Artificial Intelligence (AI):
Challenges & Opportuneties

Prof. Jalal Etesami

Computations, Information and Technology (CIT)

Agenda:

- Where is AI coming from?
- Where is it now?
- Where might it be in the future?

Why AI?

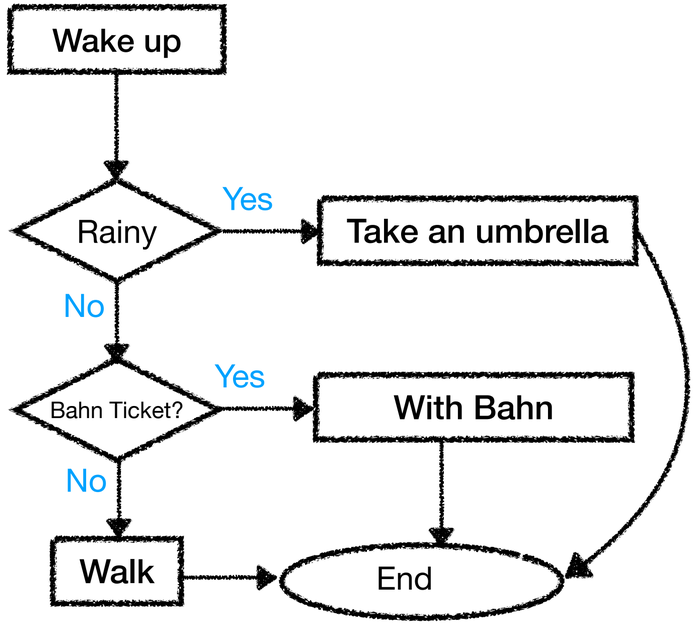
- It is about the passion to create & solve problem
- It is our future.
- With AI, we can create something that can do different jobs much faster with less errors.
- This leads into better health system, better living condition, …!
- It also leads to new problems that were not there before.

History:

- Performing a task can be divided into several smaller tasks

- How to build a bridge?
- How to play chess?
- How to perform heart transplant?
- How to multiply two numbers?

Flowchart



- Muhammad ibn Musa al-Khwarizmi (c.780 – c.850) —> **Algorithm**

History:

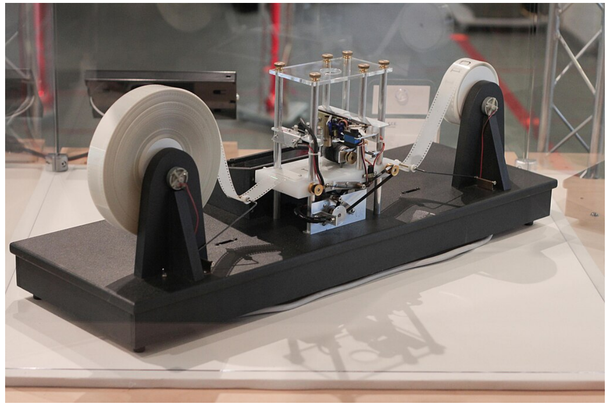
- Alan Mathison Turing (1912 –1954)
  - Computer scientists do not have Nobel prize.
  - We have Turing award.

- How to rob a bicycle?

