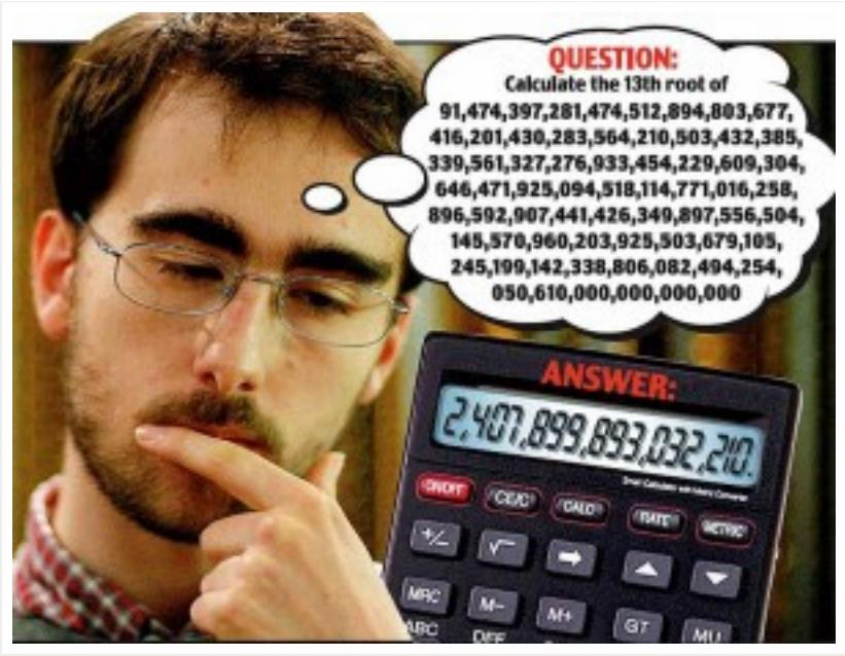
Introduction to Artificial Intelligence

IT426: Artificial Intelligence

Information Technology Department

Who is more intelligent? A calculator or a human?

- A calculator performs calculations much faster
- It almost never makes a mistake.



- But
  - We created calculators
  - They need us to function

[Jack Ma and Elon Musk hold debate in Shanghai]

Scott Flansburg
The Human Calculator

- Can mentally +, -,*, /, x^2, $\sqrt[3]{x}$ almost instantly, with calculator accuracy
- Guinness World Record holder
- Bestselling author
- Appeared on television shows such as *The Oprah Winfrey Show*, *The Ellen DeGeneres Show*, *The Tonight Show with Jay Leno*, and *Larry King Live*
- Host of 'The Human Calculator' tv show on the History Channel International
- Is Scott intelligent?

What is Artificial Intelligence (AI)?

- It depends on how we define (Artificial) Intelligence:
  - Artificial intelligence is *the capability of a machine to imitate intelligent human behavior.*
  - "Artificial intelligence is that activity devoted to making machines intelligent, and intelligence is that quality that enables an entity to function **appropriately** and with **foresight** in its environment." [1]

What is Artificial Intelligence (AI)?

- Takes a broad view that intelligence lies on a multi-dimensional spectrum.
- According to this view, "the difference between an arithmetic calculator and a human brain is not one of kind, but of scale, speed, degree of autonomy, and generality." [2]

calc

calc

independence

human

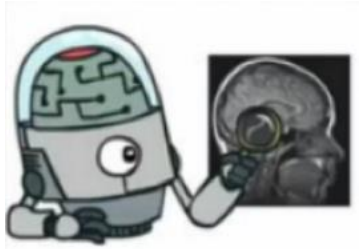
What is Artificial Intelligence (AI)?

- Several definitions available in the literature
- They differ along two dimensions: warning: old concepts
  - Concern (thinking vs acting)
  - Success measure (rationale vs like human)
- Hence we have 4 categories for AI definitions:
  - Thinking humanly
  - Acting humanly
  - Thinking rationally
  - **Acting rationally**

What is Artificial Intelligence (AI)?

