What's All the Buzz About AI?

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Artificial Intelligence (AI) has once again become a hot topic in recent days. The main cause of all the buzz was the public release of generative AI (GAI) systems such as ChatGPT, which represented a major breakthrough in AI technologies.

ChatGPT (*Generative Pre-trained Transformer*) is a powerful and highly intelligent *chatbot* developed by OpenAI and launched on November 30, 2022. It can engage in dialogue with users in multiple human languages, covering a wide range of topics with sophistication and depth.

ChatGPT demonstrated the ingenuity of GAI systems and their potential impact on various areas of business and services. Additionally, in February 2024, OpenAI announced Sora, another generative AI model capable of creating photorealistic short videos (up to 60 seconds) from textual descriptions. As such technologies develop, people have also become more concerned about potential negative effects of AI systems.

Surveys conducted by the Pew Research Center in November 2023 have shown that Americans are increasingly cautious about the growing role of AI in their lives generally.

But what exactly is AI? What is generative AI? What can AI systems do? What are some examples? How has AI evolved? What impacts will AI systems bring? What is AI phobia? Why and why not should I be concerned?

In this blog article, let's describe AI, generative AI, evolution of AI technologies, and also answer these questions.

This is the third article on AI in our *Computational Thinking* (CT) blog. You can find the other two articles–"*AI: Aiming for Intelligence*" and "*Let's Chat about AI*" in the author's new book *Becoming A Computational Thinker: Success in the Digital Age* (see website `computize.org/CTer` for more information).

What is Generative AI?

Generative AI (GAI) is a branch of *artificial intelligence* (AI) specializing in data and experience-trained computer software systems that can generate new contents similar to those in their training datasets. A GAI system is normally designed, constructed and trained for a specific application area such as producing new images, texts, conversations, translations, computer code, audios, or videos.

GAI systems are **pre-trained** because such a system is fed a large collection of well-prepared data as part of its building and training in order to perform the intended tasks (Figure 1).

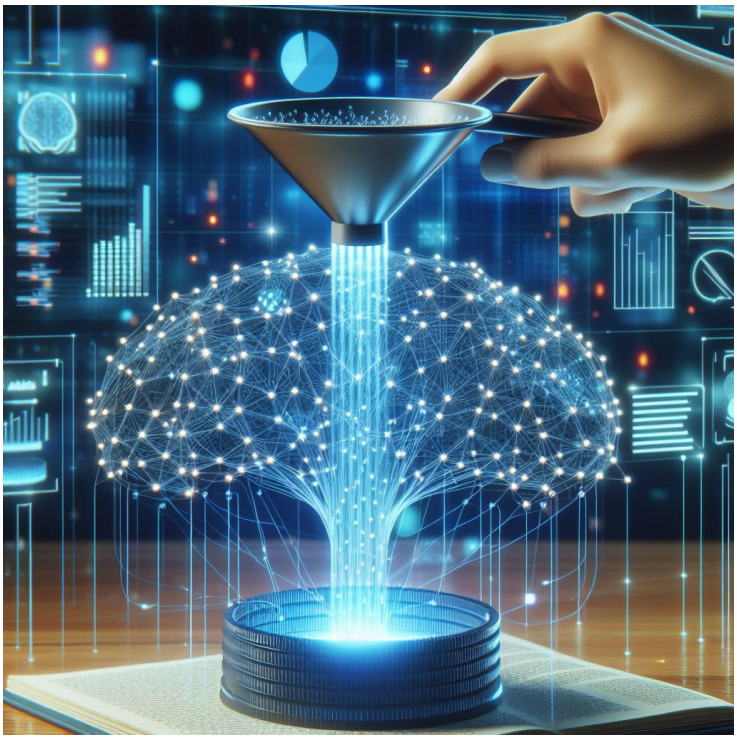

Figure 1: AI Model Data Training (credit: MS Image Creator)

It takes significant time, effort, and resources to train and build a new AI model. Data training is only part of the building process. Developing a new GAI model is not only capital intensive, but also compute intensive, needing huge amounts of data processing. To speed up the necessary computations, special **AI chips** are often used.

