

# Introduction to AI

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Russell Chap 1, Chap 27

# What is Intelligence?

- Perception

- Sensing - image, sound, touch ...
- Understanding - vision, language ...



- Reasoning

- Given facts → new facts
- Problem solving based on knowledge



- Learning

- Improving performance as it repeats
- Predicting future based on past experiences (data)



- Adaptiveness, creativity, etc.

# What is Artificial Intelligence?

Artificial intelligence (AI) is intelligence demonstrated by machines, as opposed to the natural intelligence displayed by humans or animals  
- *Wikipedia*

- Study on how to make machines perform intelligent behavior
  - To find how people think/act intelligently (system like human)
  - To develop systems that perform intelligent task (system think/act rationally)



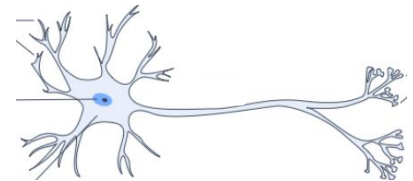
# The History of AI

## ■ Foundation

- What is mind and how it operates? – Philosophy
- How to automate the reasoning process? – Mathematics
- How do brains process information? – Neuroscience
- How do humans think and act? – Psychology
- How can we build efficient computer? - Computer Science
- How does language relate to thought? – Linguistics

## ■ Gestation (40s, 50s)

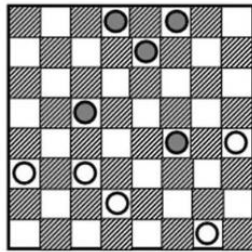
- **Artificial neuron** (McCulloch & Pitts, MIT)
  - Perceptron: a computational model of neuron
- **Logic Theorist** (Newell & Simon, CMU)
  - Non-numerical problem solving - theorem proving
- Dartmouth workshop → **“Artificial Intelligence”** (1956)



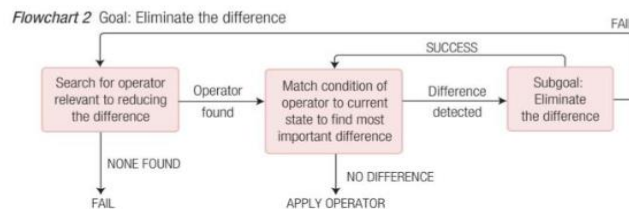
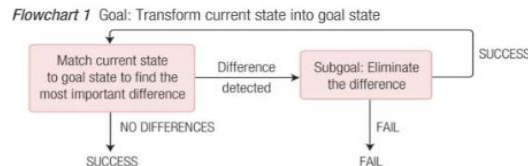
$\neg(p \vee q) \rightarrow \neg p$   
1.  $A \rightarrow (A \vee B)$   
2.  $p \rightarrow (p \vee q)$   
3.  $(A \rightarrow B) \rightarrow (\neg B \rightarrow \neg A)$   
4.  $(p \rightarrow (p \vee q)) \rightarrow (\neg(p \vee q) \rightarrow \neg p)$   
5.  $\neg(p \vee q) \rightarrow \neg p$   
Q. E. D.

# The History of AI

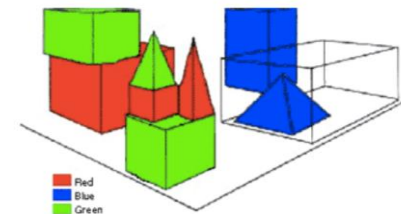
- Early enthusiasm (50s, 60s)
  - Various successful systems in limited domains
    - Checker program (Samuel, IBM), General Problem Solver (Newell & Simon, CMU), ELIZA (Weizenbaum, MIT), SHRDLU (Winograd, MIT), ...



```
ELIZA: Is something troubling you ?
YOU: Men are all alike.
ELIZA: What is the connection, do you suppose ?
YOU: They're always bugging us about something or other.
ELIZA: Can you think of a specific example ?
YOU: Well, my boyfriend made me come here.
ELIZA: Is it important to you that your boyfriend made you come here ?
YOU: He says I'm depressed much of the time.
ELIZA: I am sorry to hear that you are depressed.
YOU: It's true. I am unhappy.
ELIZA: Can you explain what made you unhappy ?
YOU:
```



```
Person: PICK UP A BIG RED BLOCK.
Computer: OK. (does it)
Person: GRASP THE PYRAMID.
Computer: I DON'T UNDERSTAND WHICH PYRAMID YOU MEAN.
```



