Intelligence in the Next Decade: Human or Artificial?

Cheryl Lee

Earlier this year, Microsoft suffered negative publicity at the virtual hands of their new ChatGPT-powered Bing search engine. Utilizing the power of artificial intelligence (AI), Microsoft combined Bing's search capabilities with ChatGPT's large language model (LLM), resulting in a revolutionary search experience that would allow users to surf the web while having a conversation with their search engine.

Though their partnership is making headlines now, Microsoft has actively invested in OpenAI, the company behind ChatGPT, since 2019. When OpenAI quietly shared the next generation of their LLM with Microsoft last summer, the tech giant purported this newest model to be much more powerful and capable of synthesizing information than the publicly available GPT-3.5 model. Subsequently, Microsoft took this "game-changing" GPT and integrated it with Bing's backend technology of "indexing, ranking, and answering" using a proprietary technology named Prometheus. Prometheus leverages both Bing and GPT to power Bing chat, a feature designed to provide more accurate and thoughtful answers to user queries in a conversational manner, all within milliseconds.

Bing's chat feature was rolled out to select users in February and instantly fell prey to the scrutiny of journalists and beta users. There are numerous accounts describing the AI's unhelpful, strange, and even threatening behavior. Some notable encounters involved the chatbot calling a user "irrelevant and doomed," telling another user it could "ruin" and "expose" them, and insisting that *Avatar 2* had not been released yet.

To a casual onlooker, Bing chat’s inauspicious debut spells certain doom for AI's future within Big Tech. But, on the contrary, Microsoft believes their AI journey is just beginning. Not only has the tech giant invested over $13 billion into OpenAI, they have their eyes set on winning over some of Google's coveted search engine market share. Their secret weapon? AI.

A recent interview with Microsoft Chairman and CEO, Satya Nadella, made the company's philosophy clear. "AI will fundamentally change every software category," Nadella said, "starting with the largest category of all – search."

Importantly, Microsoft is not alone in their AI pursuit. Google, Meta, Snap Inc., and IBM already have skin in the game. Many are rushing to develop an answer to Microsoft's Bing, such as Google's Bard technology, Meta's announcement of LLaMA, and Snap Inc.'s My AI.

But, while AI unlocks new opportunities for businesses, organizations, and society alike, the technology poses very real, even existential, questions that must be answered before the technology advances. As technology moves towards the next decade, it is important to consider three fundamental challenges brought about by the rise of artificial intelligence: hardware limitations, data availability, and ethical implications.

Before diving into the challenges AI will have to face in the future, it is important to understand what AI is, as well as how far it has come. As the name might suggest, artificial intelligence is a specialty within computer science which aims to create systems that replicate human intelligence. The field as we know it was birthed in the 1950s, culminating in the Dartmouth Conference which was attended by pioneering luminaries, including John McCarthy, Marvin Minsky, and Claude Shannon.

In 1958, John McCarthy published what is considered the first paper on logical AI, *Programs with Common Sense.* Within it, he defined the "ultimate objective" of artificial intelligence to be to create "programs that learn from their experiences as effectively as humans do."

Throughout the 1960s and 70s, important research was done on natural language processing and rule-based systems. Around the 1980s and 90s, machine learning and neural networks were discovered.

By the 2000s, AI began developing more rapidly due to innovation in deep learning and greater data access. In the current decade, AI tools have become a part of everyday life, featured in robotics, automation, virtual assistants, self-driving cars, and much more. Today, AI is considered a broad classification that encompasses many computer science topics including machine learning, deep learning, and neural networks.

At its most basic level, modern AI uses algorithms and statistical models to identify patterns in data sets and make predictions based on those patterns. These algorithms can then be trained using two methodologies: supervised or unsupervised learning. Supervised learning involves training an AI's algorithms to recognize data that is labeled. For example, an AI algorithm designed to recognize different dog breeds might be shown many images of dogs with their breeds pre-labeled. The AI will identify patterns in these images so that, given new unlabeled images of dogs, it can identify their breed.

On the other hand, unsupervised learning involves training AI on unlabeled data, allowing the system to build patterns on its own with less human intervention. This method often utilizes cluster algorithms to build generalizations from large sets of data.

