**The Impact of Artificial Intelligence**

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Title: The Impact of Artificial Intelligence on Society: Opportunities and Challenges

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**Introduction**

Artificial Intelligence (AI) has evolved from a theoretical concept to a transformative technology with wide-ranging applications. Today, AI systems perform tasks that typically require human intelligence, such as reasoning, problem-solving, learning, and language comprehension. These capabilities have not only revolutionized how industries operate but have also raised significant ethical, social, and economic questions. This paper explores what AI is, how it functions, its history and types, real-world applications, and the future it holds. Furthermore, it critically examines the challenges and potential risks posed by AI, such as privacy concerns, biased outcomes, job displacement, and overreliance on automation.

**What Is Artificial Intelligence?**

AI refers to computer systems designed to perform tasks that normally require human intelligence. These include cognitive functions such as learning, reasoning, problem-solving, perception, and language understanding (NASA). By simulating these processes, AI allows machines to interpret data, make decisions, and improve performance over time. AI systems are developed using a combination of computer science, data analytics, and domain-specific knowledge. With increased access to big data and enhanced computing power, AI is being adopted rapidly across industries.

AI is not a single technology but a broad field composed of various subfields including robotics, computer vision, and expert systems. AI algorithms can learn from historical data and adjust their behavior accordingly. Over time, with enough data, AI systems can achieve high levels of accuracy in decision-making processes. AI is also evolving to become more autonomous, requiring less human intervention as it learns to process information more efficiently.

**History of AI**

The field of AI dates back to 1950 when British mathematician Alan Turing asked the question, "Can machines think?" He proposed the Turing Test as a way to measure a machine's ability to exhibit intelligent behavior equivalent to, or indistinguishable from, that of a human. The term "artificial intelligence" was coined in 1956 by John McCarthy during a summer workshop at Dartmouth College. Throughout the late 1950s and 1960s, researchers created programs capable of playing games, solving mathematical problems, and simulating decision-making processes. One early AI system was SAINT, developed by mathematician James Slagle, which could solve calculus problems.

After a period of limited progress, interest in AI surged in the 1990s and 2000s as research shifted toward developing systems capable of solving specific, real-world problems. This era marked the rise of machine learning and data-driven AI models. As computational power increased and internet data became more available, AI began achieving results that were once thought to be impossible.

Recent breakthroughs in areas such as natural language processing, image recognition, and generative AI have reignited interest and investment in the field. The introduction of AI models like ChatGPT and other large language models has made AI a part of everyday life for millions of people. These tools are not only capable of holding conversations but also generating essays, translating languages, and even writing code.

**Types of AI**

AI can be categorized based on capabilities and functionalities:

1. **Artificial Narrow Intelligence (ANI)**: Also known as Weak AI, this is the only form of AI that exists today. It is designed to perform a specific task and cannot operate outside its trained domain. Examples include Siri, Alexa, IBM Watson, and ChatGPT.
2. **Artificial General Intelligence (AGI)**: A theoretical form of AI that could perform any intellectual task a human can. It would have the ability to learn and apply knowledge across a broad range of tasks without retraining.
3. **Artificial Superintelligence (ASI)**: A hypothetical AI that surpasses human intelligence in all aspects, including creativity and problem-solving.

Functionally, AI can also be grouped into:

* **Reactive Machines**: These systems operate solely on current data and do not have memory.
* **Limited Memory AI**: These can use recent data to make decisions but do not store it long-term.
* **Theory of Mind AI**: Not yet developed, this would understand human emotions and intentions.
* **Self-Aware AI**: A future concept of AI that would possess consciousness and emotions.

**How AI Works**

AI systems function by combining data with algorithms to make decisions and predictions. Core components include:

* **Machine Learning (ML)**: Algorithms that allow systems to learn from data.
* **Neural Networks**: Modeled after the human brain, these consist of nodes that process data.
* **Natural Language Processing (NLP)**: Enables machines to understand and respond to human language.
* **Computer Vision**: Allows machines to interpret visual information.

For example, game-playing AI uses strategic algorithms, while NLP powers chatbots and voice assistants. Deep learning, a subset of ML, uses multi-layered neural networks to improve prediction accuracy. AI also incorporates reinforcement learning, where systems learn through feedback loops by receiving rewards or penalties.

As data becomes more complex and abundant, AI systems must also evolve in their ability to filter, process, and interpret this information effectively. This is where advancements in quantum computing and edge AI may play a role, pushing the limits of what AI can accomplish.

**Applications of AI**

AI is applied across various sectors to enhance efficiency, accuracy, and personalization:

* **Healthcare**: AI assists in diagnosing diseases, personalizing treatments, and monitoring patients remotely. A powerful example is the case of Joseph Coates, whose life was saved by AI-recommended drug repurposing after being diagnosed with a rare condition.

