Chapter 2 Human Intelligence vs. Artificial Intelligence: Competition or Cooperation?

We've compared Human Intelligence (HI) and Artificial Intelligence (AI) in areas such as perception, reasoning, learning, problem-solving, and language processing. But what if we consider the relationship between AI and HI from a different perspective? Can AI and HI work together to complement each other's weaknesses? Let's explore this with a few examples:

1. Cognitive Movie Trailer by IBM Research and 20th Century Fox

IBM Research scientists collaborated with 20th Century Fox to create the world's first cognitive movie trailer for the 2016 horror-thriller Morgan. This collaboration between AI and HI showcased the potential of enhancing human expertise and creativity. While computers may not generate original ideas on their own, scientists can work with machines to better understand what appeals to or scares audiences.

2. Music Creation with IBM Watson and Alex Da Kid

Grammy-winning music producer Alex Da Kid partnered with IBM's Watson supercomputer to find inspiration in a groundbreaking way. They transformed data from music and culture into cognitive music, resulting in the song "Not Easy." While many musicians fear AI, others, like Patten, have embraced it, releasing the first commercially available AI-generated album, "Mirage FM."

3. Collaboration Between Humans and Machines

Daniela Rus, Director of MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL), believes that humans and machines should not be competitors but collaborators. An example is using AI to help visually impaired individuals navigate in autonomous vehicles.

4. AI in Wildlife Protection: PAWS

PAWS (Protection Assistant for Wildlife Security) is an AI tool developed to combat poaching. It uses historical poaching data to establish patrol routes in potential poaching areas. These routes are randomized to prevent poachers from learning the patterns. PAWS employs machine learning, a branch of AI, to continually discover new insights as more data becomes available.

5. AI's Role in the Legal Industry

AI is making significant contributions in the legal field, such as conducting time-consuming research and gathering information, which alleviates the workload of courts and legal services, speeding up judicial processes. AI can also analyze and generate legal contracts and litigation documents (e.g., using OpenAI's ChatGPT). Beena Ammanath, Global Vice President of AI, Data, and Innovation at Hewlett Packard Enterprise, emphasizes that developing robust AI products for the legal field requires a lawyer's involvement in the design process. This ensures that AI systems meet the needs of legal professionals, especially in the early stages.

Types of Artificial Intelligence

AI is one of humanity's most astonishing achievements, and this field continues to be explored and expanded with new applications. However, understanding AI's potential impact on future developments remains challenging for many, even though these topics have been widely discussed. To better understand AI's revolutionary impact, we will first look at its types to guide you through their classifications and the relationships between them.

Since AI research aims to simulate human intelligence and capabilities, we typically categorize AI from two perspectives: "Capability" and "Functionality." The "Capability" perspective classifies AI based on its ability to mimic human characteristics, focusing on techniques to achieve human-like abilities. The "Functionality" perspective looks at AI's potential to resemble human thinking and even emotional capacity. We will explore these classifications in more detail below.

Classification Based on Capability

When AI is classified based on capability, all AI systems (whether real or hypothetical) fall into one of three types:

1. Artificial Narrow Intelligence (ANI): AI with a narrow range of capabilities.
2. Artificial General Intelligence (AGI): AI with human-level capabilities.
3. Artificial Super Intelligence (ASI): AI with capabilities surpassing human intelligence.

Artificial Narrow Intelligence (ANI)

ANI, also known as Weak AI, is the only type of AI we have successfully developed so far and is the most common form of AI today. Weak AI is goal-oriented and designed to perform a single task, such as facial recognition, speech recognition, virtual assistants, autonomous vehicles, Netflix recommendation systems, and online searches. These systems can perform specific tasks exceptionally well, often surpassing human performance in certain environments.

However, despite their apparent intelligence, these machines operate within specific constraints and limitations. They are typically trained to perform a single task and cannot go beyond their predefined scope. This limitation is why they are termed "weak" AI. Weak AI does not mimic or replicate human intelligence but rather simulates human behavior based on a narrow range of data or parameters.