# The History of AI

- **LISP** (McCarthy, MIT)

- Second-oldest high-level programming language
- The name *LISP* derives from 'LISt Processor'
- Lisp source code is made of lists.

```
(defun append (x y)
  (if (equal x nil) y
      (cons (car x) (append (cdr x) y)) ))

(defun reverse (x)
  (if (equal x nil) nil
      (append (reverse (cdr x))
                (list (car x)) )))
```

- **Physical symbol system hypothesis**

- “a physical symbol system has the necessary and sufficient means for general intelligent action”

- **Difficulties in reality (60s)**

- **Lack of knowledge**

- **Machine Translation Project (NRC) failed**

Ex> “The spirit is willing but the flesh is weak” (in Russian)

→ “The vodka is good but the meat is rotten” (in English)

- **Intractability of problems (combinatorial explosion)**

- As complexity increase, the program failed to find solutions


Ex> in search for theorem proving

- **AI winter**

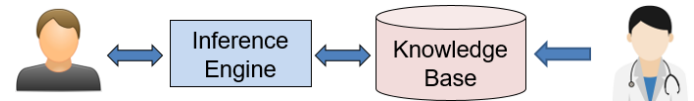
# The History of AI

- Knowledge-based systems (70s)

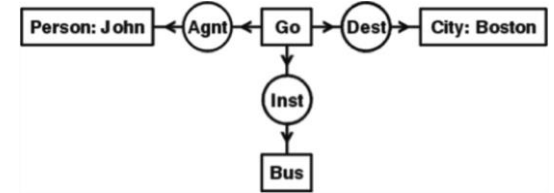
- Expert systems

- DENDRAL (Stanford) - Identify molecule structure by using mass spectrum data
  - MYCIN (Stanford) - Medical diagnosis
- 

```
IF stain of organism is gram negative
AND
morphology is rod
AND
is anaerobic
THEN
suggestive that class is enterobacteriaceae (CF 0.8)
```



- Knowledge representation for language understanding



- AI becomes an industry (80s)

- Commercial expert systems, AI companies

- DEC's R1(computer configuration expert system), DuPont, ...

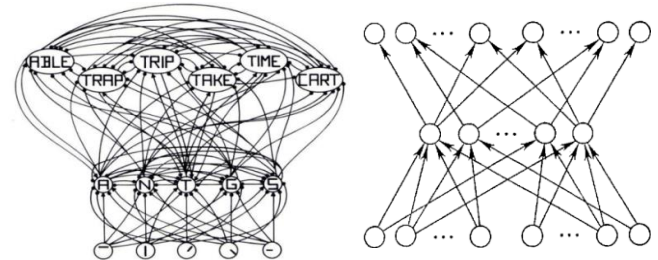
- 5th generation computer project (Japan), MCC project (USA)

- Unsuccessful → AI winter

- Return of neural networks (80s - )

