Machine Learning

- Machine Learning deals with the problem of extracting features from data so as to solve many predictive tasks
    - Ranking (Google search, author ranking)
    - Forecasting
- Apply Machine Learning
    - Human expertise is minimum/absent
    - Solution changes with time

Why Naïve Bayes is Naïve?

- Naïve Bayesian classification is called naïve because it assumes class conditional independence. In other words the effect of an attribute value on a given class is independent of the values of the other attributes

Types of Learning

- Supervised Learning
    - Classification

An example: data (loan application)

ID	Age	Has_Job	Own_House	Credit_Rating	Class: r not
1	young	false	false	fair	No
2	young	false	false	good	No
3	young	true	false	good	Yes
4	young	true	true	fair	Yes
5	young	false	false	fair	No
6	middle	false	false	fair	No
7	middle	false	false	good	No
8	middle	true	true	good	Yes
9	middle	false	true	excellent	Yes
10	middle	false	true	excellent	Yes
11	old	false	true	excellent	Yes
12	old	false	true	good	Yes
13	old	true	false	good	Yes
14	old	true	false	excellent	Yes
15	old	false	false	fair	No

Class	Young	middle	old
yes	2/7	3/7	2/7
no	3/5	2/5	0

Class	false	true
yes	4/7	3/7
no	5/5	0

P (own house | Class)

Class	false	true
yes	1/7	6/7
no	5/5	0

Class	fair	good	excellent
yes	1/7	3/7	3/7
no	3/5	2/5	0

- old,true,false good
- P(test-yes)=2/7*3/7*1/7*3/7*7/12=0.0026
- P(test-no)=0
- Class= yes - correct
- Old,true,false,excellent
- P(yes)=
- P(no)=0
- Class=yes - coreect
- Old,false,false,fair
- P(yes)=2/7*4/7*1/7*1/7*7/12=
- P(no)=0
- Class=yes – incorrect

- Accuracy= 2/3=0.666

    - Regression

- Regression is about making predictions
- Linear regression

$$a = \frac{(\sum y)(\sum x^2) - (\sum x)(\sum xy)}{n(\sum x^2) - (\sum x)^2}$$

$$b = \frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2}$$

  - Y = AX + B where X is input by user
- Logistic Regression

Study Hours(X)	Result(Y)	X^2	Y^2	XY
1	0	1	0	0
2	0	4	0	0
2	0	4	0	0
3	1	9	1	9
4	1	16	1	16
ΣX=12	**ΣY=2**	**ΣX^2=34**	**ΣY^2=2**	**ΣXY=25**

- **$\Sigma dx^2 = \Sigma x^2 - (\Sigma x)^2/n) \Rightarrow 9.8$**
- **$\Sigma dy^2 = \Sigma y^2 - (\Sigma y)^2/n) \Rightarrow 1.2$**
- **$\Sigma dxdy = \Sigma xy - (\Sigma x)(\Sigma y)/n \Rightarrow 20.6$**
- **$X = \Sigma x/n \Rightarrow 2.2$**
- **$Y = \Sigma Y/n \Rightarrow 0.4$**
- **$b = \Sigma dxdy / \Sigma dx2 = 2.1$**
- **$a = y - bx \Rightarrow -4.22$**
- // Y=ax+b
- Y = Bx + a

$$g(z) = \frac{1}{1 + e^{-\theta^T x}}$$

- Probabiility for 1 hour: $1/(1+e^{-(2.1(1)-4.22)})$
- $1/(1+8.33)$
- $1/9.33$
- 0.107

- Unsupervised Learning
  - K Mean

Sample No	X	Y

1	**185**	**72**
2	**170**	**56**
3	**168**	**60**
4	**179**	**68**
5	**182**	**72**
6	**188**	**77**

K1 = 185, 72

K2 = 170, 56

Now start with third row

$$K1 = \sqrt{(168-185)^2 + (60-72)^2}$$
$$K1 = 20.8$$
$$K2 = \sqrt{(168-170)^2 + (60-56)^2}$$
$$K2 = 4.48$$