As we delve deeper into how AI operates, you will better understand this concept. For example, think about how Siri on your iPhone interacts with you using speech recognition or how autonomous vehicles use image recognition to assess road conditions. These systems are trained to complete specific tasks through learning or programming.

Although Weak AI may seem far from true AI, advancements in machine learning and deep learning over the past

decade have led to significant breakthroughs. For instance, today's AI systems can diagnose cancer and other diseases with high accuracy, aiding early treatment.

Here are some notable applications of Weak AI:
- Google RankBrain: A machine learning algorithm that helps Google generate search results.
- Virtual Assistants: Apple's Siri, Amazon's Alexa, Microsoft's Cortana, etc.
- IBM Watson Services: Natural language processing, image recognition, speech recognition, and more.
- Facial Recognition Software: Used for unlocking phones, managing building access, crime detection, etc.
- Disease Prediction Tools: Assisting doctors in diagnosing conditions.
- Drones: Used in defense, rescue, transport, agriculture, and more.
- Spam Filters and Social Media Monitoring Tools: Handling dangerous content.
- Recommendation Engines: On platforms like YouTube, Netflix, and Amazon, recommending content based on user behavior.
- Autonomous Vehicles: Used in transportation and automated delivery.

Artificial General Intelligence (AGI)

AGI, also known as Strong AI, is one of the primary goals of AI research. The aim is for AI to think and perform any intellectual task as efficiently as a human, embodying the ability to execute general intelligence behaviors. Currently, no system can be classified as Strong AI or can perform tasks at a human level. However, with the release of OpenAI's ChatGPT in November 2022, a prototype of AGI has begun to emerge. The company even published an article titled "Planning for AGI and Beyond" in February 2023, urging the need to prepare for this type of AI.

A Strong AI would require thousands or more Weak AI systems working together, communicating to simulate human reasoning. Even with the most advanced computing systems today, such as Google TPU or Nvidia A100, training a Strong AI would take a long time, highlighting the complexity of the human brain and the challenges of building AGI with current resources. However, with the efforts of scientists and professionals, this goal may be closer than we think.

Artificial Super Intelligence (ASI)

ASI is a hypothetical AI that not only mimics or understands human intelligence and behavior but also surpasses human intelligence and capabilities. ASI has long been a favorite topic in science fiction, where robots might escape human control or even overthrow and enslave humanity.

In theory, ASI would outperform humans in every aspect, such as mathematics, science, sports, arts, medicine, and emotions, with greater memory storage, faster data processing, and superior decision-making and problem-solving abilities. However, ASI remains a speculative concept for now.

Currently, AI is at the stage of Narrow AI, focusing on specific tasks (as shown in the diagram below). However, many scientists believe that we may soon reach the next stage—AGI.

Classification Based on Functionality

Another classification is based on AI's similarity to human thinking and its ability to "think" or even "feel" like humans. Based on this classification, AI can be divided into four types: Reactive Machines, Limited Memory, Theory of Mind, and Self-Awareness.

Reactive Machines

Reactive Machines are the most basic type of AI, with very limited functionality. They merely simulate the human brain's response to different types of stimuli or operations. These machines do not have memory functions, so they cannot store or recall past experiences for future use. This means that these machines cannot use previous experiences to guide current decisions—they lack the ability to "learn" and can only automatically respond to limited inputs.

An example of a Reactive Machine is IBM's Deep Blue supercomputer, which famously defeated world chess champion Garry Kasparov in 1997. Deep Blue's goal was to play and win chess against human opponents. It could recognize the pieces on the chessboard, know how each piece moves, and search for and evaluate potential moves up to 12 steps ahead. By predicting possible actions from itself and its opponent, Deep Blue chose the best decision to win. Although Deep Blue was precise in its gameplay, it did not understand the concept of past or future, only the present state and how to respond to it.