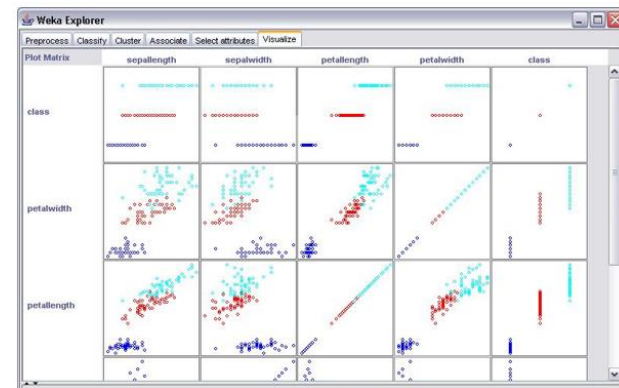
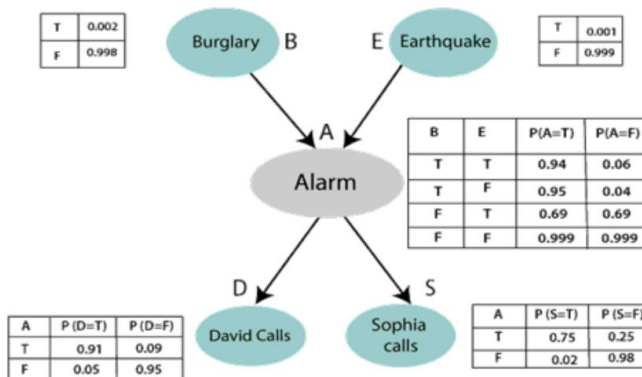
- PDP(Parallel and Distributed Processing)

- Connectionist models, backpropagation learning

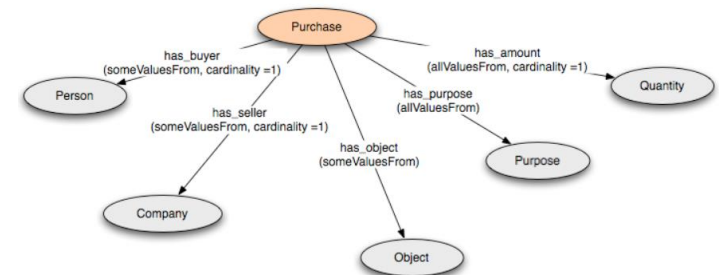


# The History of AI

- Statistical approaches (90s - )
  - Models based on probability and statistics. Statistical analysis of data
    - Ad hoc → Scientific methods
    - Knowledge → Data
  - Probabilistic reasoning, Speech recognition, Data mining, Machine learning



- Intelligent agents (2000s - )
  - A software that is intelligent, autonomous, and social
    - Semantic Web

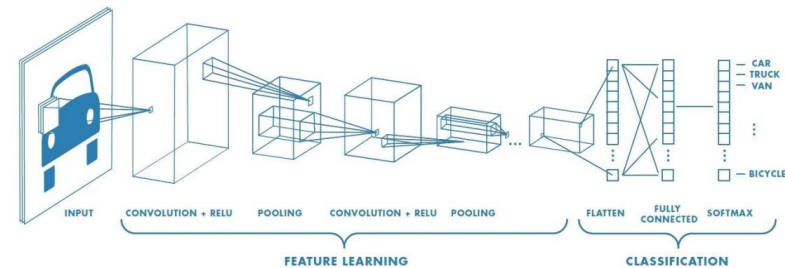
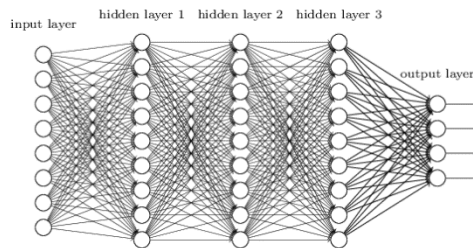




# The History of AI

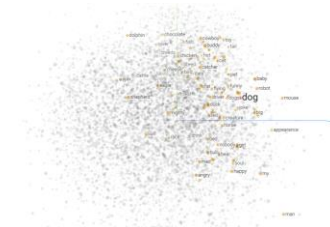
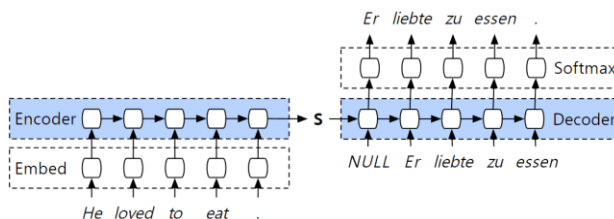
- Deep learning (2010s - )

- Large amount of data + Machine learning with deep neural network
- Computer Vision, Natural Language Processing, Game Playing, ...
  - CNN, RNN, LSTM, GAN, ...