> **CT concept–*Virtuous cycle***: *Faster processing gives rise to more powerful and intelligent machines, which can in turn increase processing speed and efficiency.*

A completed GAI system will work as is. Errors, omissions, mistakes, and biases in the training data will affect the performance of the system. The consequence can be serious indeed. In the case of Tesla's Autopilot system, a Washington Post analysis of federal data found that "*vehicles guided by Autopilot have been involved in more than 700 crashes, at least 19 of them fatal, since its introduction in 2014.*"

To improve a GAI system, the data sets must be enlarged, enriched, adjusted, and corrected in order to retrain the system.

> **CT concept–*Garbage in garbage out***: *It is important to train GAI systems with correct, unbiased, and complete data sets and to improve them continuously.*

Examples of GAI Systems

To shed more light on GAI systems, we can give a number of popular systems as examples.

1. ChatGPT: As we have mentioned, it is an innovative, powerful, and successful chatbot where you can ask questions, get answers, conduct a conversation as if with another person, not just anyone but a well-versed and knowledgeable person (`ChatGPT.com`). The GAI has been developed by OpenAI and launched on November 30, 2022. It elevated the GAI technologies, their applications as well as expectations for their future potential to great heights. GTP-4 is the latest version as of May 2024.

Figure 2: ChatGPT-4 Logo

2. DALL-E: This is a neural network-based image generation model developed by OpenAI. It's an extension of the GPT architecture specifically tailored for image generation. DALL-E can create still images (drawings and pictures) from textual descriptions, essentially understanding and synthesizing visual content based on written prompts. The current version is DALL-E 3 (November 2023).

   The name "DALL-E" is a blending of the artist Salvador Dalí and the Pixar character WALL-E, signifying its capacity for surreal creativity and its ability to generate diverse images. It's quite fascinating how it can generate images of objects, animals, and scenes that don't exist in reality based solely on textual descriptions. Microsoft employed the model in Bing's Image Creator tool which the author has used to generate Figure 1 as well as several images for his new book *Becoming A Computational Thinker: Success in the Digital Age* (`computize.org/CTer`).

3. Synthesia: It is a GAI platform that can create realistic synthetic videos of people speaking in different languages and with various facial expressions. It can generate lifelike video content by mapping the movements of a real person's face onto a digital avatar, enabling companies to create personalized video messages, virtual presenters (TV show hosts, for example), and multilingual content at scale. The avatar can be life-like with various human facial expressions and emotions. It generates talking videos based on textual input. For example Synthesia can easily turn slides or power point shows into lively video presentations (Figure 3).

Figure 3: Synthesia Video Generation

4. AlphaCode: This is a GAI system from DeepMind to assist programmers in writing efficient and high-quality code. It guides programmers

through the code-writing process and offers intelligent suggestions. AlphaCode supports a wide range of programming languages, including Python, Java, C++, and more.

5. Sora: A GAI system that can create realistic and imaginative videos (currently up to 60 seconds) from textual instructions called **prompts**. Sora is able to generate complex video scenes with multiple characters, specific types of motion, and accurate details of the subject and background. The model understands not only what the user has asked for in the prompt, but also how those things exist in the physical world.

These are just some of the most well-known GAI examples.

The Evolution of AI

In addition to GAI, there are many different types of AI systems. For example, game playing AI systems, such as IBM's Deep Blue (chess playing) or DeepMind's AlphaGo (go playing), use sophisticated algorithms and board position evaluation methods to pick moves and win games. Such a game playing AI system keeps on generating a move in response to the opponent's move until the game ends.

Indeed, AI has a rich history of evolution with numerous milestones and even modifications to the very definition of 'artificial intelligence'. Here's a condensed timeline:

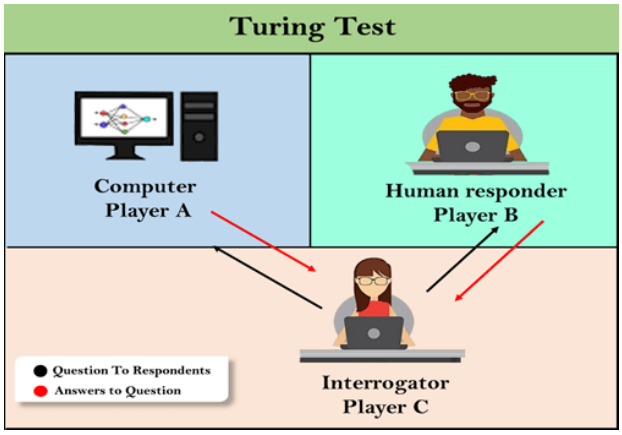

Figure 4: The Turing Test

- The Turing Test (1950): Alan Turing (father of modern computer science) proposed a test to determine a machine's ability to exhibit intelligent behavior equivalent to, or indistinguishable from, that of a human (Figure 4).
- The Birth of Neural Networks (1950s): Early development of artificial neural networks as a computational model inspired by the biological neural networks of animal brains.
- The Logic Theorist (1956): Developed by Allen Newell, J.C. Shaw, and Herbert Simon, it's the first AI program that can replicate human problem-solving skills.
- First Industrial Robots (1961): Unimate became the first industrial robot, performing tasks in a General Motors factory. See Figure 5 for a modern idea of industrial robots.
- ELIZA (1966): Joseph Weizenbaum created ELIZA, a program that simulates conversation, laying the foundation for natural language processing.

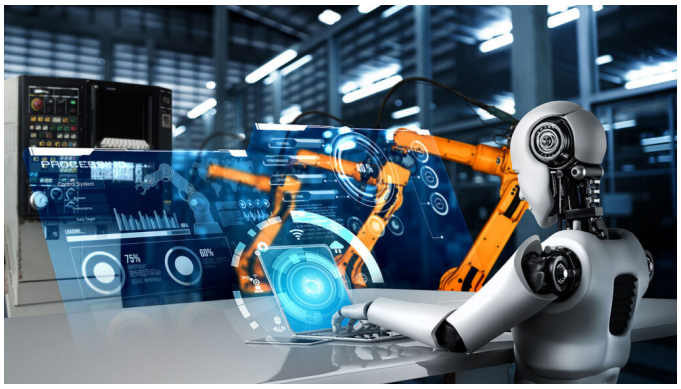

Figure 5: Modern Idea of Industrial Robots

- Expert Systems (1970s): Development of systems with domain specific expertise, like MYCIN (for treating blood infections), resulting in AI systems for specialized problem-solving.
- Backpropagation (1986): A method for training artificial neural networks, which greatly advances their capabilities.

- Reinforcement Learning (1992): Introduction of reinforcement learning algorithms, such as Q-learning, paving the way for autonomous agents that learn through trial and error.
- Deep Blue (1997): IBM's chess-playing computer won against Garry Kasparov, showcasing AI's potential in strategic decision-making.
- Big Data and Machine Learning (2000s): The explosion of data and advancements in machine learning algorithms, especially *Deep Learning*, led to breakthroughs in image recognition, natural language processing, and more.
- AlphaGo (2016): DeepMind's AlphaGo defeated the world champion Go player, Lee Sedol, demonstrating AI's ability to master complex games (Figure 6).

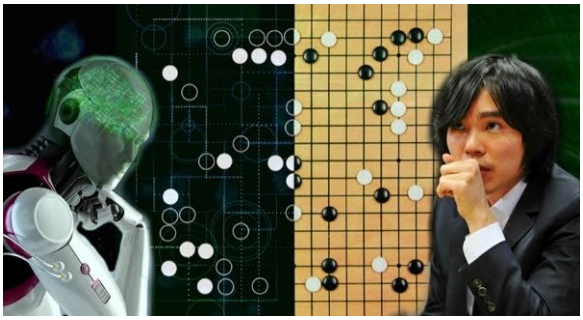

Figure 6: AlphaGo

- Transformer Models (2018-Present): These are a type of deep learning architecture effective for natural language processing, speech recognition, text-to-video generation and other tasks such as computer vision. Notable examples include BERT (Bidirectional Encoder Representations from Transformers) and GPT (Generative Pre-trained Transformer).

These milestones represent just a fraction of AI's journey, but they highlight the evolution from early theoretical concepts to today's practical applications impacting various aspects of human life.

The very definition of *artificial intelligence* has evolved from "a machine that can pass the Turing Test" (1950) to the modern form (according to *Oxford Languages*):

The theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.