The Imitation Game

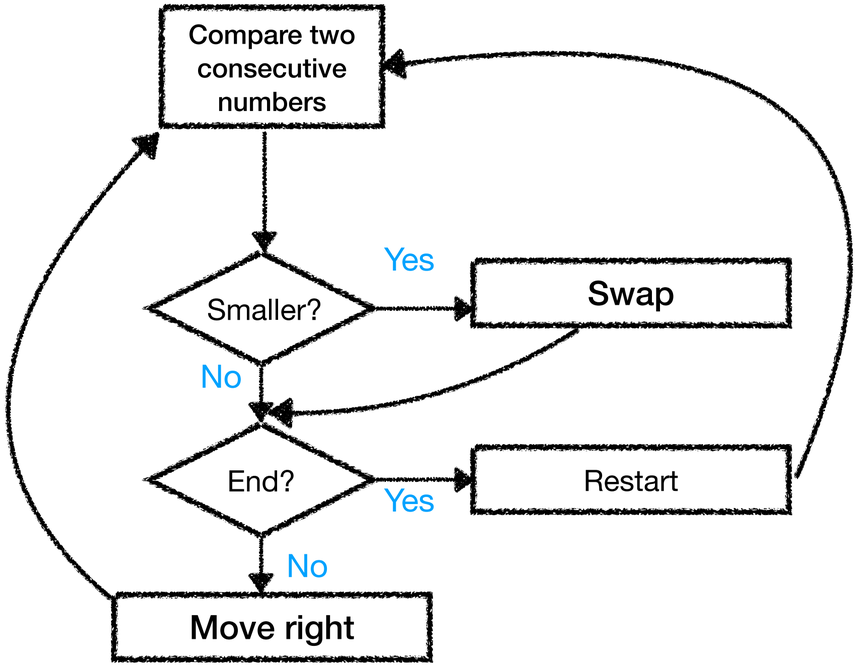
- Design an electromechanical machine that could find settings for the Enigma machine.

- A Turing machine is a mathematical model of computation describing an abstract machine that manipulates symbols on a strip of tape according to a table of rules.



• Classical Computer Science

- Tries to find an algorithm for a given task
- Transform the algorithm into computer language



- **Example**
  - Sorting a sequence of numbers

1, 4, -2, → 1, 4, -2, → 1, -2, 4, → -2, 1, 4, ✓

  - **Industrial robots**
    - Always at fixed positions
    - Performing similar tasks
      - Challenge is to find *right positions*
      - and *correct moves*

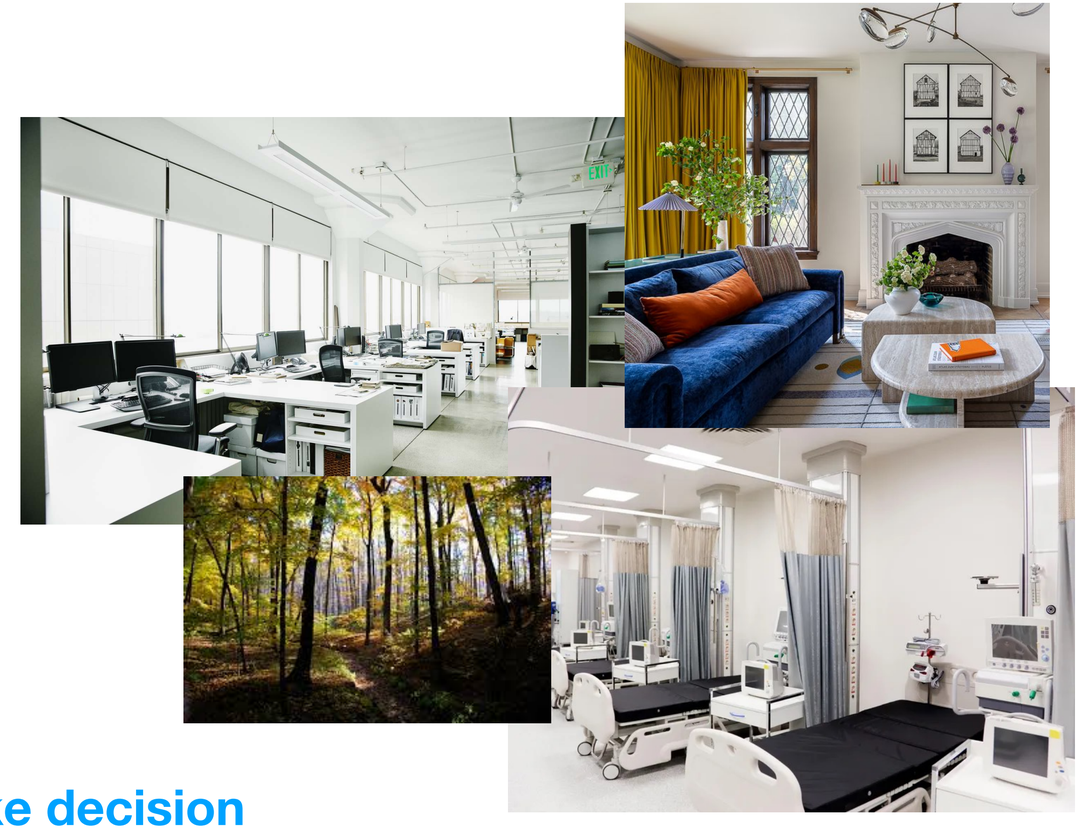
- What if the positions are not fixed?