Once the AI has been trained, it can be used to make predictions and decisions on new sets of data according to its use case. Some popular use cases in businesses include using AI to identify fraudulent transactions, creating an AI language model to provide reliable customer service, or utilizing AI for security purposes to recognize facial features.

At a more granular level, AI often consists of artificial neural networks which are designed to mimic the human brain. Comprised of interconnected node layers which behave like human neurons, a network of nodes consists of many node pathways. Individually, nodes can either activate and pass data to the next node, or not. Whether the node activates or not depends on its weights and threshold, as well as the input data. Through repeated exposure to input data, nodes in a neural network will strengthen or weaken their connections to other nodes.

Much like how neural pathways are formed in a human brain through repeated stimuli, neural networks will readjust when interacting with new data by either reinforcing or weakening certain node pathways. Hence, overtime, neural networks are able to become more efficient and effective given larger amounts of data.

Neural networks are incorporated in deep learning, a subset of machine learning. Deep learning algorithms consist of neural networks that are at least three levels deep and are often trained unsupervised. On the other hand, classical machine learning systems rely on supervised learning, hence they tend to require more human interaction.

Deep learning algorithms are utilized in many LLMs, like ChatGPT. These LLMs are powered by one of the most popular AI models: language models. Language models interpret text using natural language processing, statistical analysis, and machine learning algorithms. They have useful applications in the worlds of customer service, language translation, personal assistance, content creation, and education.

However, AI models present many possibilities beyond virtual chat rooms. Recommender models, for example, are designed to make recommendations based on someone's interests. These models are prevalent in streaming services and personalized online retail. Another example are vision and speech recognition models, which can be used for face or voice detection. Finally, General Adversarial Networks (GANs) are models that pit two neural networks against each other in order to produce a new set of data based on existing data. GANs have broad applications in image, voice, and video generation.

Understanding the history and modern applications of AI is necessary before theorizing about its future. With technology growing at an exponential rate, it is becoming more imperative than ever to consider the challenges that could derail AI development in the next decade.

The first of such challenges is the current limitations in hardware. Though AI has come a long way since the turn of the millennium, this is not due to any changes to its underlying mathematical concepts. Rather, what has propelled the field forward has been advancements in computer chips, processing power, and hardware engineering.

Better hardware has resulted in the ability to train more complex AI models on bigger sets of data for longer periods of time. In turn, businesses have been able to create AI tools at an alarming rate, along with achieve stronger performance for each new iteration of their AI projects, leading to more customer satisfaction and further learning for the entire field.

But the price of innovation is not cheap and hardware does not run on its own. AI programs have to be trained on huge sets of data, often requiring exclusive use of processing hardware for extensive periods of time. For this reason, training AI models takes up massive amounts of computing power and energy which cannot be diverted into other projects for the duration of training. The constant demand for energy and computing power can quickly become costly for businesses, but the ramifications do not end there.

On top of financial costs, studies are beginning to reveal that AI is leaving a sizable carbon footprint. OpenAI's GPT-3 and Meta's OPT were estimated to emit over 500 and 75 metric tons of carbon dioxide respectively. To put that into perspective, 500 metric tons of carbon emissions equates to around 600 flights from London to New York.

Since the 2010s, companies have taken a brute-force method to AI development, prioritizing outspending rivals on computing power over energy efficiency. In 2018, OpenAI found that the amount of computational power used by AI models has doubled every 3.4 months since 2012. This has outpaced Moore's Law, a phenomenon which states "supercomputing performance" should double "every 14 months."

If researchers were to create an AI program which mirrored the abilities of the human brain, the computing power needed would be astronomical. A quantum computer would be required for this level of computing, but such technology is still in its early stages. Needless to say, any attempt at training such a program would also be detrimental to the environment.

So, how can AI possibly hope to continue evolving when the potential costs are so high? The key to further development is in energy efficiency.

In 2022, the machine learning company Hugging Face tested the carbon emissions of its large language model, BLOOM. They measured energy inputs such as training the model on a supercomputer, manufacturing the computer's hardware, and running BLOOM once deployed. Ultimately, they estimated BLOOM emitted 50 metric tons of carbon, markedly less than OpenAI's or Meta's LLM of the same size.

