UNIVERSITY OF HARGEISA

COLLAGE OF COMPUTING AND IT

DEPARTMENT OF COMPUTER SCIENCE

Selected Topics in CS

Suleiman Gargaare

MSc in Computer Science, MSc in Project Management & BSc in Information Technology.

Lecturer

suleiman.gargaare@gmail.com

Course Contents

- **Topic 1** – Review of AI & ML
- Topic 2 – Computer Vision & IP
- Topic 3 – NLP
- Topic 4 – Neural Network & DL

Selected Topics in CS

Topic 1 – Review of AI & ML

Contents

Artificial Intelligence

- AI in Everyday life
- Scope of AI

Machine Learning

- Supervised Learning, Unsupervised Learning, Reinforcement Learning

Computer Vision

- Image Filtering, Segmentation & Enhancement
- Erosion and Dilation (Image Morphology)

Natural Language Processing

- NLP Applications
- Parsing POS Tagging, WSD (Sense Inventory, Word Net).

Why Study AI?

- AI makes computers more useful
- Intelligent computer would have huge impact on civilization
- AI cited as “field I would most like to be in” by scientists in all fields
- Computer is a good metaphor for talking and thinking about intelligence

What is the definition of?

Algorithm

Artificial Intelligence

Machine Learning

Natural Language Processing

Computer Vision & Image Processing

Neural Networks & Deep Learning

What do you think?

The definition of AI is?

Systems that think like humans	Systems that think rationally
Systems that act like humans	Systems that act rationally

Artificial Intelligence ?

- **Artificial**:

Produced by human art or effort, rather than originating naturally.

- **Intelligence**:

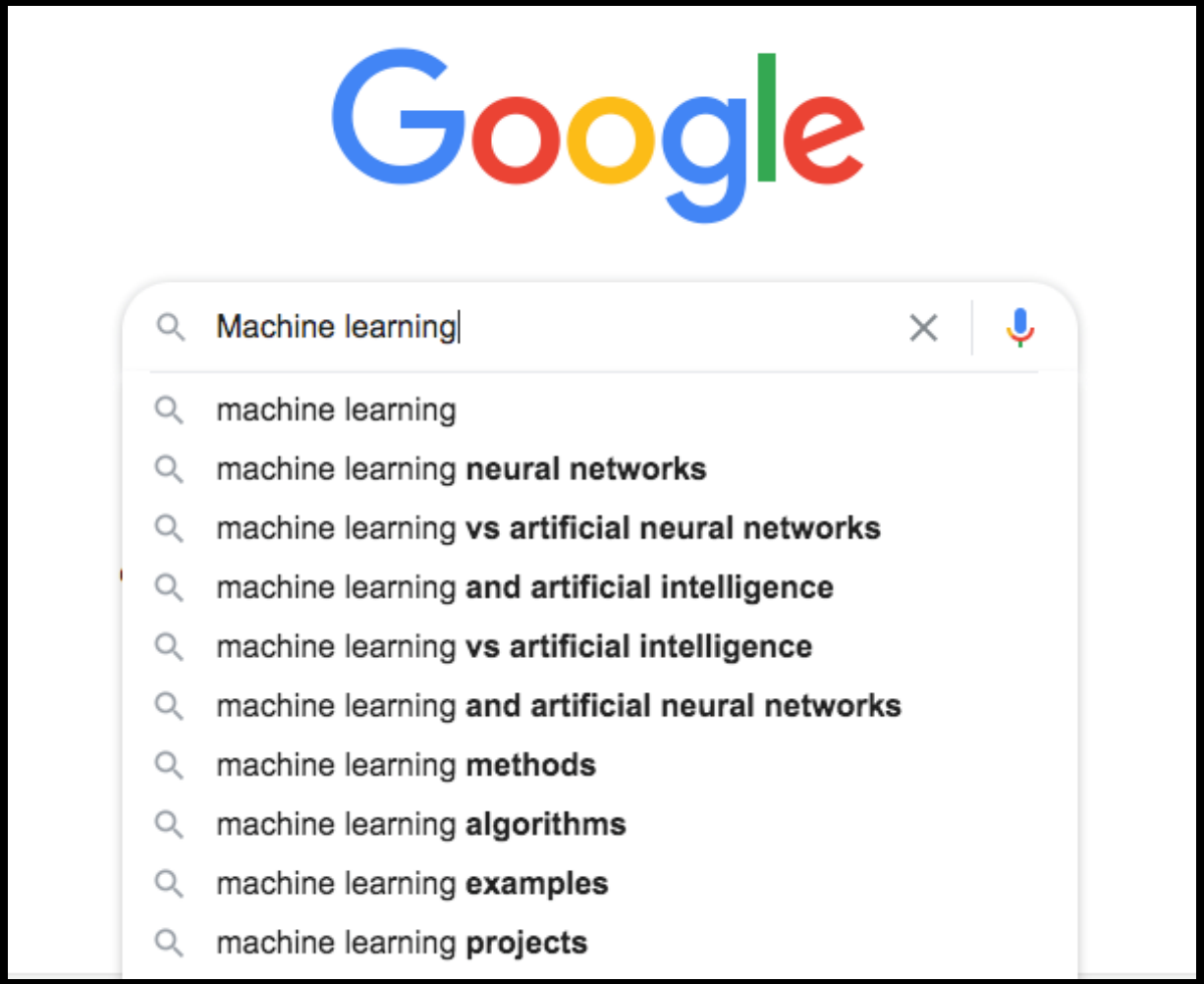
Intelligence the ability to acquire knowledge and use it.

So AI was defined as:

- ✓ AI is the study of ideas that enable computers to be intelligent.
- ✓ AI is the part of computer science concerned with design of computer systems that exhibit human intelligence

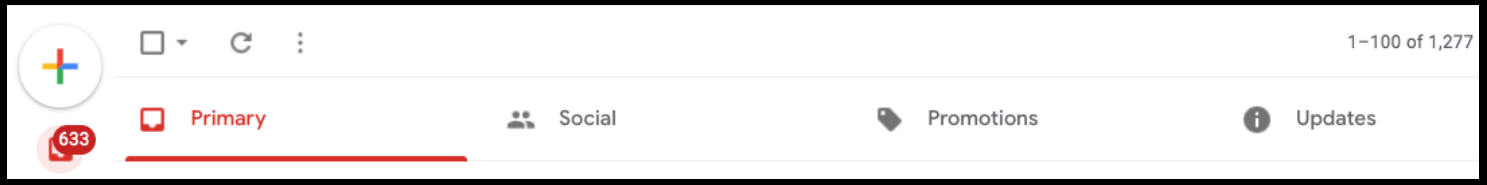
AI in Everyday Life!

