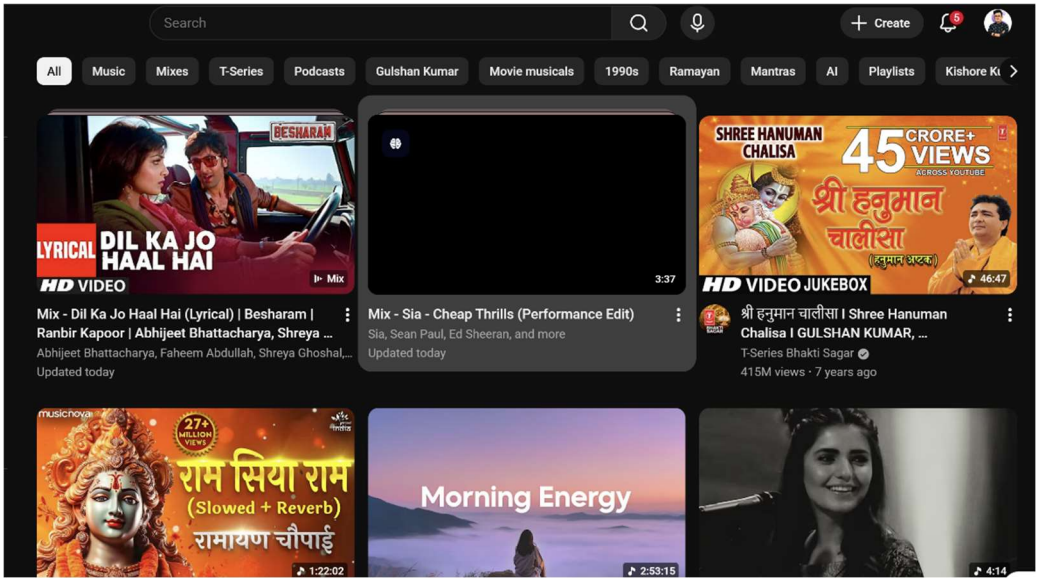
MODULE 1

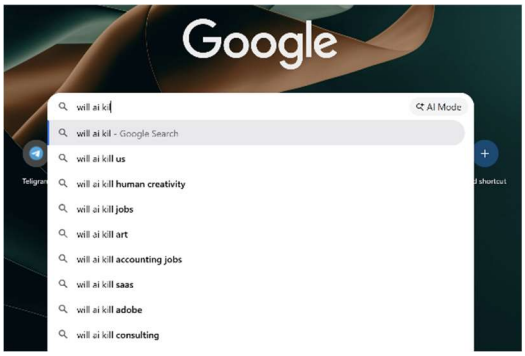
INTRODUCTION TO ARTIFICIAL INTELLIGENCE

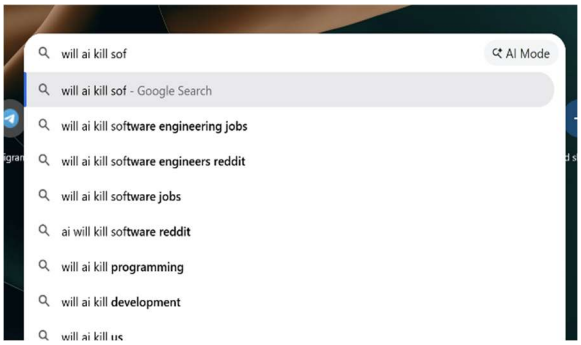
- "IMAGINE YOUR DAY TODAY.
  YOU WOKE UP, MAYBE CHECKED YOUTUBE. THE HOME PAGE ALREADY KNEW WHAT TYPE OF VIDEOS YOU LIKE.



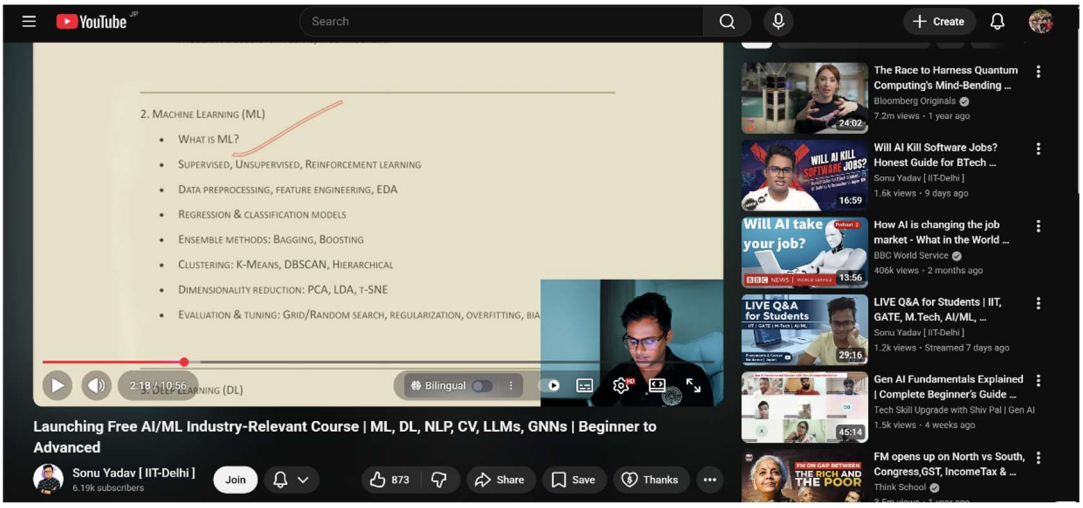
- YOUR PHONE AUTOMATICALLY GROUPED YOUR PHOTOS BY FACE.