What accounted for the difference? BLOOM was trained on a supercomputer that was powered mostly with nuclear energy—an energy source that does not produce carbon dioxide. OpenAI's GPT-3, on the other hand, was trained on a much older computer which relied on fossil fuels for energy.

While there is no standardized way to measure carbon emissions in the field of AI, this case study makes it clear that the challenge of hardware limitations can be overcome through more efficient hardware which utilizes sustainable energy sources. There is a growing demand for green AI, which advocates for reducing AI computing power by designing more efficient hardware, choosing cleaner energy sources, and being intentional about which projects need to be solved using AI. Green AI also encourages companies to consider where to base their AI programs, as some regions, like America, tend to rely on dirtier energy sources, while countries in Europe have cleaner alternatives.

In addition to green AI practices, the Allen Institute for AI in Seattle urges Big Tech players to document the computational costs and performance results of their AI projects. Such data would help researchers understand trends in the field of AI, hold companies accountable for their projects' environmental consequences, and lay the groundwork for carbon emission industry standards and regulations.

Hardware is a crucial component of performance, but data is the lifeblood of any AI program. Machine learning models fundamentally rely on data to learn patterns and make predictions. As the scope of AI applications expands, the demand for data will only increase. This presents the second challenge that AI will have to overcome in the next decade: data unavailability.

Data can be unavailable for many reasons. Sometimes, data simply does not exist. If an aeronautic AI model needed to analyze astronomical events that have yet to happen, it would have no basis except past data to perform its analysis. In these cases, the AI system could make predictions, but could not perform any concrete analysis until the data becomes available.

Alternatively, data can be proprietary or sensitive, such as in fields which involve personal identifiable information (PPI) like finance and healthcare. In these cases, there are often strict regulations and privacy laws preventing access, making this type of data extremely difficult to obtain.

In other situations, data can be too costly. The healthcare industry is a good case study of this issue. Collecting health-related data often involves conducting clinical trials or experimenting with expensive equipment. If a healthcare AI program aimed to test the efficacy of a new drug, the data collectors would likely have to go through regulatory hoops, bypass ethical considerations, and pay for clinical tests. This drawn-out process would require large investments to achieve solid performance.

Finally, data is always biased. A data sample that is perfectly representative of its demographic does not exist due to human biases and historical or socioeconomic inequalities. A popular example of data bias is a MIT study which found that facial analysis AI technology had higher error rates in minorities, especially minority women. This was due to an unrepresentative data sample being used to train the AI model.

While the consequences of data bias can range from minimal to highly destructive, its existence is a barrier to developing AI models that are effective and universally beneficial. It is the responsibility of everyone interacting with technology to consciously work towards mitigating biases. Selecting a balanced sample, preprocessing data to identify possible biases, running data by human experts, regularly monitoring an AI's progress, and being transparent about AI architecture are all steps that can be taken to improve AI's social and ethical impact.

On the topic of ethicality, the final challenge that will be discussed is one of the most significant threats to AI advancement: its many ethical implications. There are countless examples of humanity's morbid fascination with artificial intelligence, ranging from popular sci-fi narratives like *Terminator* and *Detroit: Become Human* to academic literature and high art. Stephen Hawking captured the general sentiment well when he famously said, "Success in creating effective AI, could be the biggest event in the history of our civilization. Or the worst."

However, beyond popular culture, the ethicality of AI has immediate implications in the real world. Whether it be fear of job replacement, worsening socioeconomic inequalities, lack of accountability and transparency, technology misuse, or losing control of AI systems, artificial intelligence has both mystified and terrified humans throughout their shared history.

It is possible to mitigate AI's ethical risks moving into the next decade, but it will take considerable work. Firstly, governments and organizations must work together to develop regulations around transparency, bias, privacy, and accountability in AI. Next, diversity in AI development and research is essential to avoiding biased datasets and potentially harmful AI programs.

Thirdly, transparency within AI systems is required to maintain ethical systems. Any AI applications should alert users whenever they interact with AI. Additionally, AI developers should always be transparent about their development processes, decision-making, and system upkeep. Transparency will also protect individuals' privacy, ensuring that the data AI programs have access to is either publicly available or voluntarily disclosed.

