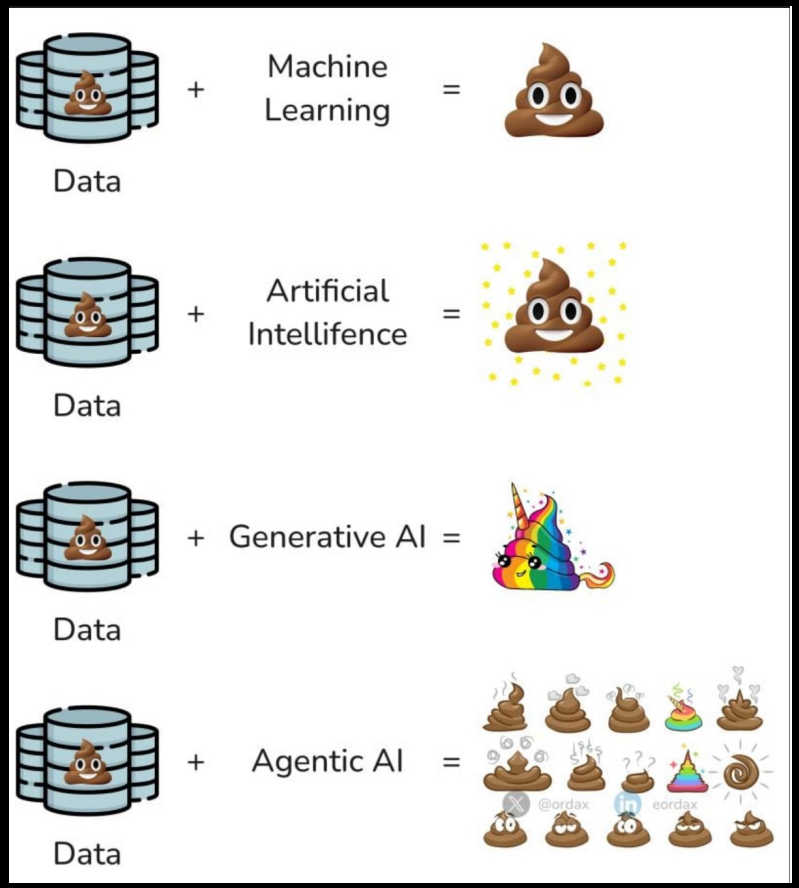
KEYSIGHT

Week 01- Session 01 - Machine Learning



Kelvin C. - PassDowns/Walkthroughs

(Obviously i didnt get paid to do this shit =/)

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Intro - Machine Learning?

