ARTIFICIAL INTELLIGENCE

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WHAT IS ARTIFICIAL INTELLIGENCE?

❖ AI is the study of complex information processing problems that often have their roots in some aspect of biological information processing. The goal of the subject is to identify solvable and interesting information processing problems, and solve them." — David Marr

❖ "The intelligent connection of perception to action" — Rodney Brooks

❖ "Actions that are indistinguishable from a human's" — Alan Turing

❖ "The science and engineering of making intelligent machines, especially intelligent computer programs" — John McCarthy

WHAT IS ARTIFICIAL INTELLIGENCE?

❖ Artificial Intelligence is a way of making a computer, a computer-controlled robot, or a software think intelligently, in the similar manner the intelligent humans think. Or, at least, think and act rationally.

❖ AI is accomplished by studying how human brain thinks, and how humans learn, decide, and work while trying to solve a problem, and then using the outcomes of this study as a basis of developing intelligent software and systems.

DEFINITION OF ARTIFICIAL INTELLIGENCE

Views of AI are divided into four

categories [Russell and Norvig, 2010]:

1. Systems that think like humans

2. Systems that act like humans

3. Systems that think rationally

4. Systems that act rationally
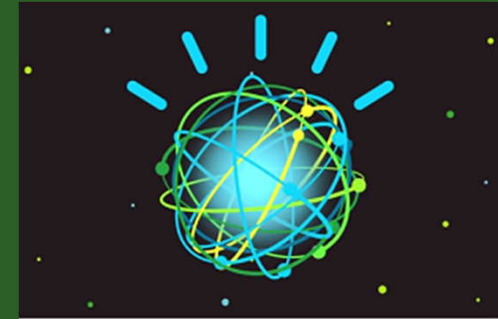
	HUMAN	RATIONAL
THOUGHT	1. Systems that think like humans	3. Systems that think rationally
BEHAVIOUR	2. Systems that act like humans	4. Systems that act rationally

THE MAIN TOPICS IN AI

❖AI has been dominant in various fields. Knowledge from these fields are used in many applications

➢<u>Computer vision</u> — How computer make sense with what it sees

➢<u>Natural language processing (NLP)</u> — How computer communicate with people using everyday languages

➢<u>Knowledge representation</u> — How to put knowledge into a form that computer can reason with

➢<u>Machine learning</u> — How computer learns and knows what to do without being explicitly programmed

➢<u>Expert system</u> — How to give advice and make decision like a human expert

EXAMPLES OF AI APPLICATIONS

AND THE PRINCIPLES AND DRIVE THEM

AI IN MODERN WORLD: SELF-DRIVING CAR

❖ For self-driving to work properly, it needs to:

➢ Safely navigate the road from visual inputs

➢ Plan the route to the destination, by itself or receive routes

from server

➢ React to unexpected events, such as pedestrian

suddenly crossing the road.

- Example: Testa Autopilot avoiding crashes:

https://www.youtube.com/watch?v=RjGe0GiiFzw (3:49m)

➢ Correctly and quickly communicate with the passengers

GOOGLE CAR PROTOTYPE

A laser sensor scans 360 degrees around the vehicle for objects.

A processor reads the data and regulates vehicle behavior.

Radar measures the speed of vehicles ahead.

An orientation sensor tracks the car's motion and balance.

A wheel-hub sensor detects the number of rotations to help determine the car's location.

Source: Google

Raoul Rañoa / @latimesgraphics

- https://youtu.be/aaOB-ErYq6Y (2.47m) Waymo (formerly Google) Car

- https://www.youtube.com/watch?v=tiwVMrTLUWg (15:29m) How it works at 7m45s

WHAT DOES GOOGLE CAR NEEDS TO WORK

❖ Computer Vision

➤ The computer needs to make sense of what is happening based on

visual data from its sensors, such as camera and from LIDAR (Laser

Illuminating Detection and Ranging), radar and sonar sensors

❖ Positioning System

➤ From sensor data, GPS, and Google map system

❖ Machine Learning

➤ We cannot program from every cases that can happen in real life

➤ We can, however, provide computer system with data, evaluate how it acts, and create

a system capable of machine learning, that it will improve its performance over time, and

eventually able to select correct actions for (almost) every situation

AI IN MODERN WORLD: GAMING

❖ What you call AI in computer might not use sophisticated AI technique at all

  ➢ Usually video game AI follows strict script, which few input data

    • "If player character is near, pursue and attack."