- **Example**
  - Design a robot to walk
    - Its algorithm is too complex
    - The environment is varying and unknown

  - How do we walk?
    - We do not teach an algorithm for walking to our kids .!
    - We have an ability to **improve** our walking by practicing.

      - Here comes **Machine Learning**:
        - An algorithm that can get *better and better* by practicing.
        - An algorithm that can perform nicely in *unseen* environments.

- **Example**
  - How do we identify what is around us?
    - Watch
    - **Identify** different objects
    - **Reason** based on the identified objects, where we are

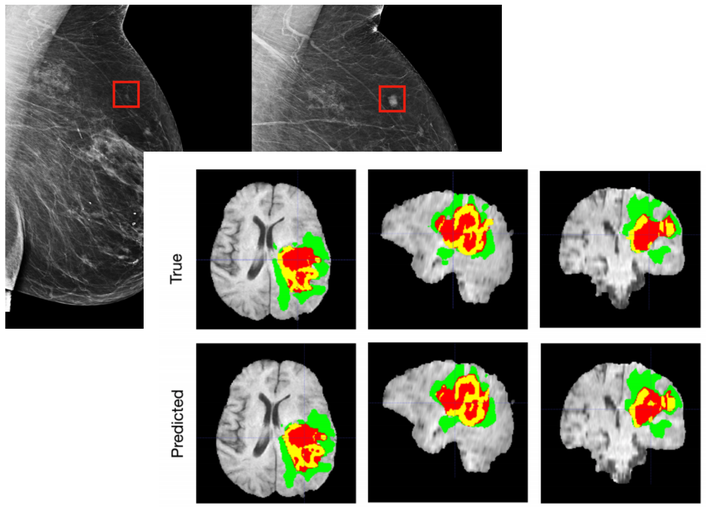


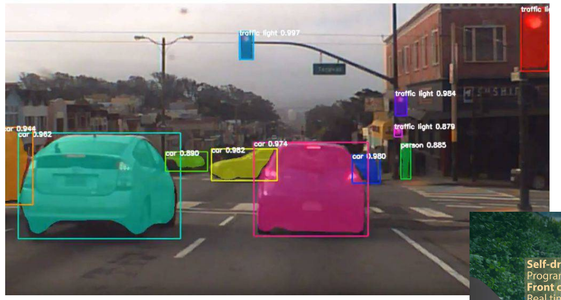
  - Here comes AI:
    - Algorithms that can **sense, reason, and make decision**

      - These examples are easy for us to do.
      - It is very hard to find their algorithms.
      - So, how do we actually do them !?

