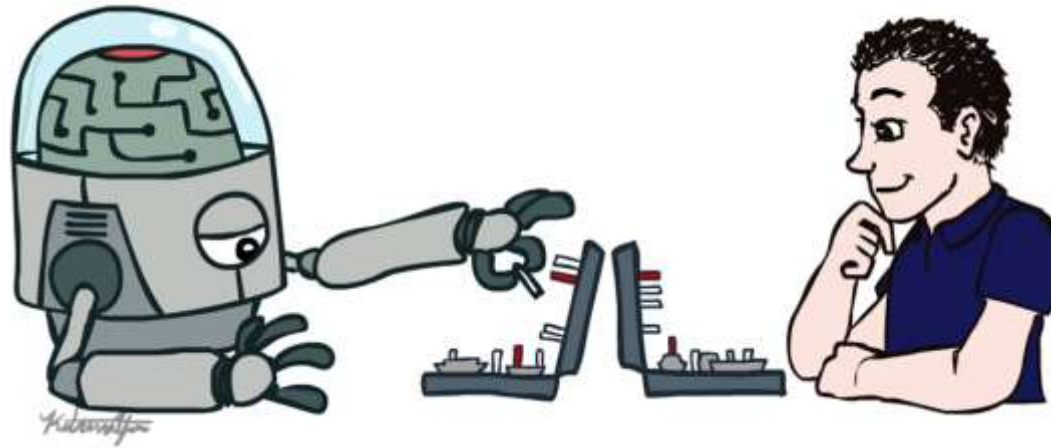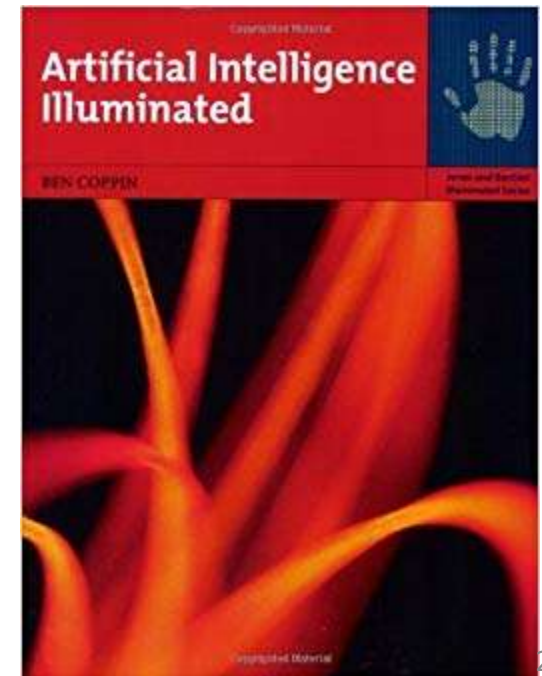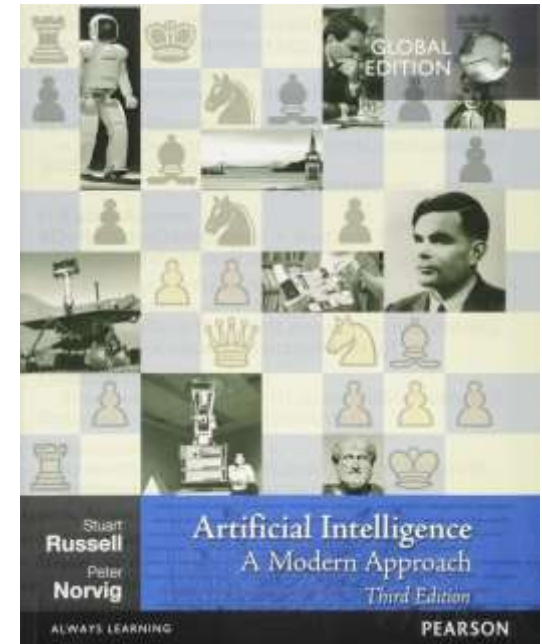# Artificial Intelligence

Lec-01 Introduction

Recommended Books

- **Artificial Intelligence: A Modern Approach**, by Russell & Norvig.