    • "If almost dying, run away."

❖ However, Advanced AI techniques are used in competitive gaming such as chess or go

❖ The goal will be different from video game (provide entertainment), to competitive game (win against other players)

ALPHAGO

❖ Traditionally, AI system played broad game by evaluating all possible moves and select the best one

❖ In game like Go, however, there are far to many moves to evaluate all of them

❖ AlphaGO by Deepmind, is a AI system that use neural network and randomized trials to limit searching only "good" moves. It has now beaten number 1 human player.

AI IN MODERN WORLD: ROBOTICS

❖ The science of designing, creating and operating of autonomous machines

❖ There are many robots in this world, with various capabilities

❖ Many disciplines are involved

➢ Computer science, especially AI

➢ Electrical engineering

➢ Mechanical engineering

ROBOTICS (cont.)

❖ Getting robots to move properly can be a substantial task

➢ https://www.youtube.com/watch?v=g0TaYhjpOfo (1:13)

➢ https://www.youtube.com/watch?v=kgaO45SyaO4 (0:24m)

❖ Robots also need to be able to handle objects

➢ https://www.youtube.com/watch?v=tf7IEVTDjng (2:27m – can start around 0:50)

❖ And handle unexpected situation

➢ https://www.youtube.com/watch?v=rVIhMGQgDkY (2:41m)

❖ Robots can even work together as a group.

➢ https://youtu.be/xK54Bu9HFRw (2:03m)

➢ https://youtu.be/YQIMGV5vtd4 (1:43m)

AI IN ROBOTICS

❖ Computer vision helps robot understand what it sees, enable it to make better decision

❖ Natural language processing allow robot to understand human verbal commands and questions

❖ Machine learning is used for robots to learn to do various task without having every steps be programmed

❖ AI techniques can also help robots to work together. For example, **swarm robotics** deal with creating a collections of small robots that work to achieve common goals

AI IN YOUR POCKET: GOOGLE TRANSLATE

❖Link: https://translate.google.com/ or mobile app

❖Provide translation services, can translate from:

>Text

>Web page

>Speech

>Handwriting

>Text on image (mobile app)

❖Can translate over 90 languages

❖Available for free
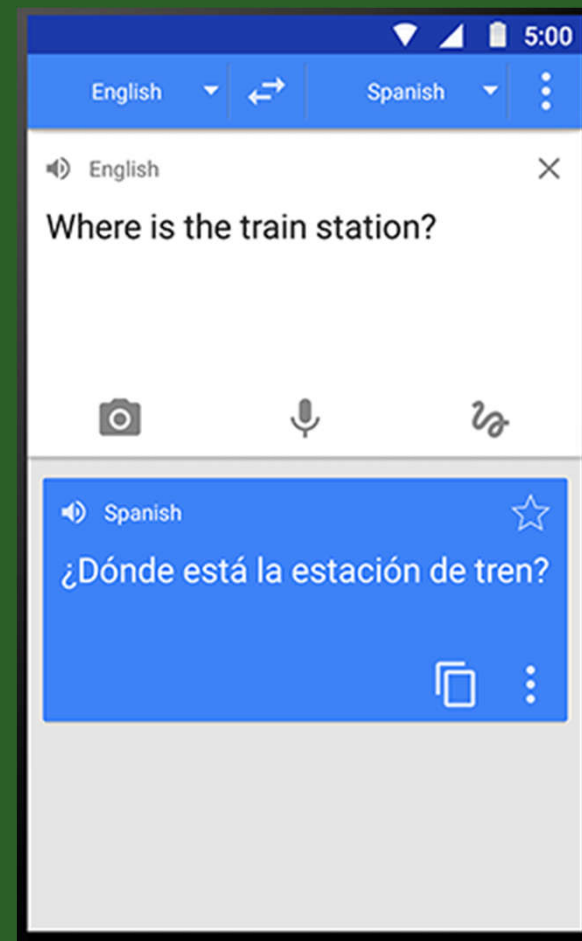
GOOGLE TRANSLATE (WORD LENS)
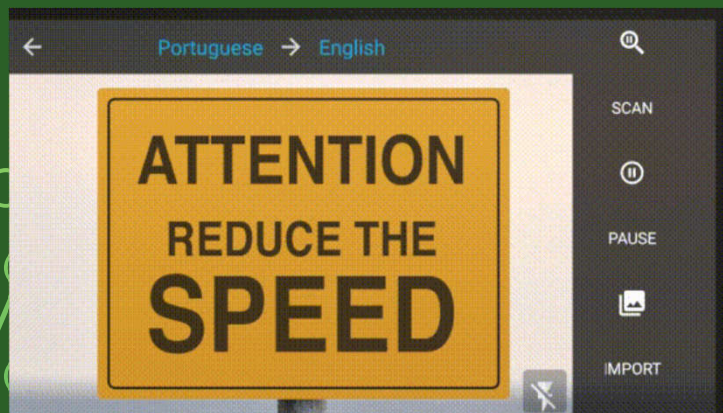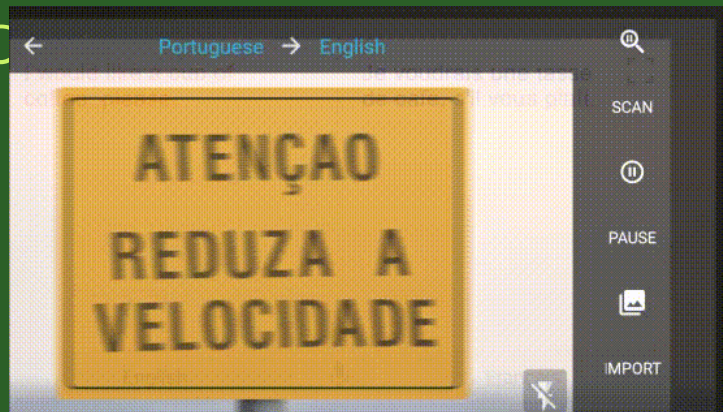
❖ Translate what you see in the camera...