- WHEN YOU TYPED A MESSAGE, YOUR KEYBOARD SUGGESTED THE NEXT WORD.





- AND RIGHT NOW, YOU'RE WATCHING ME ON YOUTUBE, AND THE RECOMMENDATION SYSTEM DECIDING WHAT TO SHOW YOU NEXT.



In this module, we will understand:

1. What exactly is AI?
2. Where did it come from – a brief history.
3. Different types of AI: Narrow, General, Superintelligent.
4. Real-world applications that you already use daily.
5. A big-picture map of subfields: ML, Deep Learning, NLP, Computer Vision, Generative AI.
6. And finally, the modern AI ecosystem: LLMs like ChatGPT, multimodal AI, and where the field is going.

By the end of this module, you should be able to explain AI confidently to any normal person, and also see clearly how the rest of this course fits together.

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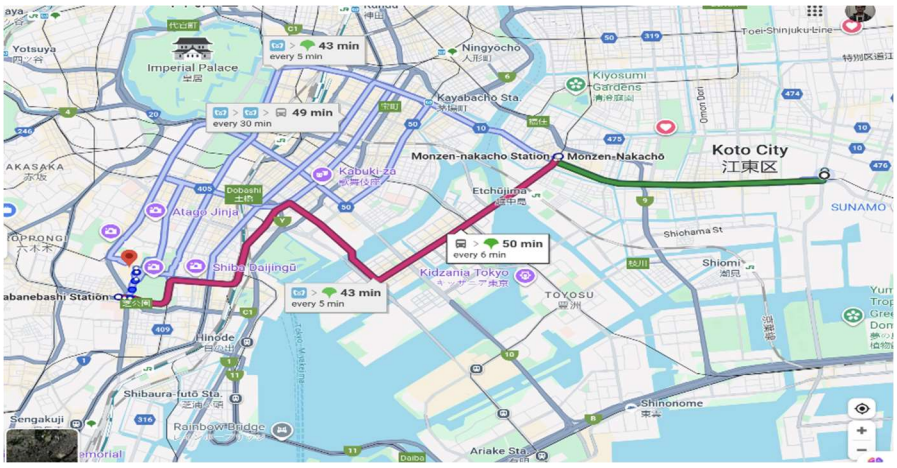
1. What is AI? Definition and Intuition

1.1 Intuitive Idea

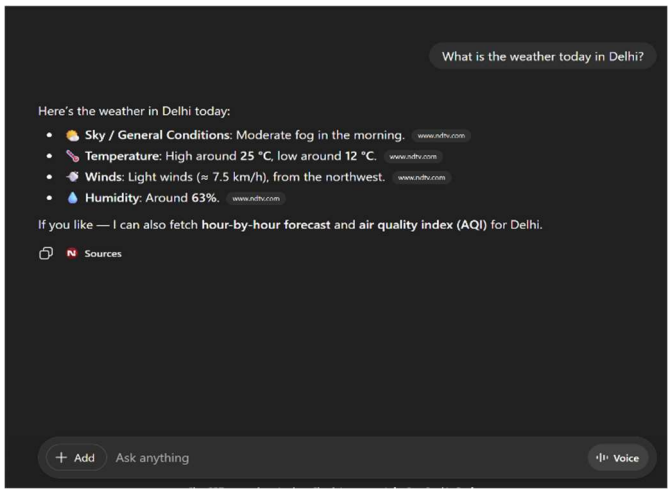
> "Very simply, AI is about making computers behave intelligently: that means they can make decisions, learn from experience, and solve problems that normally require human intelligence.

Examples:

- Phone unlocking with face → perception.
- Google Maps route recommendation → decision making.



- ChatGPT answering questions → language understanding and generation.



1.2 Formal Definition

> 'AI is the field of study that gives computers the ability to perform tasks that typically require human intelligence, such as perception, reasoning, learning, and decision-making.

1.3 Traditional AI vs Modern AI

Traditional AI (earlier days) used a lot of hand-crafted rules – we call them rule-based systems or expert systems.

Modern AI, especially Machine Learning, is different:
Instead of us writing all the rules, we show the computer a lot of examples, and it learns the rules by itself.

```python
def weather_condition(temp):
    if temp < 20:
        return "Cold"
    elif temp < 30:
        return "Warm"
    else:
        return "Hot"
```

```python
import numpy as np
from sklearn.tree import DecisionTreeClassifier

X = np.array([[15], [18], [22], [25], [32], [35]])
y = np.array(["Cold", "Cold", "Warm", "Warm", "Hot", "Hot"])

model = DecisionTreeClassifier().fit(X, y)

print(model.predict([[19]]))  # Cold
print(model.predict([[24]]))  # Warm
print(model.predict([[40]]))  # Hot
```

Key point:

> "Traditional AI is like a student who memorizes instructions.
> Machine Learning is like a student who learns from experience."

(We will go deep into ML in later modules; here just set intuition.)

