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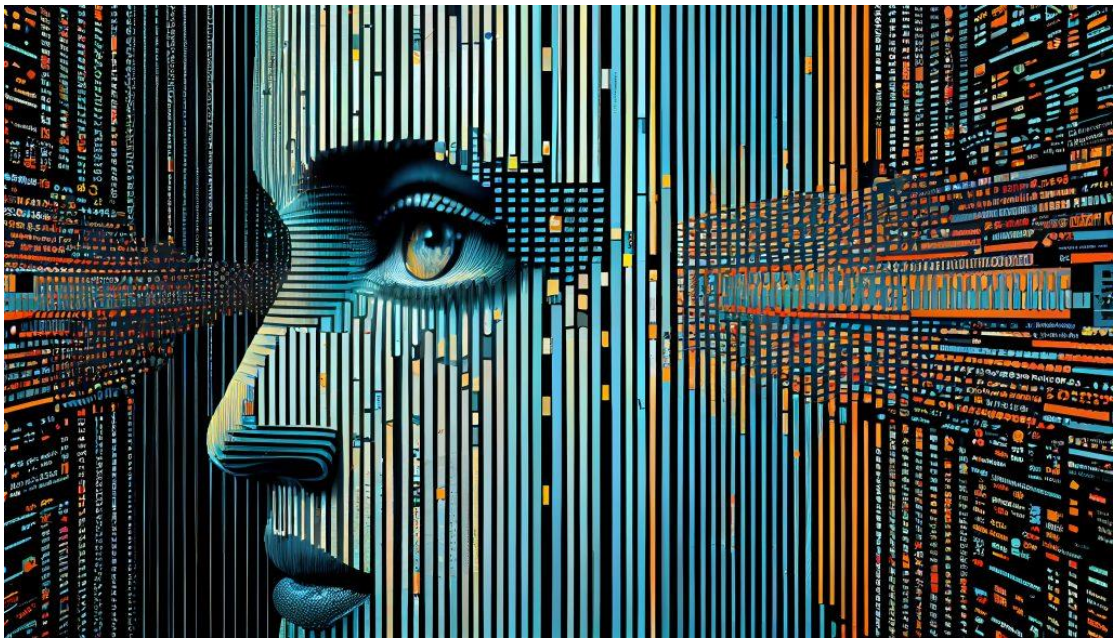
LECTURE: (2)

Subject: AI goals and AI environment
Level: First
Lecturer: Dr. Ahmed Adnan Hadi

AI goals and AI environment

In today's rapidly evolving technological landscape, Artificial Intelligence (AI) stands out as the hottest topic of the moment. AI is a swiftly advancing technology reshaping numerous industries, and sustainability is no exception. With its potential to enhance efficiency, minimize waste, and foster innovation, AI emerges as a pivotal tool in addressing environmental challenges and steering us toward a sustainable future, making it a key player in AI for Environmental Sustainability. However, we must also be mindful of the potential risks and challenges associated with AI and ensure that it is used in a responsible and ethical manner.



The most important question currently is the what are the goals of AI?

At its core, the primary goal of Artificial Intelligence is to simulate human-like intelligence in machines, empowering them to carry out complex tasks and decision-making processes autonomously. The objectives of AI encompass a wide range of applications, including but not limited to:

1. Problem-Solving and Decision Making.

2. Natural Language Processing (NLP).

3. Machine Learning and Deep Learning.

4. Robotics and Automation.

5. Enhancing Healthcare and Medicine.

6. Fostering Creativity and Innovation.

In general, the main goals of Artificial Intelligence are:

- ✓ To make computers more useful by letting them take over tedious tasks from human.
- ✓ Understand principles of human intelligence.

The benefits of AI for Environmental Sustainability

Energy Efficiency

AI can help improve energy efficiency in buildings and industries by predicting energy usage patterns and optimizing energy consumption. It can also identify areas of energy waste and suggest ways to reduce it.

Renewable Energy

AI can aid in the development of renewable energy sources such as wind and solar power by predicting energy output, optimizing performance, and improving maintenance.

Smart Grids

AI can help create smarter energy grids by analyzing data from sensors, meters, and other devices. This can help utilities better manage the supply and demand of electricity, reduce energy waste, and improve reliability. Microsoft has been using AI to improve energy efficiency in its data centers and has set ambitious sustainability goals, aiming to be carbon negative by 2030.

Sustainable Agriculture

AI can aid in sustainable agriculture practices by analyzing soil data, predicting crop yields, and identifying pest and disease outbreaks. This can help farmers optimize their crop production while reducing the use of pesticides and fertilizers. Farm wise utilizes AI-powered robots to precisely identify and remove weeds in agricultural fields, reducing the need for chemical herbicides and promoting sustainable farming practices.

Waste Management

AI can help improve waste management by analyzing data on waste production, collection, and disposal. This can help cities and municipalities optimize their waste management systems, reduce waste, and increase recycling rates. Waste Robotics employs AI-powered robots to sort and separate recyclable materials from waste streams, improving recycling efficiency and reducing landfill waste.

Water Management

AI can aid in water management by studying data on water usage, quality, and availability. This can help cities and municipalities better manage their water resources, reduce water waste, and improve water quality.

Ocean Cleanup, for instance, deploys AI-powered systems to track and collect plastic waste in the ocean, contributing to efforts to clean up marine environments.

Climate Change

AI can help address climate change by examining data on greenhouse gas emissions, weather patterns, and other environmental factors. This can help inform policies and strategies for reducing emissions and mitigating the impacts of climate change.

In various applications, including weather forecasting and climate modeling, the understanding and prediction of weather patterns and climate change impacts are aided by IBM's Watson.

