Chapter 1: Introduction to Artificial Intelligence (AI)

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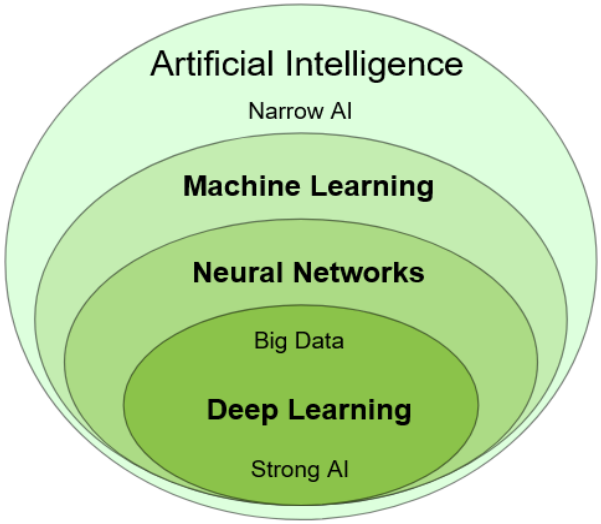
1. Definitions and Fields of Application of AI

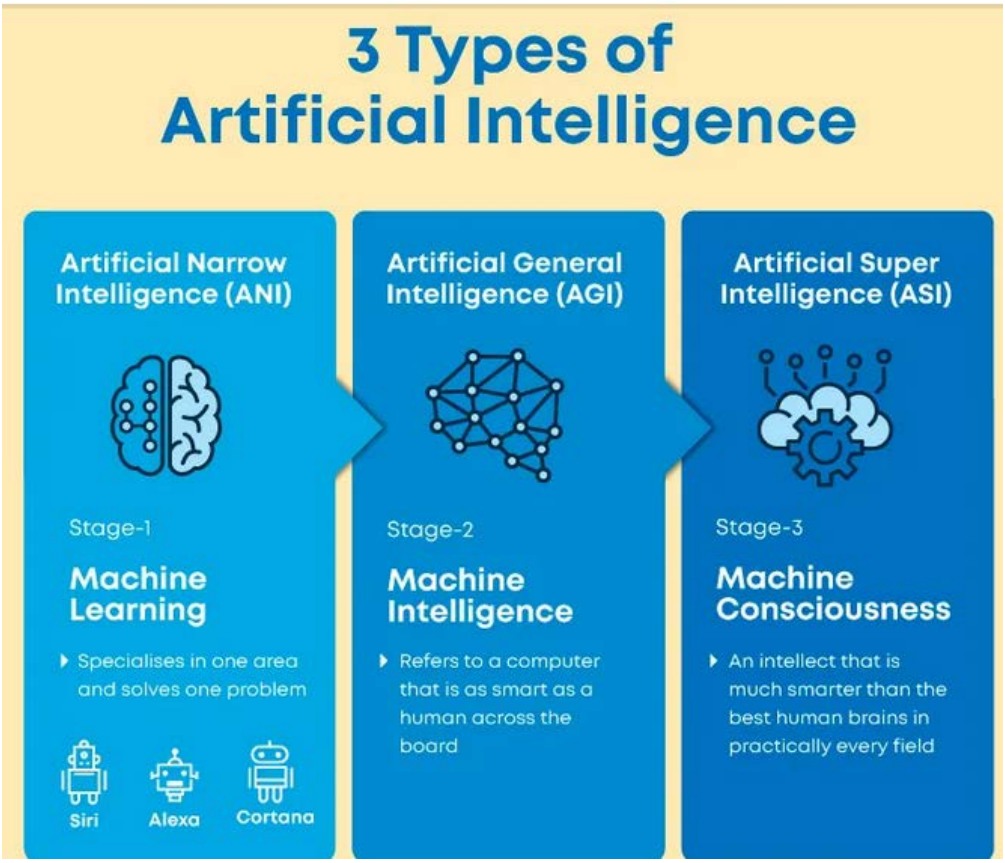
Definitions:

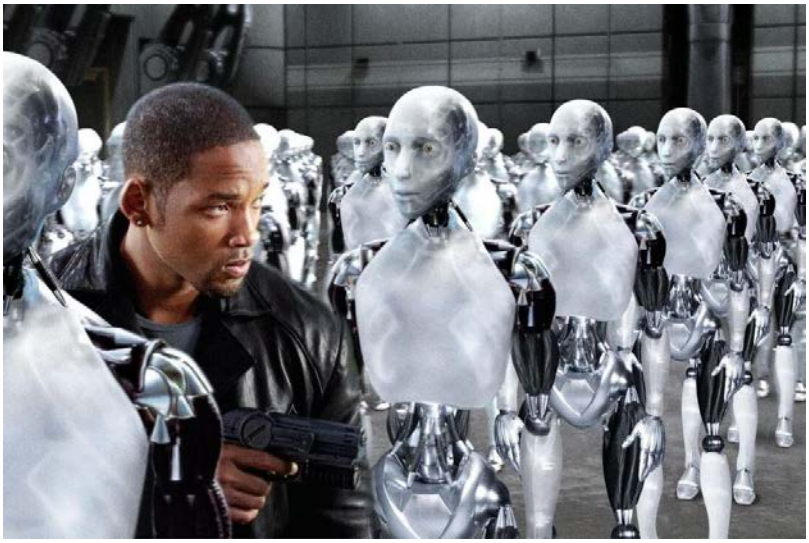
Artificial Intelligence is a scientific discipline embracing several Data Science fields ranging from narrow AI to strong AI, including machine learning, deep learning, big data and data mining.