- "**Artificial Intelligence Illuminated**" by Ben Coppin,
  (http://futuresoft.yolasite.com/resources/Artificial%20Intelligence%20Illuminated.pdf)

Recommended Books

- "Artificial Intelligence – Structures and Strategies for Complex problem solving", George F. Luger, Pearson International Edition, Latest Edition.

- "Artificial Intelligence: A new synthesis" Nils Nilsson, Morgan Kaufmann, Latest Edition

- **UC Berkeley CS188 Intro to AI** (http://ai.berkeley.edu/home.html)

Grading (Tentative)

ITEM	WEIGHTAGE
Quizzes	10 %
Assignments	10 %
Project	15 %
Mid Term	25 %
Final Term	40 %
Total	**100**

Logistics

- Quiz will be un-announced.
- Read the books
- Deadline of the assignments will not be extended
- No Late submissions will be accepted.

Other Announcements

- Email address:
  - mghouri@numl.edu.pk
- Office:
  - Room 28, Ghazali Block

Course Topics

- CLO I: Solving Problems by Searching
  - Fast search / planning
  - Constraint satisfaction
  - Blind search

- CLO II: Knowledge, reasoning, and Planning
  - Heuristics
  - Adversarial and uncertain search
  - Propositional logic
  - Predicate logic
  - Knowledge-based systems

- CLO III: Learning
  - Bayes' nets
  - Decision theory
  - Machine learning and Neural Networks

Overview

- What is artificial intelligence?
  - One could certainly define intelligence by the properties it exhibits: an ability to deal with new situations; the ability to solve problems, to answer questions, to devise plans, and so on.
  - Definition: Artificial intelligence is the study of systems that act in a way that to any observer would appear to be intelligent.

Motivation

- Scientific curiosity
  - try to understand entities/ concepts that exhibit intelligence
- Some tasks that seem to require intelligence can be solved by computers
- Recent progress in computer performance and computational methods enables the solution of complex problems by computers
- Humans may be relieved from tedious tasks

Course Objectives

- Learn how to use the basic search methods;

- Understand the basic methods for problem formulation and knowledge representation;

- Understand the basic idea of automatic reasoning;

- Know some basic concepts related to pattern recognition and machine learning;

The MAP for Knowledge Acquisition

- What is the input?
  - Map from real world to the mind model
- What is the output?
  - Map from the mind model to the real world
- What is the relation between the input and the output?
  - Abstraction of the real world

Sensors | Real world → Problem representation → Learning → Knowledge representation → Real world | Actuators

Representation Methods

- Representation of the problem
  - State space representation
- Representation of knowledge
  - Production (decision) rules
  - Predicate logic
  - Neural network

Learning Models and Algorithms

- Neural network learning
  - Including MLP, SVM, deep learning, etc.
- Evolutionary learning
  - GA or meta-heuristics in general
- Reinforcement learning
- Expert system
- Decision tree

Artificial Intelligence

- **AI is concerned with the design of <u>intelligence</u> into an <u>artifact</u>.**
- Design of computer systems which can exhibit intelligent behaviors

- **What is artificial intelligence**
  - It is the science and engineering of making intelligent machines, especially intelligent computer programs

- **What is intelligence**
  - Intelligence is the computational part of the ability to achieve goals in the world

Why AI?

- **Two main goals of AI:**

  - To create useful "smart" programs able to do tasks that would normally require a human expert

  - To understand human intelligence better as we test theories of human intelligence by writing programs which emulate them

Humans Vs Machines

Humans	Machines
• Symbolic calculation • Natural language understanding • Not very precise • Knowledge • Generalize from examples • Deal with noisy inputs	• Numeric calculation • Machine Language • Precise • Data • Cannot generalize • Cannot deal with noise

Acting Humanly:
Turing Test

- Alan Turing (1950) "Computing machinery and intelligence".