Image Source: translate.Google.com

❖ Or take a picture and highlight

WHAT GOOGLE TRANSLATE NEEDS TO WORK

❖ Natural Language Processing

➢ Can find a correct translation from source language to target language, without having direct translation of each and every possible sentences on hand

❖ Image Recognition

➢ If translate text in image, need to be able to read the text. This is called Optical Character Recognition (OCR)

❖ Voice Recognition

➢ Can understand what is being said

❖ Machine Learning

➢ Can learn to translate new words / phrases

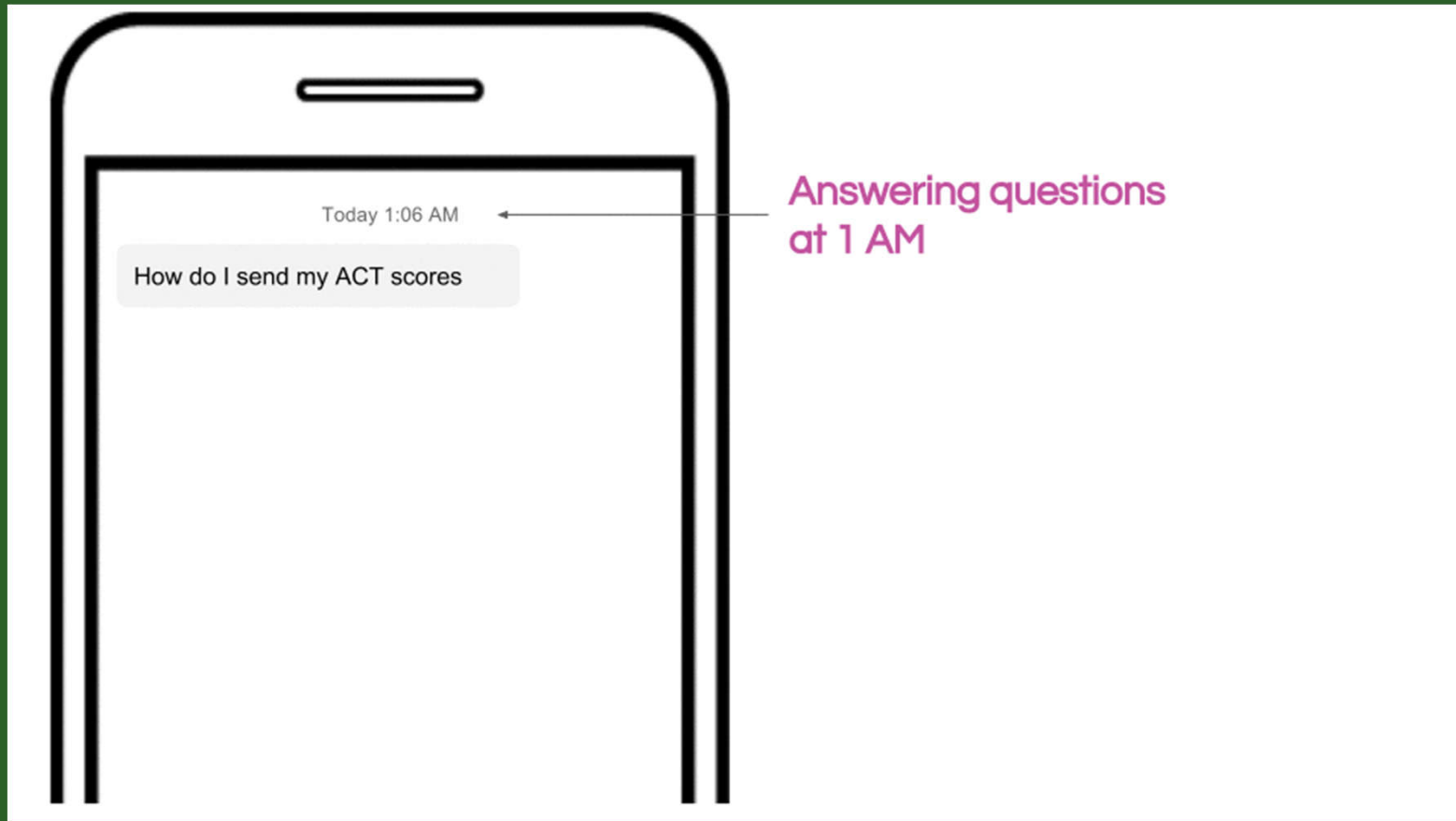# AI IN YOUR POCKET: PERSONAL ASSISTANT & CHATBOT

❖ Personal Assistant

➢ Usually communicate with one user, on various tasks

- Call someone on the contact list

- Search for some general information

➢ Specific to user. "Call Mom"