- Large language models (2020s - )

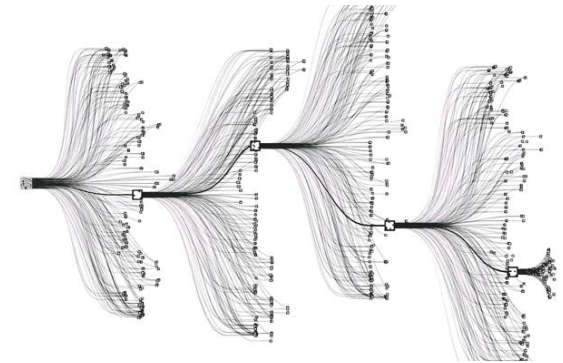
- Very large neural network model trained with vast amounts of text data
  - OpenAI's GPT-3, 4, Google's PaLM in Bard, Meta's LLaMa, ...
  - GPT-3: 300 billion words training corpus, 175 billion parameters model



Nearest points in the original space:	
disps	0.42
cat	0.37
comp	0.40
rat	0.43
weight	0.44
breast	0.44
cat	0.44
cluck	0.44
ball	0.46
horse	0.47
man	0.47
road	0.47
tomato	0.47
cats	0.48
wolf	0.48
cat	0.49
wheatland	0.49

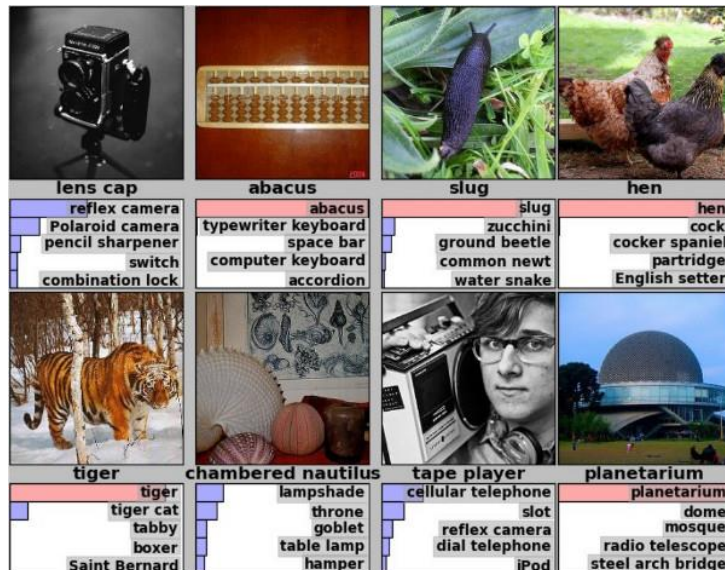
# Example – Game

- AlphaGo



# Example - Vision

- Image recognition





# Example – Language

## Machine translation, Question Answering

영어 ↔ 한국어

Artificial Intelligence (AI) is a branch of Computer Science that aims to create the intelligence of machines.

×

인공지능(AI)은 기계의 지능을 창출하는 것을 목표로 하는 컴퓨터 과학의 한 분야입니다.

ingongjineung(AI)eun gigyeui jineung-eul changchulhaneun geos-eul mogpyolo haneun keompyuteo



The "Word Lens" feature in action, instantly translating a sign in view. © Google

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Can you write me a 4 paragraph academic essay comparing and contrasting the theories of nationalism of Benedict Anderson and Ernest Gellner?