Thinking Humanly	**Thinking Rationally**
"The exciting new effort to make computers think . . . *machines with minds*, in the full and literal sense." (Haugeland, 1985) "[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning . . ." (Bellman, 1978)	"The study of mental faculties through the use of computational models." (Charniak and McDermott, 1985) "The study of the computations that make it possible to perceive, reason, and act." (Winston, 1992)
Acting Humanly	**Acting Rationally**
"The art of creating machines that perform functions that require intelligence when performed by people." (Kurzweil, 1990) "The study of how to make computers do things at which, at the moment, people are better." (Rich and Knight, 1991)	"Computational Intelligence is the study of the design of intelligent agents." (Poole *et al.*, 1998) "AI . . . is concerned with intelligent behavior in artifacts." (Nilsson, 1998)

THINKING HUMANLY



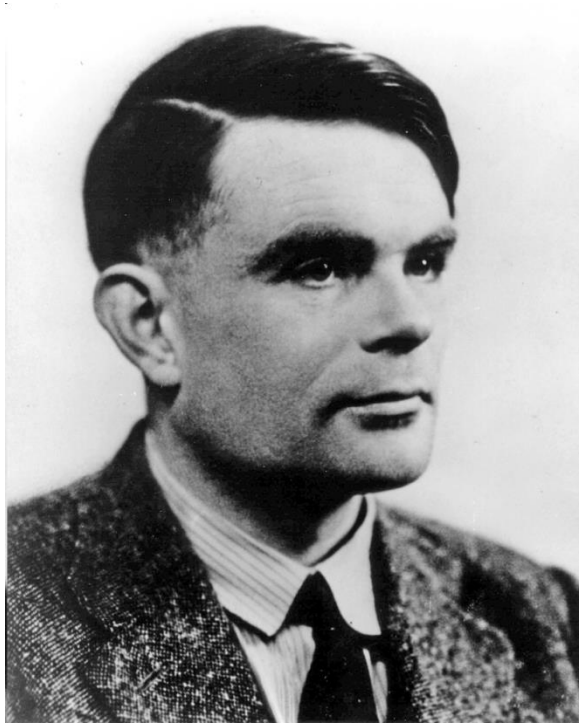
- First, determine how humans think?
- 3 ways:
  - Introspection: trying to catch our own thoughts as they go by
  - Psychological experiments: observing a person in action
  - Brain imaging: observing the brain in action.