➢ Has some access to user's personal data

❖ Chatbot

➢ Work with multiple users, for specific tasks

- Help with using a computer program

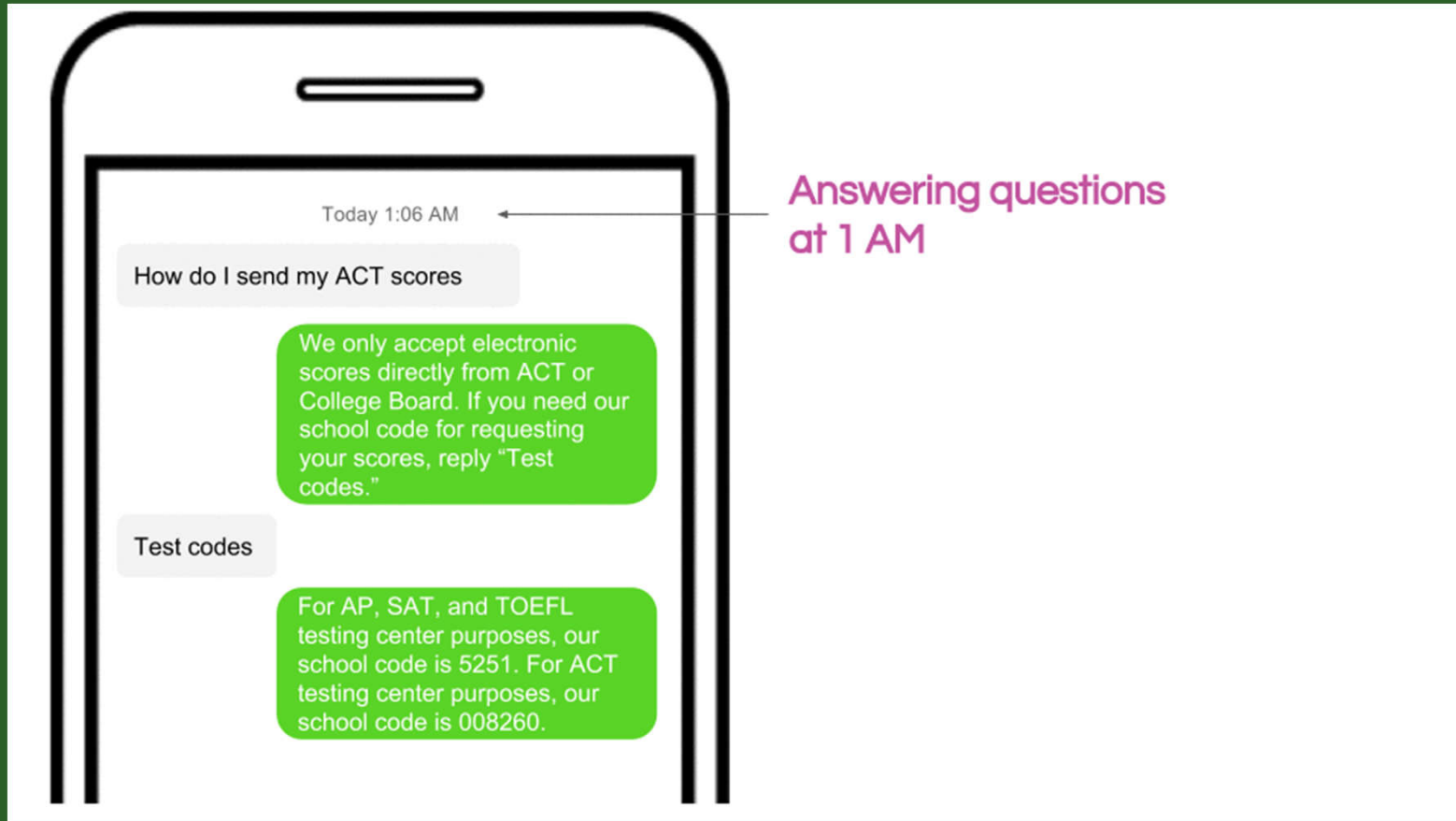- Help students with enrollment

- Handle reservation to a cinema

❖ Both can communicate with voice/ typed sentences

CHATBOT EXAMPLE

http://blog.admithub.com/case-study-how-admithub-is-freezing-summer-melt-at-georgia-state-university

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PERSONAL ASSISTANT & CHATBOT (CONT.): WHAT DO THEY NEED

❖ NLP - Use context to limit possible actions to the ones most likely to be a correct choice

➢ "Call Mom" → Look for "Mom" in contact list

➢ "When will the semester start" → know that "the semester" means the earliest semester to start

❖ Once the system know what the user wants, database/ internet search can be used to find the answer

AI IN YOUR POCKET: FARMER ASSISTANT APP

❖ In India, there experiments in using AI to help farmers.

❖ One example is that the computer will send SMS to farmers, telling them when to sow the seeds. → Yield increased by 30%!

❖ This is an example of **expert systems**. The AI system process past weather data, predict current year weather pattern, and give advice to the farmers when to sow the seeds, like a human expert would do.

http://www.icrisat.org/mobile-app-to-help-farmers-overcome-crop-damage-launched-in-india/

AI THAT KNOW WHAT TO DO AND IMPROVES BY ITSELF: MACHINE LEARNING

❖ Machine Learning is a type of artificial intelligence (AI) that provides computers with the ability to learn without being explicitly programmed

❖ Focuses on the development of computer programs that can change when exposed to new data

❖ Searches through data to look for patterns

❖ Uses that data to detect patterns in data and adjust program actions accordingly

WHY MACHINE LEARNING?

❖ In most real-world applications, it is impossible to program the computer for every possible situation, even if we know what we want the system to do.

➢ Better to have AI system learn what to do from the data themselves, and monitor whether the system learns correct behaviors or not

❖ Also, if the data are changing overtime, machine learning will help your AI system maintain its performance without having to reprogram everything

❖ Therefore, Almost all current AI systems will have some learning capabilities

EXAMPLES OF MACHINE LEARNING

❖ Google self-driving car

  ➢ Learn what to do from data it gets from camera/sensor/map.

❖ Online recommendation offers such as those from Amazon and Netflix –
  They keep some characteristics of you, then give you recommendation
  based on:

  ➢ How people with similar characteristic like/dislike a product/ a show.