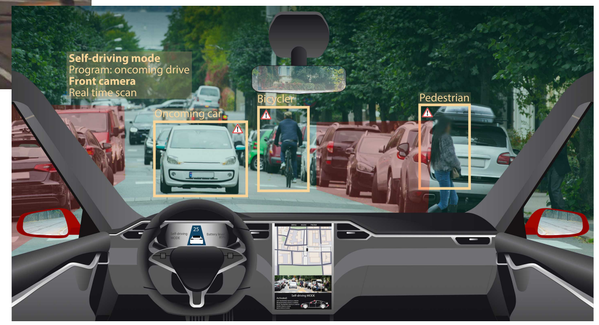
Computer Vision

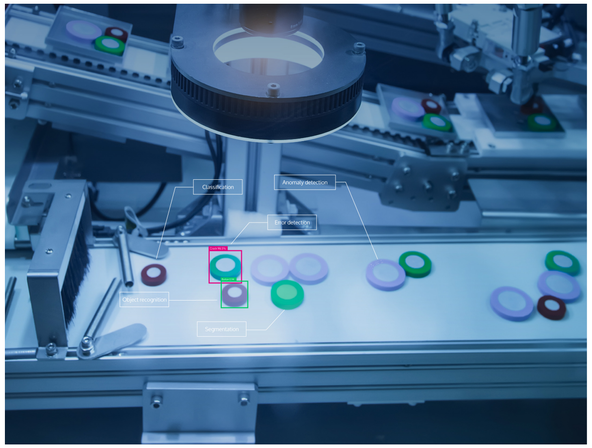
- **Healthcare**





- **Autonomous driving**



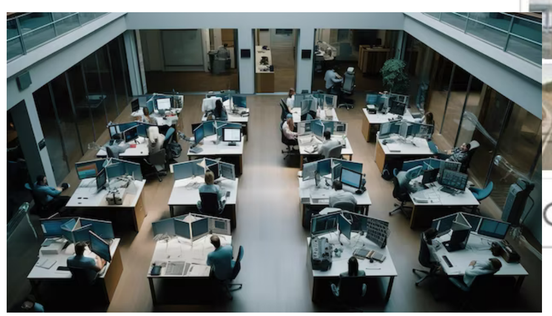


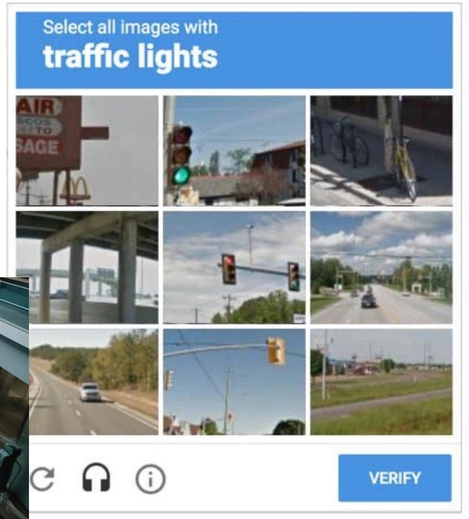
- **Industry**

- **Agriculture**

- How does our vision

  - We see ***different ex***
  - ***Learn*** the object.
  - If we see ***similar ob***

