

Artificial Intelligence

Introduction

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- ① What is Artificial Intelligence?**
- ② Types of Artificial Intelligence**
- ③ Main topics in Artificial Intelligence**
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What is Artificial Intelligence?

Making machines that think like humans?



What is Artificial Intelligence?

Making machines that think like humans?

- Psychology
- Philosophy
- Neuroscience
- Cognitive science

To make machines with human-like minds in the full and literal sense

(Haugeland, 1985)



What is Artificial Intelligence?

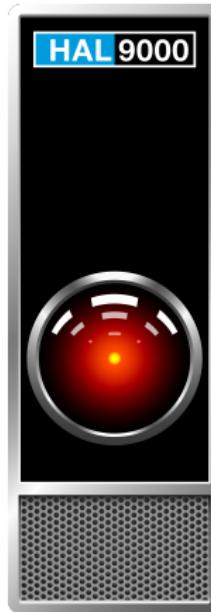


Human Brain Project

Brain exploration	Brain simulation	Silicon Brains	Understanding cognition
Medicine	Robots	Massive computing	Ethical considerations

What is Artificial Intelligence?

**Making machines that think
rationally?**



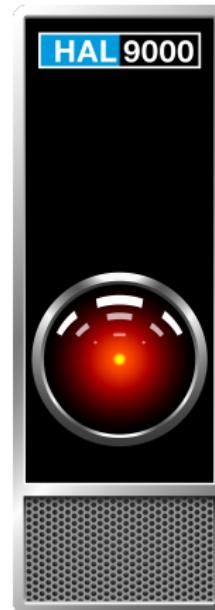
What is Artificial Intelligence?

Making machines that think rationally?

- Logic
- Knowledge & Reasoning

The study of mental facilities through the use of computational models

(Charniak and McDermott, 1985)



What is Artificial Intelligence?

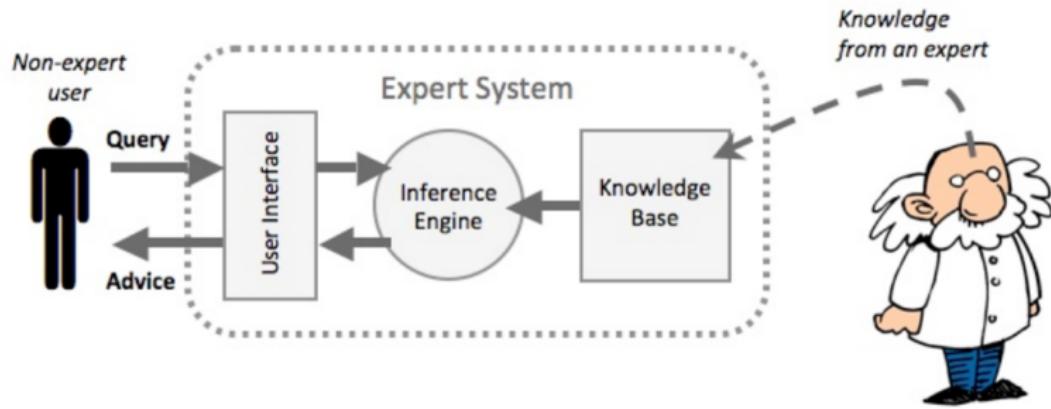


Figure 1: Diagram of an expert system

What is Artificial Intelligence?

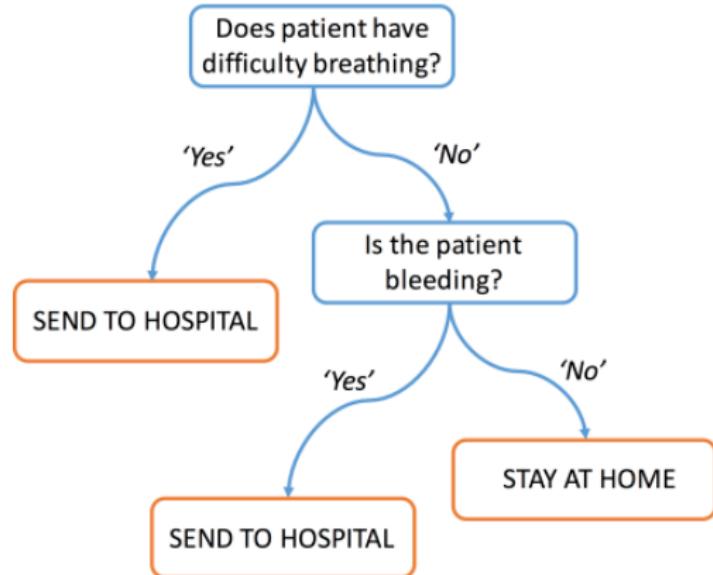


Figure 2: Diagram of an specific set of rules

What is Artificial Intelligence?