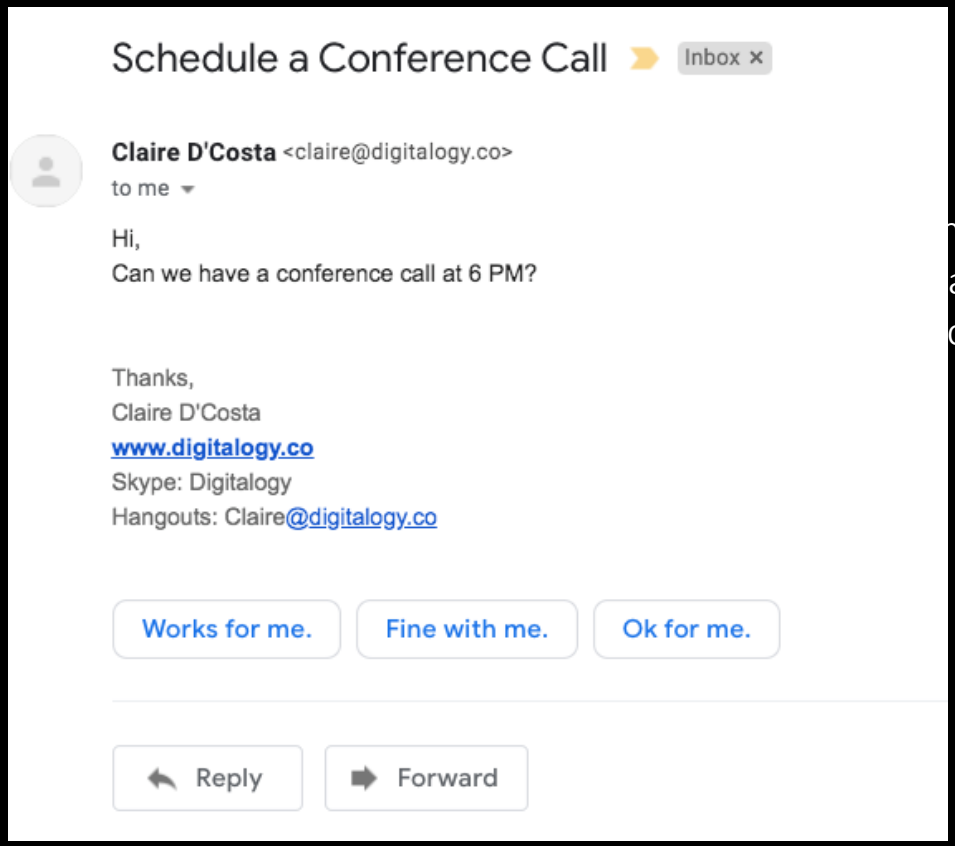
- **Google Predictive Search Algorithms**



Cont..

❖Smart Email Categorization & Replies in Gmail

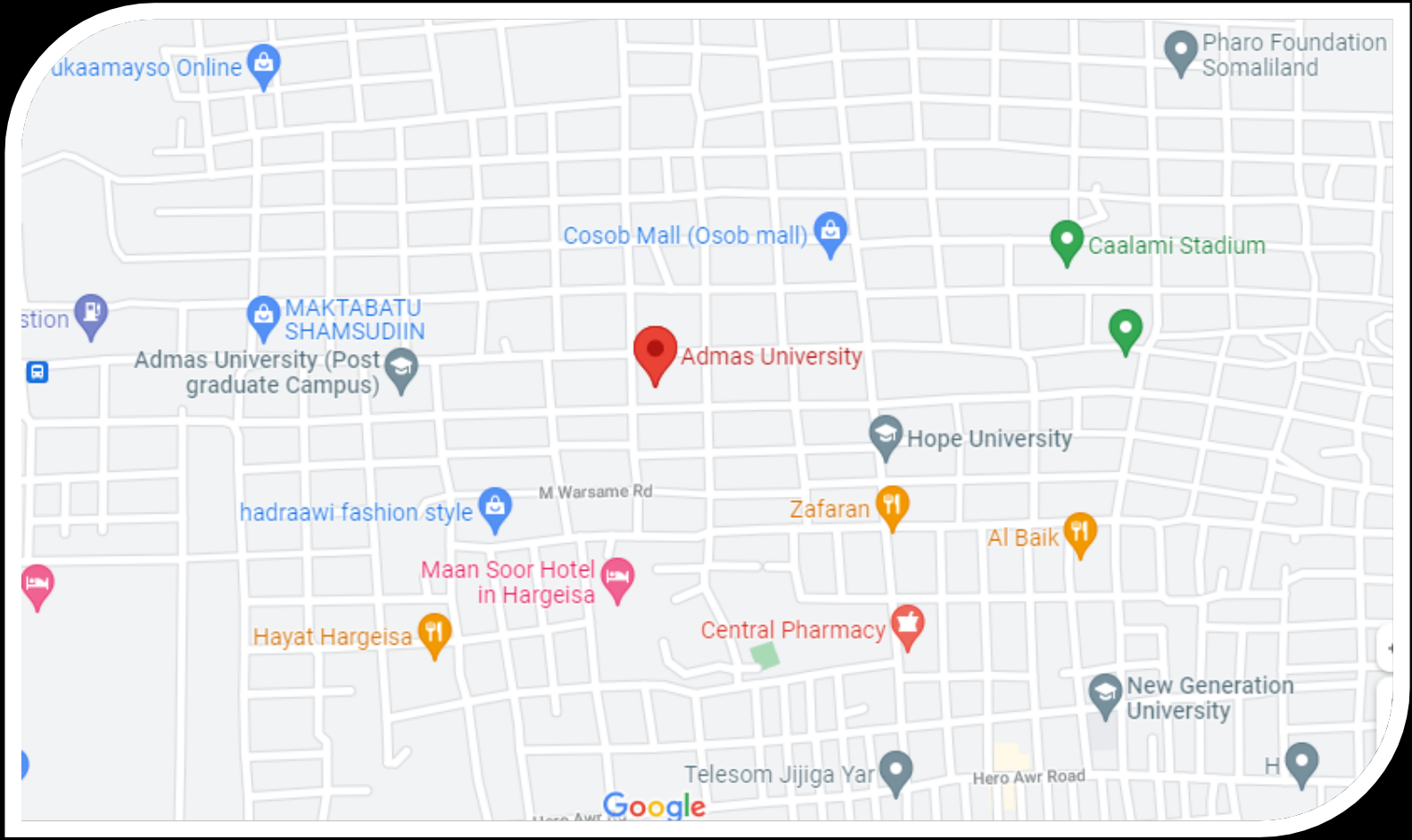




hrough the use of machine
arning algorithms, Gmail
ccessfully filters 99.9% of
spam””

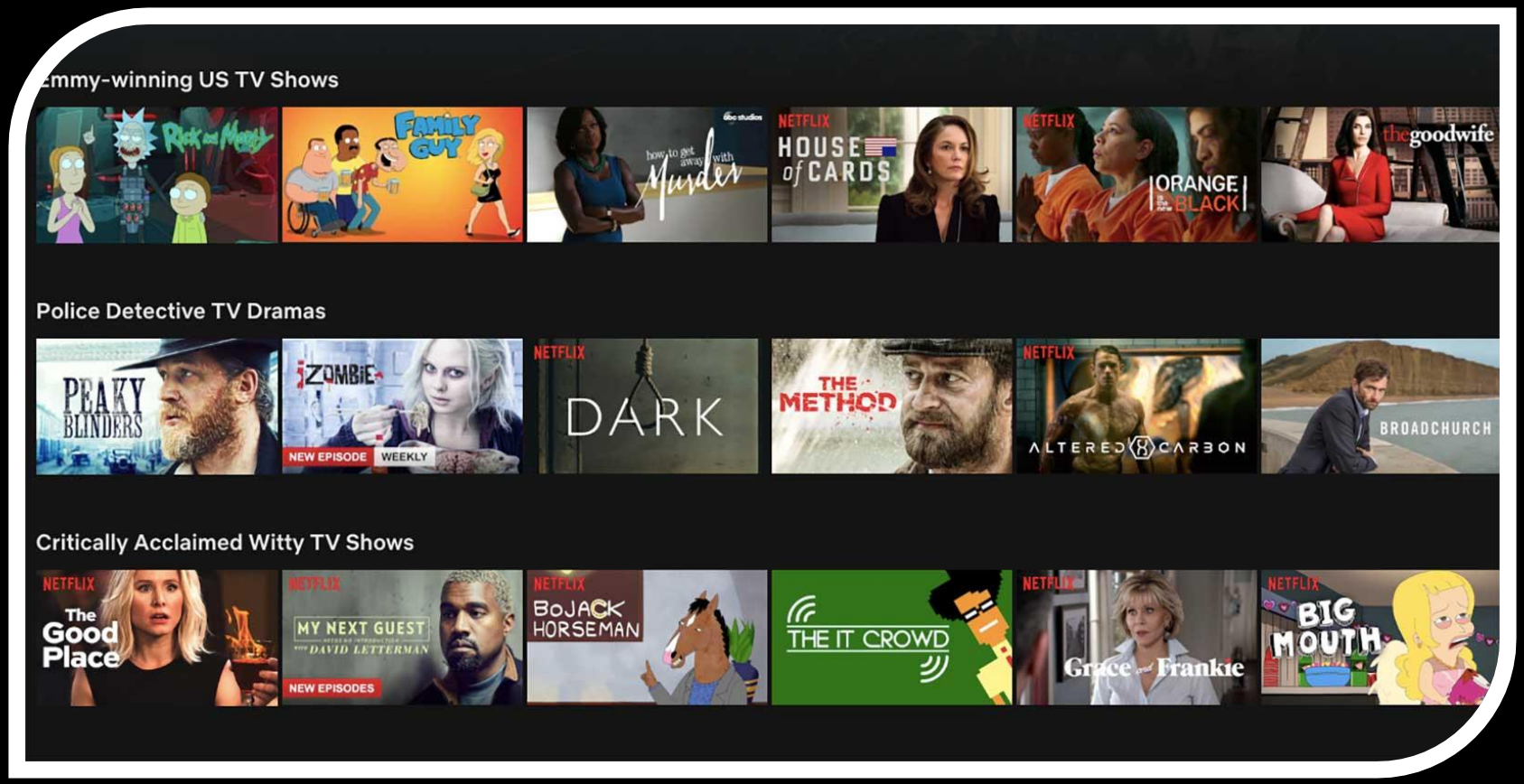
Cont..

