Artificial Intelligence

(0) Course Objectives and Outline

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Course Objectives

- To understand what is Artificial Intelligence.
- To understand the important application areas of AI.
- To understand the AI knowledge representation languages, such as predicate calculus, and semantic networks.
- To be able to use predicate calculus to represent and reason about problem domains.

- To understand State-space search algorithms.
- To be able to use the state space to represent reasoning with the predicate calculus.
- To understand the use of predicate calculus in natural Language processing.
- To be able to use AI as a tool for problem solving.

Course Outcomes

After completing this course you will be able to:

1. **Develop AI systems to solve real-world problems.**
2. **Use predicate calculus to represent and reason about problem domains.**
3. **Use tool for AI problem solving.**

Course Outline

(1) Introduction to Artificial Intelligence

- What is AI?
- Knowledge Representation Languages
- The characteristics of AI representation languages

(2) Problem Solving as Search

- State space search
- AI Application Areas

(3) Logic-based knowledge representation

- The propositional calculus
- The syntax and semantics of the propositional calculus

(4) The predicate calculus

- The syntax and semantics of the predicate calculus

Course Outline ..

(5) Inference Rules and Unification

(6) Structures for State Space Search

- **Graph Theory Basics**
- **State Space Representation of Problems**

(7) Strategies for State Space Search

- **Data-driven and goal-driven search.**
- **State space search algorithms: Backtrack algorithm, Depth-first and Breadth-first search.**

(8) Using the State Space to Represent Reasoning with Predicate Calculus

- **State Space Description of a Logical System**
- **And/Or Graphs**

(9) A natural language parser and a sentence generator.

Course Outline ..

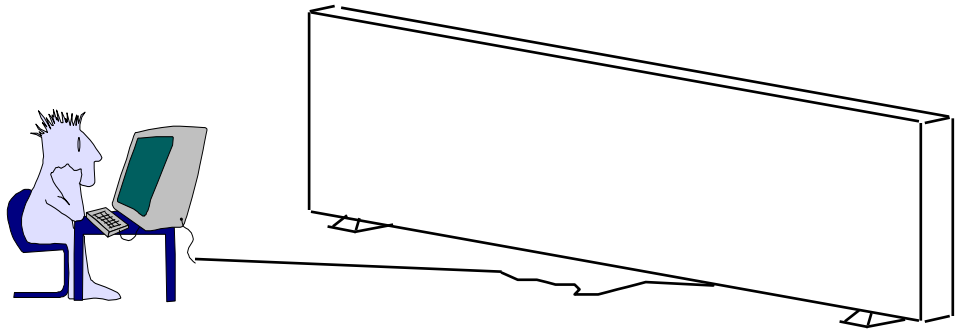
(10) Production Systems

- Definition of Production Systems
- Examples of Production Systems

What is AI

- Artificial intelligence (AI) may be defined as: *the branch of computer science that is concerned with the automation of intelligent behavior or the imitation of the human intelligence*.
- AI is the study of the computations that make it possible to perceive, reason, and act.
- Making computers that think?
- The automation of activities we associate with human thinking, like decision making, learning ... ?
- The art of creating machines that perform functions that require intelligence when performed by people ?

Systems that act like humans



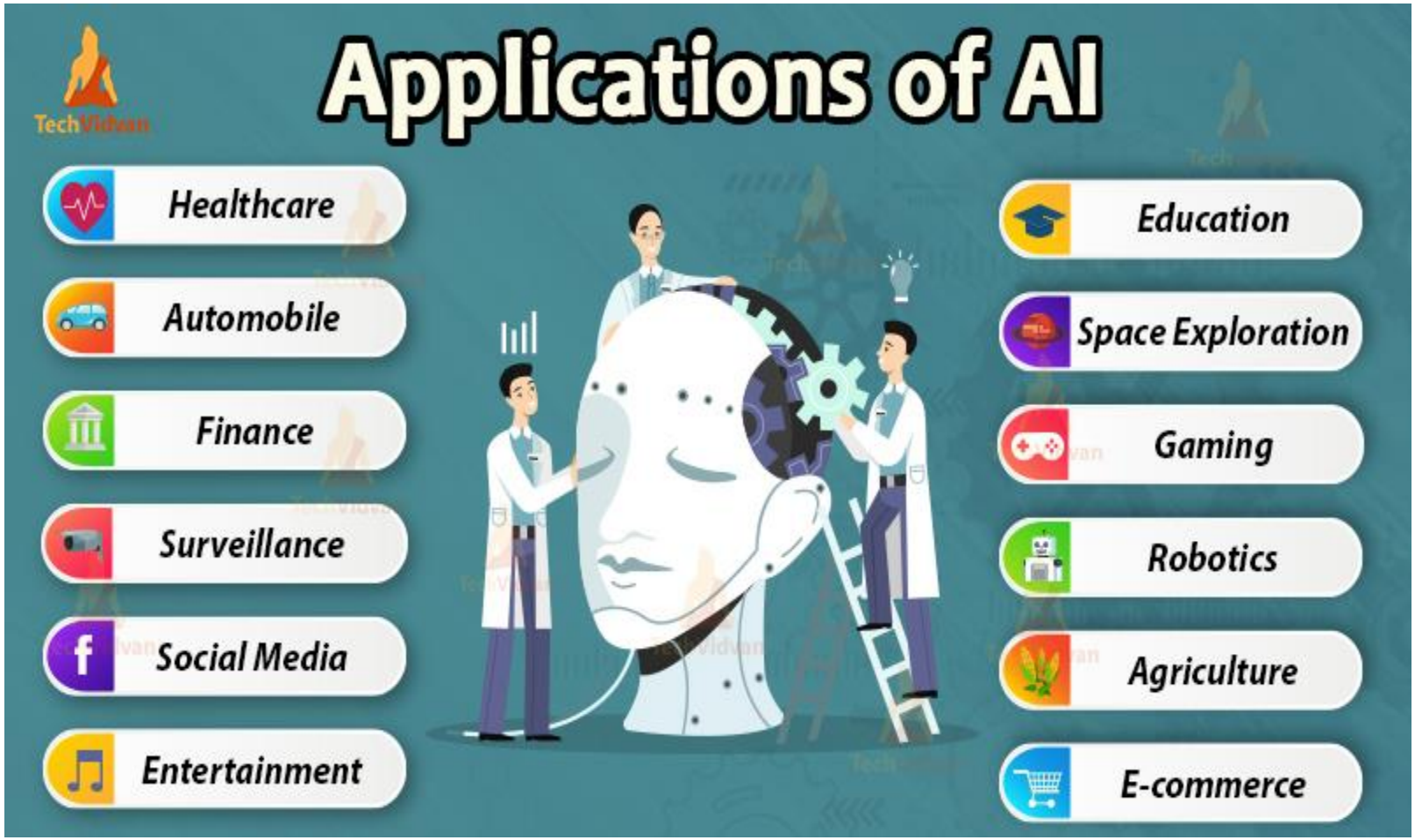
?