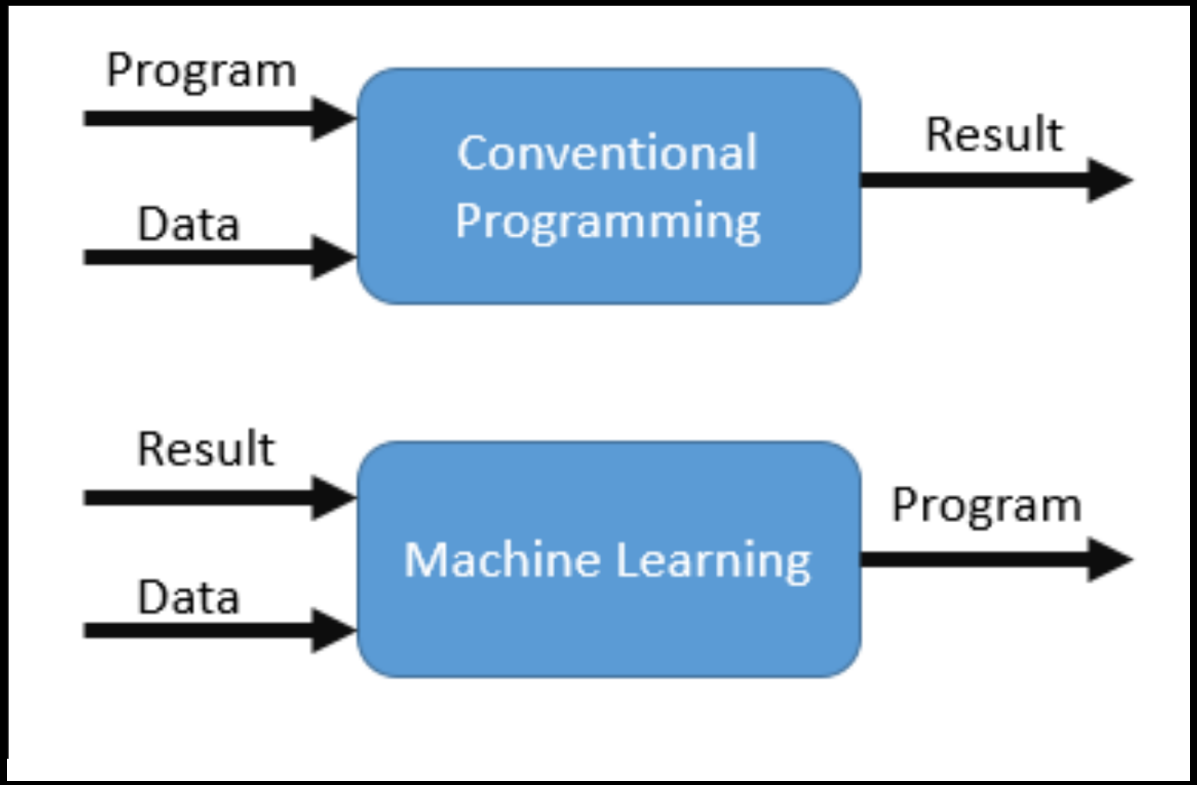


Figure: Overview of the machine learning process vs traditional.

Intro - Machine Learning

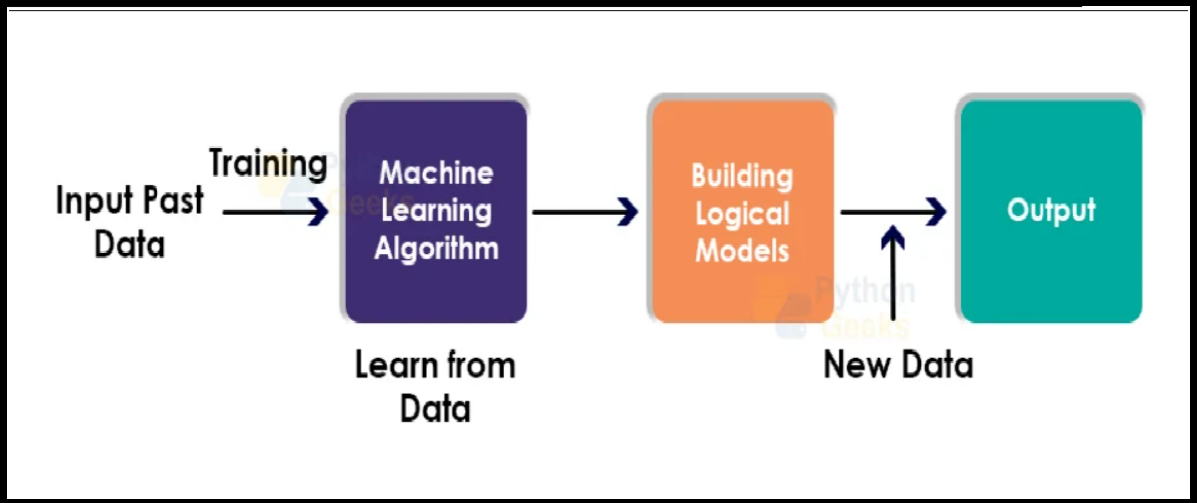


Figure: Overview of the machine learning process, from data input to prediction.

- Science of getting computers to learn without being explicitly programmed (Samuel, 1995)
- Machine learning: A computer program learning from experience E, with respect to some task T, and some performance measure P, if its performance on T as measured by P improves with experience E [Tom Mitchell,1998]
- Used for pattern recognition, prediction, and decision-making.