❖**Google Navigation (Google Maps)**



Cont..

❖**Movie Recommendations on Netflix & YouTube**



Cont..

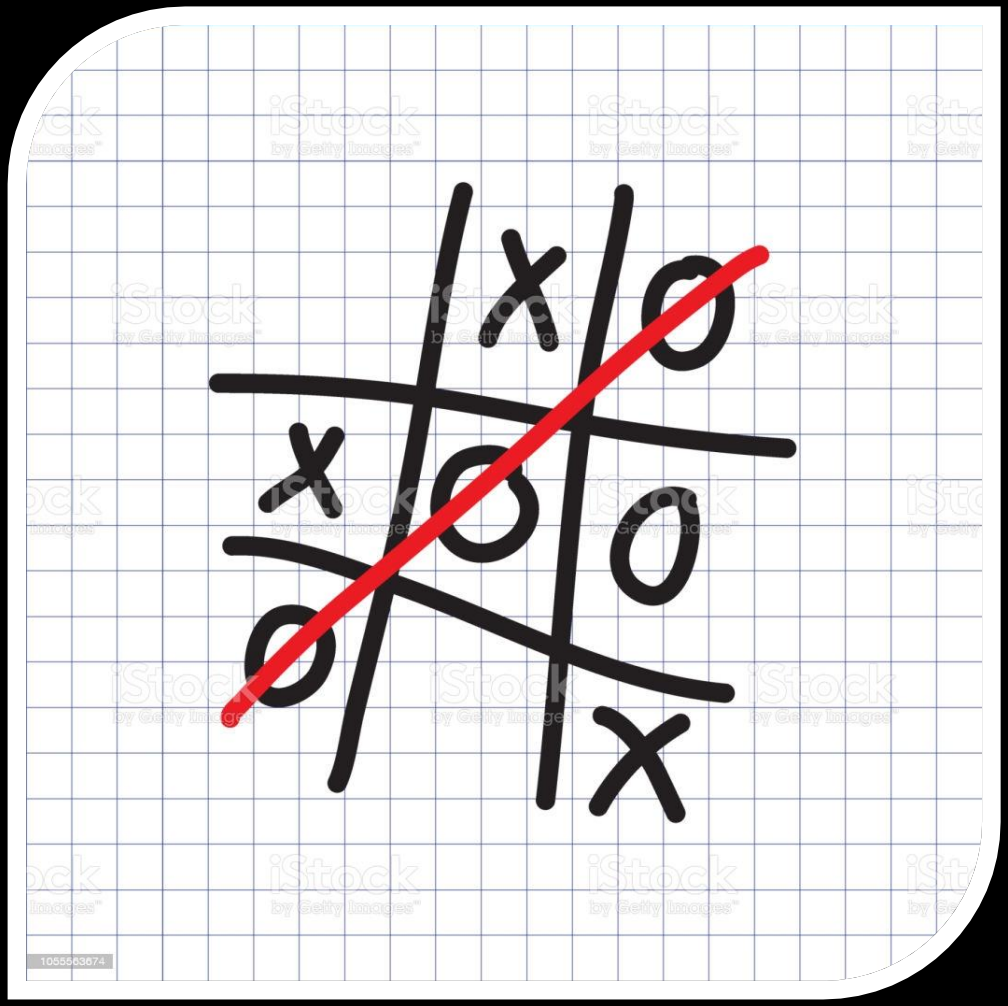
❖**Smart Cars/Self Driving Cars - Tesla**

Cont..

- **Facebook: Face Recognition & Friend Suggestion**

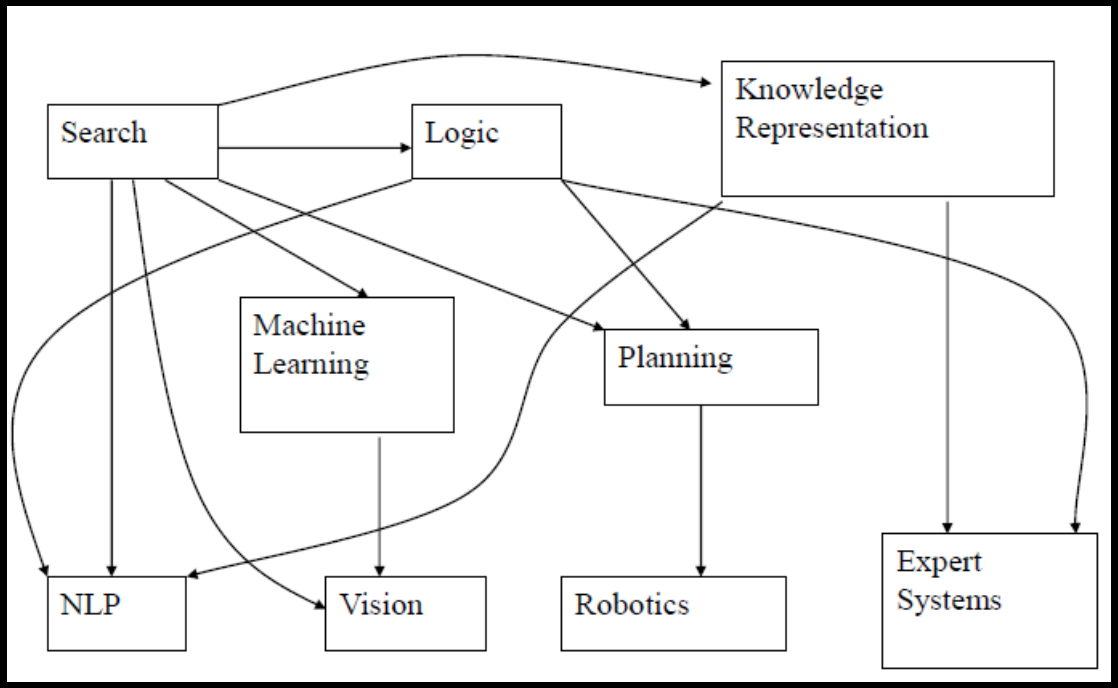
Cont..