Impacts and Concerns

As AI technologies evolve and advance, they increasingly impact our lives in both positive and negative ways. AI systems can automate many tasks, greatly increase efficiency and productivity. As AI advances, increasingly complicated and hard jobs and tasks become automatic: self-guided drones, self-driving cars, face recognition, understanding voice commands, meaningful dialogue with people, avatar show hosts (Figure 7), and more.

Figure 7: China CCTV Network Avatar Anchor: 小 C

At the same time, all this means learning new skills and ways to do things. Worse yet, many jobs will be lost to AI systems due to advanced automation. Such concerns and worries can add up to something called *AI phobia*. Let's list some factors contributing to AI phobia.

- Lack of Understanding: It is normal for people to fear what they don't understand. AI technologies can be complex and opaque to those who aren't familiar with them. Misconceptions or exaggerated portrayals

of AI in media and popular culture can further contribute to misunderstandings and fear.

- Sci-Fi Influence: Science fiction often portrays AI in dystopian or apocalyptic scenarios (Figure 8), where intelligent machines behave like humans and even pose a threat to humanity. These narratives, while entertaining, can instill deep-seated fears about AI in some individuals.

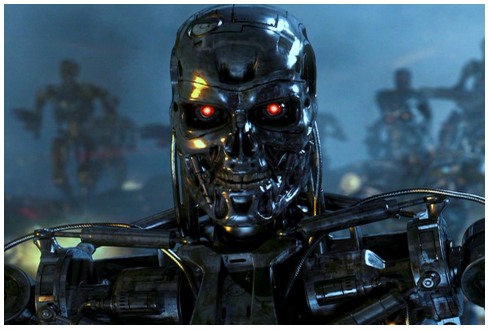

Figure 8: Terminator Army

- Job Displacement: AI enables machines and programs to increasingly perform jobs normally requiring human workers. With GAI, this could mean nurses, doctors, accountants, customer service staff, writers, editors, even programmers. Concerns of widespread job loss across various industries are real. People fear losing their livelihoods to machines that can perform tasks more efficiently and at lower costs.

- Ethical Concerns: AI technologies raise ethical questions around issues like privacy, surveillance, bias, and autonomy. Fear of the unknown consequences of AI systems operating without human oversight can contribute to phobia.

- Fear of Loss of Control: Humans naturally desire a sense of control over their environment and their future. The idea of ceding control to AI systems, especially those that make autonomous decisions, can evoke feelings of helplessness and fear.

- Fear of Superintelligence: Some individuals worry about the possibility of AI systems surpassing human intelligence and becoming uncontrollable or malevolent. This fear, often termed the "singularity," is based

on hypothetical scenarios where AI machines become superbeings and overloads of humans.

These are just some factors. People also are fearful, for good reasons, of less than knowledgeable business managers jumping on the AI bandwagon just to join the crowd or to further their own careers. Inappropriate application of GAI, or any other advanced technology, is a waste of resources at best. It may bring more serious consequences.

Finally

Loss of jobs comes with every new round of technology advancement, AI and GAI included, even though the new technologies always bring broad benefits as well as new jobs and professions. This is a dilemma that people have faced many times before. History has shown us the path: life-long learning of new things and continued efforts to keep pace with the times. This maybe hard to do. But we can at least try.

> **CT concept–*Think rationally***: *As US president Franklin D. Roosevelt famously said: there is nothing to fear but fear itself.*

No one can predict how far AI will go. Some even think we need to slow it down to let society catch up. We should put aside irrational fears and deal seriously with those legitimate concerns about negative impacts of AI.

GAI is a fresh breakthrough in AI technologies which brings unprecedented abilities and smarts to computer programs and machines empowered by AI. We begin to see that machines can, should, and must out-perform humans in their designated application areas. After all, that is the point of having and building those machines in the first place. Don't worry about robots enslaving people. That role has been filled by human beings for a long time already.

With a under-the-hood look, GAI becomes not as foreign, remote, or mysterious. As a consequence, irrational fears of AI are naturally dispelled.

At this point we may bring forth a new concept, '*a reverse Turing Test*'—A test that detects the tell-tale signs of a human on the other end of communication lines.

How would you design such a test? Where would you apply it? Hint: think of CAPTCHA.