Types of Machine Learning

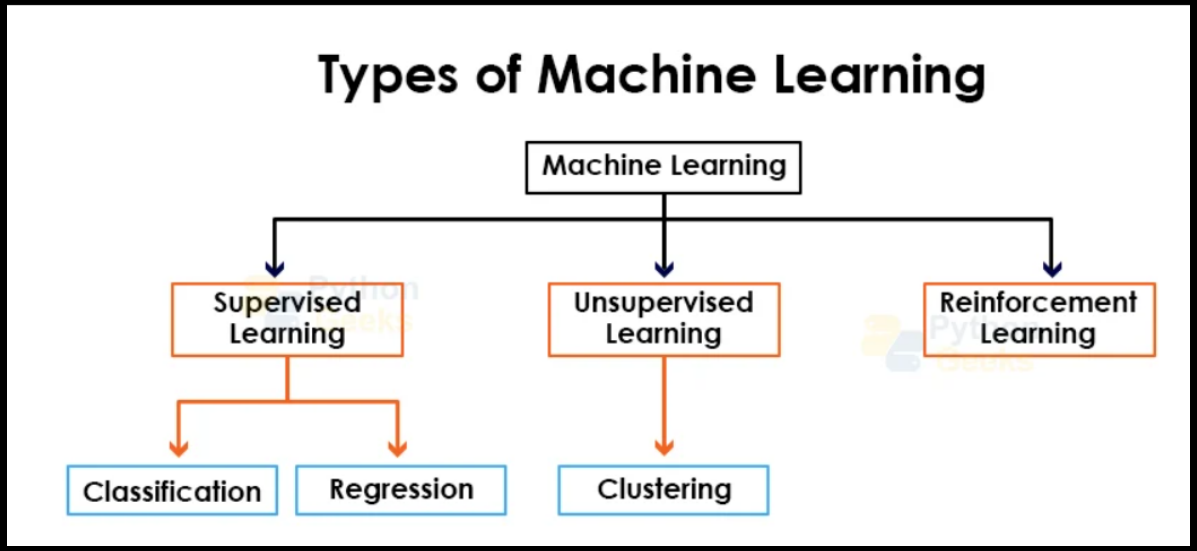


Figure: ML broadly categorized into these three types.

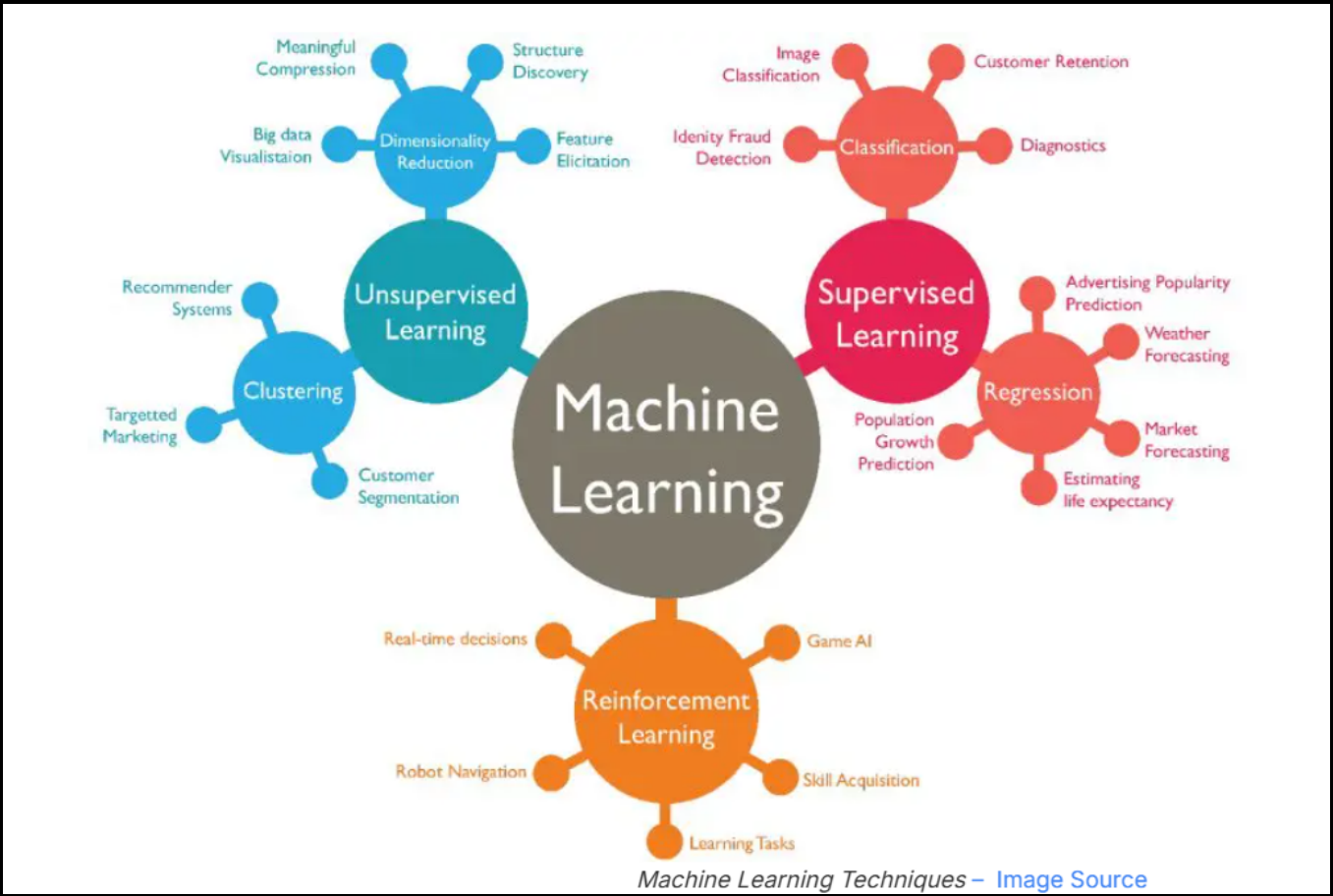
- **Classification:** Predict categorical labels.
  - Example: Predicting machine status (Working, Faulty).
- **Regression:** Predict continuous values.
  - Example: Predicting remaining useful life(RUL) of a machine.

