# Artificial Intelligence

Introduction

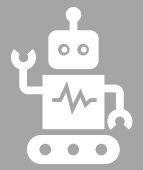
# Administrative Information

- Course Instructor
  - Dr. Hajra Waheed
  - Email-ID: hajra.waheed@nu.edu.pk
  - Office Hours: Tuesday & Thur (12:00 PM– 1:30 PM)
  - Syllabus and Grading
  - Attendance 80%
- Google classroom Code:

# General Information

## Duration

3+1 Credit hours



## Books:

- Artificial Intelligence: A modern Approach by Russel & Norvig
- Artificial Intelligence by Lugar

## Reading Material

Lecture & references

# Grading Policy

**30% Midterm exam**

**40% Final Exam**

**10% Project**

**~10% Quizzes**

Announced n unannounced quiz

5-6 quizzes

**10% Programming Assignments + HomeWorks**

3 to 4 assignments

*** The above grading distribution may change as per discretion of the instructor**

# Course Contents

- Intro, Agent CH 1 & 2
- Informed & Un-informed Search CH 3 & 4
- Adversarial SearchCH 6
- Genetic Algorithm
- Unsupervised Learning: Clustering(K-Means & Fuzzy Clustering) CH 20
- Supervised Learning: Neural Network(SLP,MLP) and backpropagation and advance topics CH 20,21

# Course Contents

- Applications
  - Image Processing
  - Image Segmentation & Classification
  - Neuroscience & Bio-medical Signal Processing
  - Speech Processing
  - Pattern Recognition
  - Text Mining
  - Bio-metrics
  - Robotics

# Image Processing

1. Computer Vision: Image processing techniques are used in computer vision to enable machines to "see" and understand the visual world. This includes tasks such as object detection, image segmentation, and face recognition.
2. Medical Imaging: Image processing is used in medical imaging to analyze medical images such as X-rays, CT scans, and MRI scans. This can include tasks such as identifying tumors, measuring the size of organs, and detecting abnormalities.
3. Autonomous Systems: Image processing is used in autonomous systems such as self-driving cars and drones to interpret visual information and make decisions about navigation and control.
4. Surveillance: Image processing is used in surveillance systems to automatically detect and track people or vehicles.
5. Robotics: Image processing is used in robotics to enable robots to perceive and understand their environment.
6. Augmented Reality: Image processing is used in Augmented Reality to process and analyze real-world images and add virtual elements to them.
7. Image compression and enhancement: To improve the quality and reduce the size of images for storage and transmission.

# Text Mining

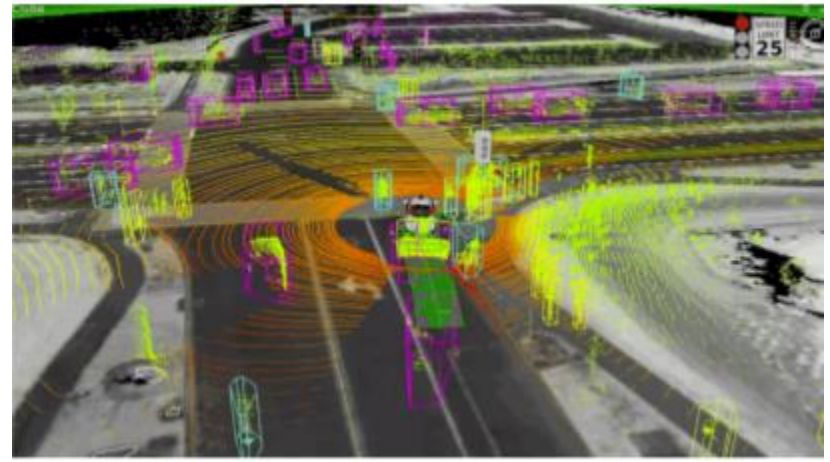
1. Sentiment analysis: Analyzing text data to determine the overall sentiment or emotion expressed, such as positive, negative, or neutral. This can be used to understand customer opinions about a product or service, or to monitor public sentiment about a particular topic.
2. Topic modeling: Identifying the main topics discussed in a collection of text documents, such as news articles or social media posts. This can be used to understand what people are talking about, or to group similar documents together for further analysis.
3. Named Entity Recognition (NER): Identifying and extracting specific entities such as people, locations, and organizations from text data. This can be used to create structured data from unstructured text, such as populating a database with information about people and organizations mentioned in news articles.
4. Text classification: Automatically categorizing text data into predefined categories, such as spam or not spam, or positive or negative sentiment.
5. Text summarization: Creating a condensed summary of a long text document or multiple documents to quickly understand the main points.
6. Text clustering: Grouping text documents based on their similarity, so that similar documents are in the same cluster.
7. Text generation: Generating new text that is similar in style or content to a given input text.