- **You enter a room which has a computer terminal. You have a fixed period of time to type what you want into the terminal, and study the replies.**
- **At the other end of the line is either a human being or a computer system.**

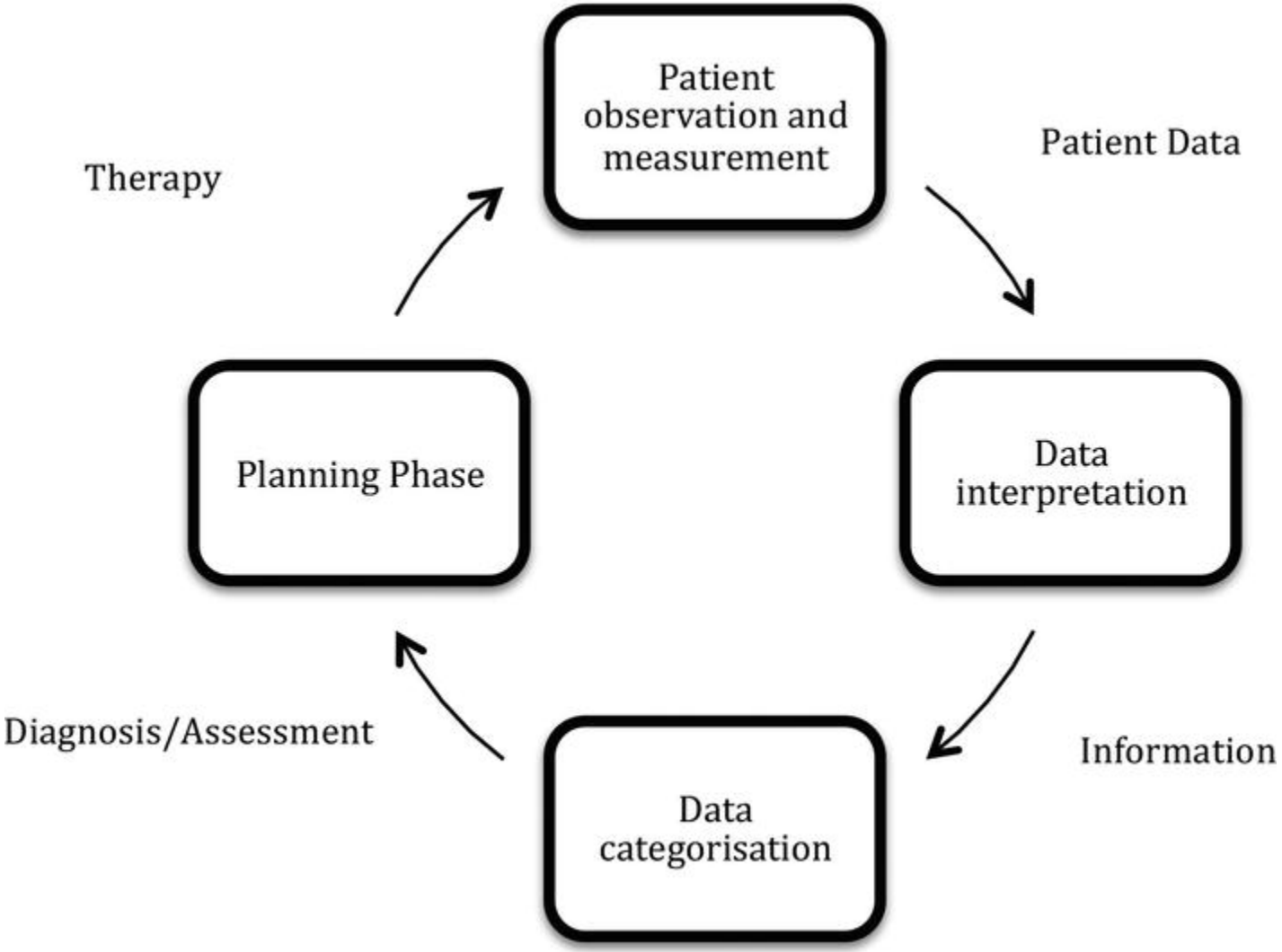
If it is a computer system, and at the end of the period you *cannot* reliably determine whether it is a *system* or a *human*, then the *system is deemed to be intelligent*.

AI Problems and Applications today

- Natural language processing such as
  - Natural Language Understanding
  - Speech Understanding
  - Language Generation
  - Machine Translation
  - Information retrieval and text mining
- Motion and manipulation such as
  - Robotics to handle such tasks as object manipulation and navigation, with sub-problems of localization (knowing where you are), mapping (learning what is around you) and motion planning (figuring out how to get there)
- Social and business intelligence such as
  - Social and customer behaviour modelling


TechVidvan
Applications of AI
Healthcare
Automobile
Finance
Surveillance
Social Media
Entertainment
Education
Space Exploration
Gaming
Robotics
Agriculture
E-commerce

AI in Healthcare

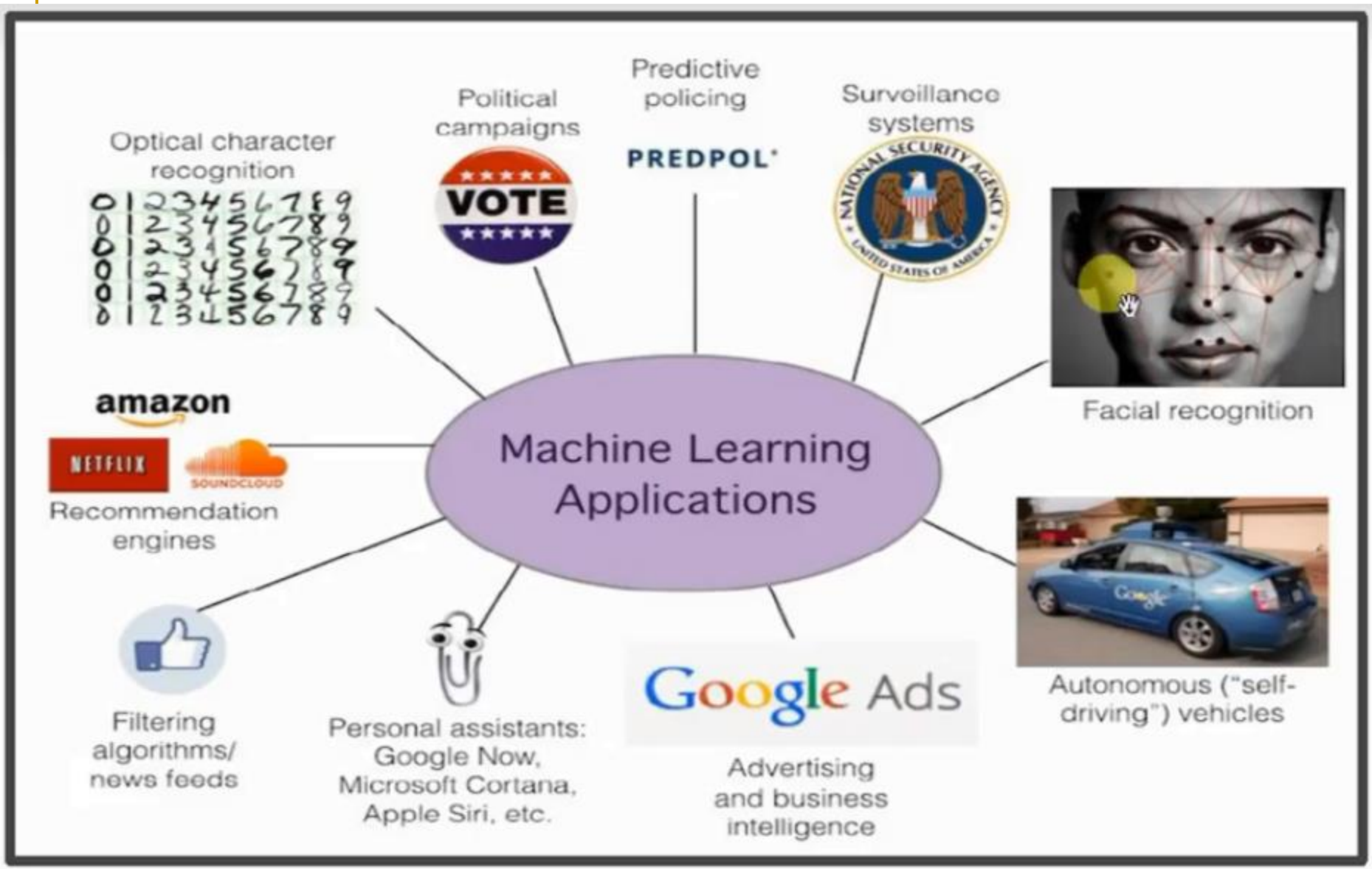

Patient observation and measurement
Patient Data
Data interpretation
Information
Data categorisation
Diagnosis/Assessment
Planning Phase
Therapy