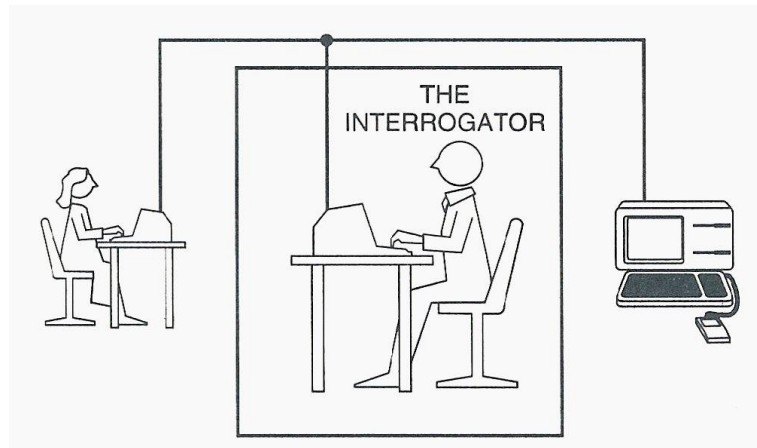
Benedict Anderson and Ernest Gellner both have theories about the origins and nature of nationalism, but their perspectives differ in key ways. Anderson believes that nationalism is a cultural construct, arising from the development of print capitalism and the creation of imagined communities. Gellner, on the other hand, sees nationalism as a product of modernization and industrialization, with nations being formed as a means of organizing society and providing a shared identity.

One key difference between the two theories is the role of culture. For Anderson, culture is central to the creation of nationalism, as the spread of print media

# Can Machines Think?

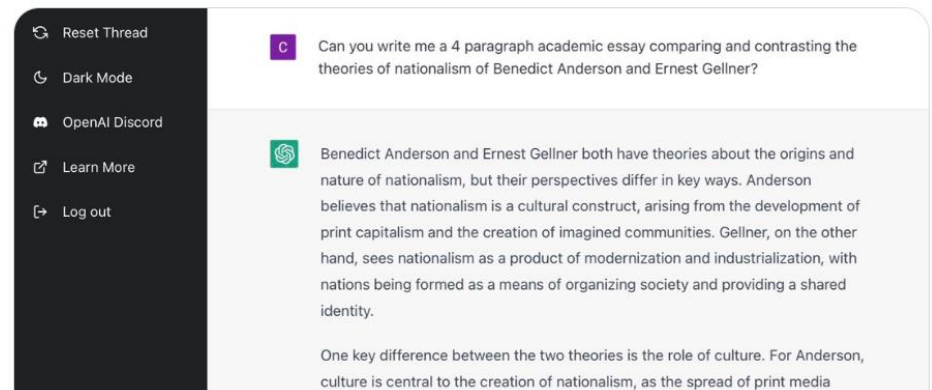
- Turing Test

- Alan Turing (1950) - Can machine be intelligent?



- Chat GPT

- OpenAI



# Conversation with Robots

- KISMET

- A robot made in MIT AI lab



- Sophia

- A robot made in Hansen Robotics



# The Chinese Room Experiment

- Thought experiment

- John Searle (1980)



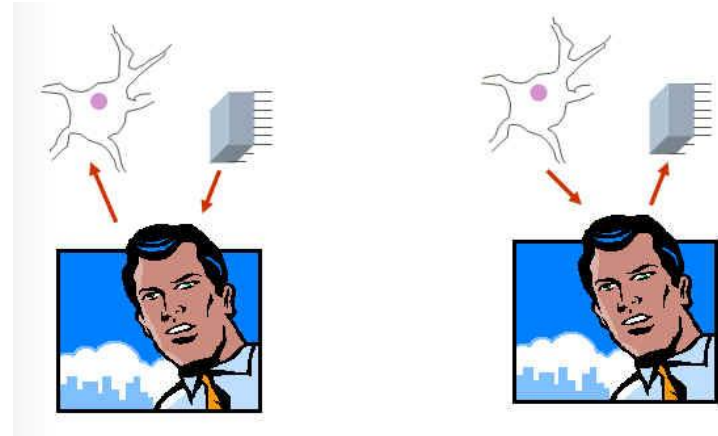
- Searl's argument

- The man in the room does not have any understanding
  - No matter how intelligent-seeming a computer behaves and no matter what programming makes it behave that way, since the **symbols it processes are meaningless to it**, it's not really intelligent. It's not actually thinking.