Sample No	X	Y	Assignment
1	**185**	**72**	**1**
2	**170**	**56**	**2**
3	**168**	**60**	**2**
4	**179**	**68**	
5	**182**	**72**	
6	**188**	**77**	

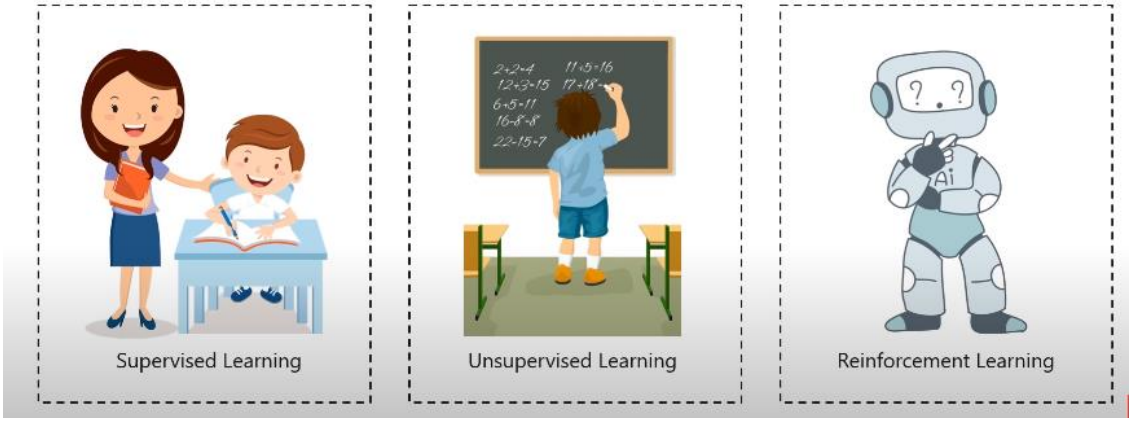
K1 = 185, 72

$$K2 = \left(\frac{170+168}{2}, \quad \frac{60+56}{2}\right) = (169, \quad 58)$$

Same for each row

- Reinforcement learning

Reinforcement Learning	Supervised Learning	Unsupervised Learning
Establish pattern and behavior. Like if you drop an isolated Ireland then what you do, you may think about water and where to get food. You learned from experience in simple	Machine learn under guidance like small child learn under teacher	Machine learn without any guidance. You just give data and on sample data, machine automatically configured answer Other example you are adult and you don't need guidance



- Neural Networks
    - An artificial neuron is a device with many inputs and one output
    - The neuron has two modes of operation;
        - The training mode
        - The using mode
- Decision Trees
    - Decision trees are trees which classify instances by testing at each node some attribute of the instance

After Mid

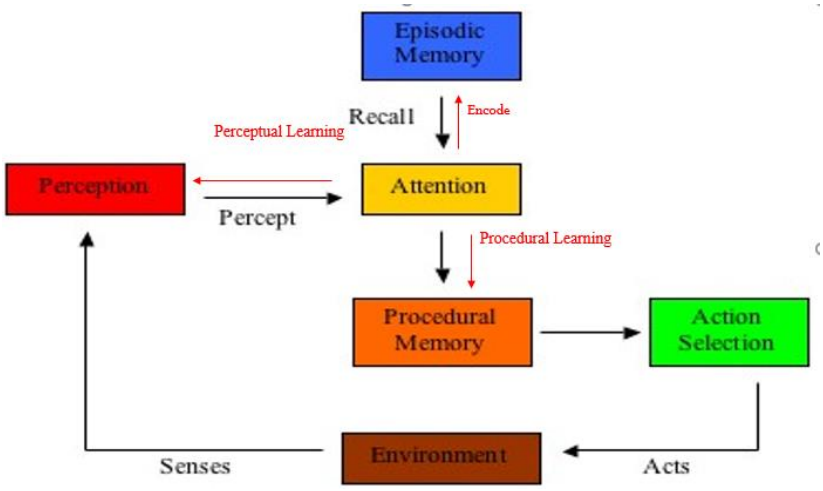
AGI

- Artificial general intelligence (AGI) is the intelligence of a machine that could successfully perform any intellectual task that a human being can

AI Programs	Robots
They usually operate in computer-stimulated worlds.	They operate in real physical world
The input to an AI program is in symbols and rules.	Inputs to robots is analog signal in the form of speech waveform or images

They need general purpose computers to operate on.	They need special hardware with sensors and effectors.