AI simplifies the lives of patients, doctors and hospital administrators by performing tasks that are typically done by humans, but in less time and at a fraction of the cost.

AI can be used to analyze data throughout a healthcare system to mine, automate and predict processes.

AI can improve clinical workflows and even pinpoint a patient's risk of hospital-acquired infections.

More Examples ???


Machine Learning Applications
Optical character recognition
Political campaigns
VOTE
Predictive policing
PREDPOL
Surveillance systems
NATIONAL SECURITY AGENCY
Facial recognition
amazon
NETFLIX
SOUNDCLOUD
Recommendation engines
Filtering algorithms/ news feeds
Personal assistants: Google Now, Microsoft Cortana, Apple Siri, etc.
Google Ads
Advertising and business intelligence
Autonomous ("self-driving") vehicles

- Predictive maintenance or condition monitoring
- Warranty reserve estimation
- Propensity to buy
- Demand forecasting
- Process optimization
- Telematics

Manufacturing

- Predictive inventory planning
- Recommendation engines
- Upsell and cross-channel marketing
- Market segmentation and targeting
- Customer ROI and lifetime value

Retail

- Alerts and diagnostics from real-time patient data
- Disease identification and risk stratification
- Patient triage optimization
- Proactive health management
- Healthcare provider sentiment analysis

Healthcare and Life Sciences

- Aircraft scheduling
- Dynamic pricing
- Social media – consumer feedback and interaction analysis
- Customer complaint resolution
- Traffic patterns and congestion management

