 100 millions movie ratings to learn recommendations automatically.
- *year 2006*
 - *source: https://en.wikipedia.org/wiki/Netflix_Prize*
- 18) The AlexNet system, developed at the University of Toronto by Alex Krizhevsky, a PhD student of Geoffrey Hinton, wins the ImageNet Challenge and shows that deep learning techniques can achieve significantly better results than classical machine learning techniques in image processing. This is considered to be a defining moment in the history of AI.

- *year 2012*
 - *source: <https://en.wikipedia.org/wiki/AlexNet>*
- 19) While having a beer at *Les 3 Brasseurs* at the corner of McGill College and Ste-Catherine, Ian Goodfellow, a PhD student of Yoshua Bengio, comes up with an idea for a neural network that could generate realistic images. He called it *Generative Adversarial Networks*, a.k.a. GANs.
- *year 2014*
 - *source: https://en.wikipedia.org/wiki/Generative_adversarial_network and <https://www.technologyreview.com/s/610253/the-ganfather-the-man-whos-given-machines-the-gift-of-imagination/>*
- 20) Google launches its Neural Machine Translation system based on recent advances in Deep Neural Networks, and little by little drops the Statistical Machine Translation approach of the years 2000's.
- *year 2016*
 - *source: <https://research.googleblog.com/2016/09/a-neural-network-for-machine.html>*
- 21) AlphaGo beats the world's champion at the game of Go. AlphaGo's strategy is learned automatically from playing a large number of games against itself.
- *year 2016*
 - *source: <https://en.wikipedia.org/wiki/AlphaGo>*
- 22) Canada invests massively in 3 AI research institutes: Amii in Alberta, Mila in Montréal, and Vector Institute in Toronto.
- *year 2017 (note: Amii exists since 2002, but received massive funding in 2017 that allowed it to expend significantly)*
 - *source: <https://www.cifar.ca/ai/pan-canadian-artificial-intelligence-strategy>*
- 23) OpenAI develops GPT and GPT-2, two language models that can predict the next word in a text given the previous ones. GPT-2 is so powerful compared to previous models, that it can generate fake stories in English that are somewhat coherent.
- *year 2018*
 - *source: <https://openai.com> and <https://openai.com/blog/better-language-models/>*
- 24) A Portrait of Edmond Belamy created by a Generative Adversarial Network (GAN) sells for \$432,500, at Christie's auction in New York city.
- *year 2018*

- *source: <https://www.christies.com/features/A-collaboration-between-two-artists-one-human.aspx>*

25) The Association for Computing Machinery (ACM) names Yoshua Bengio (from MILA, Montreal), Geoffrey Hinton (from Vector Institute, Toronto), and Yann LeCun (from Facebook) recipients of the Turing Award for their contribution in the field of AI and Deep Learning.

- *year 2018*
- *source: <https://awards.acm.org/about/2018-turing>*

26) OpenAI releases its artificial intelligence chatbot, ChatGPT, on top of its GPT-3.5 and GPT-4 language models.

- *year 2022*
- *source: <https://openai.com/blog/chatgpt>*

Question 2. Do some research. To what extent are the following computer system instances of artificial intelligence (AI). If so, which AI disciplines play the major role?

- 1) Voice bots that answer your call when you contact the customer service of a company
- 2) Barcode scanners in the stores
- 3) Cheque deposit through banking apps (via taking a picture)
- 4) Recommendation systems (Amazon, Netflix, etc) that suggest you a “product”

- Voice bots (like chat bots) are noticeable instances of AI ,also known as conversational AI. They are empowered by natural language understanding (NLU) and natural language processing (NLP) techniques.
- Barcode scanners work based on analyzing the pattern of reflected light from the barcode. They may use some basic computer vision techniques but they are not AI instances. Note that more advanced and recent scanners may use AI to improve the scanning process in non-ideal situations (brightness, scanning angle, distance, etc) (similar to reading handwritten digits).
- AI is used to read the handwritten text (amount, payee, date, etc) (machine learning, optical character recognition (OCR), computer vision). In addition, in the back-end, banking systems may be equipped to AI-powered counterfeit cheque detection systems (anomaly detection, machine learning).

- Most recommendation systems are AI-based. They usually work based on Collaborative Filtering (customer similarities) or Content-based filtering (product similarities). Machine learning clustering and reinforcement learning are used.

Question 3. What distinguishes a Touring Test from a *Total* Touring Test? Which additional capabilities are required to pass the test?

To pass the Turing test, the following capabilities were at least required:

- Natural Language Processing to communicate successfully
- Knowledge Representation to *store* and efficiently *retrieve* knowledge.
- Automated Reasoning to infer new knowledge and draw new conclusions
- Machine Learning (ML) to adapt to new circumstances and detect patterns

In the Total Turing Test, more advanced sensing and acting capabilities are assumed, and the machine should be able to interact with human. The machine thus need skills of computer vision, speech recognition, and robotics.