❖**Tic Tac Toe - Game**



Scope of AI

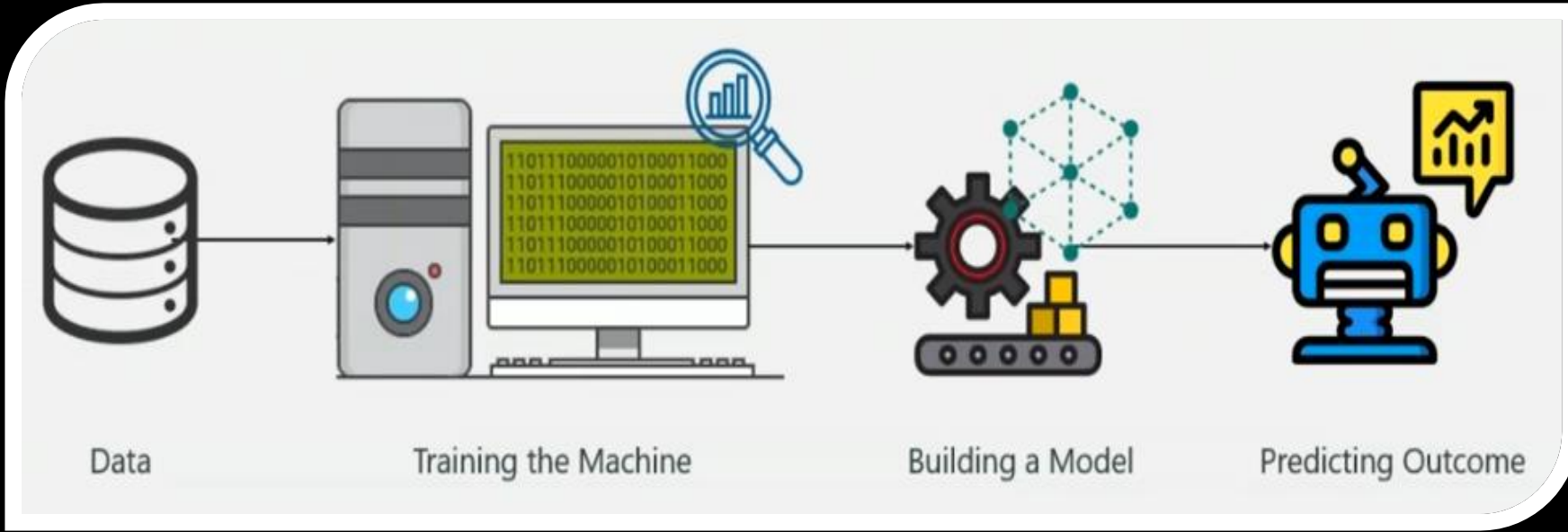
- Search
- Knowledge Representation & Inference.
- Natural Language
- Computer Vision
- Machine Learning



Machine Learning?

Machine Learning ?

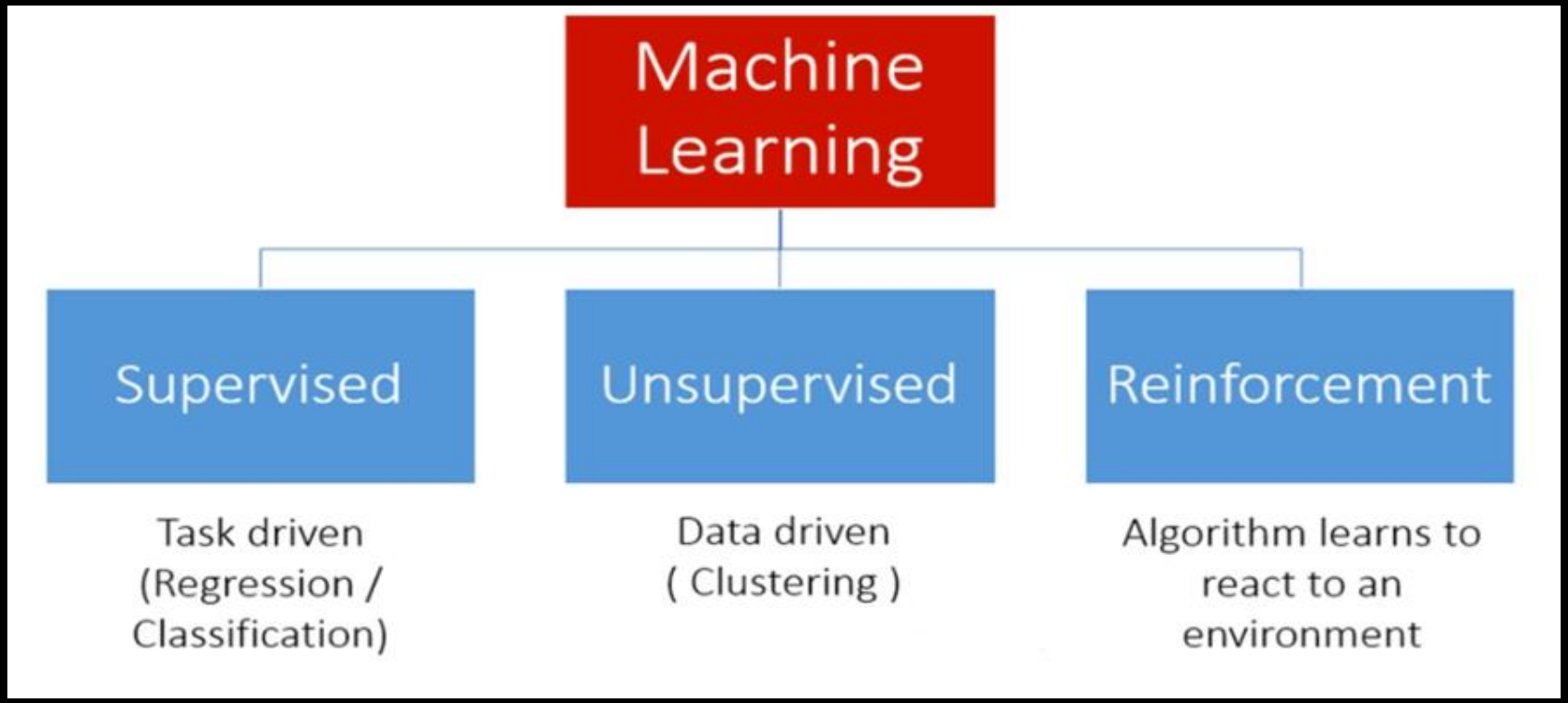
- Machine Learning is a subset of Artificial Intelligence (AI) which provides machine the ability to learn automatically and improve from experience without being explicitly programmed.



Cont.