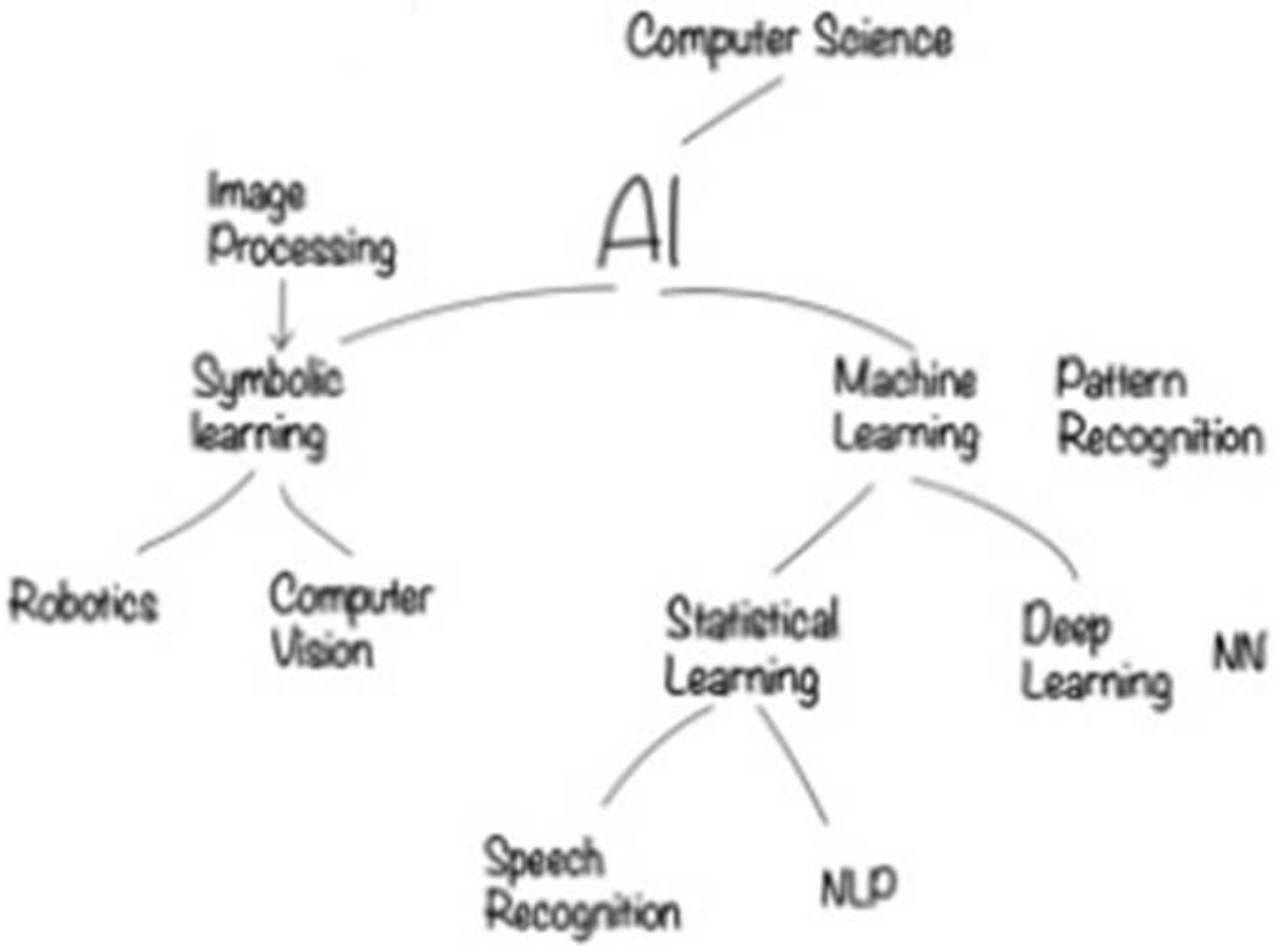
Travel and Hospitality

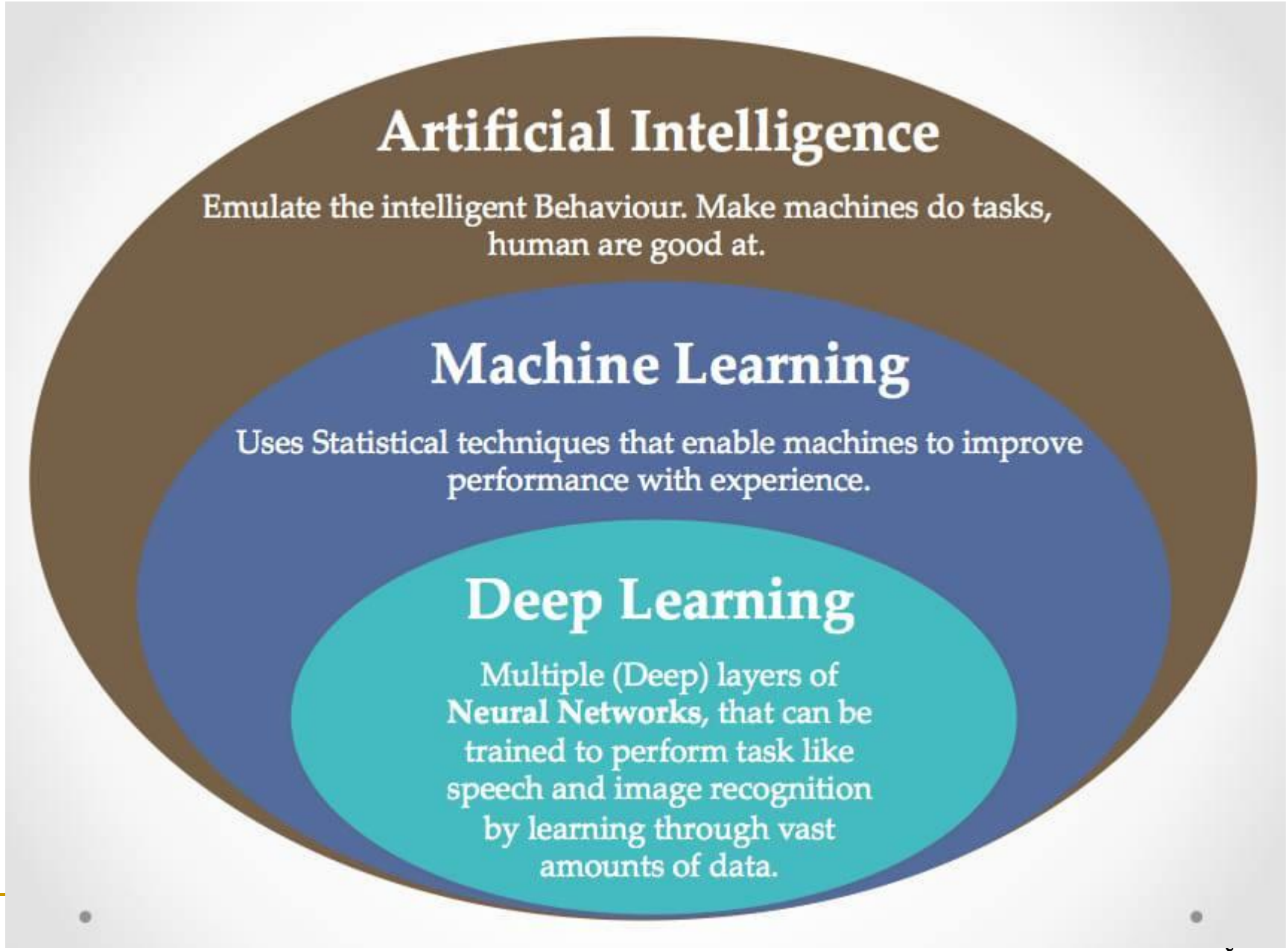
- Risk analytics and regulation
- Customer Segmentation
- Cross-selling and up-selling
- Sales and marketing campaign management
- Credit worthiness evaluation

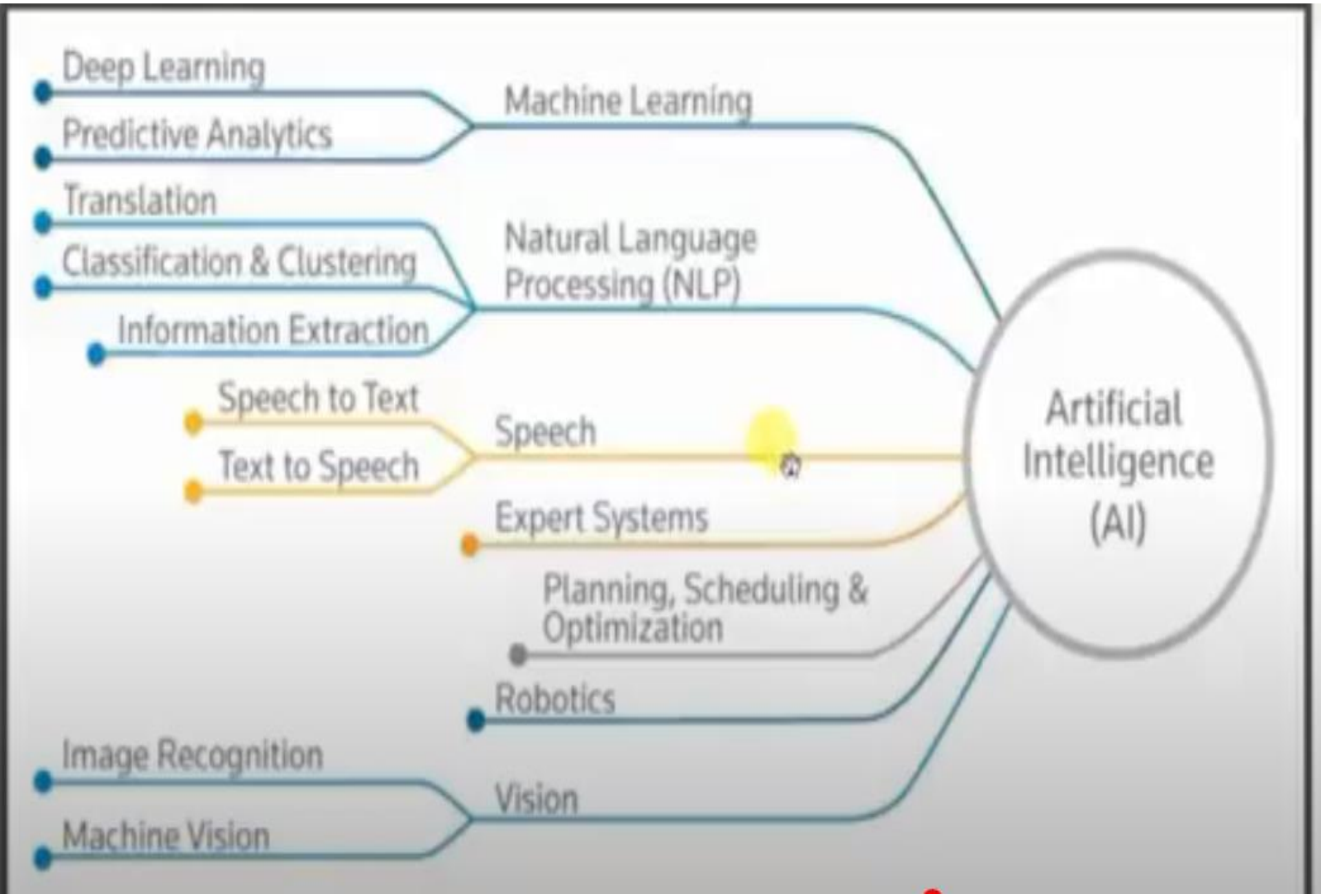
Financial Services

- Power usage analytics
- Seismic data processing
- Carbon emissions and trading
- Customer-specific pricing
- Smart grid management
- Energy demand and supply optimization