AI ⊃ Machine Learning ⊃ Deep Learning

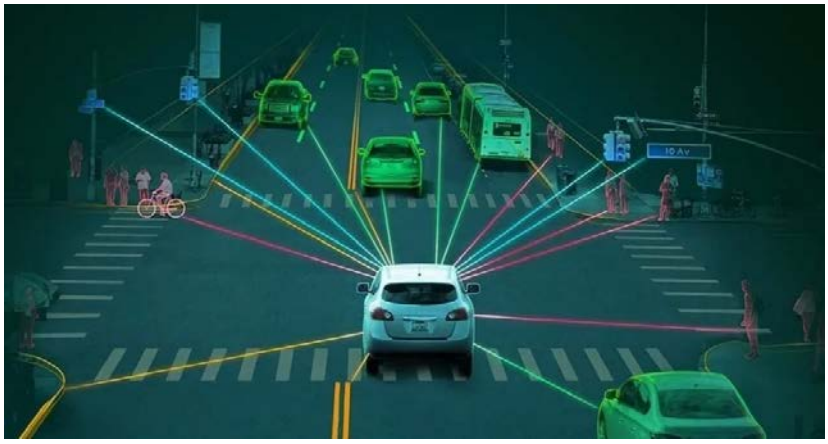
- **Weak AI (or Narrow AI)**: Systems specialized in a specific task (e.g., chess player, virtual assistant).
- **Strong AI (or General AI)**: A hypothetical system capable of understanding, learning, and adapting to any intellectual task like a human (not yet achieved).
- **Super intelligent AI**: A hypothetical level of AI that surpasses human intelligence in virtually every field, including scientific creativity, general wisdom, and social skills.





Fields of Application (examples):

- **Healthcare:** Assisted diagnosis, medical imaging analysis
- **Finance**: Fraud detection, algorithmic trading
- **Transportation**: Autonomous vehicles, logistics optimization
- **Education**: Adaptive tutorials, automated grading
- **Smart Home & Robotics**: Personal assistants, industrial robots
- **Media**: Content recommendation (YouTube, Netflix), assisted creation


2. Historical Evolution of AI

1. 1950s-1960s: Birth of AI

- 1956: Dartmouth Conference, the term "Artificial Intelligence" is officially coined (John McCarthy, Marvin Minsky, etc.)
- First symbolic programs: Logic Theorist (Newell & Simon), problem solving through logical reasoning

2. 1970s-1980s: AI Winters

- Limitations of symbolic systems in dealing with real-world complexity
- Funding reduction (Lighthill Report, 1973)
- Emergence of **expert systems** (1980s): use of knowledge bases in narrow domains (e.g., MYCIN for medical diagnosis)

3. 1990s-2000s: Renaissance through Data and Learning

- Development of **Machine Learning** thanks to increased data availability and computing power
- Practical successes: spam filtering, character recognition, search engines

4. 2010s to Present: Deep Learning Explosion and Modern AI

- Rapid progress thanks to **deep neural networks**, GPUs, and Big Data
- Remarkable successes: AlphaGo (2016), language models (GPT), image generation (DALL-E), etc.
- AI becomes ubiquitous in consumer products

3. Introduction to Major Domains

• Machine Learning (ML)

ML is a subfield of AI that enables a system **to learn from data** without being explicitly programmed for each task.

Main Categories:

1. **Supervised Learning**
    - The model learns from labeled data (input → known output)
    - *Examples:* classification (spam vs non-spam), regression (price prediction)
2. **Unsupervised Learning**
    - Unlabeled data; the model looks for structures or groupings
    - *Examples:* clustering (customer segmentation), dimensionality reduction
3. **Reinforcement Learning**
    - An agent learns through rewards/penalties by interacting with an environment
    - *Examples:* video games, robotics, autonomous driving

• Deep Learning (DL)

A subdomain of ML using **artificial neural networks** with many layers ("deep").

Characteristics:

- Works particularly well with raw, massive data (images, sound, text)
- Architecture inspired by the human brain (connected neurons)
- Requires significant computing power (GPUs) and large amounts of data

Typical Applications:

- **Computer Vision**: Facial recognition, object detection
- **Natural Language Processing (NLP)**: Machine translation, chatbots
- **Content Synthesis**: Image generation, music generation, text generation

4. Python Examples in AI

Example: Natural Language Processing Example

```python
# Simple NLP example
text = "Natural Language Processing is Fun!"

# Tokenization (split text into words)
words = text.lower().split()

print(words)
```

Output:

```text
['natural', 'language', 'processing', 'is', 'fun!']
```