Limited Memory

Limited Memory AI can, in addition to the functions of Reactive Machines, learn from historical data to make decisions. Almost all AI applications today fall into this category, including systems that use deep learning. These systems are trained on vast amounts of data to form reference models for solving future problems.

For example, in image recognition, AI is trained on thousands of labeled images. When presented with a new image, it references the training data and, based on its "learning experience," determines what the image depicts. As more training data is added, the accuracy improves.

Self-driving cars are a prime example of this type of AI. After being trained on extensive road scenario data, they can observe their surroundings, monitor other vehicles and people, and store information about nearby cars' speeds, distances, speed limits, and other road navigation details to determine the safest and most appropriate driving route. Chatbots are another common example of Limited Memory AI.

Theory of Mind

This type of AI aspires to achieve decision-making abilities equivalent to human cognition. While some machines currently exhibit human-like capabilities (e.g., voice assistants), none can engage in fully human-relevant

conversations.

Researchers are working on the next generation of AI systems with this concept, hoping to develop machines that understand human emotions, needs, beliefs, and thoughts and can engage in social interactions like humans. Essentially, the goal is to create AI that can "understand" humans. If AI systems are to exist and operate among us, they must understand how we treat ourselves and others, as well as adjust their behavior accordingly.

Although this type of AI is still a concept or ongoing research, significant efforts and improvements are being made. Notable examples include Kismet and Sophia, robots developed in 2000 and 2016, respectively. Kismet, developed by Professor Cynthia Breazeal, could recognize human facial signals (e.g., emotions) and replicate these emotions with its face, which was designed to resemble human facial features such as eyes, mouth, eyebrows, and ears.

Sophia, a humanoid robot created by Hanson Robotics, is distinguished by its facial expressions, visual capabilities (computer vision), and ability to interact with appropriate facial expressions. The robot Ameca, created by Engineered Arts and unveiled in 2022, took these human-like appearances and behaviors to the next level.

Although these robots cannot yet engage in fully human-like conversations, they already display human-like emotions, pushing this type of AI forward.

Self-Awareness

Self-aware machines represent the future of AI and the ultimate goal of all AI research. These machines would possess super intelligence, self-awareness, and human-like emotions. Although such AI does not yet exist, achieving it would be one of the greatest milestones in AI development and possibly its final stage.

Creating this type of AI might take decades or even centuries, but if it were to exist, concerns would arise about the dangers of such advanced AI. It could have its own emotions, desires, beliefs, and potentially surpass human intelligence, posing a threat to humanity. However, since this type of AI does not yet exist, these concerns remain hypothetical.

The Impact of Artificial Intelligence

AI means different things to different people and has varying impacts:

- Game Designers: For game designers, AI is the code that controls non-human characters, enemy behaviors, or the environment's reactions to players.
- Drivers: For drivers, AI assists in avoiding vehicles and pedestrians and optimizing routes.
- Data Scientists: For data scientists, AI is used to explore and classify data to meet specific goals and generate actionable insights.
- Doctors: For doctors, AI helps diagnose patients more accurately, predict future health conditions, and recommend better treatment options.
- Artists: For artists, AI can break traditional boundaries, explore the complex relationship between humans and machines, and attempt to push the limits of human creativity.

What other impacts might AI have? We can explore several areas to help you feel its influence in everyday life:

- Chatbots: Chatbots have a wide range of applications. For example, customer service chatbots respond instantly to general inquiries, freeing up time for customer service representatives to focus on more valuable conversations, improving the customer experience. In education, chatbots provide students with an easy-to-use conversational interface and on-demand online tutoring. In healthcare, chatbots interact with patients through basic diagnostic questions using Natural Language Processing (NLP) technology.

- Speech Recognition: AI can convert spoken language into corresponding text (Speech to Text, STT), and speech synthesis combines speech recognition with other NLP technologies. Companies use AI voice technology to enhance customer experiences and provide a unique voice for their brand. In medicine, AI helps patients with amyotrophic lateral sclerosis (ALS) regain their natural voices instead of using computerized voices.