One remarkable case that highlights the life-saving potential of AI involves a man named Joseph Coates. At 37 years old, Coates was diagnosed with POEMS syndrome, a rare and often deadly blood disorder that affects multiple systems in the body. With traditional treatments proving ineffective and his condition rapidly declining, doctors had little hope. Refusing to give up, Coates’s partner reached out to Dr. David Fajgenbaum, a researcher who used an AI system to analyze vast medical databases in search of alternative treatments. The AI identified a combination of chemotherapy, immunotherapy, and steroids as a possible solution. After following this treatment plan, Coates's condition significantly improved. Four months later, he was healthy enough to undergo a successful stem cell transplant. This case demonstrates how AI can be a powerful tool in identifying new uses for existing medications and providing hope to patients with rare or incurable diseases.

* **Education**: Adaptive learning platforms use AI to tailor educational content to individual students' needs. AI can provide real-time feedback, automate grading, and identify learning gaps, improving overall academic outcomes.
* **Business**: AI boosts productivity by automating tasks, enhancing data analysis, and improving customer service. Companies use AI to forecast trends, personalize marketing strategies, and streamline supply chains.
* **Agriculture**: AI supports precision farming through data analysis related to weather, soil, and crops. Drones and sensors collect real-time data, allowing farmers to optimize irrigation, pest control, and harvesting schedules.
* **Transportation**: Self-driving cars and smart traffic systems use AI to improve safety and efficiency. AI-powered logistics systems optimize delivery routes and reduce fuel consumption.
* **Cybersecurity**: AI identifies patterns and threats, strengthening defense systems. AI tools can detect anomalies, analyze cyber threats in real time, and suggest mitigation strategies.
* **Finance**: AI assists with fraud detection, credit scoring, and algorithmic trading. Robo-advisors use AI to help investors manage portfolios and make informed decisions.
* **Smart Homes**: AI adjusts settings in real time to improve energy efficiency and comfort. Smart assistants can control lighting, heating, and appliances based on user preferences.

**Ethical Frameworks in AI: NASA’s Approach**

As AI systems grow more powerful and integrated into critical functions, ensuring their ethical use has become a top priority. NASA, as a leading scientific institution, has introduced a robust ethical framework for AI that outlines six key principles aimed at guiding responsible development and deployment.

* **Fairness**: AI systems must be designed to treat all individuals equitably. This includes actively preventing bias, promoting diversity, and ensuring no group is disproportionately harmed or excluded.
* **Transparency and Explainability**: NASA emphasizes that AI’s role in any system must be clearly communicated. The logic behind its decisions should be understandable to stakeholders, supported by proper documentation and transparency.
* **Accountability**: Developers and organizations are responsible for the AI they create and deploy. Clear governance is necessary to monitor outcomes, prevent misuse, and ensure ethical integrity.
* **Safety and Security**: AI applications should protect user privacy and minimize harm. Ongoing human supervision, especially in machine learning processes, is critical to reduce risks and correct unexpected behavior.
* **Human-Centric Design**: AI must serve societal interests and comply with existing laws. It should be used in a way that aligns with human values and supports the well-being of individuals and communities.
* **Scientific Rigor**: NASA insists on using data-backed methods in AI development. Systems must be tested thoroughly, peer-reviewed, and grounded in reliable scientific practices.

These principles demonstrate that ethical considerations are not optional, but essential to trustworthy AI. NASA’s model offers a standard for other organizations to follow, emphasizing transparency, safety, and accountability at every level.

**Negative Impacts and Ethical Concerns**

Despite its benefits, AI presents significant risks:

* **Bias and Discrimination**: AI systems can replicate existing social biases, especially in hiring or law enforcement. Algorithms trained on biased data can perpetuate inequalities and produce unfair outcomes.
* **Privacy Concerns**: Extensive data collection can infringe on individuals' rights. AI used in surveillance and targeted advertising raises questions about consent and data protection.
* **Job Displacement**: Automation may reduce the need for human labor in some sectors. Low-skill and repetitive jobs are most at risk, although new roles in AI development and maintenance may emerge.
* **Transparency and Accountability**: Some AI decisions are difficult to trace or understand. The "black box" nature of certain algorithms can obscure responsibility when errors occur.
* **Overreliance on Technology**: Excessive trust in AI can reduce human judgment and autonomy. Critical thinking and ethical reasoning should remain central in decision-making processes.
* **Security Risks**: Malicious use of AI in cyberattacks, misinformation campaigns, and autonomous weapons can pose serious threats to global stability.

Addressing these concerns requires transparent AI development, diverse training data, human oversight, and international cooperation. Ethical frameworks and accountability mechanisms must evolve alongside technological advances.

**Conclusion**

AI is one of the most transformative technologies of our time. It offers immense potential to improve lives, optimize industries, and address complex challenges. However, it also introduces risks that must be carefully managed. A balanced approach—leveraging AI's power while addressing its limitations—will be essential to creating a future where technology supports the well-being of all.

Investing in AI education, ethical standards, and inclusive innovation will help society navigate the opportunities and challenges ahead. AI should be used not just to make systems more efficient, but to make lives more equitable and meaningful.

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