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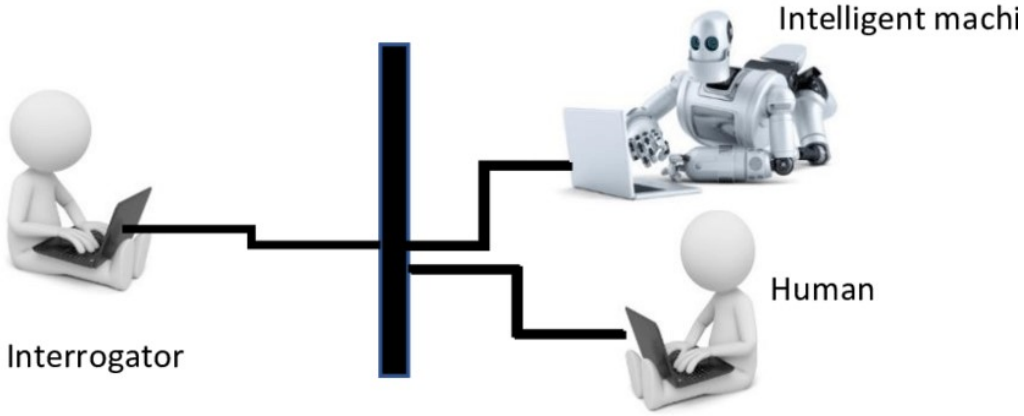
2. Brief History of AI (Timeline with Story)

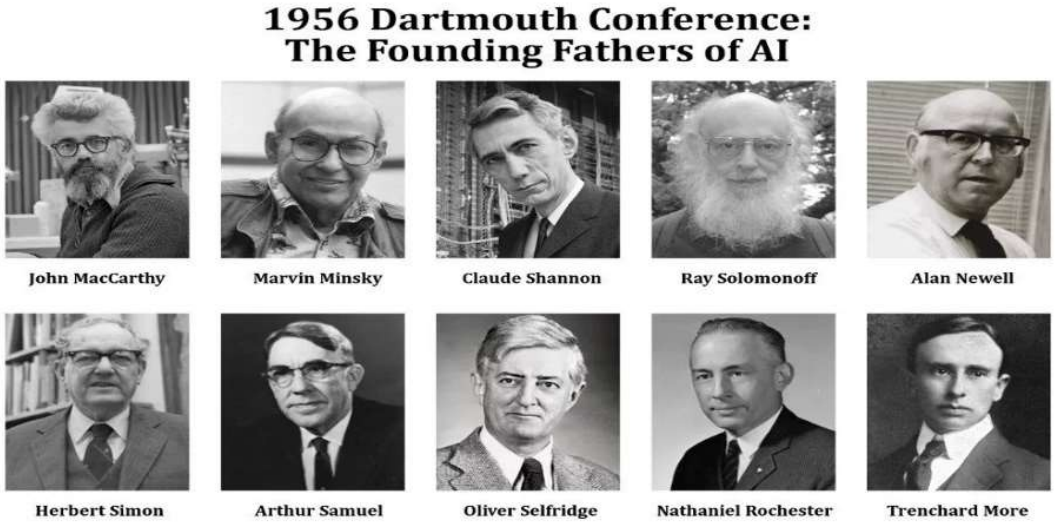
2.1 1950s – The Dream Starts

- 1950: Alan Turing proposes the **Turing Test** – can a machine's behavior be indistinguishable from a human in conversation?



- 1956: Term "**Artificial Intelligence**" coined at the Dartmouth Conference.

A small group of researchers gathered at Dartmouth in 1956 and basically



said:

"*We believe every aspect of intelligence can be so precisely described that a machine can be made to simulate it.'*

That moment is considered the birth of AI as a field."

2.2 1960s–1970s – Symbolic AI and Rule-Based Systems

In these early decades, AI was mostly symbolic.
That means people tried to encode knowledge as symbols and rules.

This style of AI led to expert systems – programs that tried to mimic human experts in narrow domains like medical diagnosis, chemistry, etc.

Examples:

- MYCIN – diagnosed bacterial infections using hundreds of rules.
  week1
- DENDRAL – predicted molecular structures.

2.3 AI Winters

"People initially **overpromised**. They thought human-level AI would come very soon.
But ***hardware*** was weak, ***data*** was scarce, and ***rule-based*** systems couldn't handle the complexity of the real world.

Funding dropped, hype collapsed – these periods are called 'AI winters'."

2.4 1980s–2000s – Statistical Learning and Foundations of ML

To handle uncertainty and noise, people started using statistics and probability.

This is where things like Bayesian methods, decision trees, early neural networks, and SVMs became popular.

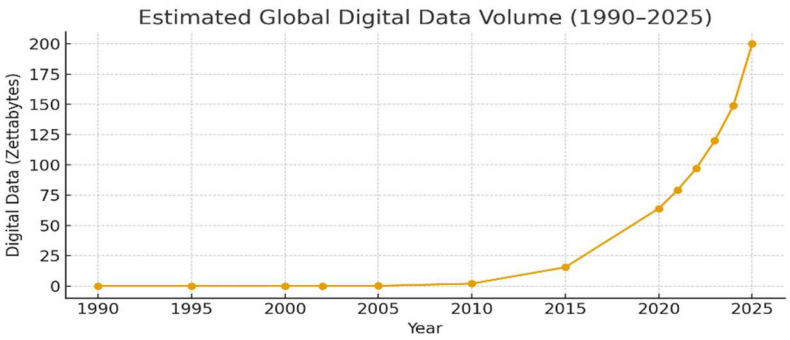
But still, neural networks were limited by:

- Compute.
- Lack of big data.
- Training difficulties.