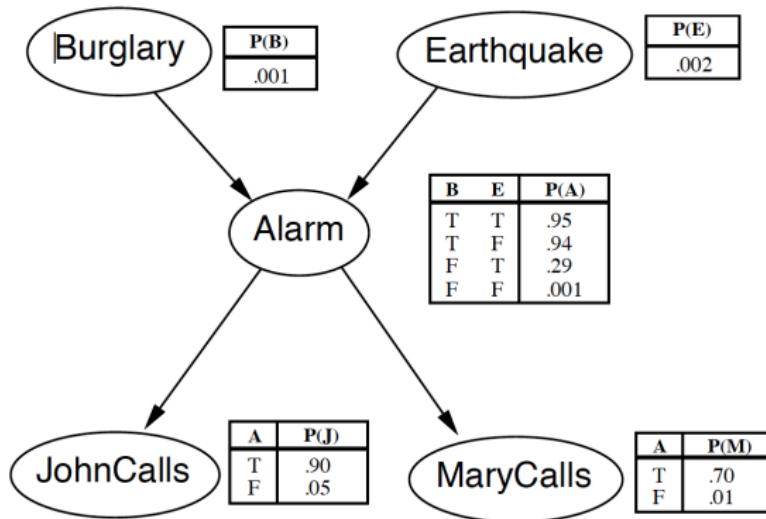


Figure 3: A simple Bayesian network

What is Artificial Intelligence?

**Making computers do things
that, at the moment, people
are better?**



What is Artificial Intelligence?

**Making computers do things
that, at the moment, people
are better?**

- Computer engineering
- Machine learning
- Reinforcement learning



*Creating machines to perform actions
that require intelligence when
performed by people*

(Kurzweil)



What is Artificial Intelligence?

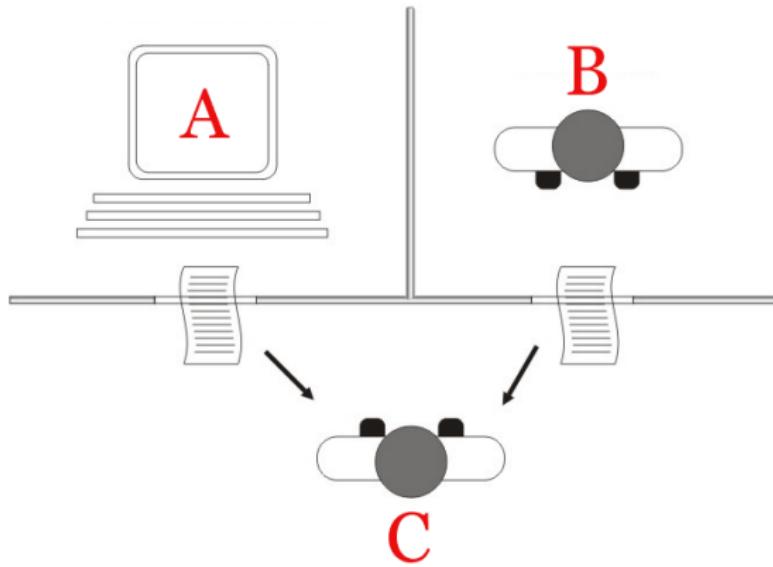
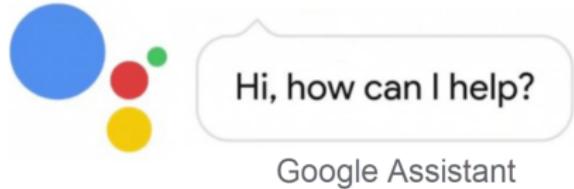