  ➢ How you enjoy/search for similar/related product/show in the past.

❖ Facebook's News Feed uses machine learning to personalize each
  member's feed.

  ➢ If a member frequently stops scrolling in order to read or "like" a particular
    friend's posts / post of certain topics, the News Feed will start to show more
    of that friend's activity / post of that topic earlier in the feed.

TYPES OF MACHINE LEARNING

❖ Supervised learning

  ➢ Learn with training data (correct answers provided). Use learned system to correctly predict answer for samples the system has not seen before.

❖ Unsupervised learning

  ➢ No correct answers provided. Learn hidden characteristics/structures of the data.

❖ Reinforcement learning

  ➢ No feedback for one individual action, but a sequence of actions will yield an outcome. Find a way to always get the best sequence.

SUPERVISED LEARNING

❖ Provided with <u>training data</u>, with correct answers provided

❖ Task: Classification:

  ➢ Given a collection of records (*training set*)

  ➢ Each record contains a set of *attributes*, one of the attributes is the *class*.

❖ Find a *model* for class attribute as a function of the values of other attributes

❖ Goal: <u>previously unseen</u> records should be assigned a class as accurately as possible.

  ➢ A *test set* is used to determine the accuracy of the model. Usually, the given data set is divided into training (to build model) and test sets (to validate the model) .

Tid	Attrib1	Attrib2	Attrib3	Class
1	Yes	Large	125K	No
2	No	Medium	100K	No
3	No	Small	70K	No
4	Yes	Medium	120K	No
5	No	Large	95K	Yes
6	No	Medium	60K	No
7	Yes	Large	220K	No
8	No	Small	85K	Yes
9	No	Medium	75K	No
10	No	Small	90K	Yes

Training Set

Learning algorithm

Induction

Learn Model

Model

Tid	Attrib1	Attrib2	Attrib3	Class
11	No	Small	55K	?
12	Yes	Medium	80K	?
13	Yes	Large	110K	?
14	No	Small	95K	?
15	No	Large	67K	?