2.5 2010s – **Deep Learning Boom**

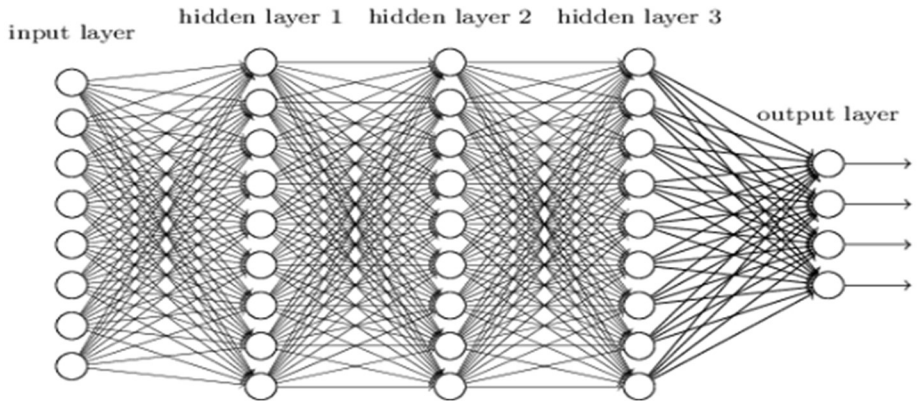
"Around 2010–2012, three things changed:

1. Massive data (internet, social media, sensors).

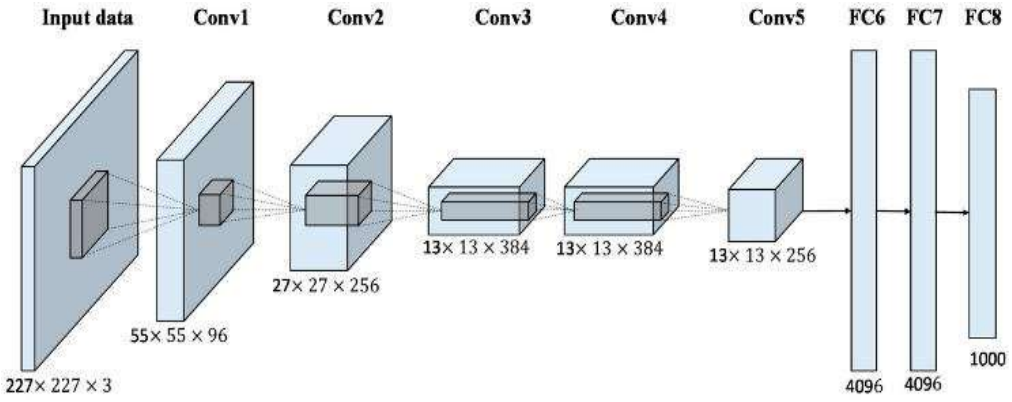


2. Powerful GPUs (gaming hardware used for matrix multiplication).

3. ALGORITHMIC IMPROVEMENTS (BETTER NEURAL NETWORK ARCHITECTURES, REGULARIZATION, ETC.).



IN 2012, A DEEP NEURAL NETWORK CALLED ALEXNET (CNN) CRUSHED THE IMAGENET (DATASET) IMAGE RECOGNITION COMPETITION.



THAT TRIGGERED THE MODERN DEEP LEARNING REVOLUTION."

IMPACT:

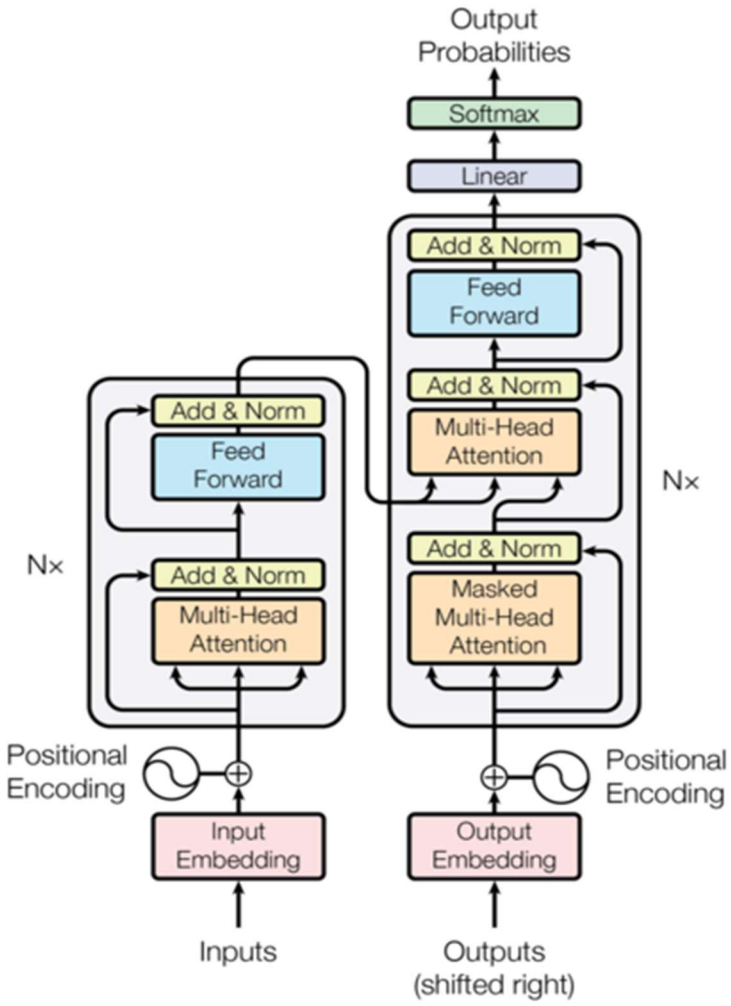
- COMPUTER VISION, SPEECH RECOGNITION, TRANSLATION, RECOMMENDATION SYSTEMS – ALL STARTED IMPROVING DRASTICALLY.