Machine Learning Applications

Machine learning is used in a variety of fields and industries, including:

- **Healthcare:** Medical diagnostics, drug discovery, personalized treatment.
- **Finance:** Fraud detection, algorithmic trading, credit scoring.
- **Retail:** Customer segmentation, recommendation systems, inventory management.
- **Natural Language Processing (NLP):** Sentiment analysis, machine translation, chatbots.
- **Entertainment:** Movie/Music recommendations(Netflix/Spotify), e-commerce purchasing (Amazon/Ebay)

Machine Learning Applications By Types

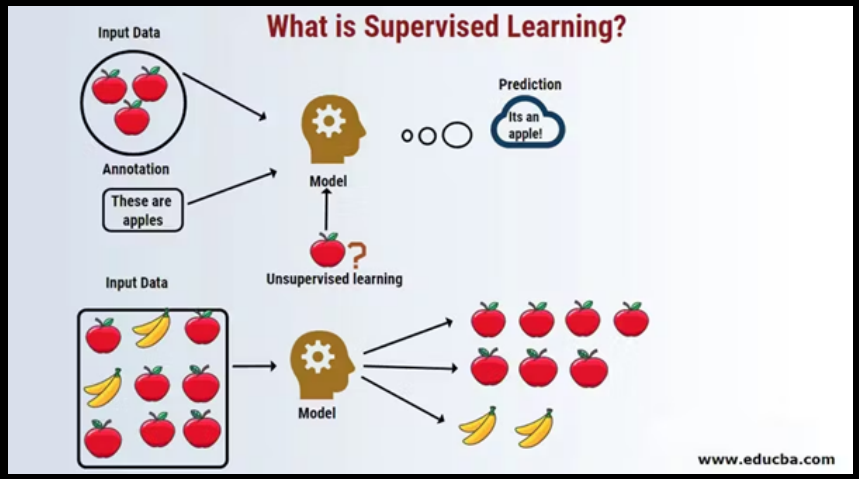


Machine Learning Techniques – Image Source

Keysight's Favourite - LLM

And of course, we wont miss this afterall.....