# The Brain Prosthesis Experiment

- Thought experiment

- John Searle (1980),
- Hans Moravec (1988)

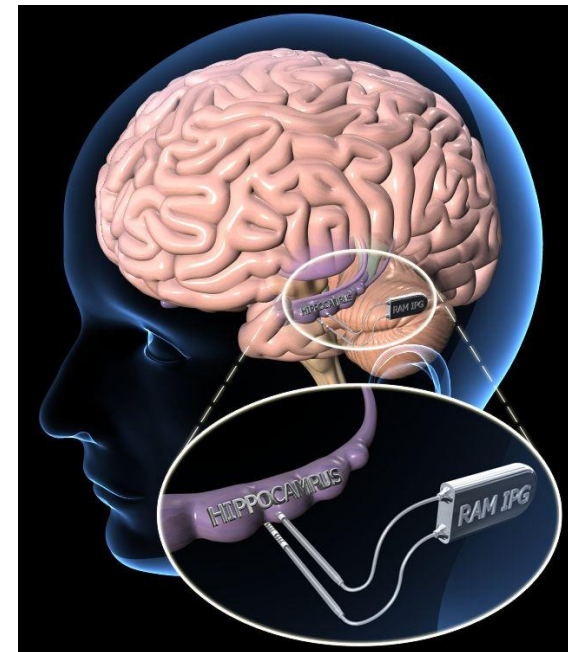
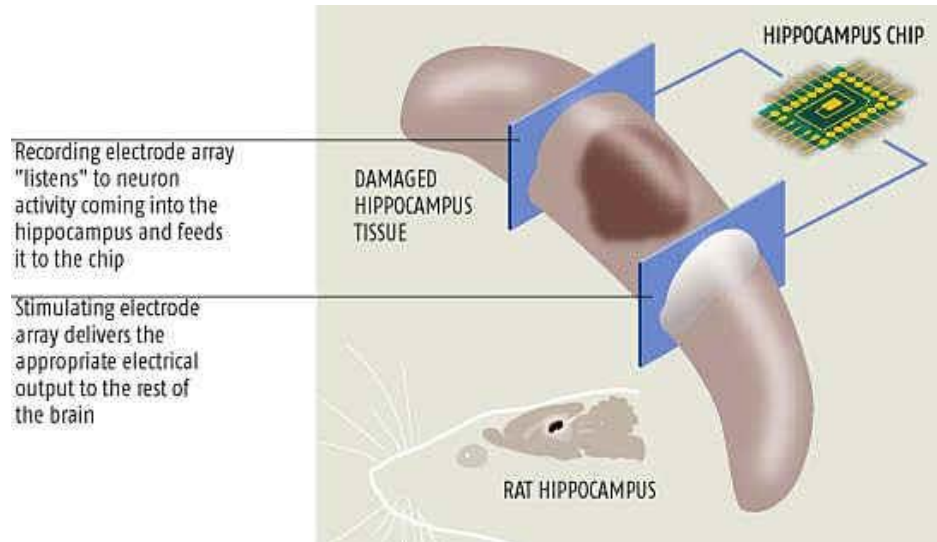


- Will you remain conscious?

- Hans Moravec: Yes. It will show exactly same behavior with real brain.  
**The mechanism involved in consciousness are still operating in the electronic brain**, which is therefore “conscious”
- John Searle: No. You would end up losing your control over your behavior. (Problem: The consciousness cannot be removed instantaneously)



# Real Brain Prosthesis



# Can Machines Think?



*Am I thinking or what?*

- Weak AI
  - Intelligence in a limited task
  - Yes, in narrow sense.
- Strong AI
  - **Artificial General Intelligence (AGI)** : Intelligent agent that could learn to accomplish any intellectual task that human beings can perform
  - Consciousness
  - Debate unsolved.