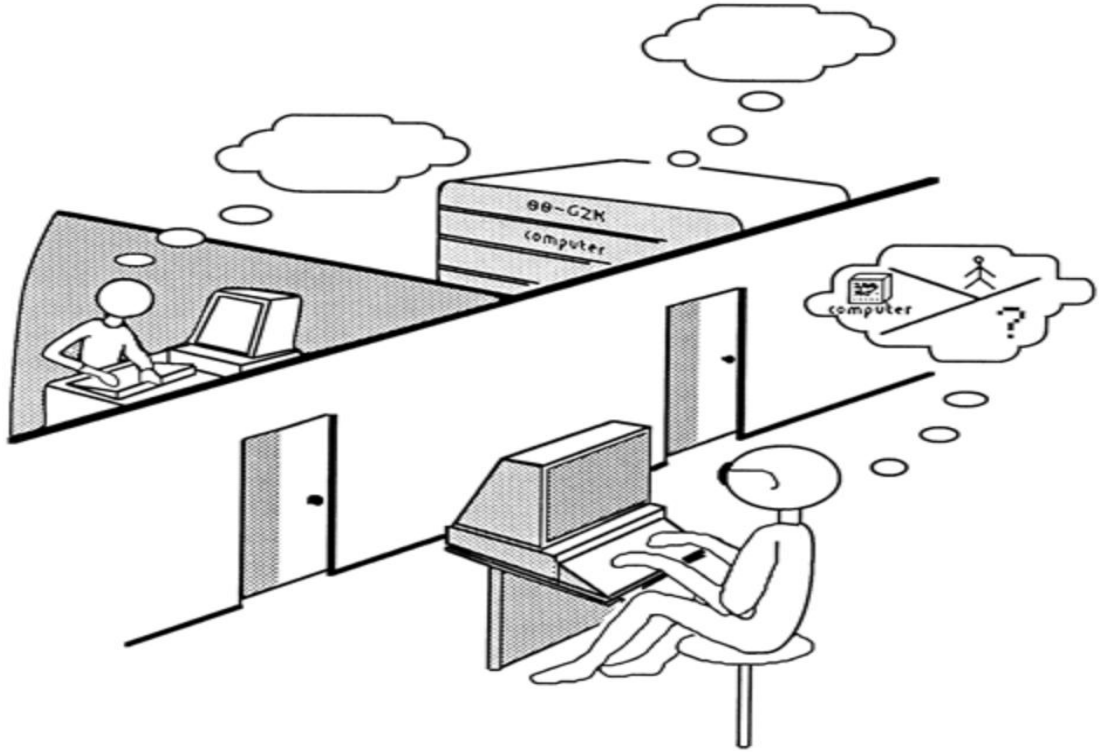
nueral science

- **Cognitive science** brings together computer models from AI and experimental techniques from psychology to construct precise and testable theories of the human mind.