# Applications

Play Chess

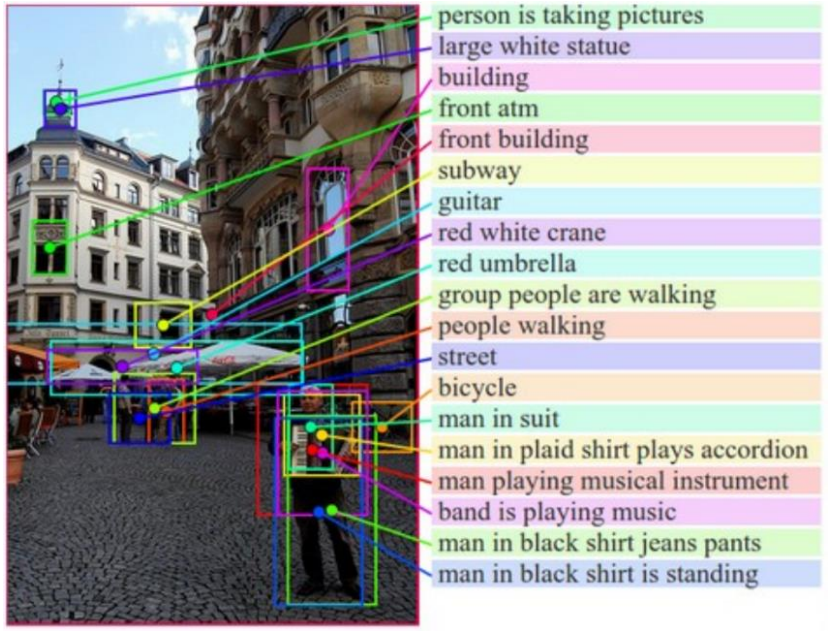
this small bird has a pink breast and crown, and black primaries and secondaries.