Test Set

Apply Model

Deduction
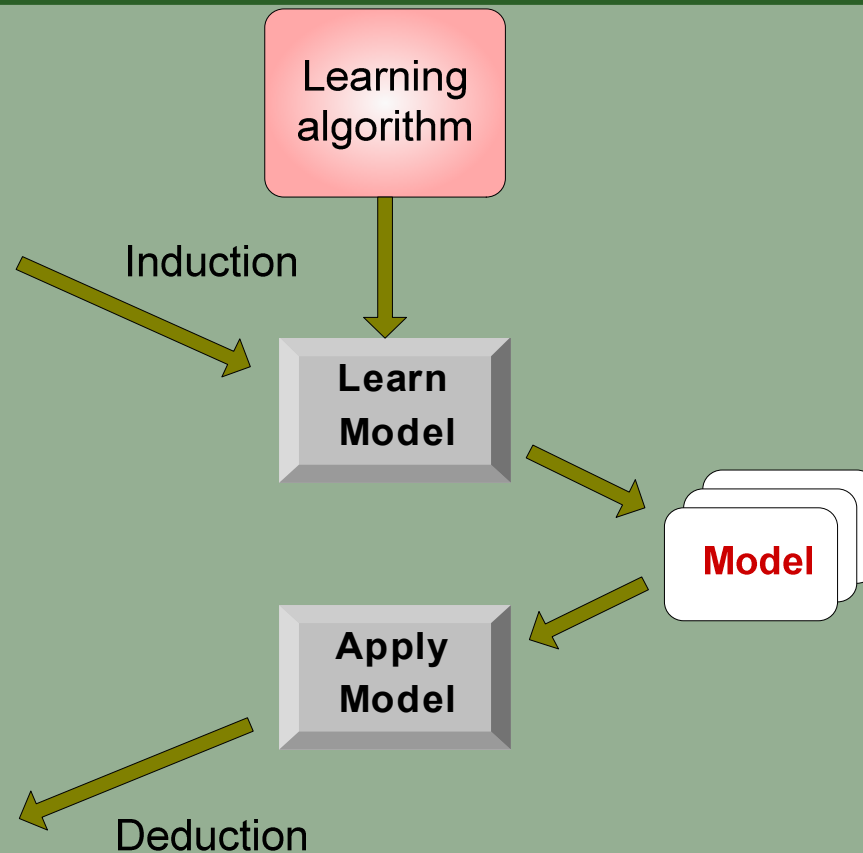
UNSUPERVISED LEARNING

❖ No correct answers provided

❖ Learn hidden structure of data

  ➢ Clustering – Divide data into groups of sample with similar

  characteristics
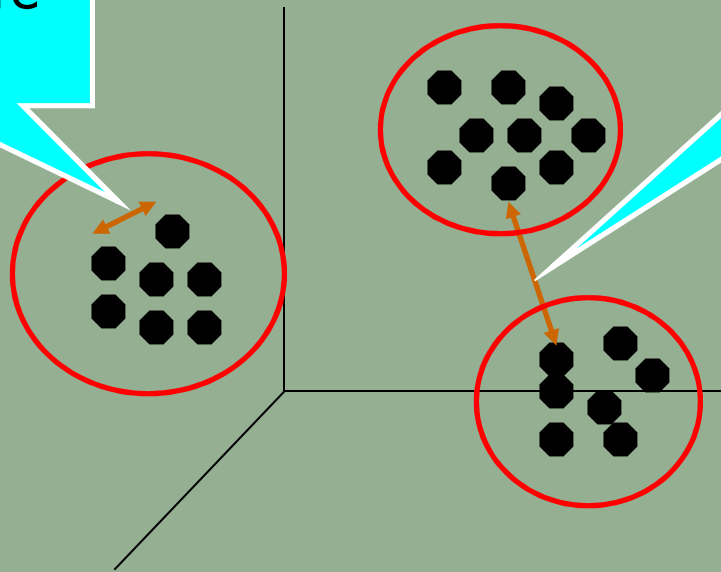
  ➢ Examples of Clustering:

   • Divide potential customers into market segments

   • Divide patients into groups to analyze each group further

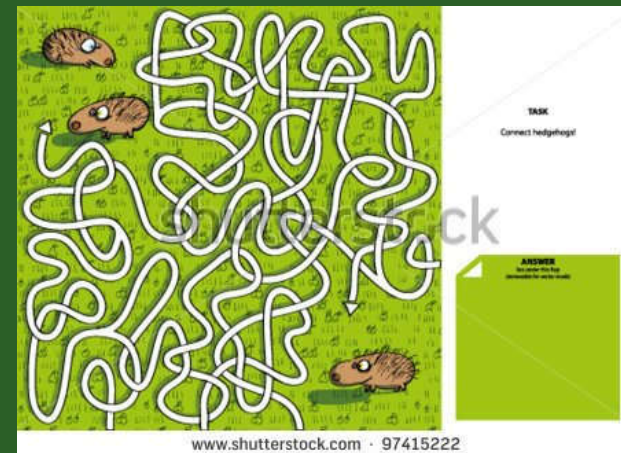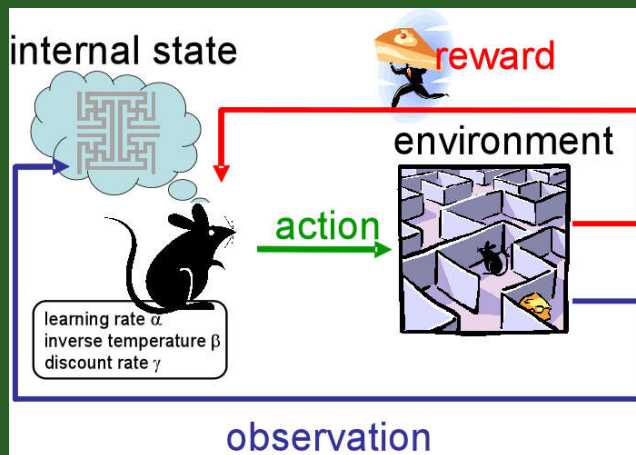   • Identify "hot spot", locations with higher crime rates

CLUSTERING

REINFORCEMENT LEARNING

❖ Each action may not have immediate reward/punishment

❖ But **sequence** of actions will lead to an (good/bad/neutral) outcome

❖ How to get sequence of actions that will lead to the best cumulative reward?

❖ Example: self-driving car, traveling to a maze, playing Go

OTHER APPLICATIONS OF AI & MACHINE LEARNING

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

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

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

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

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

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

AI & MACHINE LEARNING-RELATED COMPANIES