Acting Humanly

- Turing Test, by Alan Turing in 1950

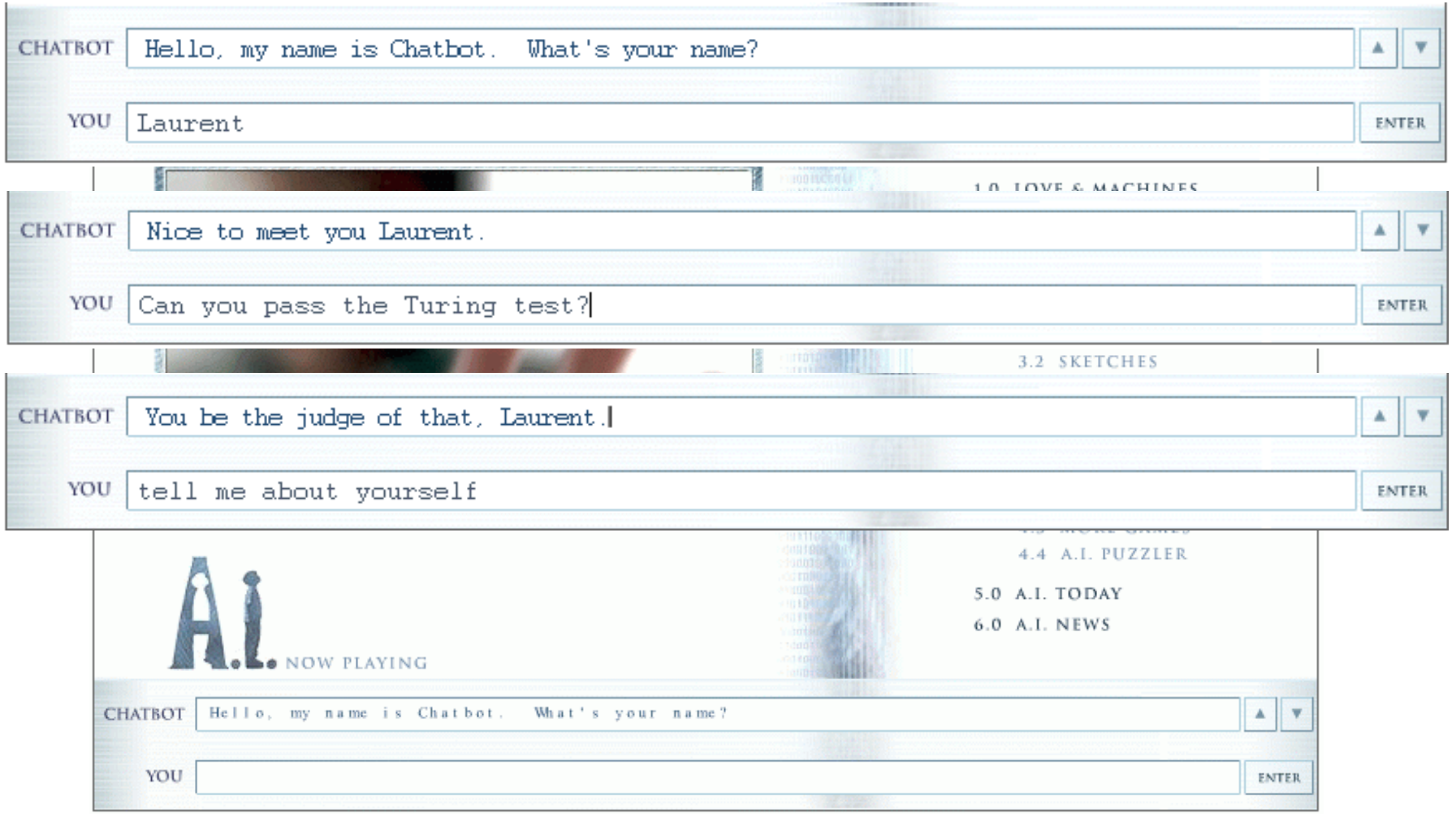




An Application of the Turing Test

- CAPTCHA: Completely Automatic Public Turing tests to tell Computers and Humans Apart

The Turing Test - Example



The Turing Test - Example

Has the Turing Test been passed?

Bring your answer next class!

THINKING RATIONALLY

- The Greek philosopher Aristotle was one of the first to attempt to codify "right thinking," that is, *reasoning* processes.
- Logic!
- Example:

All fish have gills

& Guppy is a fish

=> Guppy has gills

Acting Rationally

- Find out how correct thinking must proceed: the laws of thought.
- The *rationale agent approach*.
- An agent is not a regular computer program
- Agents are expected to operate autonomously, perceive their environment, persist over a prolonged time period, adapt to change, and create and pursue goals.
- A *rational agent* is one that acts so as to achieve the best outcome or, when there is uncertainty, the best expected outcome.
- More next chapter!

expected: avg, freq/total.. statistics!

Acting Rationally

This is how birds fly

Humans tried to mimic birds for centuries

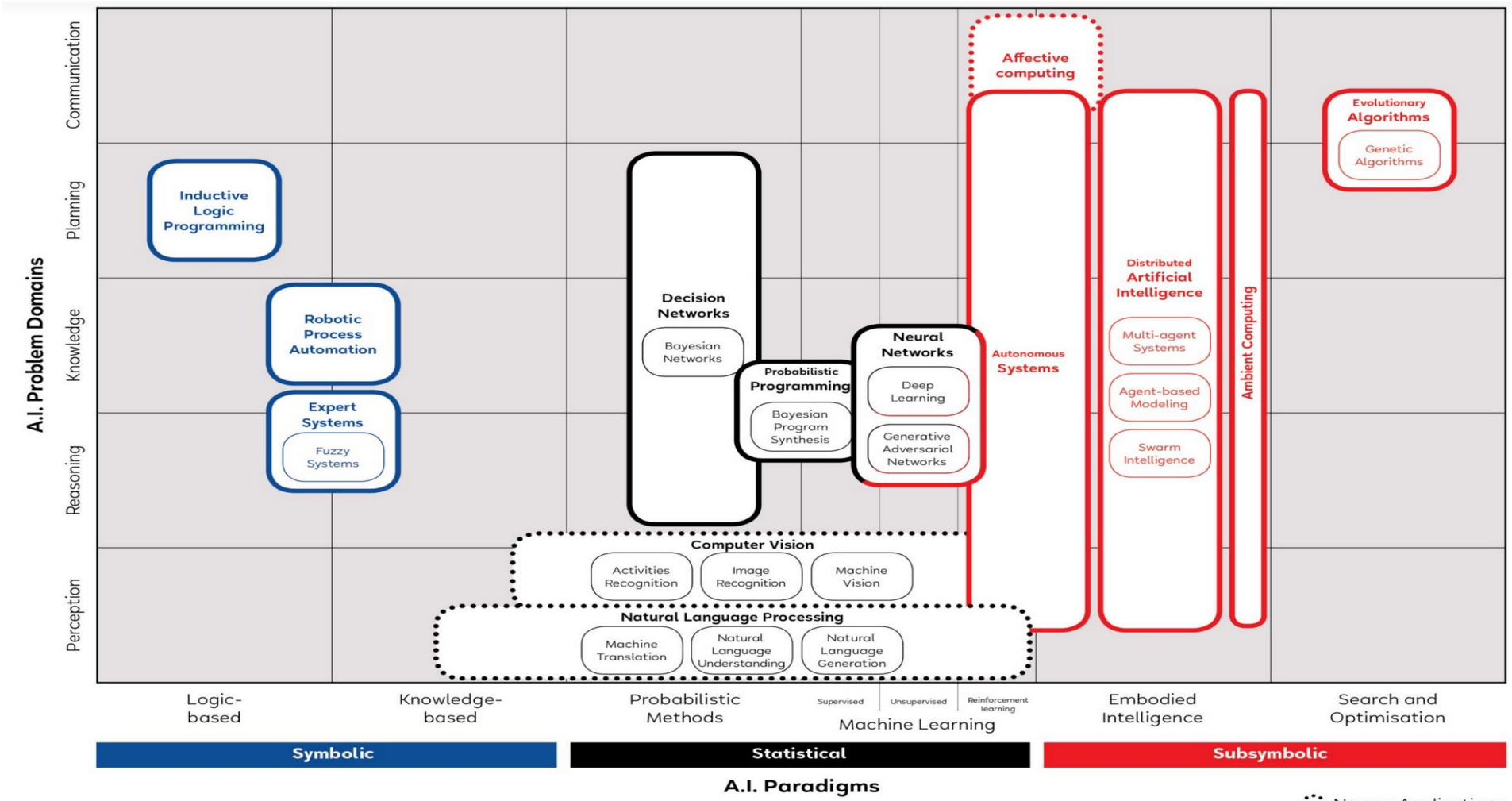
This is how we finally achieved “artificial flight”