Text to Image Generation

# Applications

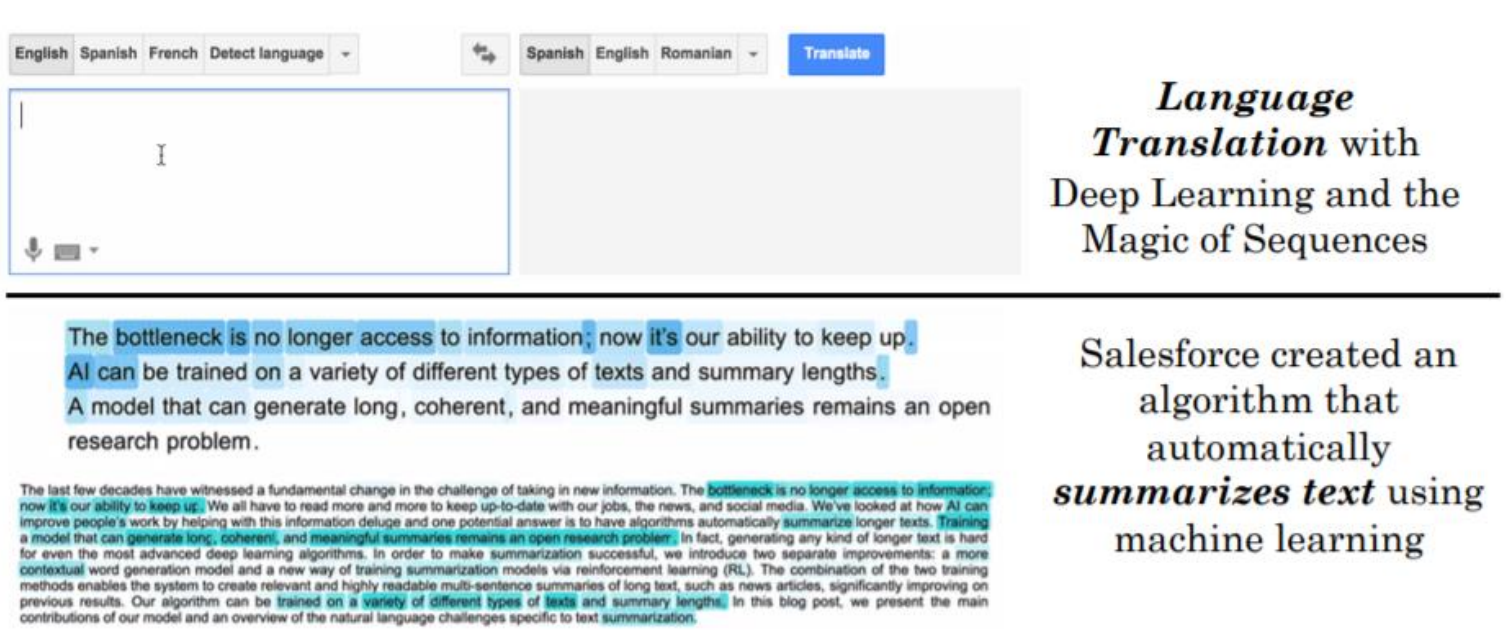
**Image Understanding**




**Video Games**

**Human Pose Estimation**

# Applications




**Text Generation**


**Recommend Movies**

Others:
**https://medium.com/@ageitgey/machine-learning-is-fun-part-5-language-translation-with-deep-learning-and-the-magic-of-sequences-2ace0acca0aa**

# Definition of AI

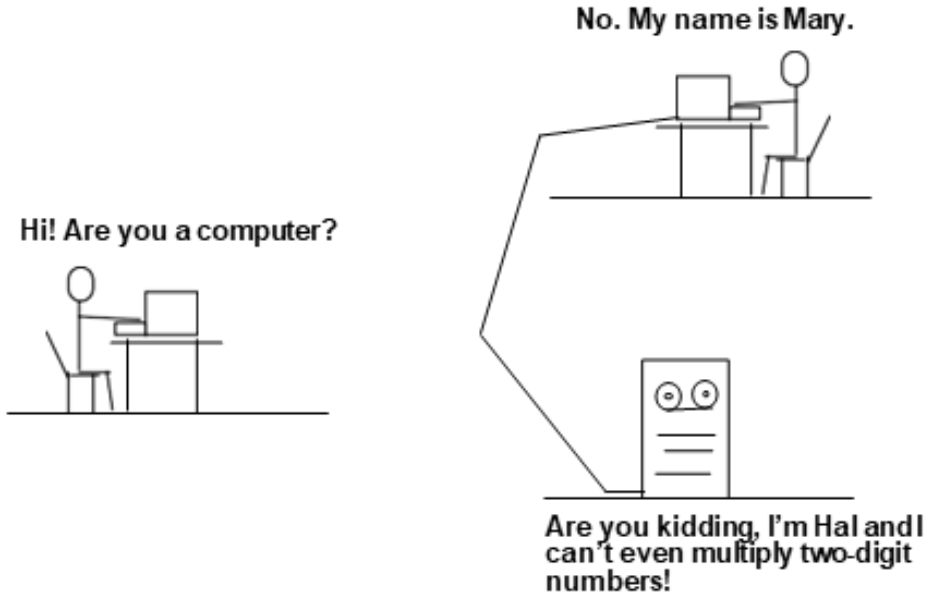
- "The art of creating machines that perform functions that require intelligence when performed by people" (Kurzweil, 1990).
- "The branch of computer science that is concerned with the automation of intelligent behavior." (Luger and Stublefield, 1993)

| **Thinking Humanly** | **Thinking Rationally** |
|---|---|
| "The exciting new effort to make computers think . . . *machines with minds*, in the full and literal sense." (Haugeland, 1985)<br><br>"[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)<br><br>"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)<br><br>"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)<br><br>"AI . . . is concerned with intelligent behavior in artifacts." (Nilsson, 1998) |