Cognitive Cycle



NLP

- The attempt to get computers to process human languages in textual form in a way that utilizes knowledge of language in order to perform some useful task
- Stages
    - Phonetics, Phonology, Graphetics, Graphology
        - Phonetics is the study of how to describe and classify speech sounds
        - One approach to phonology seeks to find minimal sound units which if changed in a word alter the words meaning Phonology
        - Graphetics is the study of the physical properties of the symbols making up writing systems
        - Graphology is the study of the characteristics of the symbol systems used in human languages
    - Morphology
        - Morphology is the study of the structure of words
        - The smallest meaningful elements into which words can be decomposed are called **morphemes**
            - dis-agree-ment-s – 4 morphemes
        - **Inflectional morphology** is concerned with the differing forms one word takes to signal differing grammatical roles
            - boy/ boys singular/ plural
        - **Derivational morphology** is concerned with how new words may be constructed from component morphemes

- Lexical Analysis
  - If word in sentences have two or words then is lexical analysis like below example
    - The tank was full of water
      - Tank has two mean and water tank or army tank so word in sentence have two meaning then its lexical analysis
- Syntactic Analysis
  - If sentence have two or more meaning
    - Old man and woman were taken to safe place
      - In sentence there is two meaning one that old man and all woman and second that old man and old woman
- Semantics Analysis
  - We discuss about meaning
  - The car hit the pole while its moving then complexity that car moving or pole moving
- Pragmatics
  - Multiple meaning of sentence like why sentence used
  - Police are coming
    - We cannot understand police come for me or maybe you
- Discourse
  - The study of discourse involves the analysis of the structure and meaning of text

Proglog

- **In slide**

Knowledge Representation

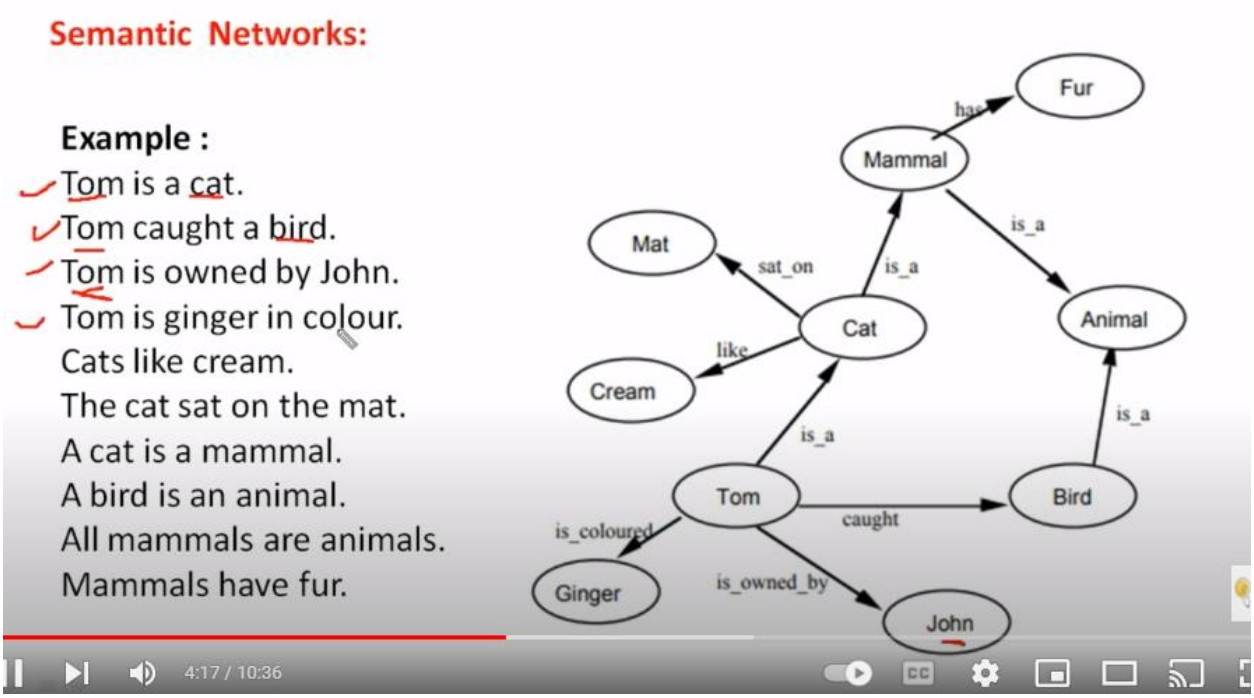
- Representing information about the world in a form that a computer system can utilize to solve complex tasks