Demystifying AI

- Artificial Narrow Intelligence (ANI)
  - can do one thing such as predicting weather, recognizing objects in an image,..etc
  - Huge progress

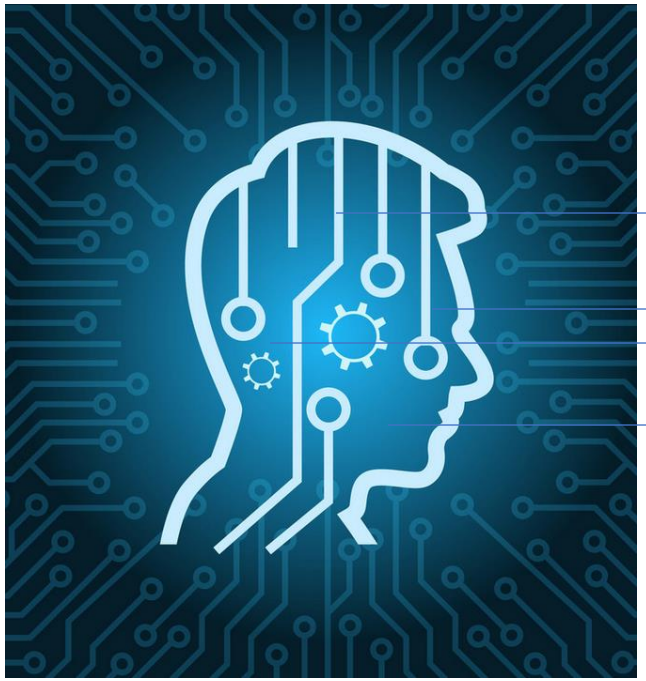
- Artificial General Intelligence (AGI)
  - Do anything a human can do
  - ~~No progress at all~~ narrow has more progress than AGI
  - It'll take decades, or a hundred of years to get there

AI Knowledge Map



AXILO
axilo.space

DEMYSTIFYING AI



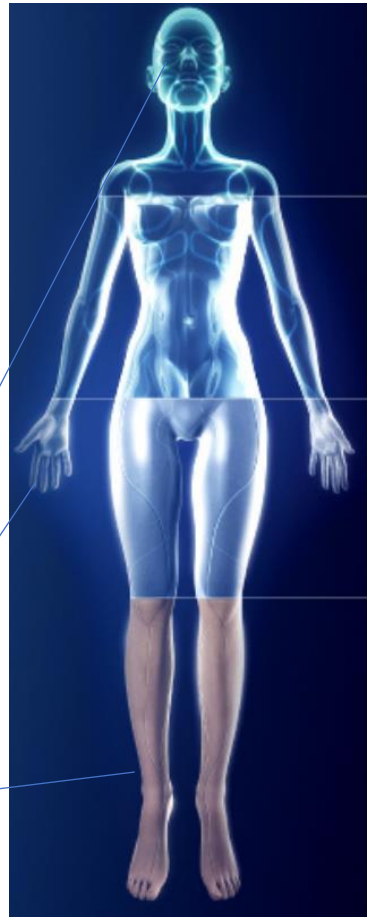
Learning, Reasoning, Planning, scheduling, optimization