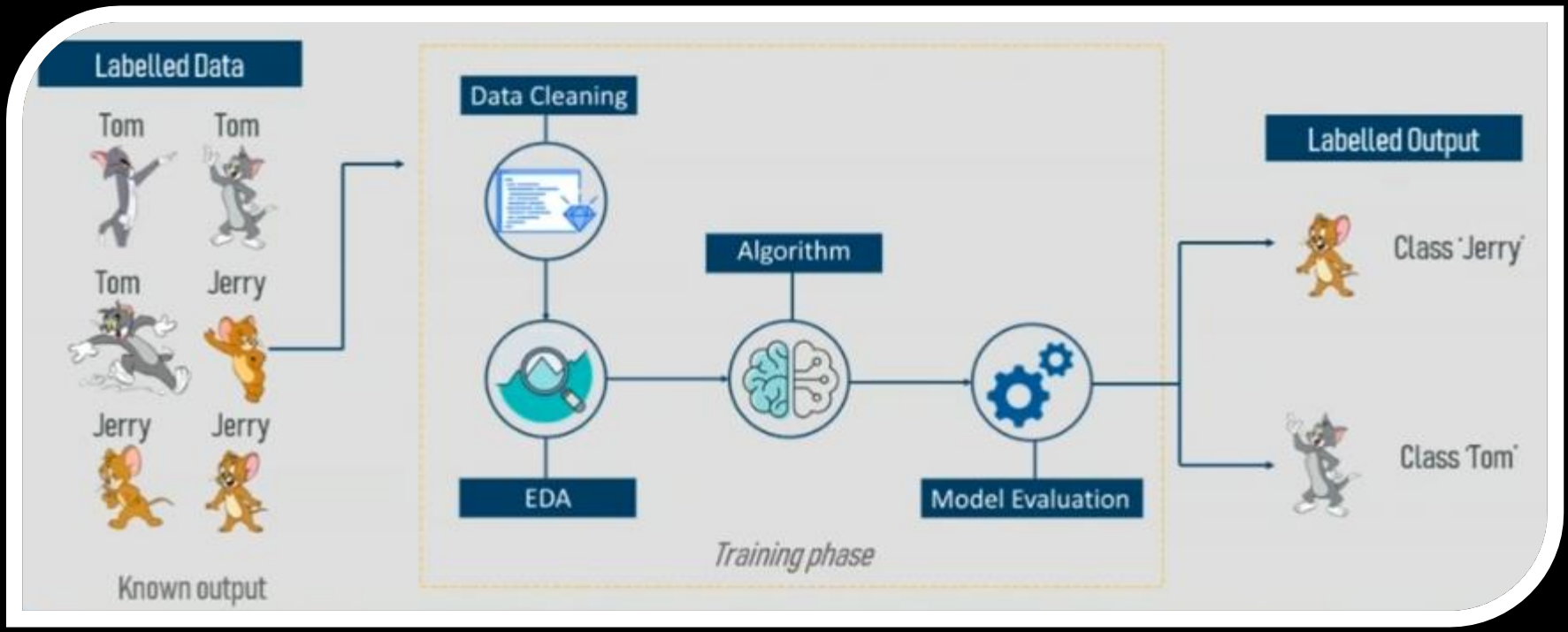
- Machine Learning process involves building a Predictive model that can be used to find a solution for a Problem Statement.

Types of Machine Learning



Supervised Learning

- Is a technique in which we teach or training the machine using data which is well labelled.
- Given a data set of input-output pairs, learn a function to map inputs to outputs.



Cont.

Classification

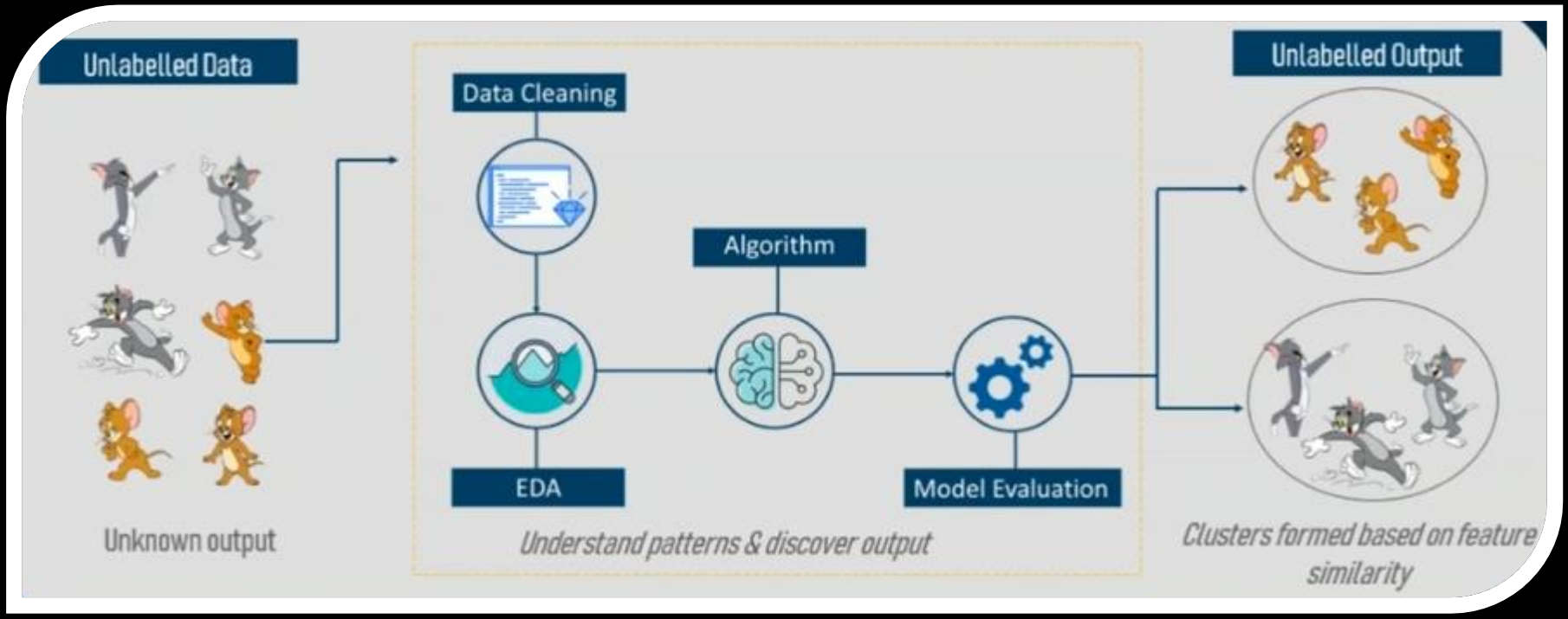
- Supervised learning task of learning a function mapping an input point to a discrete category

Some Classification Applications: -

- Weather Prediction
- Email Filtering
- Text Categorization
- Speech Recognition
- Handwriting Recognition
- Biometric Identification

Unsupervised Learning

- ❖Is the training of machine using information that is unlabeled and allowing the algorithm to act on that information without guidance
- ✓Given input data without any additional feedback, learn patterns.



Cont.

Clustering

- Organizing a set of objects into groups in such a way that similar objects tend to be in the same group.

Some Clustering Applications: -

- Genetic Research
- Image Segmentation
- Market Research
- Medical Imaging
- Social Network Analysis.

Reinforcement Learning

- ❖ Is a part of Machine Learning where an agent is put in an environment and he learns to behave in this environment by performing certain actions and observing the rewards which it gets from those actions.
- ✓ Given a set of rewards or punishments, learn what actions to take in the future.
- ✓ RL is all about Learning from the environment. Good example of RL is Deep Blue (Chess Computer).

Cont.

Example of RL: Robot flipping Pancake.

NLP?