Figure 4: Diagram of the Turing test

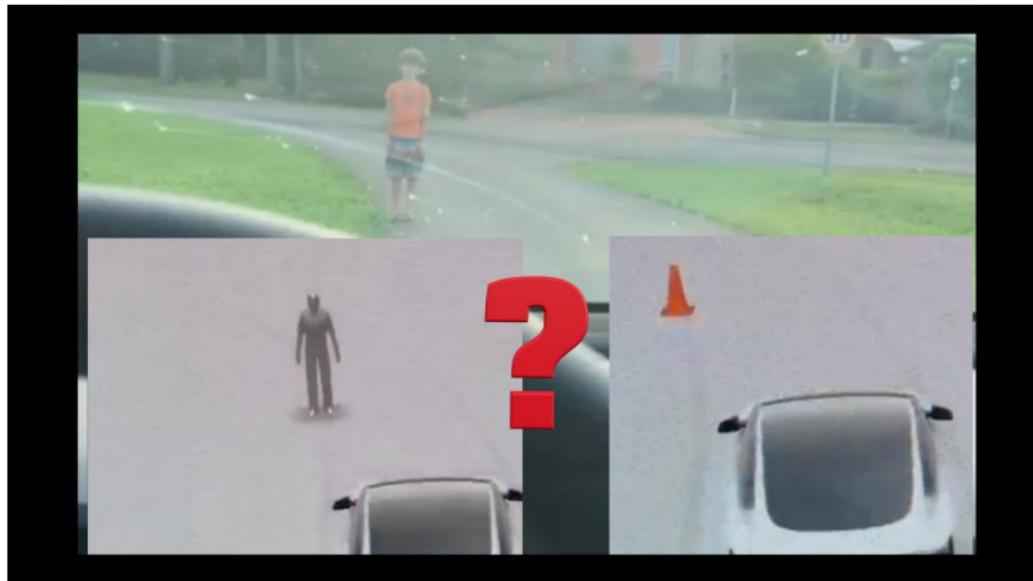
What is Artificial Intelligence?



What is Artificial Intelligence?



What is Artificial Intelligence?



What is Artificial Intelligence?

Automating intelligent behaviour?



What is Artificial Intelligence?

Automating intelligent behaviour?

- Logic
- Decision theory
- Economics
- Machine learning

Rational agents perform the action with the optimal expected outcome

(Russell & Norvig, 2003)



What is Artificial Intelligence?

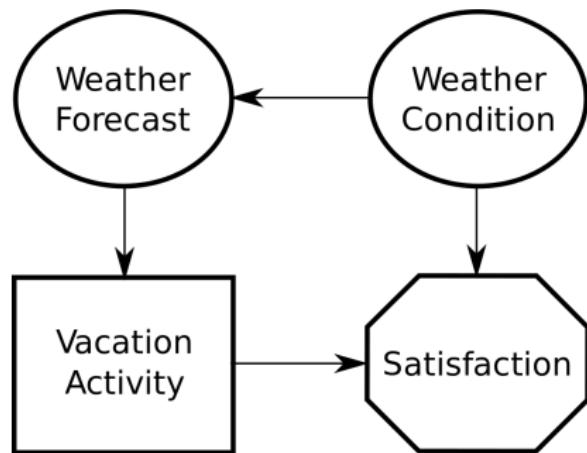


Figure 5: A simple influence diagram

What is Artificial Intelligence?

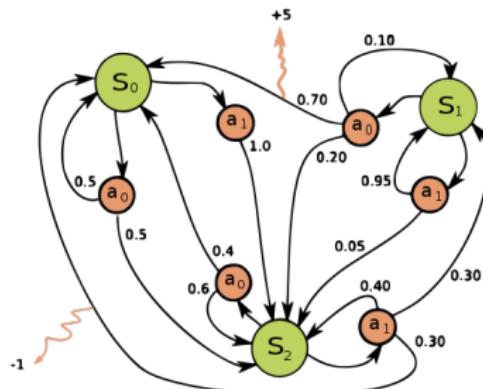


Figure 6: A simple Markov decision process

What is Artificial Intelligence?

Think like humans	Think rationally
 A movie poster for the film "Transcendence" featuring Johnny Depp as a scientist who becomes a cyborg. The poster has a futuristic, digital aesthetic.	 A black rectangular computer terminal with a glowing red circular light at the bottom, labeled "HAL 9000".
Act like humans	Act rationally
 A photograph of a person performing a handstand on a sandy surface under a clear blue sky.	 A large digital screen displaying financial data from the New York Stock Exchange, including tickers for INDU, INDP, NYSE, NYA, UTIL, DXY, and TNX, along with current stock prices and graphs.

