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Artificial Intelligence and/or Machine Learning (AI & ML)

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AI & ML

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Understanding Artificial Intelligence

- AI aims to create machines performing tasks requiring human intelligence.
- Encompasses understanding language, recognizing patterns, making decisions, learning from experience.
- AI augments human capabilities and improves efficiency.
- Applications range from healthcare to entertainment.
- AI is a blend of computer science, mathematics/statistics, cognitive science, and engineering.
Things I work on. How I use AI.

- Making computer vision work on embedded/mobile devices.
- Empirical software engineering: Understanding reuse and adaptation patterns in pre-trained model ecosystems (e.g. Hugging Face).
- Neuroscience (Carbon) focused on the shape and texture play in computer vision vs. human perception.
- History of Computing (COMP 111, former core, now writing-intensive) and Platform Studies.
- Curricular mapping and analysis; learning outcomes.
- Automating administrative work: reports, course scheduling, etc. 😊
- Using AI to reduce tedious coding and writing. Tedious everything, actually.
Machine Learning and Artificial Intelligence

- Machine Learning is a *subset* of AI focused on data-driven learning.
- AI includes rule-based (logic) systems, ML, and more.
- ML is data hungry and improves with experience, using algorithms to find patterns in data (ML=rocket, data=fuel, *Andrew Ng*).
- Key ML types: supervised, unsupervised, and reinforcement learning.
- ML powers applications such as speech recognition and predictive analytics, text classification, vision, robotics.
- GPT4 and other generative methods are not the only interesting applications of machine learning.
Challenges

• AI requires tremendous computational power (supercomputer class systems).
• Generalized reasoning and common sense remain challenges.
• AI struggles with creativity and emotional intelligence (affective reasoning). The fake, “I’m sorry.” or “I apologize.”
• Ethical reasoning and moral judgment are complex for AI.
• Long-term planning and strategic thinking are underdeveloped in AI.
• Bridging these gaps could lead to more human-like AI but will likely require different (non-ML) methods.
Potential Benefits of AI and ML

- Revolutionizing healthcare with diagnostics and personalized treatment.
- Enhancing environmental conservation and sustainability.
- Transforming education through personalized learning.
- Improving disaster response and public safety.
- Advancing agriculture with optimized production and sustainability.
- Integration into robotics. Great example: Psyonic Ability Hand (startup by Aadeel Akhtar, CS + Biology @ LUC; featured on Shark Tank) for those who have lost limbs (focused on arms/hand).
Star Trek makes you wonder: How did it take this long to get here?

- The Universal Translator - Introduced in the original Star Trek series, first appearing in "Metamorphosis" (1967).
- The Computer - Featured in various Star Trek series, with notable appearances in numerous episodes, starting from the original series.
- The EMH (Emergency Medical Hologram) - Also introduced in Star Trek: Voyager, in the same episode "Caretaker" (1995).
# The Cyclical Nature of AI: Winters and Summers

<table>
<thead>
<tr>
<th>Event</th>
<th>Details</th>
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<tbody>
<tr>
<td>AI winters</td>
<td>periods of reduced funding and interest due to unmet expectations.</td>
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<tr>
<td>AI summers</td>
<td>times of optimism, breakthroughs, and increased investments.</td>
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<tr>
<td>Ongoing AI summer</td>
<td>since the early 2000s, fueled by ML and big data. <em>Is the next winter coming?</em></td>
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Pioneers and Landmarks in AI Development

• Alan Turing: Turing Test and conceptual foundations of AI.
• Frank Rosenblatt: Developed the perceptron, an early neural network model.
• Geoffrey Hinton: Key figure in the resurgence of neural networks and deep learning.
• Yann LeCun, Yoshua Bengio, and Hinton: Deep learning pioneers.
Evolution from Basic Neural Networks to Advanced Models

- From single-layer perceptrons to multi-layered neural networks.
- Introduction of backpropagation enabled learning in deep networks.
- CNNs for spatial data processing, RNNs for sequential data.
- Transformers revolutionized NLP with attention mechanisms.
- AI's evolution reflects growing complexity and capability in modeling intelligence.
The Ethical and Social Implications of AI

- Job displacement and economic impacts due to automation.
- Privacy concerns with widespread data collection and surveillance.
- Ethical dilemmas in decision-making processes.
- The need for transparency and accountability in AI systems.
- The importance of ethical AI development and use.