2.6 2020s – LLMs, GenAI, Multimodal AI

ChatGPT era:

Today, we are in the era of foundation models and Generative AI:

- Large Language Models (LLMs) like GPT, LLaMA, Mistral.
- Diffusion models for images like Stable Diffusion, DALL·E, etc.
- Multimodal models that can handle text, images, audio, video.



The key shift:
One big model, pretrained on massive data, can be adapted to many tasks – translation, coding, summarization, Q&A, creative writing, etc."

3. Types of AI: Narrow, General, Superintelligent

3.1 Narrow AI (ANI – Artificial Narrow Intelligence)

Definition:

> Narrow AI is AI that is designed and trained for a specific task or a narrow range of tasks.
>
> It can be superhuman in that one task but is useless outside it.

Examples:

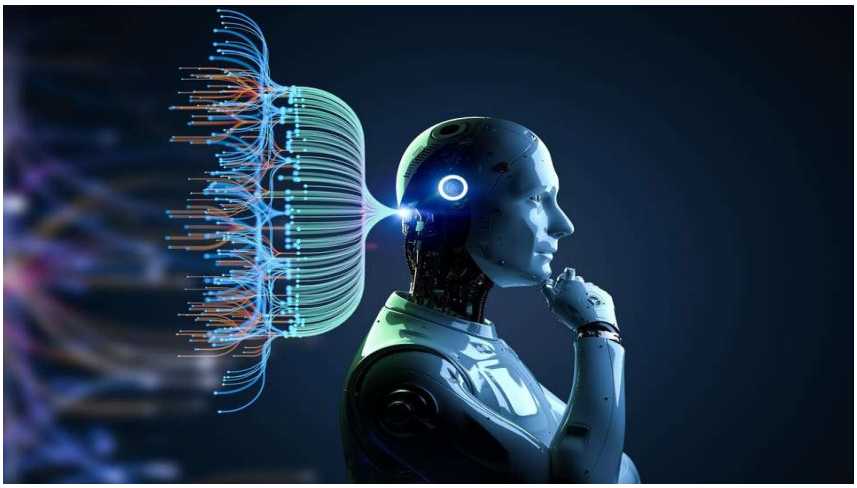
- A model that only recognizes cats vs dogs in images.
- A model that recommends YouTube videos.

example:

> Think of Narrow AI as a student who has prepared only one subject for the exam but is a topper in that subject.

Everything we have today in practice is Narrow AI, even ChatGPT. It is powerful, but still not general human intelligence.

3.2 General AI (AGI – Artificial General Intelligence)



Definition:

AGI is a hypothetical system that can understand, learn, and perform any intellectual task that a human being can, with similar flexibility and adaptability.

Current status:

"We do not yet have true AGI.

Some people believe advanced LLMs are steps towards AGI, others disagree.

3.3 Superintelligent AI (ASI – Artificial Superintelligence)

Definition:

Artificial Superintelligence refers to a system that surpasses human intelligence in almost all economically relevant tasks, creativity, scientific discovery, emotional understanding, etc.

"This is the idea that an AI could become not just as smart as the best human, but far beyond – like how humans are smarter than animals. It's a popular topic in sci-fi and serious research discussions about safety and alignment."

Hence:

- Narrow AI → what we actually build and use today
- AGI → goal or hypothesis
- Superintelligence → speculative future"

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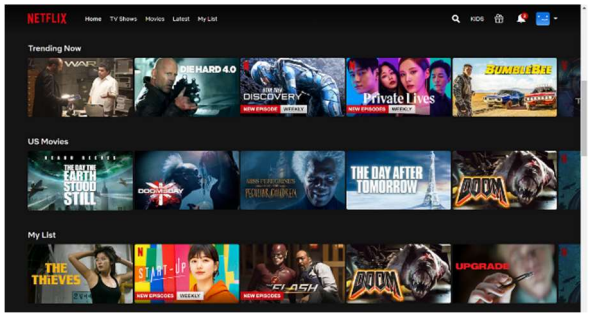
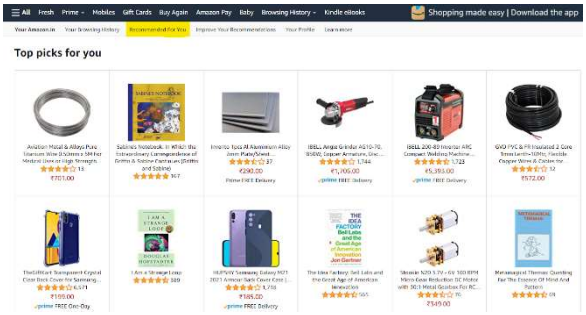
4. Real-World Applications of AI

4.1 Everyday Consumer Applications

- Recommendation systems:
  - YouTube, Netflix, Amazon, Spotify.