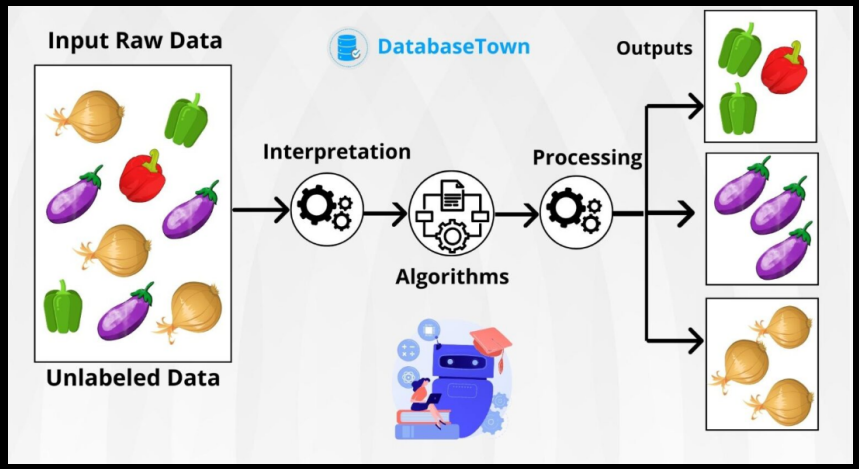
Supervised Learning



In supervised learning, the model is trained on labeled data. The goal is to learn a mapping from inputs to outputs.

- **Training Data:** Contains input-output pairs.
- **Objective:** Learn a function that maps inputs to correct outputs.
- **Examples:**
  - **Classification:** Assigning labels (e.g., spam vs. not spam).
  - **Regression:** Predicting continuous values (e.g., house prices).
- **Algorithms:**
  - Linear Regression
  - Decision Trees
  - Support Vector Machines (SVM)

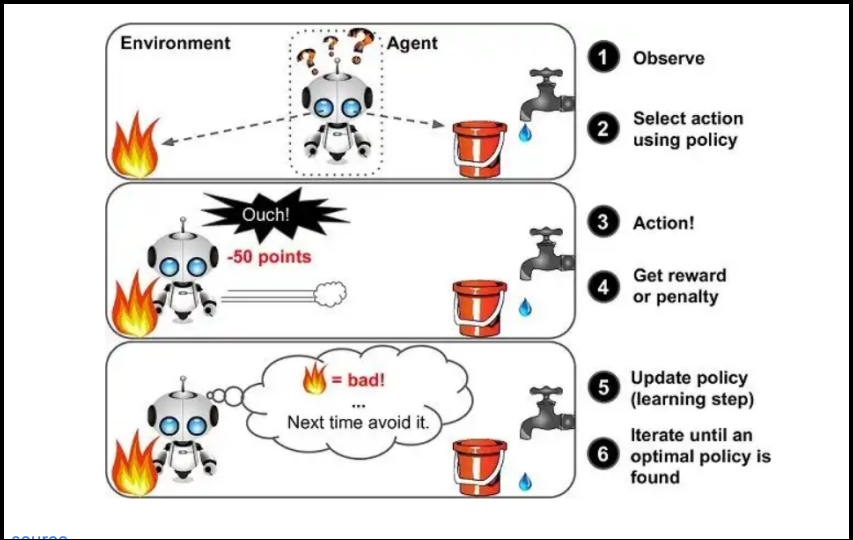
Unsupervised Learning



Unsupervised learning deals with data that has no labels. The goal is to find hidden patterns or structures in the data.

- **Training Data:** Only input data, no labels.
- **Examples:**
  - **Clustering:** Grouping similar data points (e.g., customer segmentation).
  - **Dimensionality Reduction:** Reducing the number of features (e.g., PCA).
- **Algorithms:**
  - K-Means Clustering
  - Hierarchical Clustering
  - Principal Component Analysis (PCA)