- Computer Vision: AI advancements have allowed computer vision to surpass human capabilities in detecting and labeling objects, such as factory robots efficiently marking defective products or autonomous vehicles detecting and recognizing objects on the road. Facial recognition algorithms match features with a facial database, aiding law enforcement in identifying criminals in video footage. Consumer devices can verify the identity of their owners through facial recognition. Computer vision algorithms are also helping automate tasks, such as detecting cancerous moles in skin images or identifying symptoms in X-rays and MRI scans.

In addition to these applications, AI impacts our lives daily in areas like Netflix recommendations, Google Maps navigation, spam prevention, and financial crime prevention. However, the ability of AI to access vast amounts of information also raises concerns about privacy violations. As AI continues to develop, these issues should be carefully considered.

Strengths and Weaknesses of AI

From AI's history, it's clear that while AI's journey has been relatively short compared to other disciplines, it has still been a significant one. In the past decade, AI has become faster than humans at processing data and making predictions, excelling in areas such as assisting doctors with disease diagnosis, effectively handling human language (translating and transcribing speech), outperforming humans in complex strategy games (e.g., AlphaGo), creating realistic images (using Generative Adversarial Networks, GANs), and providing timely and useful response suggestions for your emails (e.g., Gmail).

However, while AI excels in many areas and exceeds early expectations, there are still many things it cannot do well. For example, current AI cannot exercise free will or explain its decisions and typically requires human involvement. This section will explore what AI can and cannot do, focusing on factual discussions rather than hype.

What AI excels at?

- Learning from Data: AI systems can learn specific recognition abilities, such as how to play Go or drive on the road, similar to how humans learn. To teach AI a behavior, we must provide it with data, just as we teach children to recognize an "apple" by pointing to pictures or showing them a real apple. If the child doesn't remember after one viewing, we repeat the process until the child learns to identify the apple's features.

- Recognizing Images: AI's ability to recognize objects in static or dynamic images is equivalent to human visual abilities, known as computer vision, a subfield of AI. Computer vision can be used in medical imaging, autonomous driving, facial recognition for identity verification, and more. While training AI requires more data—children may recognize an apple after seeing it a few times, whereas AI may need thousands of images—AI can learn more subtle features, such as the differences in size, color, and shape between different apple varieties, and identify them almost instantaneously. For instance, AI can quickly classify apples in a wholesale market.

- Processing and Analyzing Human Language: Another AI subfield is Natural Language Processing (NLP). AI can now handle various human languages, such as translation, chatbots, emotion detection in text, and author style recognition.

- Making Predictions: AI can be used to make predictions in fields like sales performance, stock market trends, and the likelihood of certain people developing heart disease. For example, Facebook's AI application can predict potential suicide attempts based on changes in users' posts and behavior, alerting relevant authorities.

- Providing Recommendations: Recommendation systems are increasingly important, as they directly interact with users daily. AI excels in this area, as seen in Amazon's product recommendations and Netflix's movie and show suggestions. In fact, 80% of Netflix views come from AI-driven recommendations.

- Writing Articles and Creating Music: Writing articles can be challenging for many people, so one might think it's even more difficult for AI. However, AI can efficiently write fluent news reports and legal documents, providing higher timeliness. For example, the Associated Press uses AI to automatically generate brief reports on sports results or company earnings, giving journalists more time to focus on other stories. During the 2014 Los Angeles earthquake, the Los Angeles Times' AI algorithm Quakebot published a report just three minutes after the quake.

AI can also be used in music creation. For example, AIVA, developed in Luxembourg, can compose classical music, rock, and various soundtracks, while AI Music, acquired by Apple, can edit copyright-free music into new background tracks based on user interaction or even heart rate. Some artists are already using AI to create entire songs or parts of them.

- Writing Code: While AI cannot yet fully replace human programmers, tools like GitHub Copilot, developed in collaboration with OpenAI, can automatically generate code with the necessary functionality based on a few lines of instructions, significantly improving developer efficiency.