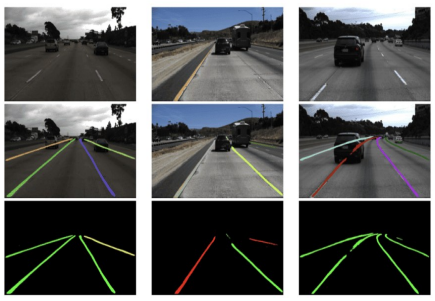


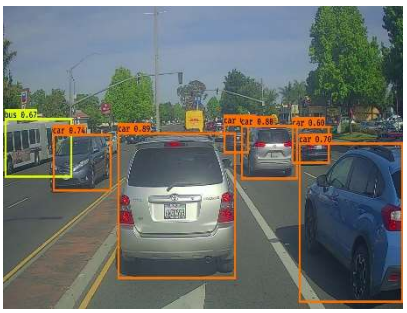


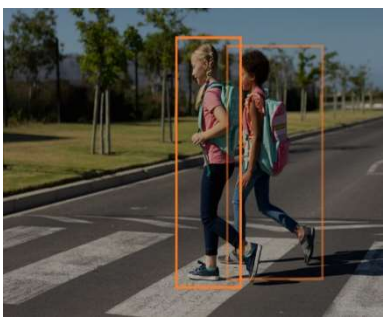
- Smartphones:
  - Face unlock, fingerprint matching.
  - Photo enhancement, portrait mode, auto-focus.
  - Keyboard next-word prediction, autocorrect.

4.2 Computer Vision in the Real World

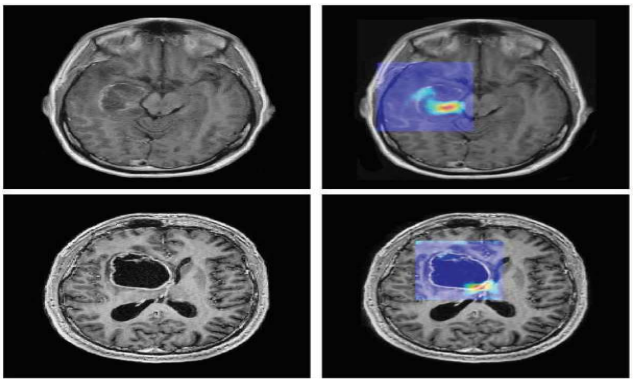
- Autonomous driving assistance:
  - Lane detection, object detection (cars, pedestrians).



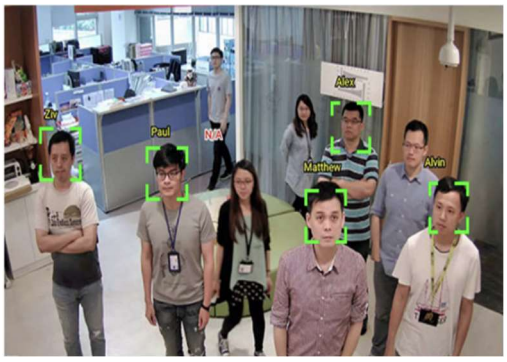


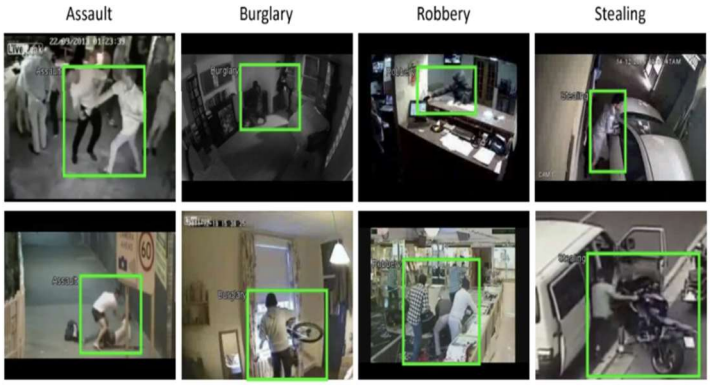


- MEDICAL IMAGING:
    - CANCER DETECTION FROM MRI, CT, X-RAY.



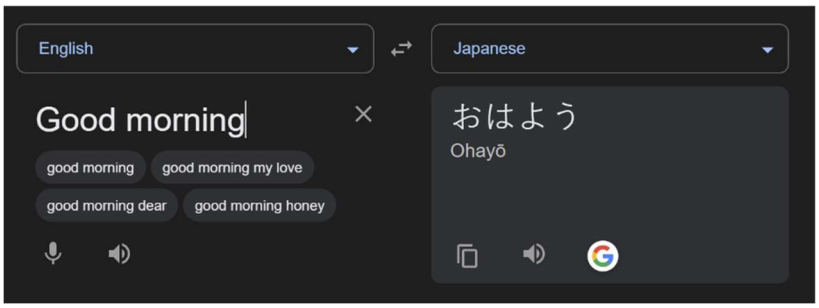
- SECURITY:
    - CCTV ANOMALY DETECTION, FACE RECOGNITION.



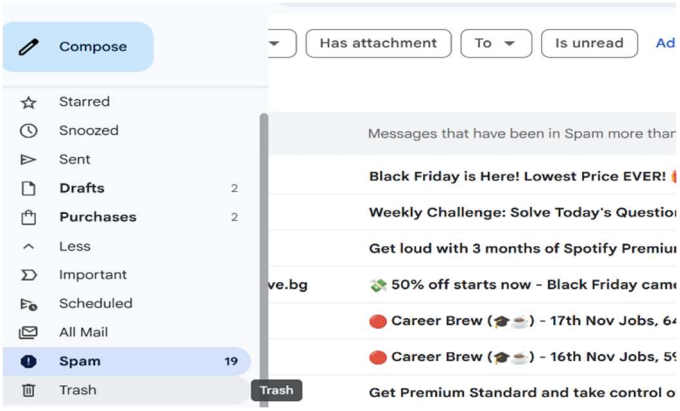


4.3 NLP and Language Applications

- Machine translation (Google Translate).