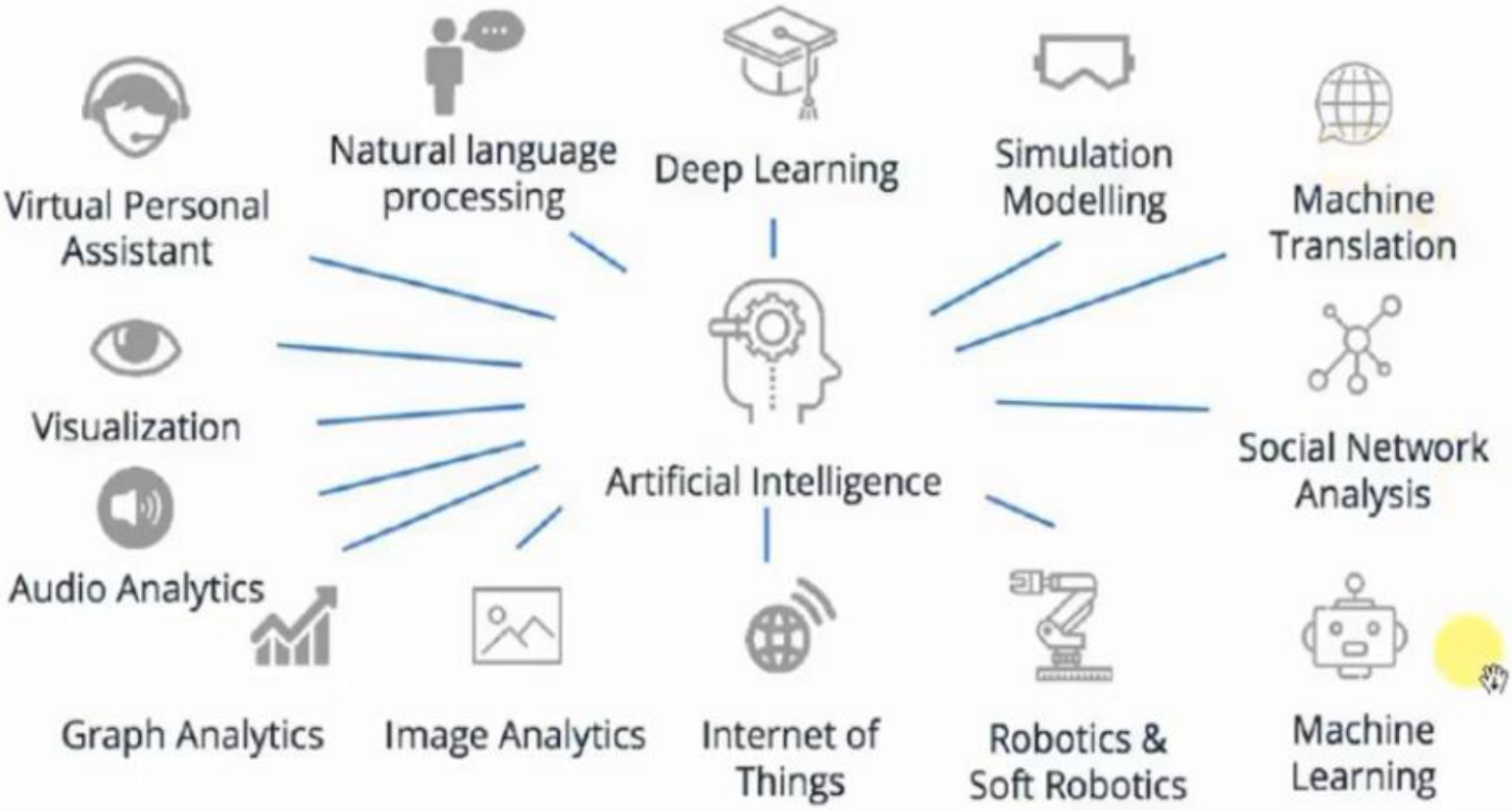
Energy, Feedstock, and Utilities


Computer Science
AI
Image Processing
Symbolic learning
Machine Learning
Pattern Recognition
Robotics
Computer Vision
Statistical Learning
Deep Learning
NN
Speech Recognition
NLP


Artificial Intelligence
Emulate the intelligent Behaviour. Make machines do tasks, human are good at.
Machine Learning
Uses Statistical techniques that enable machines to improve performance with experience.
Deep Learning
Multiple (Deep) layers of Neural Networks, that can be trained to perform task like speech and image recognition by learning through vast amounts of data.


Deep Learning
Predictive Analytics
Machine Learning
Translation
Classification & Clustering
Information Extraction
Natural Language Processing (NLP)
Speech to Text
Text to Speech
Speech
Expert Systems
Planning, Scheduling & Optimization
Robotics
Image Recognition
Machine Vision
Vision
Artificial Intelligence (AI)