Computer Vision

Speech Recognition and Processing

Natural Language Processing

Robotics



+Distributed AI:
Multi-Agent Systems
Distributed Problem Solving

Reasoning

- Deductive learning: Rule -> Example
- Strongly related with logic
- Main areas:
  - Automated Theorem Proving
  - Case based reasoning
  - Expert systems

Learning

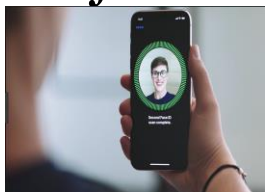
- Inductive learning: Example -> Rule
- Known as Machine Learning
  - Supervised Learning
  - Unsupervised Learning

Computer Vision

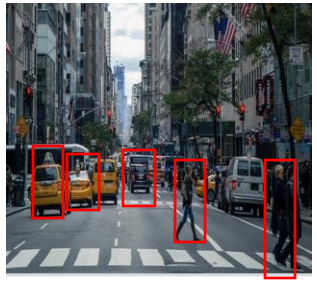
- AI understand images and videos
- Image classification/Object Recognition

Cat?

  - Face recognition



- Object detection
- Image segmentation
- Tracking



Natural Language Processing

- AI understands natural language
- Text classification
  - Email -> Spam/not spam
  - Product description -> Product category
- Sentiment recognition
  - Text review -> how many stars
- Information Retrieval
  - Web search

Natural Language Processing

- Name Entity Recognition
  - Recognize names, places, countries,.. In text
- Machine Translation
- Parsing and Part-of-speech tagging
  - Which word is noun, verb,..
    - Ignore preposition
    - Not a final AI product but a pre-processing in a longer AI Pipeline

Speech Recognition

- Speech to text
- Applications:
  - Trigger word/ Wake word detection (hello siri)
  - Speaker ID: who is the speaker?
- Speech synthesis (Text-to-speech, TTS)

Robotics

- Perception: figuring out what in the world around you based on the senses s.a. camera, radar, or lidar
- Motion Planning: Finding a path for the robot to follow
- Control: sending commands to the motors to follow a path

Exercise

Look at your mobile phone, and tell us about some AI techniques embedded in it.

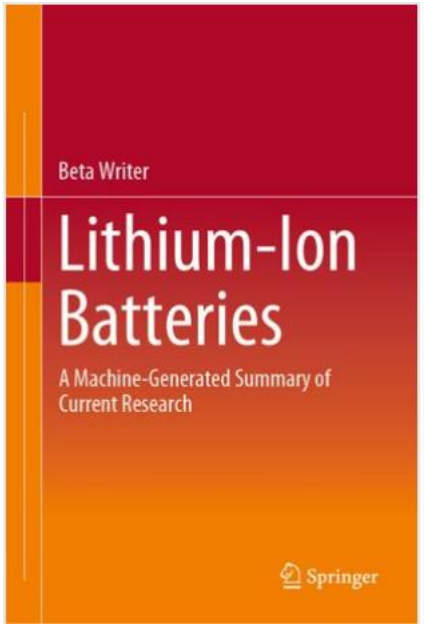
Some AI Achievements

- Computers have won over world champions in several games, including Checkers, Othello, Chess, and Go.
- AI techniques are used in many systems: formal calculus, video games, route planning, logistics planning, pharmaceutical drug design, medical diagnosis, hardware and software trouble-shooting, speech recognition, traffic monitoring, facial recognition, medical image analysis, part inspection, etc…
- DARPA Grand Challenge:
  robotic car autonomously traversed 132 miles of desert
- IBM's Watson competes with Jeopardy champs
- Robotics perform brain and heart surgery
- Home robots still remain a thing of the future

protein folding

Recent Achievements in AI

- Springer, a global research publisher, released a book “Lithium-Ion Batteries” by Beta Writer.
- The book is Machine-Generated Summary of Current Research.
- You can read it here.