- Chatbots, virtual assistants (Siri, Alexa, ChatGPT).
- Spam classification in email.



4.4 Business & Finance

- Fraud detection in credit cards and online payments.
- Algorithmic trading.
- Credit scoring and risk assessment.
- Recommendation for loans, products, services.

4.5 Industry and Manufacturing

- Predictive maintenance:
  - Predict when a machine will fail based on sensor data.
- Quality control:
  - Detect defects in products using CV.
- Process optimisation:
  - Optimising supply chains, logistics, inventory.

4.6 Healthcare

- Diagnosis support (radiology AI, dermatology, pathology).
- Personalised treatment recommendations.
- Drug discovery (using GNNs and other models on molecules).

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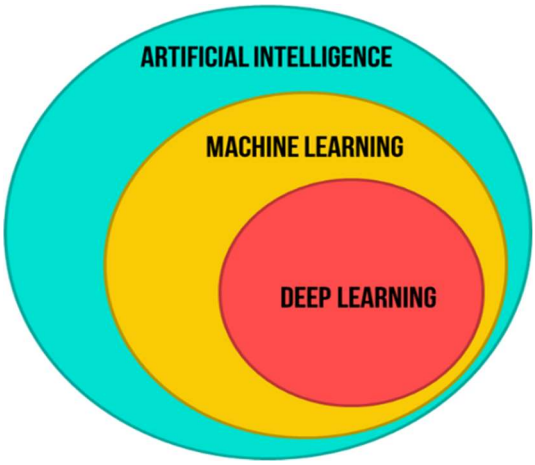
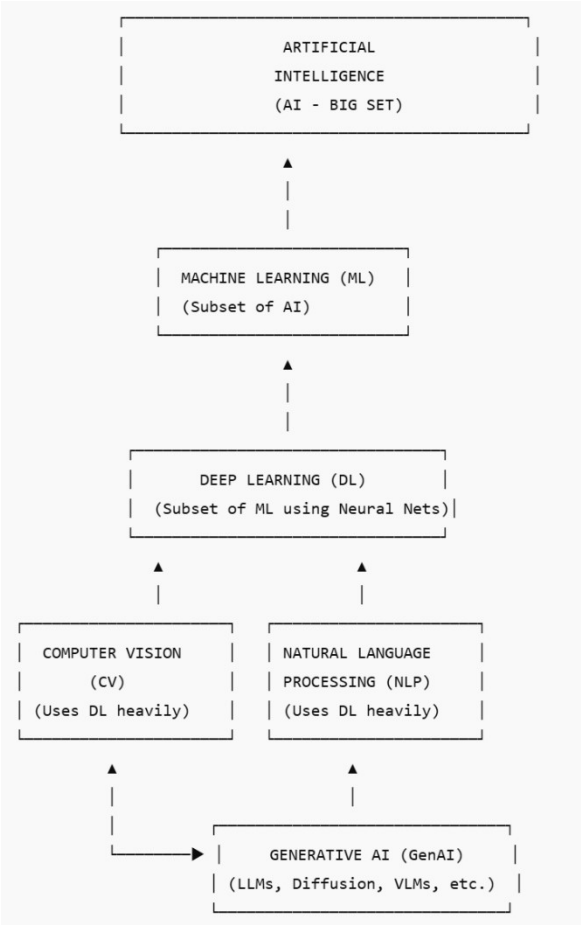
5. Overview of ML, DL, NLP, CV, GenAI

5.1 AI vs ML vs DL





Machine Learning (very high level now, detailed later):

> "Machine Learning is a subset of AI where instead of writing rules by hand, we train models using data so that they can make predictions or decisions."

Deep Learning:

> "Deep Learning is a specific approach in ML that uses deep neural networks with many layers. These models automatically learn features from raw data like images, audio, or text."

5.2 NLP (Natural Language Processing)

NLP is the subfield of AI that deals with language – text and speech.

Example:

- Sentiment analysis.
- Machine translation.
- Question answering and summarisation.

** modern NLP is heavily based on Transformers and LLMs, which I'll cover later.

5.3 Computer Vision (CV)

"CV is the subfield that deals with images and videos.

examples:

- Is there a cat or dog in this image?
- Where exactly is the object? (detection, segmentation)
- Who is in this image? (face recognition)
- What is happening in this video?

5.4 Generative AI (GenAI)

Generative AI refers to models that don't just classify or predict, but generate new content:

- Text: stories, code, essays (LLMs).
- Images: new artwork, logos (diffusion models).
- Audio: music, speech, sound effects.

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6. Modern AI Ecosystem: LLMs, Multimodal AI, Agents

This is the "now" part – what's happening in 2020s.

6.1 Large Language Models (LLMs)

LLMs are very large neural networks(billions or trillions) trained on massive text data to predict the next token (word, subword, character).

Examples: GPT, LLaMA, Mistral, Gemini, etc.

If you train a model to predict the next word in enough contexts – news, Wikipedia, code, novels – it ends up learning a huge amount of world knowledge and language structure.

That's why LLMs feel 'intelligent' in conversation.