Possible applications for Artificial Intelligence



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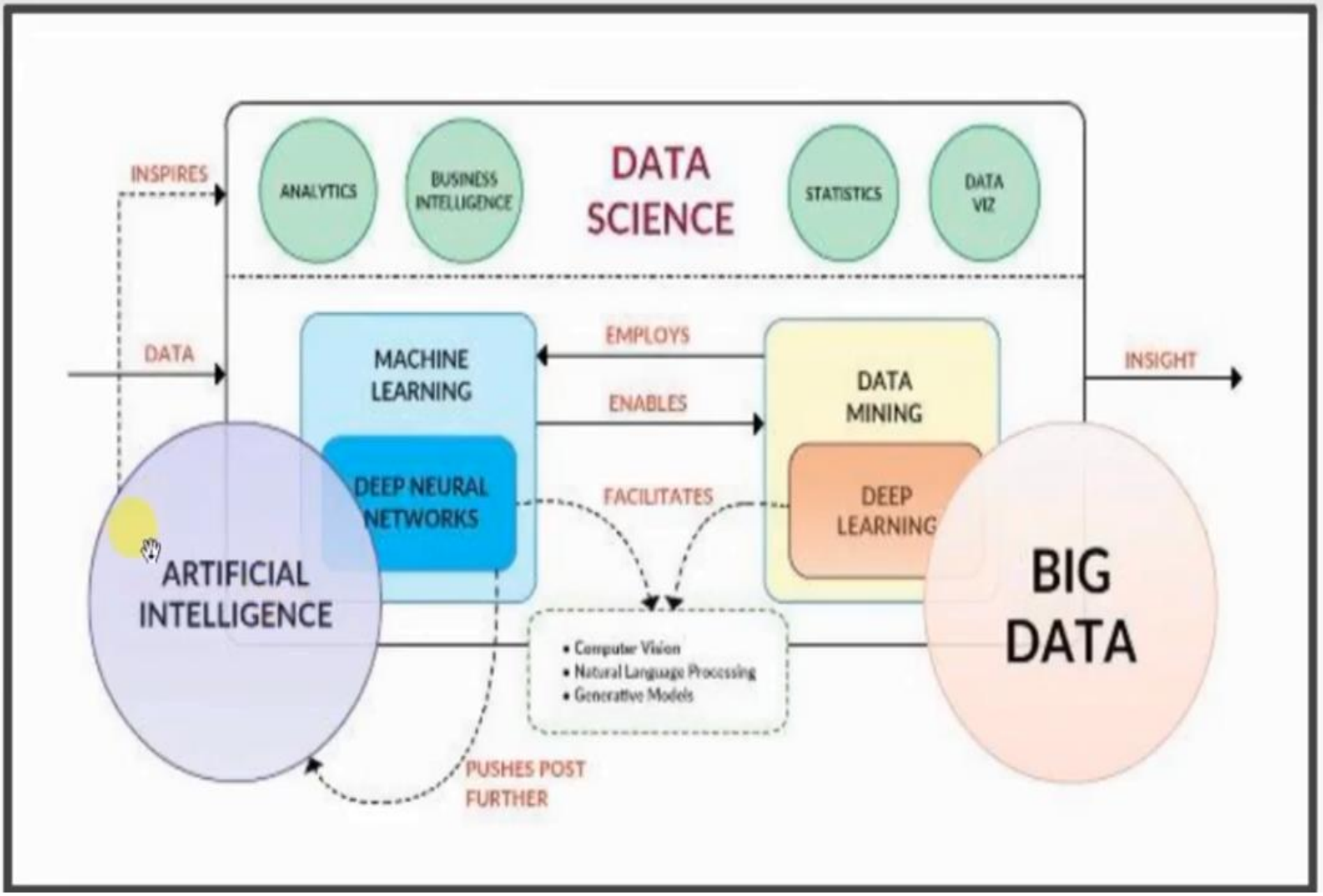
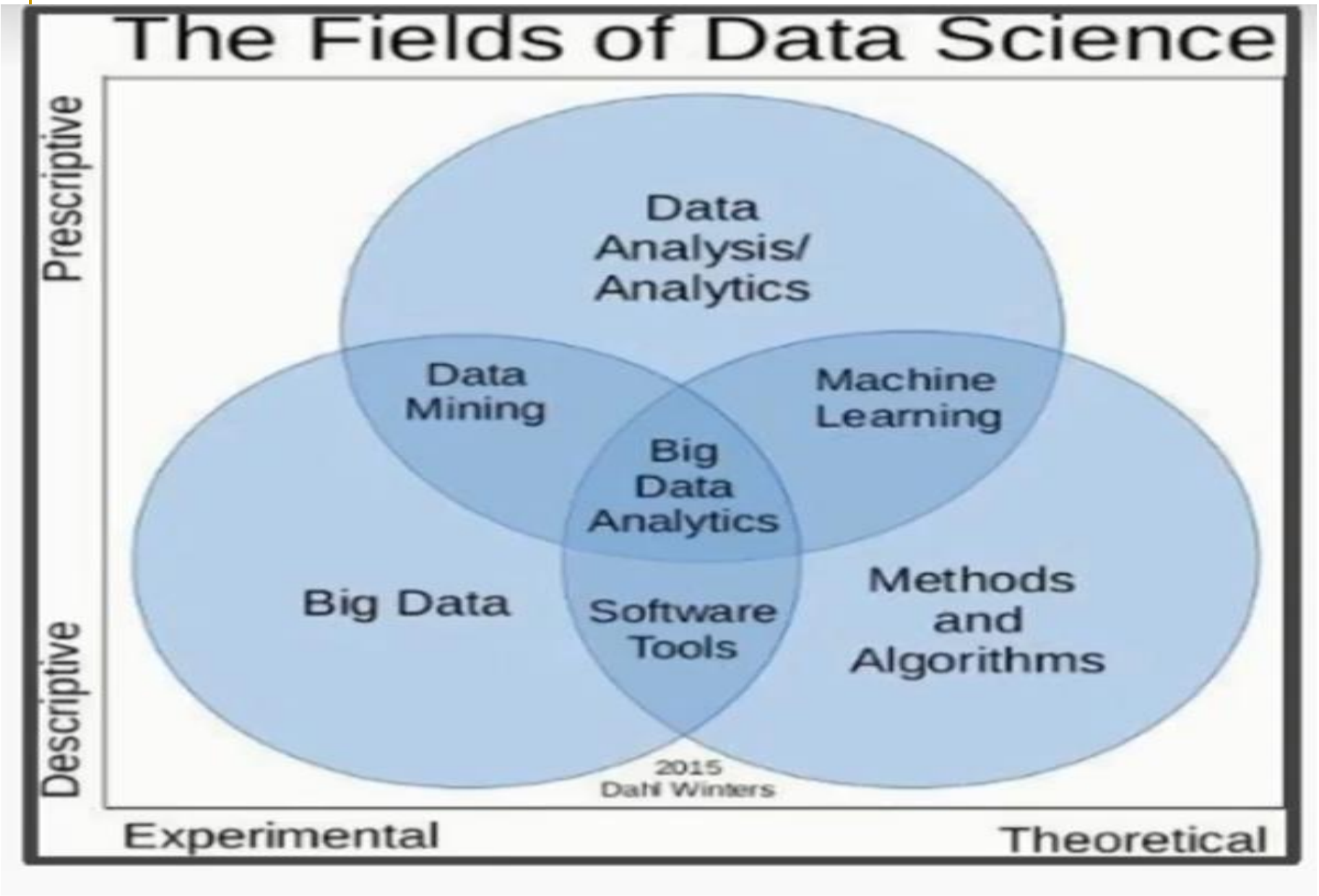
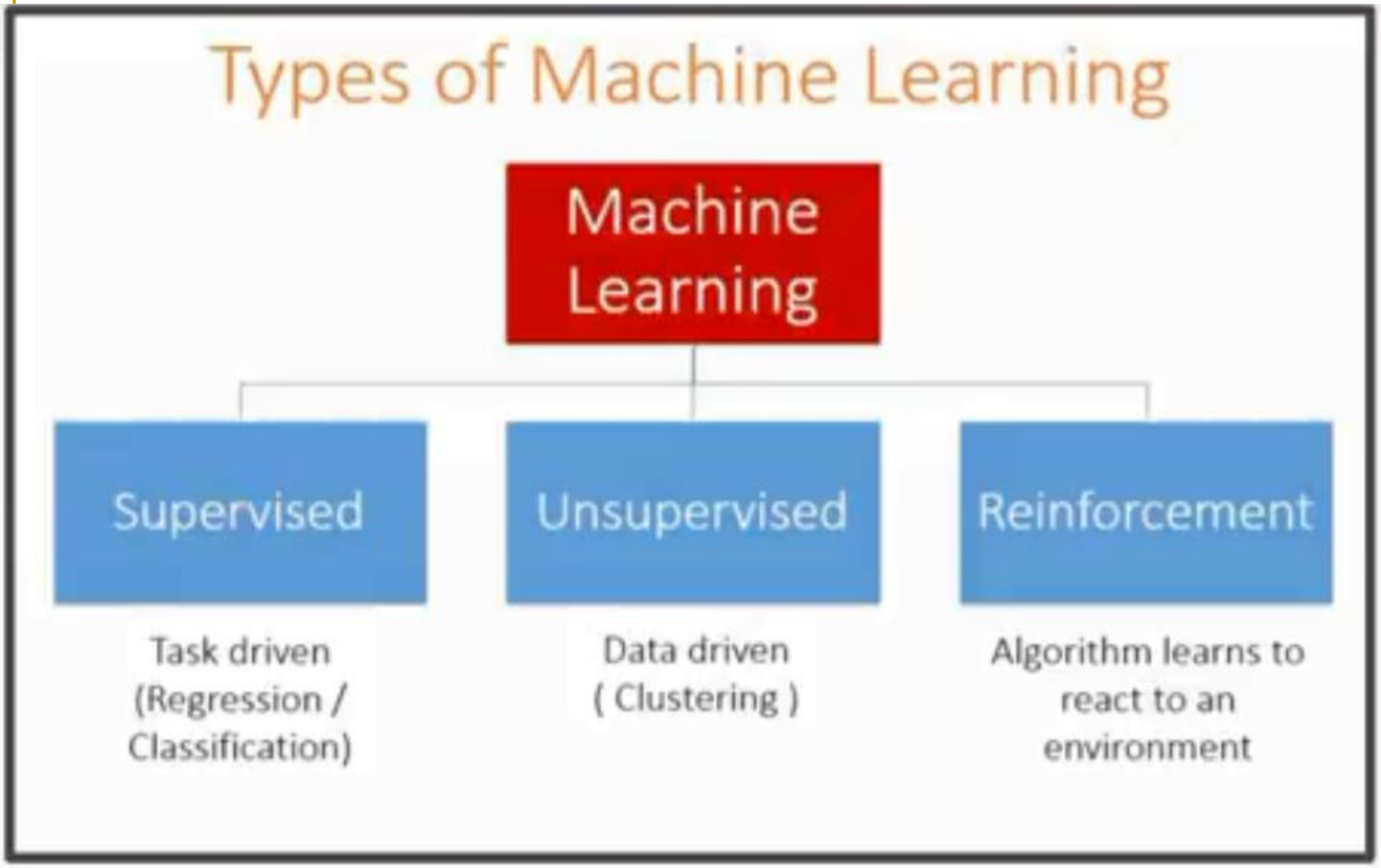