**Figure 1.1** Some definitions of artificial intelligence, organized into four categories.

# Acting Humanly: Turing Test

- If the response of a computer to an unrestricted textual natural-language conversation cannot be distinguished from that of a human, then it can said to be intelligent.
- Computer need following capabilities:
  - Natural Language Processing
  - Knowledge Representation
  - Automated Reasoning
  - Machine Learning




Loebner Prize: Current contest for restricted form of the Turing test.

# Acting Humanly: Turing Test

- When we say AI should "act humanly," we mean that AI systems should **mimic human behavior and actions.** This involves understanding and replicating human gestures, actions, and responses. Examples include:
- Speech recognition and synthesis to enable machines to communicate like humans.
- Natural language processing to understand and generate human language.
- Computer vision to recognize objects, scenes, and people in a similar way to humans.

# Thinking Humanly: Cognitive Modeling

- This aspect refers to creating AI systems that **simulate human cognitive processes and thought patterns**. This involves understanding how humans think, reason, learn, and solve problems, and then emulating these processes in machines. Examples include:
- Cognitive architectures that model human-like reasoning and decision-making processes.
- Emulating human learning mechanisms in machine learning algorithms, like reinforcement learning inspired by behavioral psychology.

# Thinking Humanly: Cognitive Modeling

- Method must not just exhibit behavior sufficient to fool a human judge but must do it in a way demonstrably analogous to human cognition.
- Requires detailed matching of computer behavior and timing to detailed measurements of human subjects gathered in psychological experiments.
- Cognitive Science: Interdisciplinary field (AI, psychology, linguistics, philosophy, anthropology) that tries to form computational theories of human cognition.

# Acting Rationally:

- When we say AI should "act rationally," we mean that AI systems should make **decisions based on logical reasoning and optimal strategies.** This may lead to decisions that are not necessarily similar to human decisions but are logically sound. Examples include:
- Game-playing AI that searches for optimal moves in games like chess and Go.
- Automated reasoning systems that prove mathematical theorems or analyze logical arguments.

# Acting Rationally: The Rational Agent Approach

- Agent
  - It is just something that acts
- Rational Agent
  - The one that acts as to achieve the best outcome or, when there is uncertainty, the best expected outcome
  - The rational agent approach is based on the assumption **that the agent is rational, meaning it is logical, consistent and unbiased in its decision making**

# Thinking Rationally: The “law of thought” approach

- This aspect refers to developing AI systems that **utilize formal rules of logic to reach conclusions.** This involves creating systems that can perform tasks that require formal reasoning and deduction. Examples include:
- Expert systems that use rule-based reasoning to diagnose medical conditions or provide legal advice.
- Automated theorem proving systems that prove mathematical theorems based on logical axioms.

# Thinking Rationally: The “law of thought” approach

- Right Thinking – Aristotle
  - Socrates is a man, all men are mortal; so, Socrates is mortal
- Logic
  - Law of thoughts were supposed to govern the operation of mind
- It is not easy to take informal knowledge and state in the formal term

# Foundations of AI

- Philosophy
  - 450 BC, Socrates asked for algorithm to distinguish pious from non-pious individuals
  - Aristotle developed laws for reasoning
- Mathematics
  - 1847, Boole introduced formal language for making logical inference
- Economics
  - 1776, Smith views economies as consisting of agents maximizing their own well being (payoff)
- Neuroscience
  - 1861, Study how brains process information
- Psychology
  - 1879, Cognitive psychology initiated
- Linguistics
  - 1957, Skinner studied behaviorist approach to language learning

# Homework

- Readings
  - CH 1- Introduction (Section 1.1 , 1.2 )