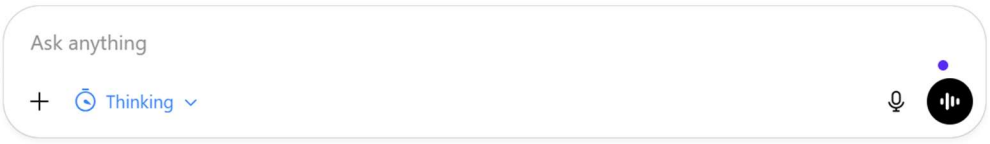
6.2 Multimodal AI

Multimodal models handle more than one type of input – for example:

- Text + Image (describe this image, answer questions about it).
- Text + Audio (transcribe and then analyse).
- In future maybe: text + image + audio + video + sensor data.

Examples:

- ChatGPT-like systems that can see images and respond.



6.3 AI Agents and Tools

On top of LLMs, people now build agents – systems that can:

- Call tools (like calculators, search APIs, code runners).
- Plan multi-step workflows.
- Interact with other software autonomously.

Intuition:

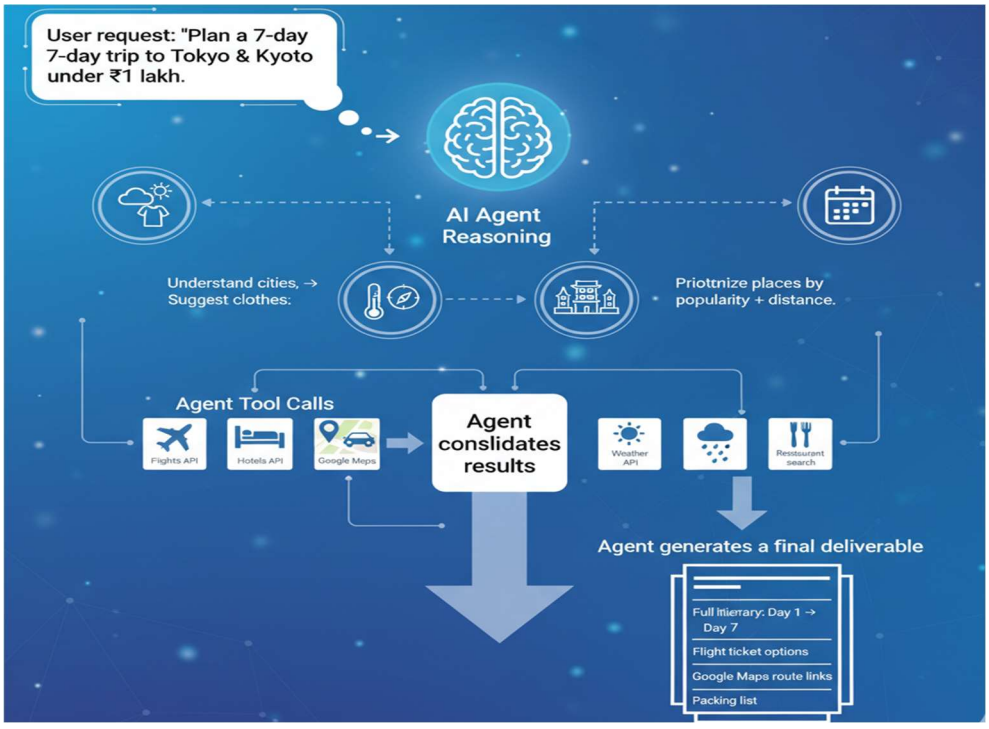
Think of LLM as the 'brain' that understands and generates language.

Agents are like giving that brain hands and legs – the ability to act in the digital world.

example: Full Travel Itinerary Planning Agent (End-to-End)

Goal: Plan a complete 7-day Japan trip.

How an AI agent works end-to-end:



1. **User request:**
   "Plan a 7-day trip to Tokyo & Kyoto under ₹1 lakh."
2. **Agent reasoning:**
   - Understand cities, budget, duration.
   - Fetch weather → Suggest clothes.
   - Prioritize places by popularity + distance.
3. **Agent tool calls:**
   - **Flights API** → get prices, timings
   - **Hotels API** → get best budget options
   - **Google Maps API** → calculate travel time
   - **Weather API** → daily weather
   - **Restaurant search** → veg/non-veg preferences
4. **Agent consolidates results**
   Organizes them into **Day 1** → **Day 7** with timings.
5. **Agent generates a final deliverable:**
   - Full itinerary
   - Hotel links
   - Flight ticket options
   - Google Maps route links
   - Packing list
   - Total estimated cost

6.4 Open-Source vs Closed Models

"Some models are closed-source (e.g., proprietary APIs).
Others like LLaMA, Mistral, many diffusion models are open or semi-open.
As practitioners, we should know both ecosystems:

- Closed models: easier to use, powerful, but limited control.
- Open models: more control, can run locally, but may require more engineering."

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7. Let's quickly revise what we did in this module:

1. Defined AI and understood it intuitively as computers that sense, think, and act.
2. Traced the journey from symbolic, rule-based AI and expert systems to today's deep learning and LLM era.
3. Understood the three capability types of AI: Narrow, General, Superintelligent – and realised that everything we use today is still Narrow AI.
4. Saw real-world applications: from YouTube recommendations and spam filters to medical diagnosis and self-driving cars.
5. Built a mental map of AI subfields: ML, Deep Learning, NLP, CV, and Generative AI.
6. Looked at the modern AI ecosystem – LLMs, multimodal AI, and agents."