Reinforcement Learning

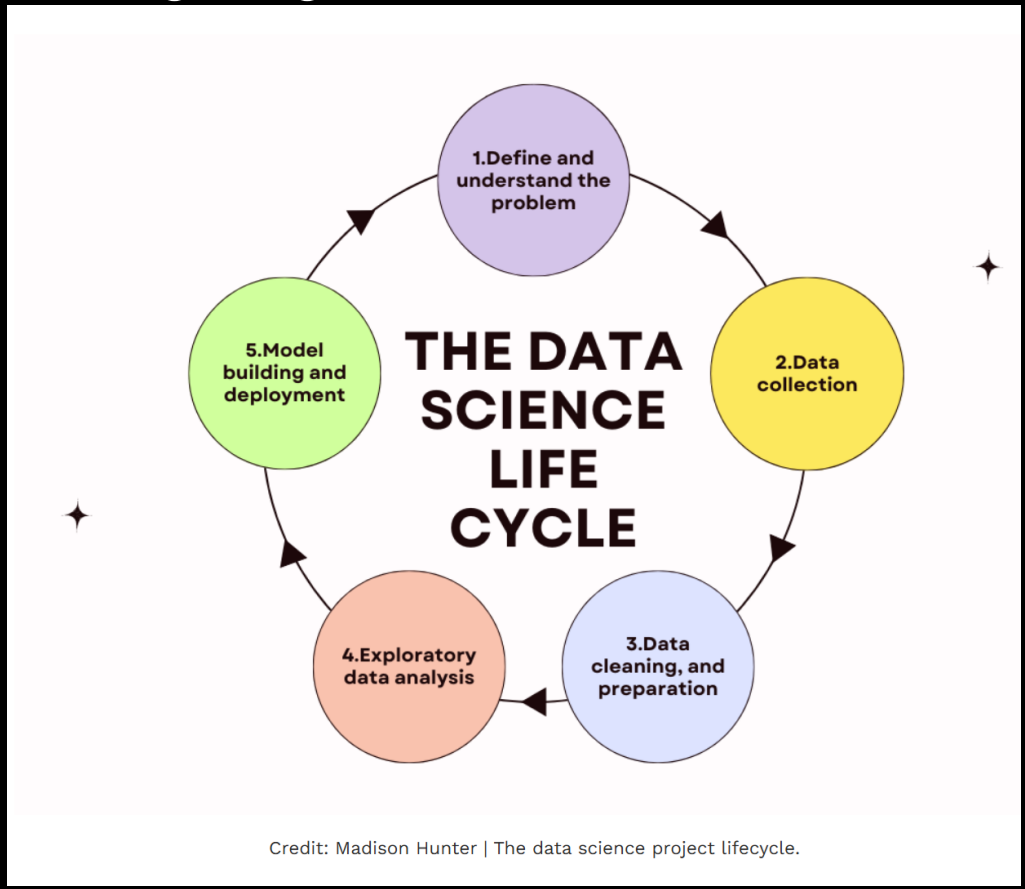


Reinforcement learning (RL) is based on agents that learn to make decisions by interacting with an environment.

- **Agent:** The learner or decision maker.
- **Environment:** Everything the agent interacts with.
- **Reward:** Feedback from the environment after each action.
- **Objective:** Maximize cumulative rewards over time.
- **Examples:**
  - Video game AI
  - Robotics (e.g., learning to walk)
  - Autonomous vehicles (Tesla)

Data Science Lifecycle

Data Science is the field of study that uses scientific methods, processes, algorithms, and systems to extract knowledge and insights from structured and unstructured data.
The data science lifecycle involves several steps that guide the process of extracting insights from data:



Credit: Madison Hunter | The data science project lifecycle.

Whats Next?