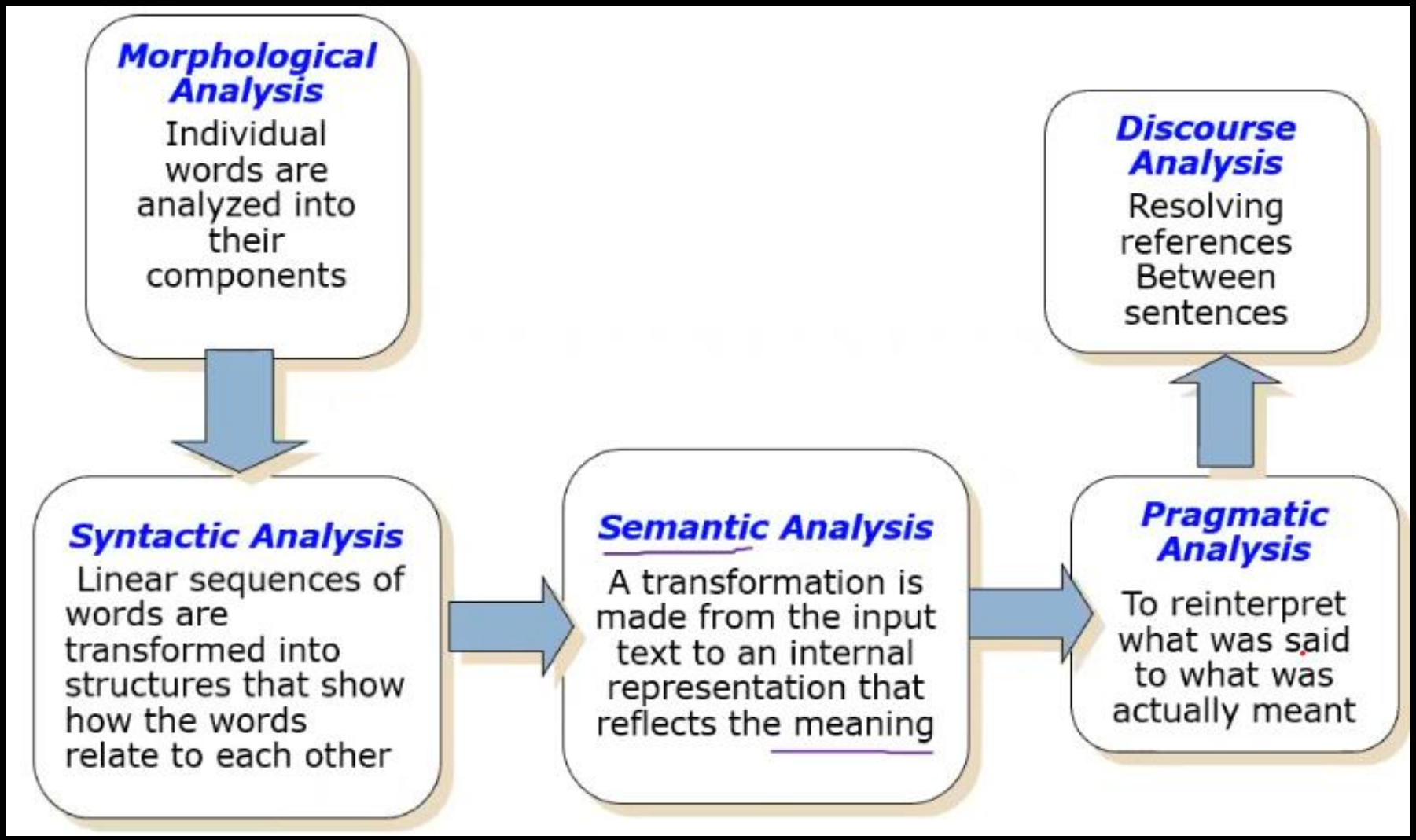
Natural Language Processing?

- **Natural Language Processing (NLP)** is a both a modern computational technology and a method of investigating and evaluating claims about human language itself.
- Also called **Computational Linguistics** which links to **Artificial Intelligence** (AI), the general study of cognitive function by computational processes, normally with an emphasis on the role of knowledge representations, that is to say the need for representations of our knowledge of the world in order to understand human language with computers.

To Solve NLP Problems, We have to Learn these Linguistic Concepts!

- Phonetics & Phonology?
- Morphology?
- Free & Bound Morpheme?
- Syntax & Semantics?
- Pragmatics & Discourse?
- Word Formation Methods? Affixation, Compounding, Reduplication, Derivational & Inflectional Morphemes.
- Lemmatization & Stemming?

Stages of NLP (Textual form)



Language Technology

mostly solved

Spam detection

Let's go to Agra!

Buy DraG...

Part-of-speech (POS) tagging

ADJ ADJ NOUN VERB ADV

Colorless green ideas sleep furiously.

Named entity recognition (NER)

PERSON ORG LOC

Einstein met with UN officials in Princeton

making good progress

Sentiment analysis

Best roast chicken in San Francisco!

The waiter ignored us for 20 minutes.

Coreference resolution

Carter told Mubarak he shouldn't run again.

Word sense disambiguation (WSD)

I need new batteries for my *mouse*.

Parsing

I can see Alcatraz from the window!

Machine translation (MT)

第13届上海国际电影节开幕...

The 13th Shanghai International Film Festival...

Information extraction (IE)

You're invited to our dinner party, Friday May 27 at 8:30

Party May27 add

still really hard

Question answering (QA)

Q. How effective is ibuprofen in reducing fever in patients with acute febrile illness?

Paraphrase

XYZ acquired ABC yesterday

ABC has been taken over by XYZ

Summarization

The Dow Jones is up

The S&P500 jumped

Housing prices rose

Economy is good

Dialog

Where is Citizen Kane playing in SF?

Castro Theatre at 7:30. Do you want a ticket?

Cont.

- Solving the language-related problems, is the main concern of the fields known as Natural Language Processing and Computational Linguistics.
- Few applications of language processing
  - **spelling correction**,
  - **grammar checking**,
  - **information retrieval**,
  - **machine translation,**
  - **speech processing, etc.**

Approaches to NLP

- **Rule Based (Hand Crafted Rules)**
  - Develop the rules to process the natural languages based on known facts and exceptions
- **Machine Learning**
  - Capture rules from examples and apply on new instances
    - ✓ Supervised: learn by comparing with expected output
    - ✓ Unsupervised: blind learning. Create knowledge by association rather than predefined output

NLP Applications

- Question answering
  - Who is the first Taiwanese president?
- Text Categorization/Routing
  - e.g., customer e-mails.
- Text Mining
  - Find everything that interacts with user1.
- Machine (Assisted) Translation
- Language Teaching/Learning
  - Usage checking, Grammar, Spelling, etc.
- Spelling correction
  - Is that just dictionary lookup?

Computer Vision & Image Processing?

What is Computer Vision?

- Deals with the development of the theoretical and algorithmic basis by which useful information about the 3D world can be automatically extracted and analyzed from a single or multiple 2D images of the world.

Computer Vision

Make computers understand images and video.

What kind of scene?

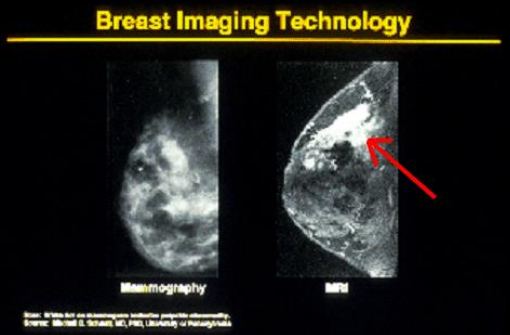
Where are the cars?

How far is the building?