- Enhancing Cybersecurity: Cybersecurity is a major issue for internet users, and AI has proven effective in this area, such as automatically filtering spam emails and comments, blocking hacker or bot attacks, and diagnosing system vulnerabilities.

- Playing Games: AI technology has numerous applications in the gaming industry, including playing many games, often outperforming humans. For example, Google DeepMind's AI excels in games like ping pong, chess, Go, and even real-time strategy games like StarCraft 2, which require decision-making based on incomplete information.

- Acting as a Smart Assistant: AI can also serve as a personal assistant, sometimes outperforming human assistants. Popular AI assistants include Amazon's Alexa, Google Assistant, Microsoft's Cortana, Apple's Siri, and Samsung's Bixby. These assistants can search for information online, help control smart home devices, and manage and remind you of daily tasks.

In addition to these, AI can assist in many other tasks, such as supporting medical consultations, enhancing law enforcement, creating art, fintech, stock trading, weather forecasting, and more.

What AI struggles with?

Despite its impressive achievements, AI is not magic, and there are still things it cannot do:

- Lack of Originality and Imagination: While AI is used in many creative fields, such as writing, poetry, music, advertising, film, and art, it still lacks original creativity. Humans can create something entirely new from nothing, whereas AI must generate new works based on existing creations. For instance, the world's first robot artist, Ai-

Da, creates beautiful drawings but still requires some human assistance, proving this point.

- Inability to Experience True Emotions: Current AI cannot understand emotions or truly comprehend human emotions. Although AI has made significant progress in emotional recognition, such as identifying human emotional expressions and interpreting them, it cannot experience emotions itself or express them as genuine feelings.

- Lack of Free Will: AI cannot currently make decisions independently without direct or indirect human control. It is also impossible for AI to act autonomously without human permission.

- Bias Issues: Most AI systems today learn from human-provided data and classifications, which may be biased. Numerous studies have shown that AI can learn biases similar to those of humans. For example, a 2018 study by Amnesty International revealed that an AI system used to identify gang members was more likely to classify Black individuals as gang members because its training data predominantly came from minority groups, particularly Black people.

- Inability to Truly Understand Behavior: AI can interact with humans but cannot understand the true meaning of its behavior. For example, when we interact with smart speakers like Amazon's Alexa or Google Home, they can perform tasks for us, such as playing music, providing weather information, or telling a joke, but they do not actually understand the content they deliver. Similarly, AI can be trained to recognize various apples but doesn't know that it's identifying apples—it just knows it's searching for the objects it was trained on.

Due to this limitation, AI knows certain things are related but cannot determine the causal relationship between them or explain how it found that connection (i.e., it lacks self-explanation). Before we can develop true AGI, we may be trapped by AI systems that neither understand nor explain themselves.

- Inability to Make 100% Accurate Predictions: Using AI to predict various outcomes, from weather to stock markets to medical conditions, has become increasingly common. However, the real world is full of variables, and AI's predictive accuracy will never be perfect. For example, an AI system built on data during the COVID-19 pandemic may become outdated once the pandemic ends.

- AI Without Data Is Useless: As we've seen, machine learning-based AI technology requires data for training. As HP General Manager Raf Peters says, "AI without data doesn't exist." Without big data, AI cannot achieve anything. If Google didn't have billions of searches daily, it wouldn't have the large, real-time datasets needed to continuously learn our search preferences, nor could it provide a good search experience. Similarly, without billions of hours of spoken language data to help Siri learn our language, it wouldn't be able to respond intelligently to our requests.

- Most AI today falls under the category of Narrow AI (ANI). It requires data training to function and is usually limited to the tasks for which it was trained.
- AI is not omnipotent. It cannot produce 100% accurate predictions, and its methods for finding connections are

often hard to explain, sometimes even biased due to training methods.
- AI lacks creativity and abstract thinking but can outperform humans in recognizing certain objects and performing high-efficiency, repetitive tasks.

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