INSPIRES
ANALYTICS
BUSINESS INTELLIGENCE
DATA SCIENCE
STATISTICS
DATA VIZ
DATA
MACHINE LEARNING
EMPLOYS
ENABLES
DATA MINING
INSIGHT
DEEP NEURAL NETWORKS
FACILITATES
DEEP LEARNING
ARTIFICIAL INTELLIGENCE
• Computer Vision
• Natural Language Processing
• Generative Models
BIG DATA
PUSHES POST FURTHER


The Fields of Data Science
Prescriptive
Descriptive
Experimental
Theoretical
Data Analysis/ Analytics
Data Mining
Machine Learning
Big Data Analytics
Big Data
Software Tools
Methods and Algorithms
2015
Dahl Winters


Types of Machine Learning
Machine Learning
Supervised
Unsupervised
Reinforcement
Task driven (Regression / Classification)
Data driven (Clustering)
Algorithm learns to react to an environment

Intelligent Agent

In AI, an intelligent agent (IA) refers to an autonomous entity which acts, directing its activity towards achieving goals (i.e. it is an agent), upon an environment using observation through sensors (i.e. it is intelligent).

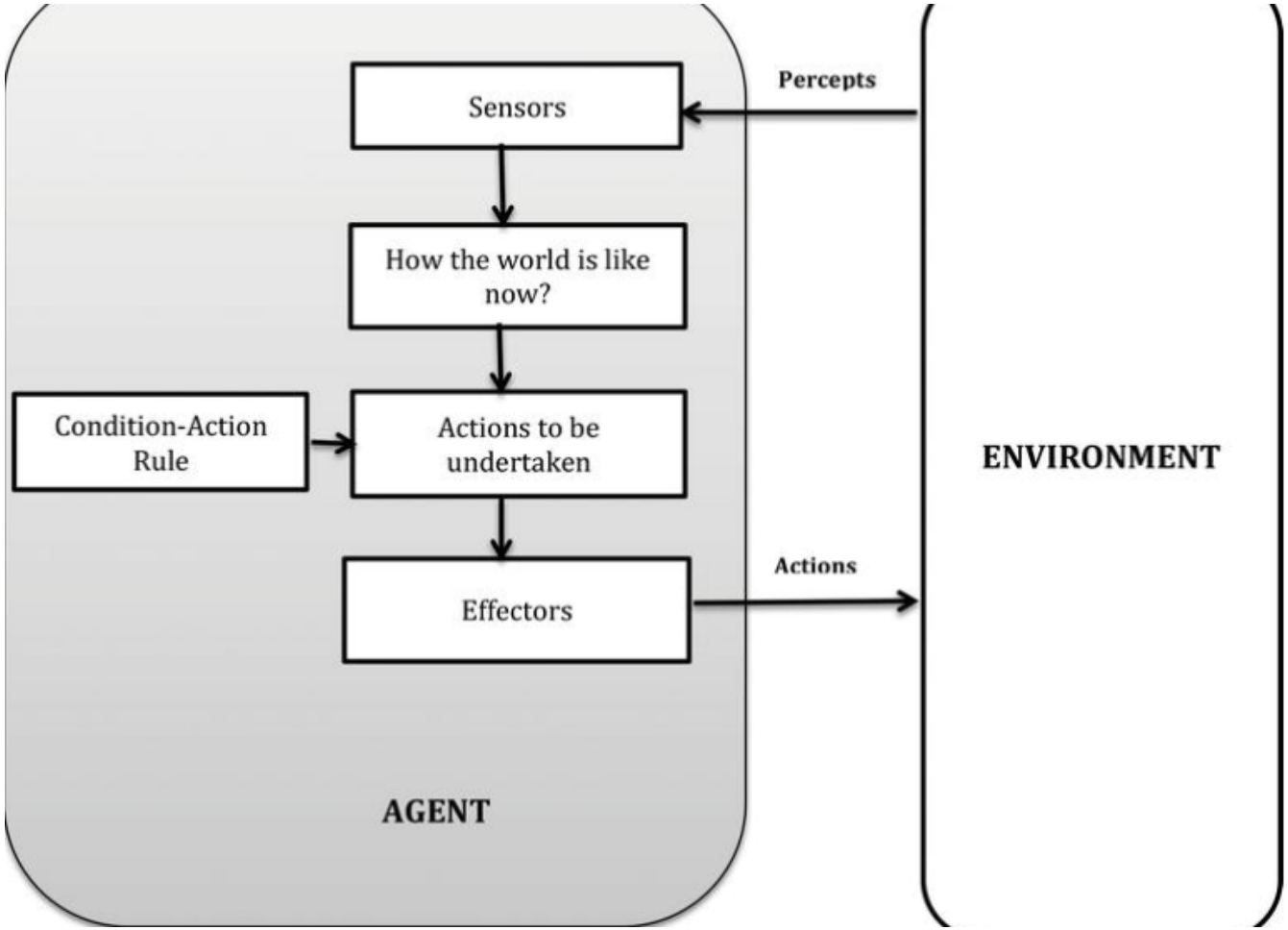
An *agent* is anything that can be viewed as perceiving its environment through *sensors* and acting upon that environment through *actuators*.