…

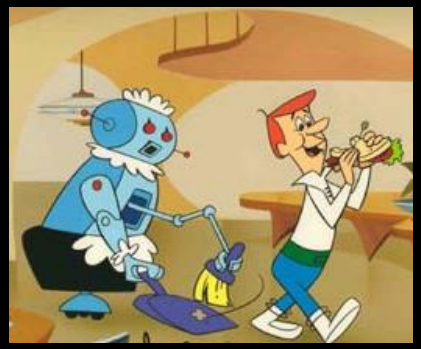
Why computer vision matters

Safety



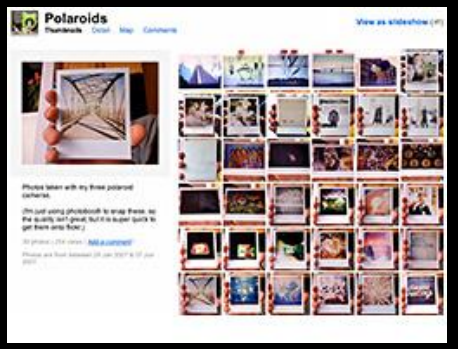
Health

Security



Comfort

Fun



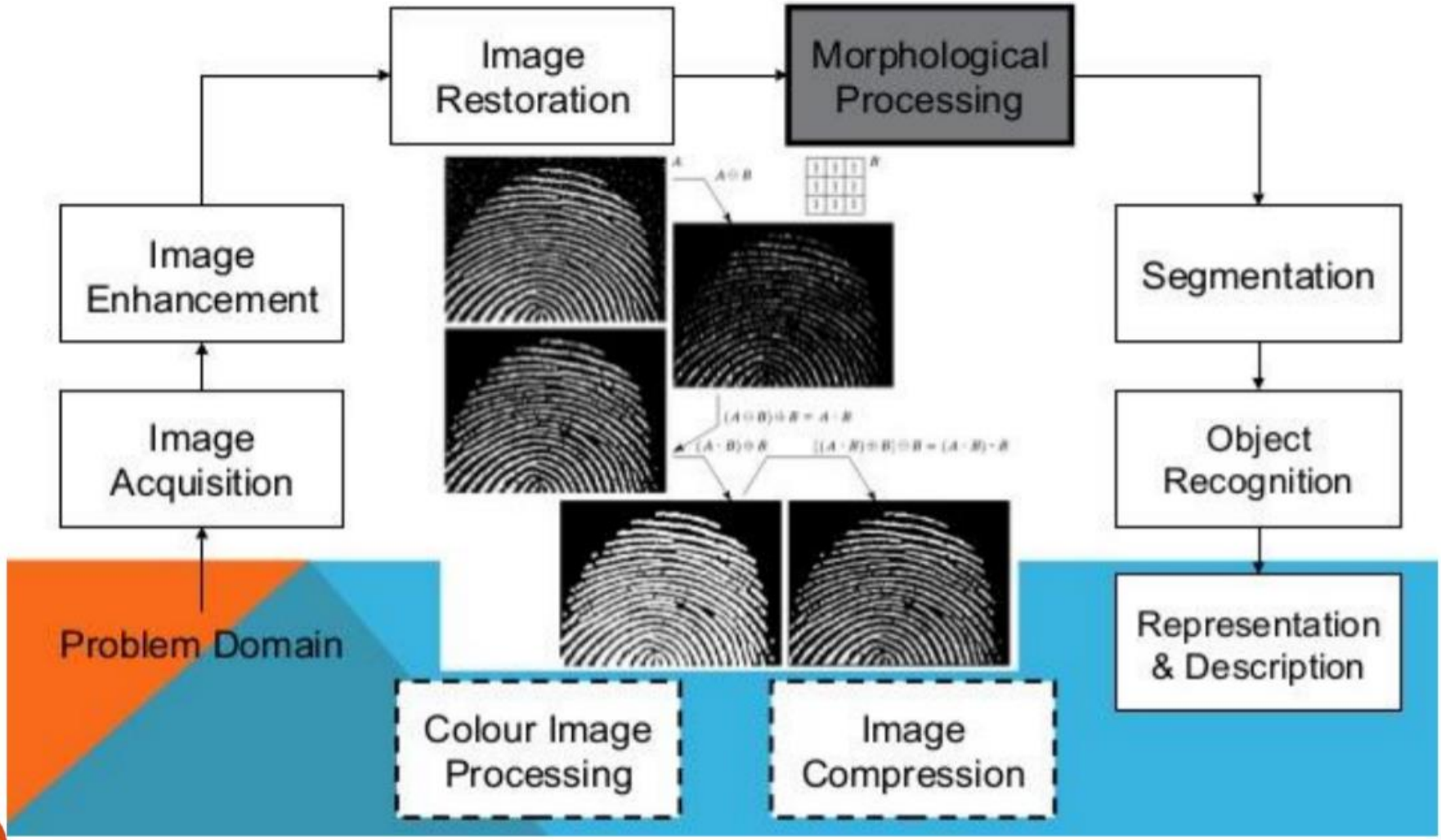
Access

Login without a password…

Fingerprint scanners on many new laptops, other devices

Face recognition systems now beginning to appear more widely
http://www.sensiblevision.com/

Computer Vision



Computer Vision

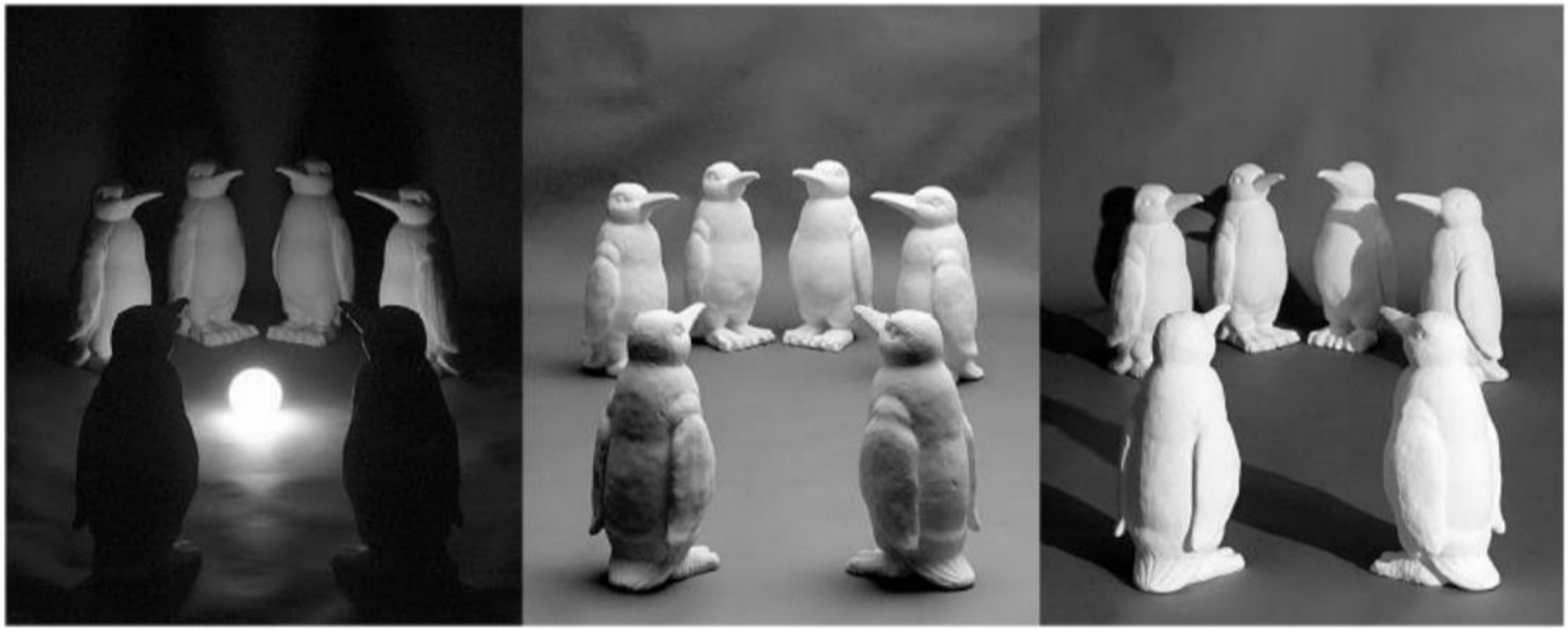
- **Reconstruction**
  - Representation
  - Recover 3D information from data
- **Recognition**
  - Feature extraction
  - Segmentation of image parts
  - Detect and identify objects
- **Understanding**
  - Giving context to image parts
  - Knowing what is happening in the scene?