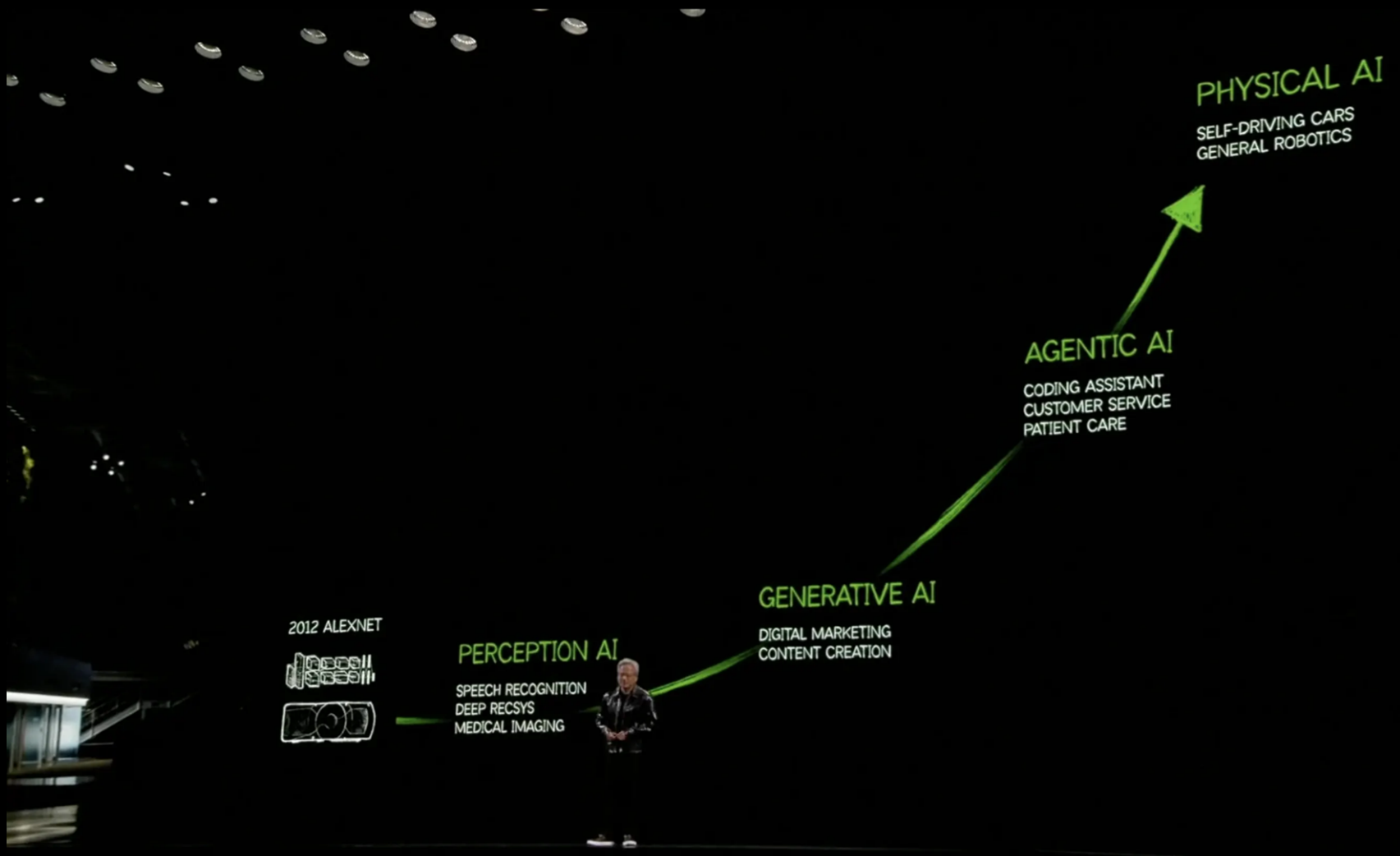
- Classification Tutorial
- Regression Tutorial

Useful Videos on YouTube

Check out these interesting YouTube video on machine learning:

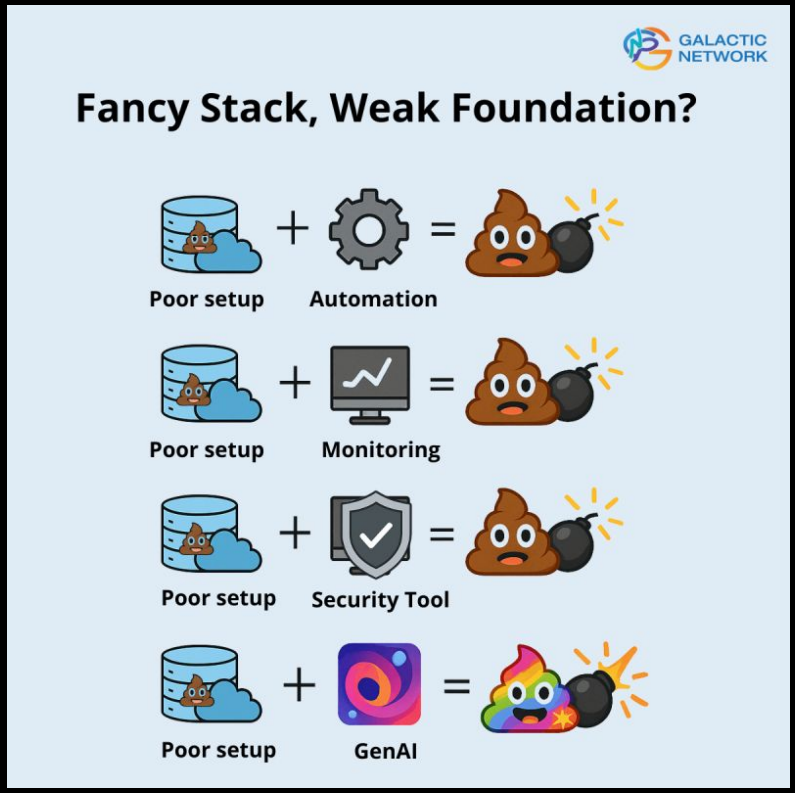
- Data Science Lifecycle
- ML vs Deep Learning
- DL I
- DL II
- DL III

Current Meta/Trend in AI



KEYSIGHT

Week 01 - Session 02 - Operation Research



Kelvin C. - PassDowns/Walkthroughs

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What is Operations Research?

Operations Research (OR) is a discipline that uses advanced analytical methods to help make better decisions.

- Combines mathematics, statistics, and theoretical computer science.
- Focuses on optimal decision-making under constraints.
- Widely used in business, engineering, military, and public services.

History of Operations Research

- Originated during **World War II** to solve military logistics and planning problems.
- Post-war, it expanded to industrial, commercial, and governmental applications.
- Formalized as an academic discipline in the 1950s and 60s.
- Modern OR incorporates AI, data analytics, and simulation.

Applications of Operations Research

Operations Research is applied across diverse domains:

- **Logistics and Supply Chain:** Routing, inventory management.
- **Manufacturing:** Production scheduling, resource allocation.
- **Healthcare:** Staff scheduling, patient flow optimization.
- **Finance:** Portfolio optimization, risk analysis.
- **Transportation:** Traffic management, airline scheduling.

OR Applications in Manufacturing

Optimization in Operations Research

A core focus of OR is **optimization**: finding the best solution under given constraints. Key techniques include:

- **Linear Programming (LP):**
  - Models problems with linear objectives and constraints.
  - Solved using the simplex method or interior-point methods.
  - Example: Maximize profit given limited resources.
- **Queuing Theory:**
  - Analyzes waiting lines and service systems.
  - Helps optimize staffing, reduce wait times, and improve service.
  - Example: Customer service centers, hospitals and restaurants/fast-food franchise.
- **Discrete Event Simulation (DES):**
  - Models systems as sequences of events in time.
  - Useful when analytical models are too complex.
  - Example: Simulating airport operations or emergency departments.

How Keysight DnE Roll?

Summary

- Operations Research is a powerful decision-making discipline rooted in mathematical modeling.
- Originated in military strategy, now widely applied in industry and services.
- Optimization is central to OR, with methods like:
  - Linear Programming
  - Queuing Theory
  - Discrete Event Simulation
- OR continues to evolve with data science and AI integration.

Useful Videos on YouTube about OR

Check out these interesting YouTube video on machine learning:

- LP I
- LP II
- Origin of TCS
- How to end WW II with Physics

The Quote

"Data Science(Science)'s like sheet music. The important thing isn't can you write/copy codes, it's can you hear it. Can you hear the music, Gregy? " =D

— Edited from Niels Bohr (from the film *Oppenheimer*)

References

- Samuel, A. L. (1995).Some studies in machine learning using the game of checkers. *IBM J. Res. Dev.*, *44*, 206–227. https://api.semanticscholar.org/CorpusID:2126705
- Tan, V. (2024). AI / Machine Learning in Supply Chain Management.