What is Artificial Intelligence?

AI foundations:

- Philosophy
- Psychology
- Neuroscience
- Mathematics
- Statistics
- Control theory & Cybernetics
- Linguistics

What is Artificial Intelligence?

Definition of AI:

- *The theory and development of computer systems able to perform tasks normally requiring human intelligence*
(Oxford dictionary)

Goals of AI:

- To develop machines that take over dangerous, tedious or difficult tasks from humans
- To help understand the principles of human intelligence

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Types of Artificial Intelligence

- Two types of AI given the **scope of its tasks**
- **Artificial Narrow Intelligence (ANI)**
 - Able to perform one or several specific tasks
 - There is no model of mind
 - All current AIs are narrow (Roomba, Siri, Alexa, etc)
- **Artificial General Intelligence (AGI)**
 - Able to perform all human cognitive functions
 - For the moment is simply science fiction (at least 50-100 years)
 - Ethical considerations → superintelligence (?)
- The industry is currently focused on **narrow AIs**

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Main topics in Artificial Intelligence

- Search
- Knowledge representation & reasoning
- Planning
- Learning
- Environment interaction (e.g. vision, speech recognition, robotics)
- Natural language processing

Search

What do we search (Goal):

- Possible answers, decisions, etc.

Where do we search:

- Structured state space

How do we search:

- Set of actions with cost

Types of search:

- Blind
- Informed

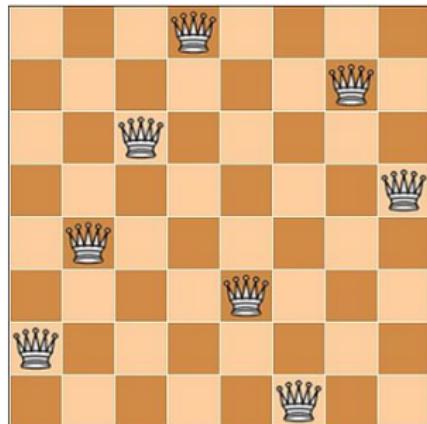


Figure 7: Eight queens problem

Knowledge representation & reasoning

Intelligence requires knowledge

Two types of knowledge:

- Declarative (What is...)
- Procedural (How to...)

Reasoning = Inference

- Logical. *Is Socrates a mortal?*
- Probabilistic. *Probability of rain?*

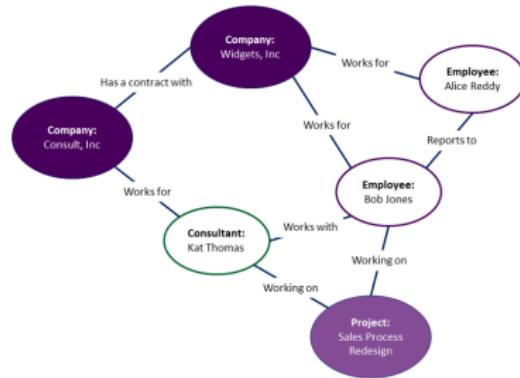


Figure 8: A simple ontology graph

Planning

What do we have:

- A set of goals
- A very large search space

What do we want:

- To construct a sequence of actions that achieve those goals

What happens if the space changes while we execute the plan?



Figure 9: Amazon warehouse

Learning

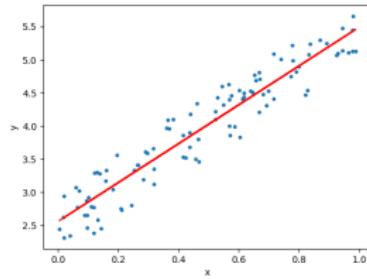
How do we recognize patterns in the environment?

How do we generate new concepts?

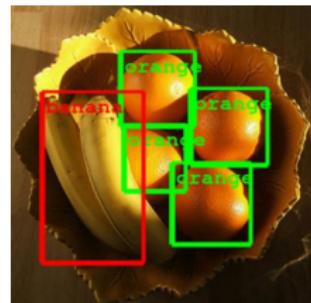
How do we improve our actions?