Issue of Contrast

- Objects appear to the eye to become darker as the background gets lighter.
- The example below is a piece of paper that seems white when lying on a desk, but can appear totally black in a lighter background

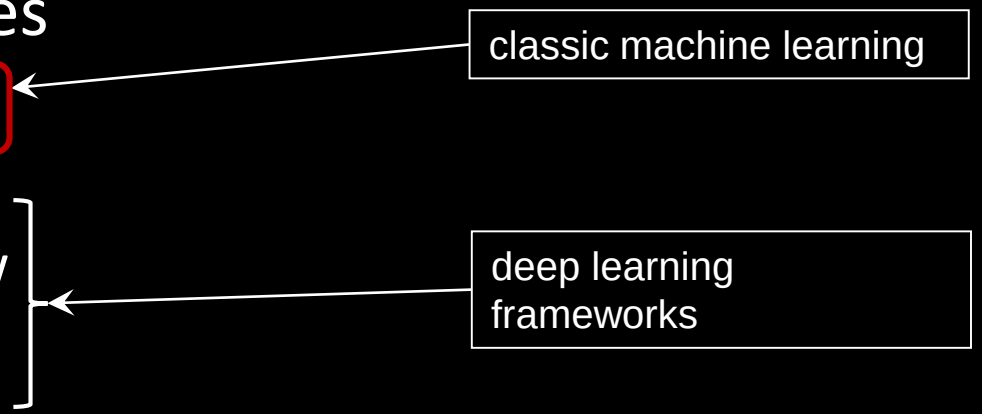
Issue of Illumination

- Same objects and arrangement
- Different angle of light



Frameworks

- Programming languages
  - Python
  - R
  - C++
  - …
- Many libraries
  - scikit-learn
  - PyTorch
  - TensorFlow
  - Keras
  - …



scikit-learn

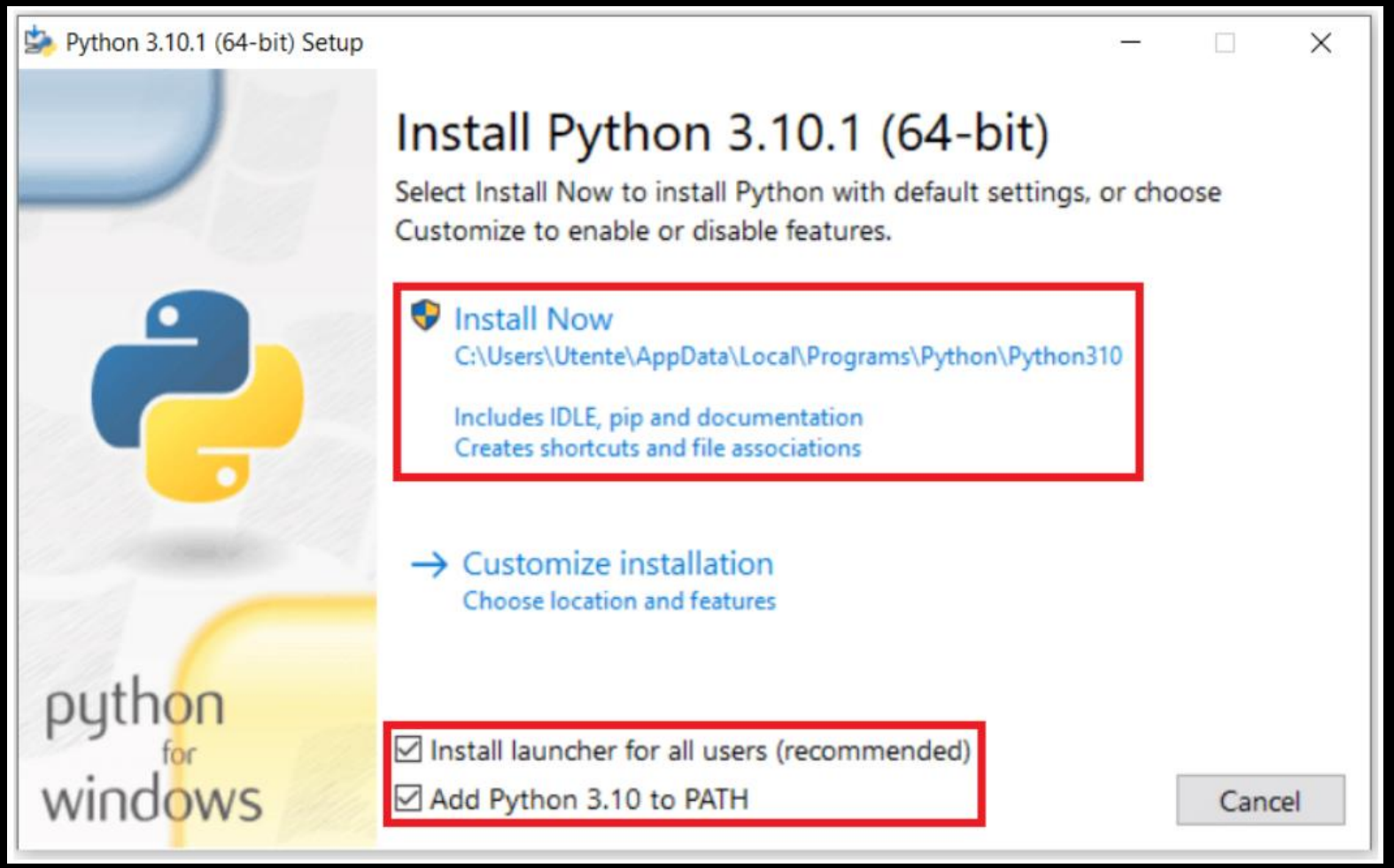
- Nice end-to-end framework
  - data exploration (+ pandas + holoviews)
  - data preprocessing (+ pandas)
    - cleaning/missing values
    - normalization
  - training
  - testing
  - application
- "Classic" machine learning only
- https://scikit-learn.org/stable/

Keras

- High-level framework for deep learning
- TensorFlow backend
- Layer types
  - convolutional
  - pooling
  - embedding
  - recurrent
  - activation
  - …
- https://keras.io/

Keras

Installing Python



After you install Python into this way, then other python frameworks & packages, you can get or install by writing **pip Install numpy** or other package name.

Activity One: Deep Blue! How it Works?

- On May 11, 1997, an IBM computer called IBM ® Deep Blue ® beat the world chess champion after a six-game match: two wins for IBM, one for the champion and three draws.
- The match lasted several days and received massive media coverage around the world. It was the classic plot line of man vs. machine.
- Behind the contest, however, was important computer science, pushing forward the ability of computers to handle the kinds of complex calculations needed to help discover new medical drugs; do the broad financial modeling needed to identify trends and do risk analysis; handle large database searches; and perform massive calculations needed in many fields of science.

Cont..

- The champion and computer met at the Equitable Center in New York, with cameras running, press in attendance and millions watching the outcome.
- The odds of Deep Blue winning were not certain, but the science was solid.
- The IBM guys knew their machine could explore up to 200 million possible chess positions per second.
- The chess grandmaster won the first game, Deep Blue took the next one, and the two players drew the three following games. Game 6 ended the match with a crushing defeat of the champion by Deep Blue.

Appendix

Research Article

iMedPub Journals
www.imedpub.com

American Journal of Computer Science and Engineering Survey

2021
Vol. 9 No. 4: 24

Machine Learning Algorithms for Document Classification: Comparative Study

Suleiman Mohamed Abdi[1*] and Abdirkadir H Aden[2]

1 Department of Computer Science,

Performance Analysis of Karp-Rabin and Brute Force string searching Algorithms in Somali String

Suleiman M. A. Gargaare

Thank You!