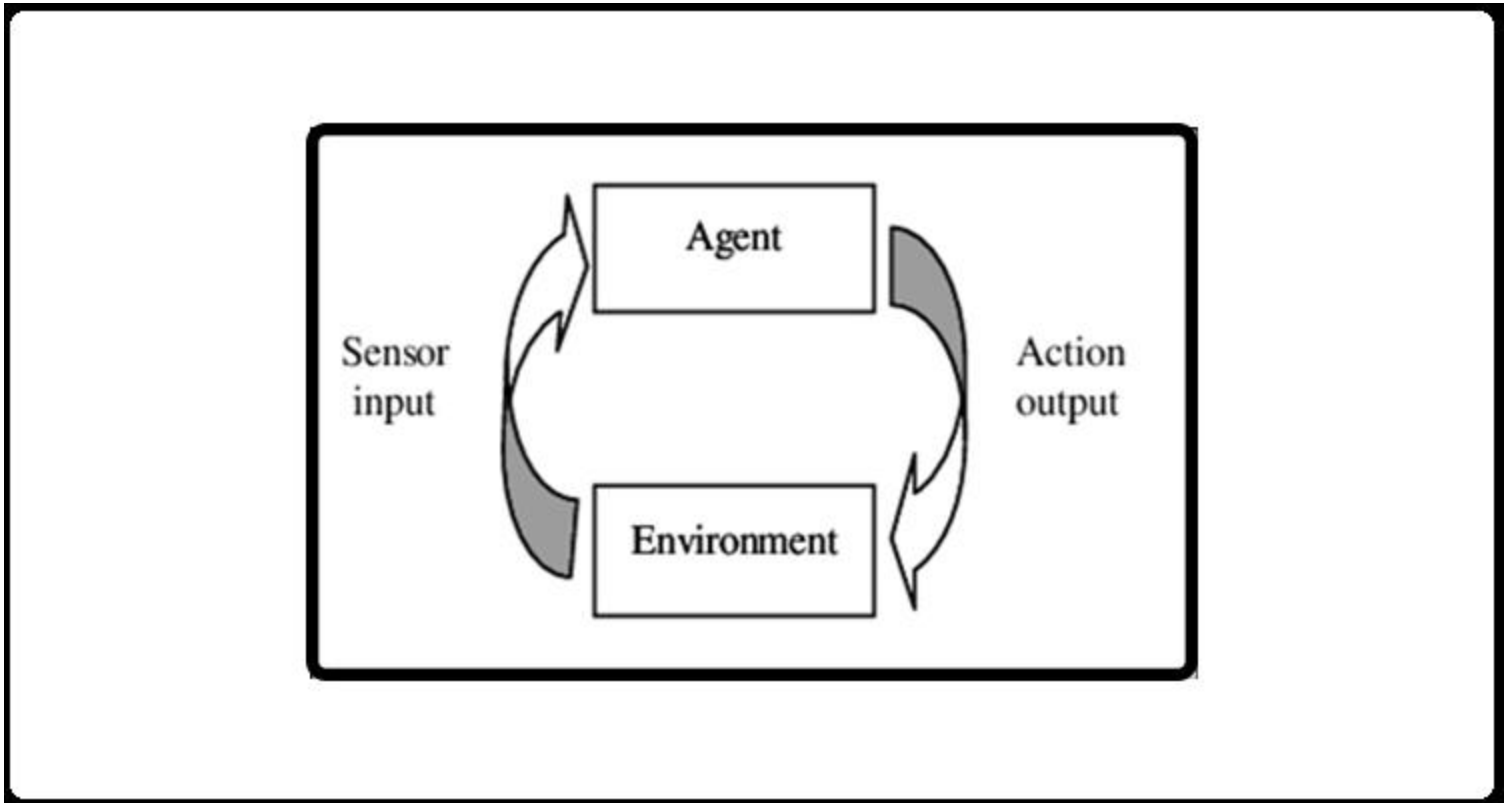
Human agent: **eyes, ears, and other organs for *sensors*; hands, legs, mouth, and other body parts for *actuators*.**

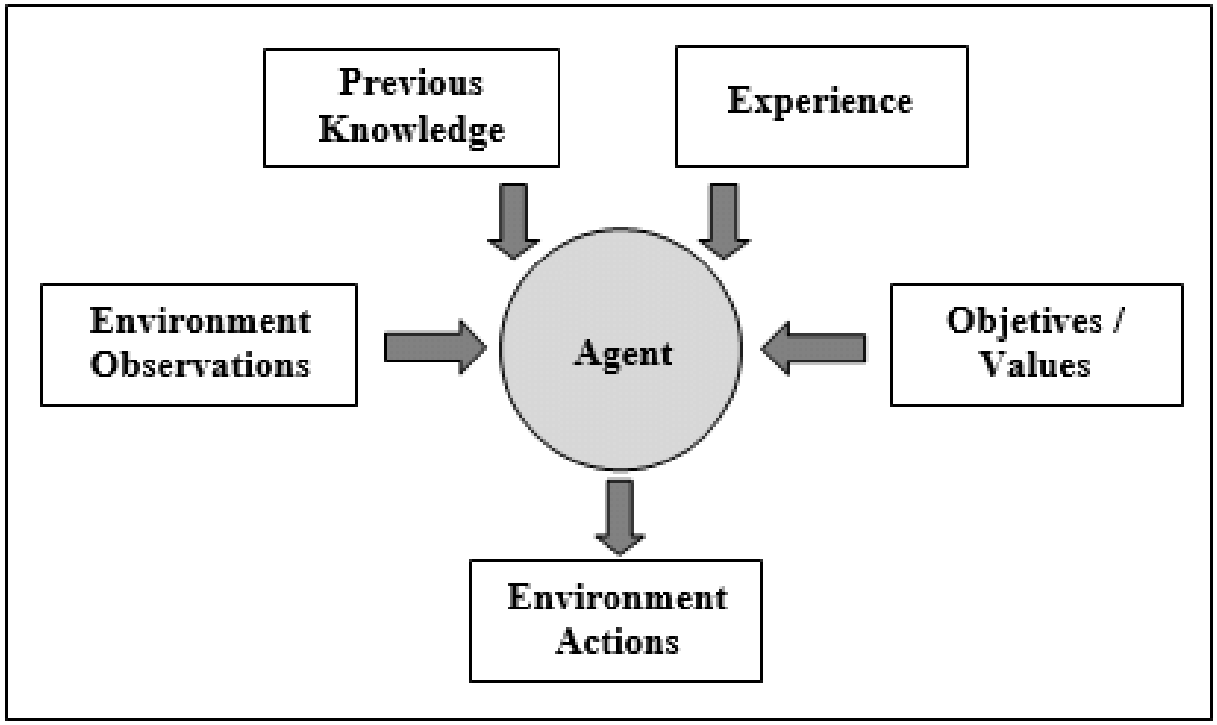
Robotic agent: **cameras and infrared range finders for *sensors*; various motors for *actuators*.**

An intelligent agent should be skilled in perception, practical reasoning and have an ability to take action to achieve its goals.

The agent utilizes the environment, it operates within, to both receive input and take action.




Agent
Sensor input
Action output
Environment


Previous Knowledge
Experience
Environment Observations
Agent
Objetives / Values
Environment Actions

- **An agent should strive to "do the right thing", based on what it can perceive and the actions it can perform. The right action is the one that will cause the agent to be most successful.**

- **Performance measure: An objective criterion for success of an agent's behavior.**

Some key inputs that feed into an agent and potentially, which it can draw itself are current observations about the environment, prior knowledge about the environment, past experiences that it can learn from and the objectives it needs to achieve.

The agent perceives the environment through sensors and acts on the environment through effectors.

Consider, e.g., the task of designing an automated taxi driver:

Performance measure
Environment
Actuators
Sensors

Performance measure: Safe, fast, legal, comfortable trip, maximize profits

Environment: Roads, other traffic, pedestrians, customers

Actuators: Steering wheel, accelerator, brake, signal, horn

Sensors: Cameras, sonar, speedometer, GPS, odometer, engine sensors, keyboard

Reasoning and knowledge representation

In AI, reasoning involves manipulation of data to produce actions.

In information technology a reasoning system is a software system that generates conclusions from available knowledge using logical techniques such as deduction and induction.

Textbook

- **Artificial Intelligence – Structures and Strategies for Complex Problem Solving.**

  Author: George F. Luger.

  Publisher: Pearson Education Ltd.