Three key elements:

- Data
- Algorithms
- Models



Environment interaction



Platforms

BostonDynamics 



SpotMini



Spot



Atlas



Handle

Natural language processing

More Deeper Application of NLP

Group 1	Group 2	Group 3
Cleanup, Tokenization	Information Retrieval and Extraction (IR)	Machine Translation
Stemming	Relationship Extraction	Automatic Summarization/Paraphrasing
Lemmatization	Named Entity Recognition (NER)	Natural Language Generation
Part of Speech Tagging	Sentiment Analysis/Sentance Boundary Dismbiguation	Reasoning over Knowledge Based
Query Expansion	World sense and Dismbiguation	Quation Answering System
Parsing	Text Similarity	Dialog System
Topic Segmentationand Recognition	Coreference Resolution	Image Captioning & other Multimodel Tasks
Morphological Degmentation (Word/Sentences)	Discourse Analysis	

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An intelligent agent

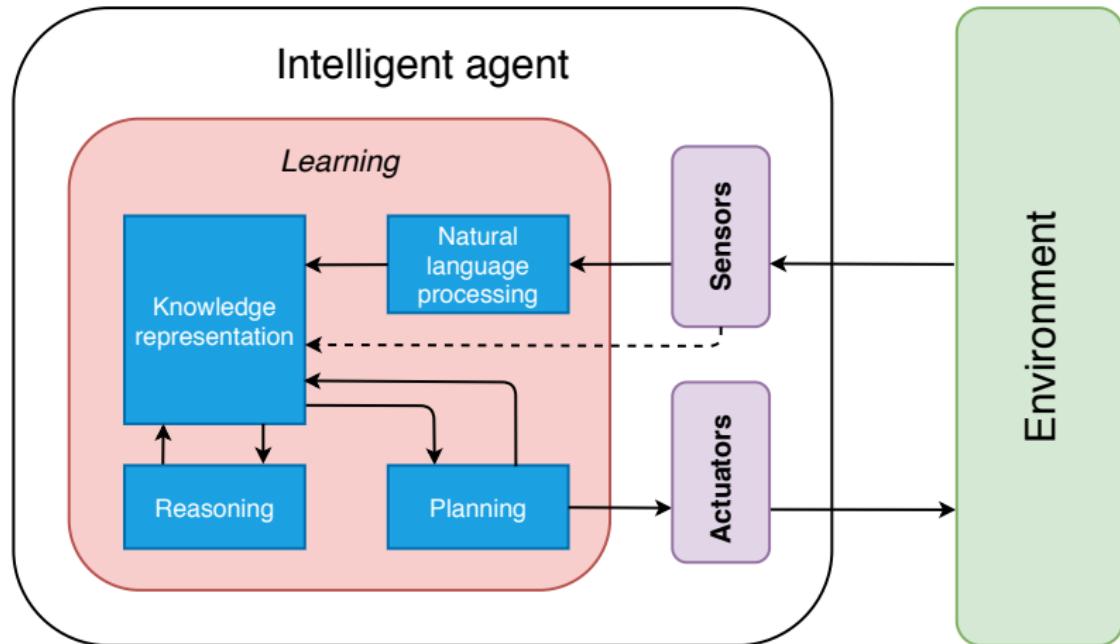


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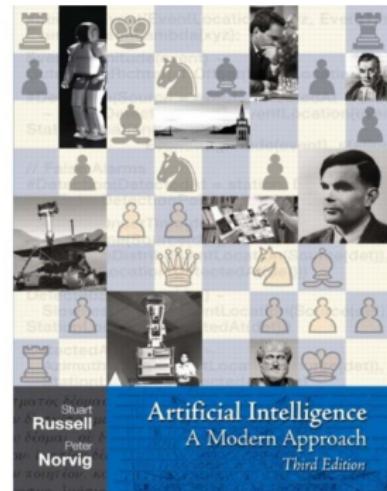
Focus of this course

- Machine learning and data mining
- Deep learning*
- Reasoning with uncertainty

Starting point in AI

Artificial Intelligence: A Modern Approach, Third Edition

Stuart Russell and Peter Norvig



Some interesting links

Talks:

- Pedro Domingos: The Master Algorithm
- Judea Pearl: The New Science of Cause and Effect
- Nick Bostrom: Superintelligence
- Stuart Russell: Long-term Future of AI

Webs:

- OpenAI
- Google AI blog (with 2019 recap)

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