Biodiversity Conservation

AI can aid in biodiversity conservation by investigating data on species populations, habitats, and threats. This can help inform conservation strategies and improve our understanding of the complex relationships between different species and

their environments. Conservation International uses AI for Environmental Sustainability, employing advanced algorithms to analyze biodiversity data and track changes in ecosystems. This technology plays a crucial role in the conservation and protection of critical natural habitats.

The Sustainability Risks Posed by AI

On the other hand, there are many risk to apply A.I to sustainability such as:

- *Energy consumption*
- *E-waste*
- *Bias and discrimination*
- *Privacy and security*
- *Job displacement*
- *Dependence on technology*

Environment of AI

An environment in artificial intelligence is the surrounding of the agent. The agent takes input from the environment through sensors and delivers the output to the environment through actuators. Several types of environments in AI are commonly used which are:

- *Fully Observable Vs Partially Observable*

When an agent sensor is capable to sense or access the complete state of an agent at each point in time, it is said to be a fully observable environment else it is partially observable.

♦ *Deterministic vs Stochastic*

When a uniqueness in the agent's current state completely determines the next state of the agent, the environment is said to be deterministic.

The stochastic environment is random in nature which is not unique and cannot be completely determined by the agent.

♦ *Competitive vs Collaborative*

An agent is said to be in a competitive environment when it competes against another agent to optimize the output.

An agent is said to be in a collaborative environment when multiple agents cooperate to produce the desired output.

♦ *Single-agent vs Multi-agent*

An environment consisting of only one agent is said to be a single-agent environment. A person left alone in a maze is an example of the single-agent system.

An environment involving more than one agent is a multi-agent environment. The game of football is multi-agent as it involves 11 players in each team.

♦ *Static vs Dynamic*

An environment that keeps constantly changing itself when the agent is up with some action is said to be dynamic. A roller coaster ride is dynamic as it is set in motion and the environment keeps changing every instant.

An idle environment with no change in its state is called a static environment. An empty house is static as there's no change in the surroundings when an agent enters.

♦ *Discrete vs Continuous*

If an environment consists of a finite number of actions that can be deliberated in the environment to obtain the output, it is said to be a discrete environment. The game of chess is discrete as it has only a finite number of moves. The number of moves might vary with every game, but still, it's finite.

The environment in which the actions are performed cannot be numbered i.e. is not discrete, is said to be continuous. Self-driving cars are an example of continuous environments as their actions are driving, parking, etc. which cannot be numbered.

♦ *Episodic vs Sequential*

In an Episodic task environment, each of the agent's actions is divided into atomic incidents or episodes. There is no dependency between current and previous incidents. In each incident, an agent receives input from the environment and then performs the corresponding action.

In a Sequential environment, the previous decisions can affect all future decisions. The next action of the agent depends on what action he has taken previously and what action he is supposed to take in the future.

♦ *Known vs Unknown*

In a known environment, the output for all probable actions is given. Obviously, in case of unknown environment, for an agent to make a decision, it has to gain knowledge about how the environment works.

Artificial Intelligence challenges

Essentially, we could boil AI challenges down to five critical issues:

- Encountering technology-related problems in the development process.
    1) Poor architecture choices.
    2) Inaccurate or insufficient training data.
    3) Lack of AI explain-ability.
- Struggling to scale AI systems across different fields.

  Other factors behind AI scalability challenges include:

    1) The size of data sets for algorithm training and the quality of their data
    2) The utilization of significant computing resources for AI model training and deployment.
    3) The increasing complexity of present-day AI models
    4) The need to expand the underlying cloud infrastructure horizontally or vertically to accommodate for the AI model evolution and implementation across multiple use cases
    5) The necessity to integrate AI models with other systems within a company's IT infrastructure
- Solving the ethical challenges of AI adoption.
    1) Bias in algorithmic decision making.
    2) Moral implications.
    3) Limited transparency and explain-ability.

From the point of view of computers, the most important challenges of artificial intelligence are:

A- Bias in algorithms

AI algorithms can inherit biases present in the data used for training, leading to unfair or discriminatory outcomes. This challenge is particularly crucial as AI systems play an increasingly significant role in decision-making processes across various domains.

B- Technical difficulties

Implementing AI systems involves overcoming various technical challenges, such as data storage, security, and scalability. Companies should invest in robust infrastructure that can handle the volume and complexity of AI-related data. Ensuring data security and privacy throughout the AI lifecycle is critical to building user trust. Scalability should be considered from the outset to accommodate the increasing demands and potential expansion of AI systems.

C- Unreliable results

AI systems may produce unreliable outcomes due to various factors, including biased or incomplete datasets, algorithmic limitations, or the complexity of the task at hand. To address these challenges in artificial intelligence, companies should emphasize rigorous testing and validation processes during the development of AI systems. Continuous monitoring and refinement are crucial to improving reliability and ensuring that AI solutions deliver consistent and accurate results.

D- Lack of data

AI systems heavily rely on large and diverse datasets for training and achieving optimal performance. However, not all industries have access to the required volume or quality of data. Companies can address these challenges in artificial intelligence by fostering collaborations and partnerships to gain access to relevant datasets. Furthermore, techniques like transfer learning, data augmentation, and synthetic data generation can help mitigate the issue of limited data availability.

E- Privacy concerns

AI systems often rely on vast amounts of data to train and operate effectively. However, this data can include personal and sensitive information, leading to concerns

regarding privacy and data protection. To mitigate these concerns, companies must prioritize implementing robust privacy measures, such as data anonymization, secure data storage, and compliance with relevant data protection regulations. Transparent data usage policies and obtaining informed consent from individuals can also enhance trust and alleviate privacy concerns.