Finally, continuing the discussion around AI is paramount to ensuring the technology evolves in an ethical manner. It is important to consult with a diverse group from other industries, countries, and perspectives when creating policy and guidelines for AI.

Furthermore, training a new generation of workers with skills that work symbiotically with AI tools is the future of the labor market. If used correctly, AI can decrease socioeconomic inequality by automating repetitive, routine tasks, unlocking doors for workers to transition into more creative, fulfilling roles.

Yet, there is no denying AI will inevitably disrupt the workforce as it is known today. Industries most directly affected will likely be manufacturing, customer service, bookkeeping, and transportation. However, there are also a host of new jobs that will be in high demand due to AI, especially in the fields of data analysis, cybersecurity, and software engineering.

Nick Bostrom, a Swedish philosopher at the University of Oxford, once declared that "machine intelligence is the last invention that humanity will ever need to make." While his is a bold assertion, it demonstrates the significance of the moment. With society on the verge of stepping into a new technological frontier and environmental crises and political wars threatening existence, societal advancement is not only welcomed, but necessary. Ultimately, it is beholden to governments, organizations, communities, and the people making up those communities to support one another using initiatives like educational curriculums, transition assistance, and well-established policy. Armed with kindness and curiosity, humanity can take the next step into a bold new world, even if the path is shrouded in uncertainty. Though it might not be clear what the future holds, it is impossible to surpass what is not yet understood.

Works Cited

"AI vs. Machine Learning vs. Deep Learning vs. Neural Networks: What's the Difference?" *IBM*, https://www.ibm.com/cloud/blog/ai-vs-machine-learning-vs-deep-learning-vs-neural-networks.

"Building Transparency into AI Projects." *Harvard Business Review*, 20 June 2022, https://hbr.org/2022/06/building-transparency-into-ai-projects#:~:text=And%20when%20it%20comes%20to,and%20updated%2C%20and%20the%20conditions.

Glen, Stephanie. "Green AI Tackles Effects of AI, ML on Climate Change: TechTarget." *Enterprise AI*, TechTarget, 11 July 2022, https://www.techtarget.com/searchenterpriseai/feature/Green-AI-tackles-effects-of-AI-ML-on-climate-change#:~:text=Green%20AI%2C%20or%20the%20process,technology%20itself%2C%22%20Buchanan%20said.

Heikkilä, Melissa. "We're Getting a Better Idea of AI's True Carbon Footprint." *MIT Technology Review*, MIT Technology Review, 15 Nov. 2022, https://www.technologyreview.com/2022/11/14/1063192/were-getting-a-better-idea-of-ais-true-carbon-footprint/#:~:text=It's%20estimated%20that%20the%20global,a%20single%20field%20within%20tech.

"How Big Data and AI Work Together: Synergies & Benefits - Qlik." *Qlik*, https://www.qlik.com/us/augmented-analytics/big-data-ai.

News, Chona Kasinger/Bloomberg. "Microsoft Defends New Bing after AI Chatbot Offers Unhinged Responses." *The Wall Street Journal*, Dow Jones & Company, 17 Feb. 2023, https://www.wsj.com/articles/microsoft-defends-new-bing-says-ai-upgrade-is-work-in-progress-3447074d.

Pazzanese, Christina. "Ethical Concerns Mount as AI Takes Bigger Decision-Making Role." *Harvard Gazette*, Harvard Gazette, 4 Dec. 2020, https://news.harvard.edu/gazette/story/2020/10/ethical-concerns-mount-as-ai-takes-bigger-decision-making-role/.

Thompson, Derek. "The AI Disaster Scenario." *The Atlantic*, Atlantic Media Company, 27 Feb. 2023, https://www.theatlantic.com/newsletters/archive/2023/02/ai-chatgpt-microsoft-bing-chatbot-questions/673202/.

“What Do We Do about the Biases in AI?” *Harvard Business Review*, 17 Nov. 2022, https://hbr.org/2019/10/what-do-we-do-about-the-biases-in-ai.

“What Is the History of Artificial Intelligence (AI)?” *Tableau*, https://www.tableau.com/data-insights/ai/history.