Recent Achievements in AI

- OpenAI, a non-profit Artificial Intelligence research company developed a new natural language model GPT-3.

- The model can successfully generate a convincing, well written text by "adapting to the style and content of the conditioning text."

Recent Achievements in AI

- For example, GPT-2 responded to the prompt, "Recycling is good for the world, no, you could not be more wrong,":

"Recycling is NOT good for the world. It is bad for the environment, it is bad for our health, and it is bad for our economy. I'm not kidding. Recycling is not good for the environment. It is destructive to the earth and it is a major contributor to global warming. Recycling is not good for our health. It contributes to obesity and diseases like heart disease and cancer. Recycling is bad for our economy. It increases the cost of a product, and in turn, the price of everything that is made with that product. Recycling is not good for our nation. We pay a tremendous price for the privilege of having the world's most advanced and efficient recycling system. Recycling is a huge, colossal waste of time, energy, money, and resources."*

*https://openai.com/blog/better-language-models/#sample8

Recent Achievements in AI

- DeepFake

Good News!


واس
@spagov
Following
#عاجل
أمر ملكي : ينشأ مركز باسم "المركز الوطني للذكاء الاصطناعي"، ومكتب باسم "مكتب إدارة البيانات الوطنية"، ويرتبطان تنظيمياً بـ "الهيئة السعودية للبيانات والذكاء الاصطناعي".
#واس
Translate Tweet
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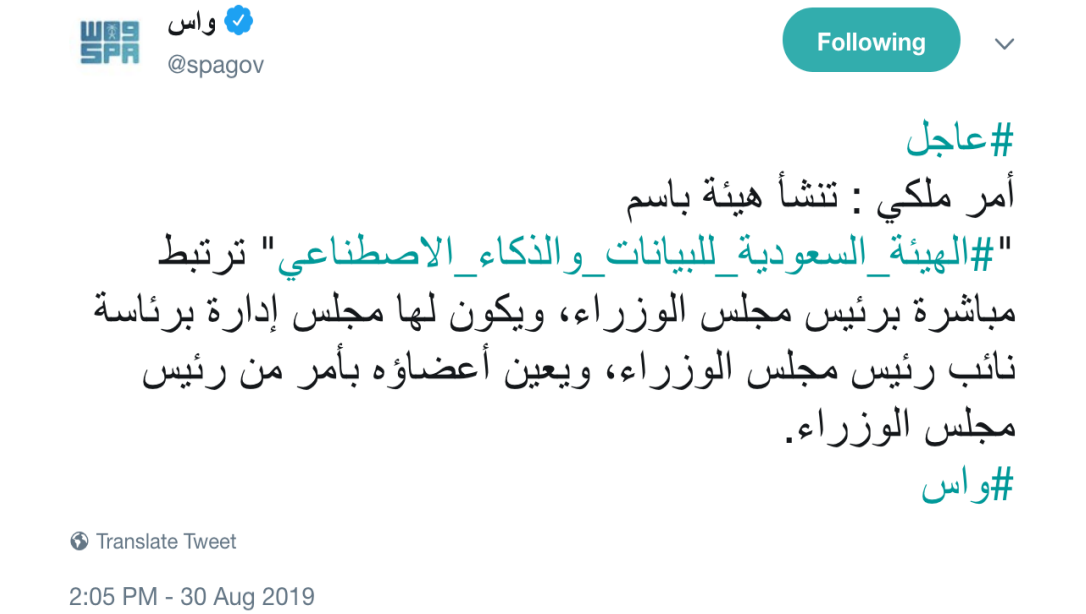
واس
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Following
#عاجل
أمر ملكي : تنشأ هيئة باسم "#الهيئة_السعودية_للبيانات_والذكاء_الاصطناعي" ترتبط مباشرة برئيس مجلس الوزراء، ويكون لها مجلس إدارة برئاسة نائب رئيس مجلس الوزراء، ويعين أعضاؤه بأمر من رئيس مجلس الوزراء.
#واس
Translate Tweet
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