

AI Applications

Week 9

PRESENTED BY MICHAL, AREN, SERGI

How Do They Know?

- **The Problem:** Spotify has 100 million songs. You have 5 minutes. How do they connect you to the right track?
- **The Old Way:** Curated playlists by humans (Slow, biased, limited).
- **The AI Way:** Recommendation Systems.

- **Content-Based Filtering:** "You liked Star Wars, so here is Star Trek." (Based on tags/metadata).
- **Collaborative Filtering:** "Users who liked Star Wars also liked Inception." (Based on user behaviour patterns).
- **Hybrid Models:** Combining both to solve the "Cold Start" problem (what to suggest to a brand new user).

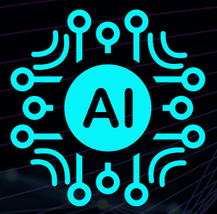
Vector Embeddings & Matrix Factorisation

The Latent Space



Imagine a 3D graph. The AI plots "You" at coordinates [0.5, 0.9, 0.2] and "Movie A" at [0.6, 0.8, 0.1].

Cosine Similarity



The AI calculates the angle between your vector and the movie's vector.

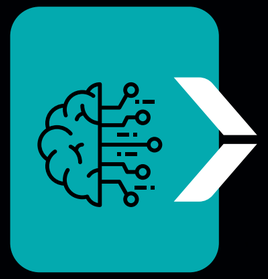
Small Angle = High Similarity



If the vectors point in the same direction, the Recommendation Engine predicts you will love it.

- **Everything is a Number:** AI doesn't know "Pop Music" or "Action Movies." It converts users and items into Vectors (lists of numbers).
- **Matrix Factorisation:** breaking down a massive grid of User vs. Item ratings to find hidden patterns (e.g. identifying that User A loves "Dark Comedies" without the genre ever being explicitly tagged).

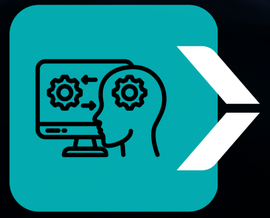
Computer Vision in Diagnostics



Radiology & Pathology:
Humans get tired; AI does not.
CNNs (Convolutional Neural Networks): The same tech we used for the MNIST digits (Week 6) is scaled up to detect micro-fractures, tumors, or retinal bleeding in X-rays and MRI scans.



AI models have achieved a 99% accuracy rate in detecting metastatic breast cancer (Google Health), reducing false negatives significantly compared to human-only review.



The Human-in-the-Loop: AI highlights the "suspicious" region; the doctor makes the diagnosis. It’s not replacement; it’s augmentation.

Drug Discovery & AlphaFold



The protein solving problem

- Proteins are the building blocks of life. Their shape determines what they do (and how to treat diseases).
- Predicting a protein's 3D shape from its DNA sequence used to take years of lab work.



The Solution

- Using Deep Learning, AlphaFold predicted the shape of nearly all 200 million known proteins in months.



Impact

- Accelerates drug discovery for diseases like Malaria and Cancer.
- Allows scientists to design new enzymes to digest plastic waste.

Predicting the Future of Machines



Reactive Maintenance:
Fix it when it breaks. (Costly downtime).

Predictive Maintenance:

- IoT Sensors record vibration, heat, and sound data from machinery 24/7.
- Anomaly Detection: AI learns the "sound" of a healthy engine. When a bearing starts to wear (changing the vibration frequency by 0.1%), the AI alerts the team weeks before failure.

Digital Twins:

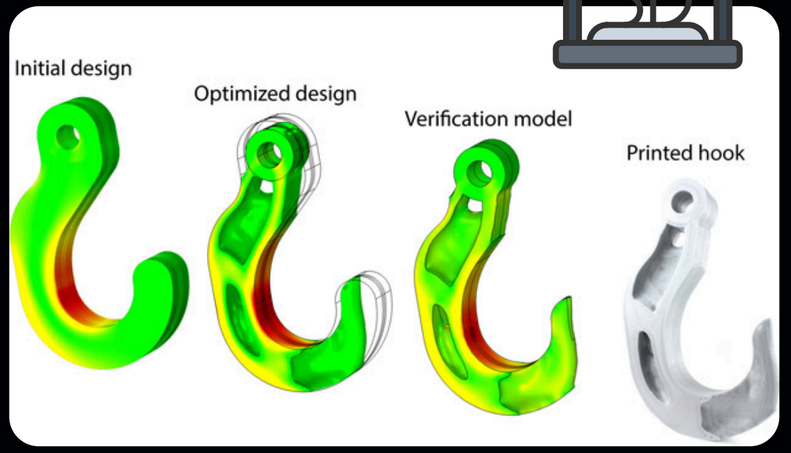
- Creating a perfect virtual replica of a jet engine or a factory.
- Engineers run simulations on the "Twin" to test extreme scenarios without risking the real asset.

The Engineer’s Copilot

Traditional Engineering: An engineer draws a part, tests it, and refines it.

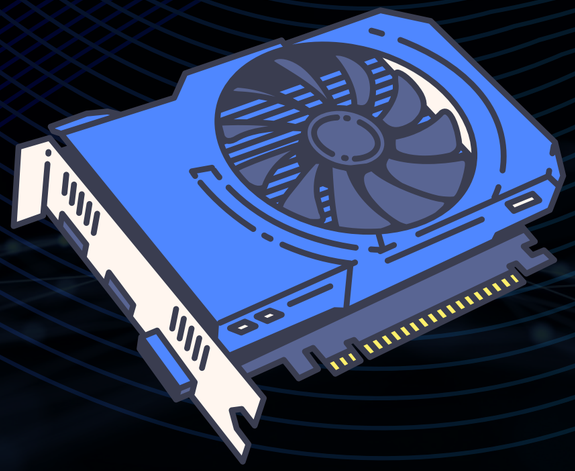
Generative Design (Topology Optimization):
The Prompt: "I need a bracket that connects Point A to Point B, withstands 500kg of load, and weighs less than 100g."
The Process: The AI simulates thousands of iterations, adding material only where stress is high and removing it where it's not needed.

The Result: "Alien-looking" organic shapes that are 40% lighter and 20% stronger than human designs (used by Airbus and NASA).





Expanding Horizons:
The Computer Science Society





Why the Change?

AI is powerful, but it is just one pillar of the tech world.
To build great AI, you need to understand the hardware, the security, and the code behind it.

What to Expect:

Broader Topics: Cybersecurity, Game Development, Web 3.0, Hardware/Robotics, and Competitive Programming.

Hackathons and Competitions: Termly coding battles to build real projects.

Same Time, Same Place. New Ideas.

Final Thoughts

Week 1 - Week 9

- We have moved from Understanding AI (Neural Nets, Backpropagation) to Applying AI.
- Whether it is finding your next favourite song, curing diseases, or designing spacecraft, AI is the underlying layer of modern innovation.

In The Future

Next Week: The launch of the Computer Science Society.

Roadmap:

1. Introduction and Fundamentals
2. LLMs and Neural Networks
3. Agentic AI & Diffusion Models
4. Natural Language Processing, AI in vision
5. Ethics & the Future of AI, Cyber Security
6. Creating Classifier Models & Chatbots
7. Independent Projects
8. Reinforcement Learning
9. Applications of AI

“By far the greatest danger of Artificial Intelligence is that people conclude too early that they understand it.”
— Eliezer Yudkowsky

Thank you for listening.

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