Types of Knowledge

- Prior knowledge: Comes before knowledge perceived through senses
- Posteriori knowledge: Knowledge verifiable through the senses
- Procedural knowledge: Knowing how to do something
- Declarative knowledge: Knowing that something is true or false
- Tacit knowledge: Knowledge not easily expressed by language
- Meta Knowledge: It's a knowledge about knowledge and how to gain them
- Heuristic: Representing knowledge of some expert in a field or subject
- Structural: Describes what relationship exists between concepts/ objects

Knowledge Representation

- Semantic net
  - A semantic network is a graphical knowledge representation technique



- Frames
  - A frame is a data structure represents related knowledge about a subject
  - Frames has two parts: slots and facets

Example 2:

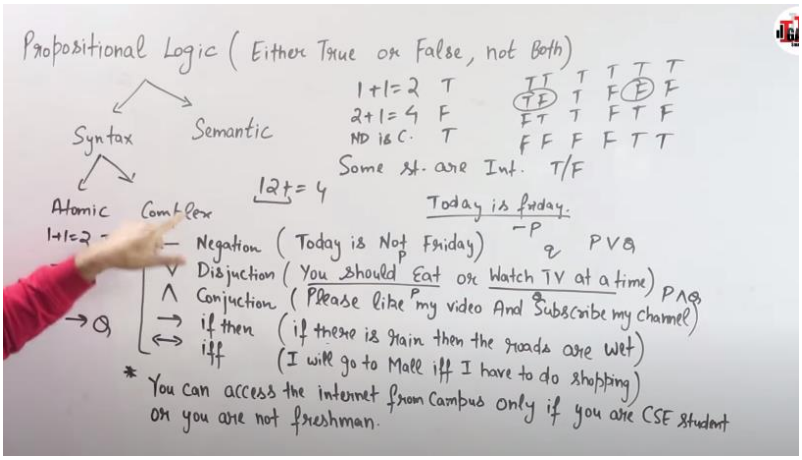
"Tweety is a yellow bird having wings to fly"

```
Tweety(
        (Species        (Value    bird))
        (color          (Value    yellow))
        (Activity       (Value    Fly))
)
```

Simple Frame Example

Slot Name	*Filler*
name	Astérix
height	small
weight	low
profession	warrior
armor	helmet
intelligence	very high
marital status	presumed single

- Logic
  - Simple statements either true or false



- Script
  - Define sequence of event
  - Represent particular context

Scripts on Slide

Script: Goint to a restaurant Props: Food Tables Menu Money Roles: Owner Customer Waiter Cashier	Scene 1: Entering the restaurant Customer enters the restaurant Scans the tables Chooses the best one Decides to sit there Goes there Occupies the seat
	Scene 2: Ordering the food Customer asks for menu Waiter brings it Customer glances it Chooses what to eat Orders that item
Entry Conditions: Customer is hungry Customer has money Owner has food	Scene 3: Eating the food Waiter brings the food Customer eats it
Results: Customer is not hungry Owner has more money Customer has less money Owner has less food	Scene 4: Paying the bill Customer asks for the bill Waiter brings it Customer pays for it Waiter hands the cash to the cashier Waiter brings the balance amount Customer tips him Customer moves out of the restaurant

Fig. 6.9 Pseudo-form of a restaurant script