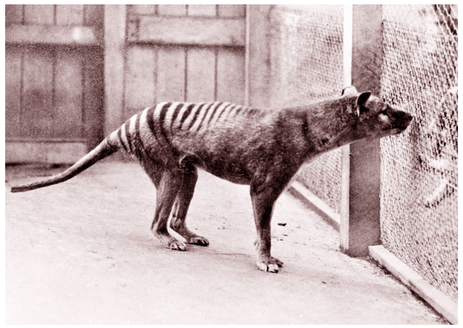




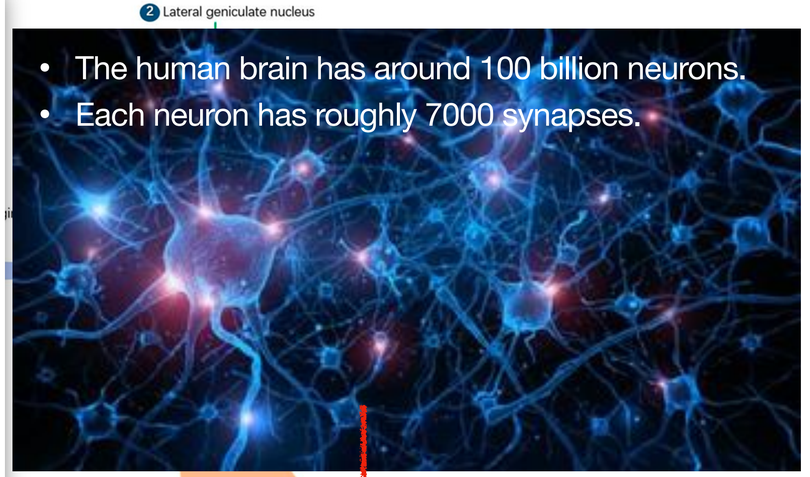
Dog

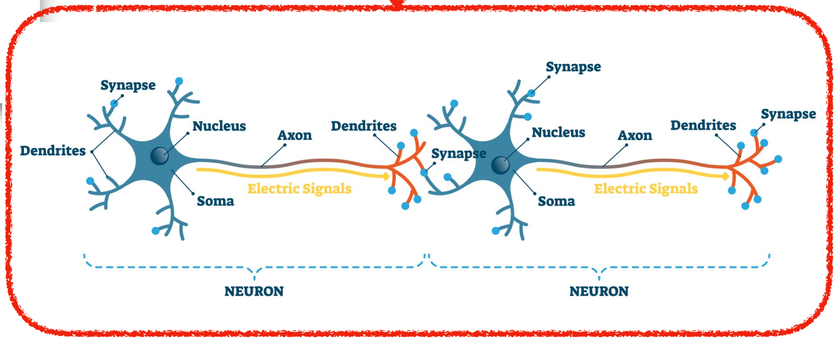
Tiger

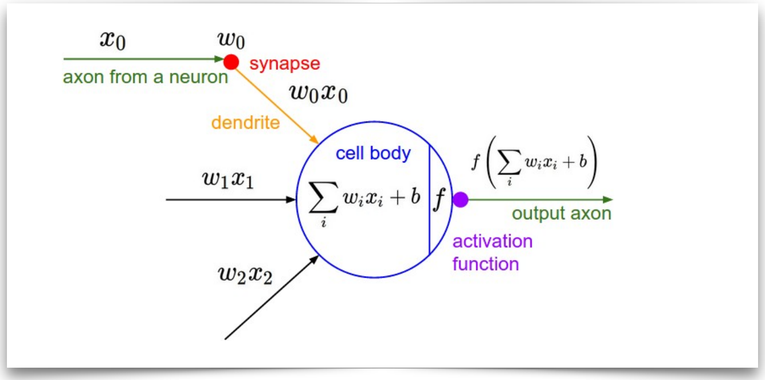
What is this?



What is this?



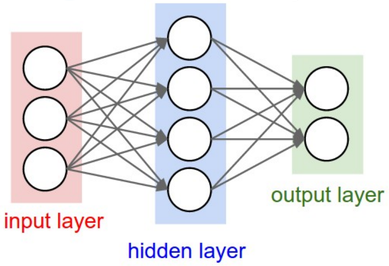


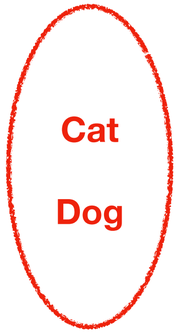


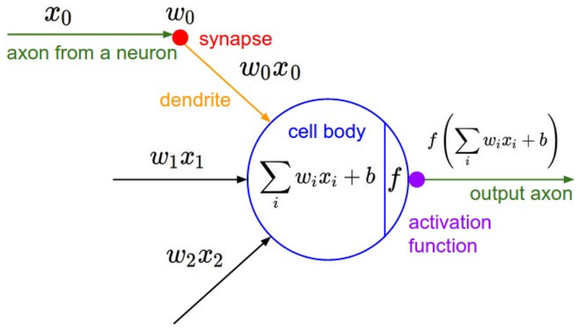
Mathematical Model

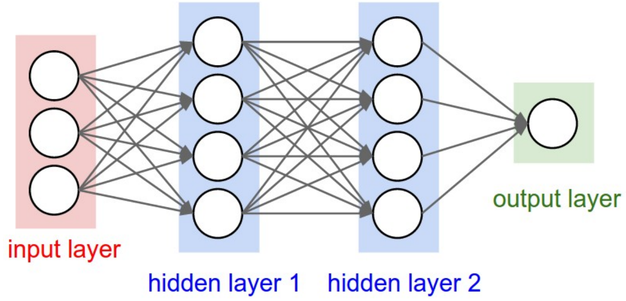
• Neural Networks (NN)

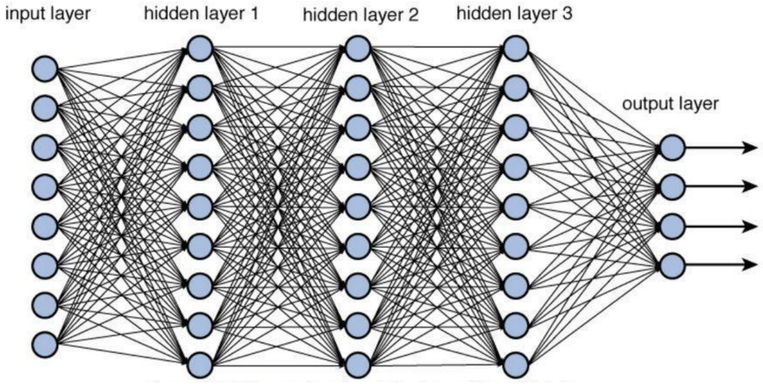
Training with many many examples

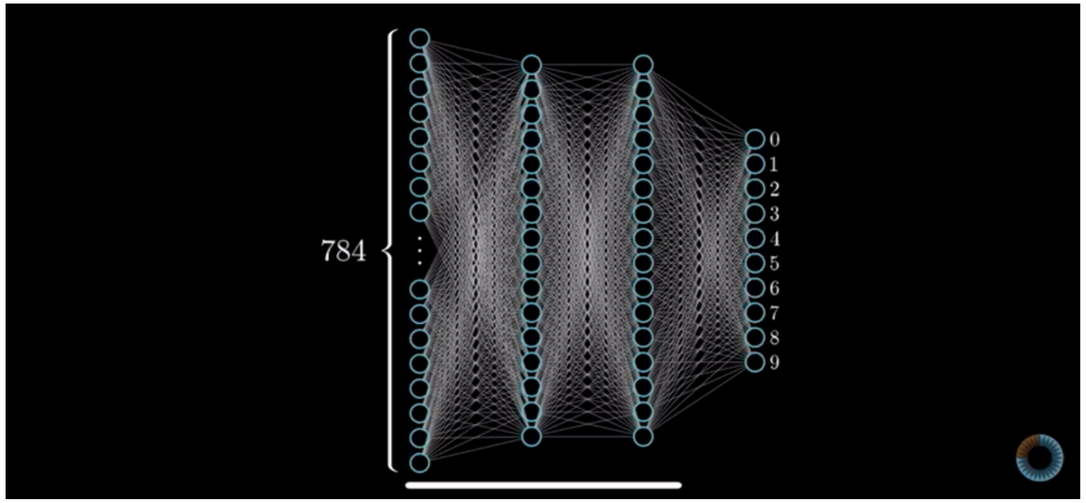










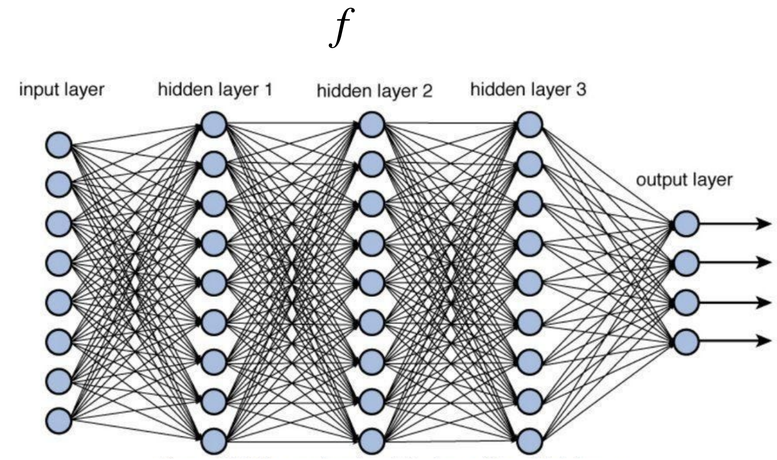


Deep Neural Networks (DNN)

• Regression

- In high-level, all we hope to do is to find a *mapping function* from input to output.

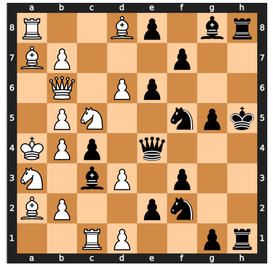
Input $\xrightarrow{\quad f \quad}$ Output



$f($  $) = Cat$

$f($  $) = Dog$

$f($  $)$ = Reduce Speed

$f($  $)$ = Move Queen to left