A computer passes the test if a human interrogator, after posing some written questions, cannot tell whether the written responses come from a person or from a computer.
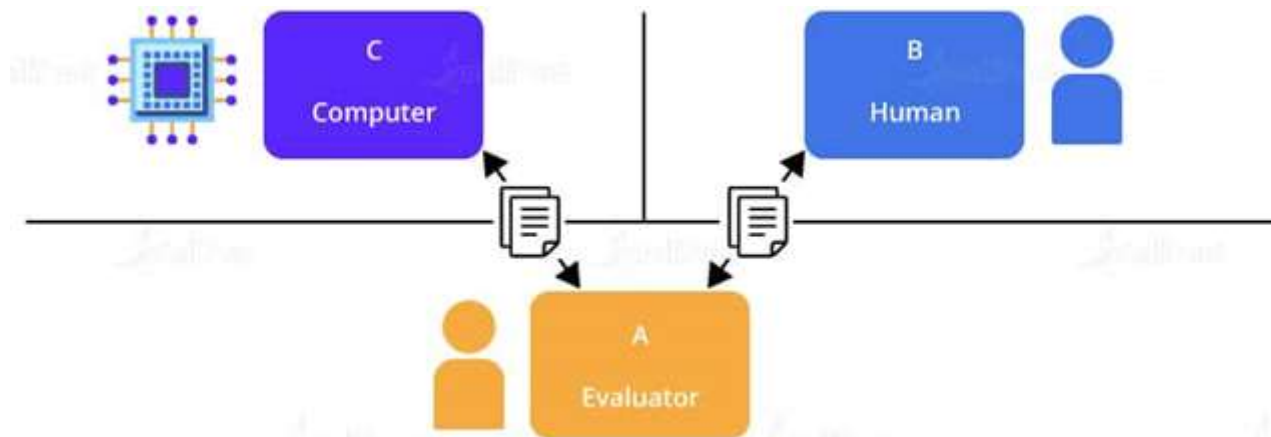
Little effort by AI researchers to pass the Turing Test: Why?

- It is more important to study the underlying principles of intelligence than to duplicate an exemplar.

- The quest for **"artificial flight"** succeeded when the Wright brothers and others stopped imitating birds and started using wind tunnels and learning about aerodynamics.

- Aeronautical engineering texts do not define the goal of their field as making "machines that fly so exactly like birds that they can fool even other birds."

Types of AI

- Weak AI
  - Only simulates human thoughts and actions

- Strong AI
  - Intelligent on their own

- Applied AI
  - Commercially valuable

- Cognitive AI
  - Test Theories about how human mind works

Approaches to AI

- **Strong AI**
  - Strong AI aims to build machines that can truly reason and solve problems who is self aware and whose overall intellectual ability is indistinguishable from that of a human being. ChatGpt?

- **Weak AI**
  - Weak artificial intelligence (**weak AI**), also known as narrow AI, is artificial intelligence that is **focused on one narrow task**.
  - Deals with the creation of some form of computer-based artificial intelligence that **cannot** truly reason and solve problems, but can act as if it were intelligent.
  - **Alexa, Siri** are good examples of narrow intelligence, an app which can make call, send texts, use other apps, and get things done with just your voice.

Weak and Strong AI

- **Weak AI** is AI that can not 'think', i.e. a computer chess playing AI does not think about its next move, it is based on the programming it was given, and its moves depend on the moves of the human opponent.

- **Strong AI** is the idea/concept that we will one day create AI that *can* 'think' i.e. be able to play a chess game that is not based on the moves of the human opponent or programming, but based on the AI's own 'thoughts' and feelings and such, which are all supposed to be exactly like a real humans thoughts and emotions and stuff.

Approaches to AI

- Applied AI – agent designed to do specific task:
  - Aims to produce commercially viable smart systems – for example a security system that is able to recognize the faces of people who are permitted to enter the building.

- Cognitive AI:
  - Computers are used to test theories about how the human mind works – for example, theories about how we recognize face and other objects. E.g. image recognition

Disciplines involved in AI

- Many disciplines contribute to goal of modelling intelligent entities:

  - Computer Science
  - Psychology (human reasoning)
  - Philosophy (nature of belief, rationality, etc)
  - Linguistics (structure and meaning of language)
  - Human Biology (how brain works)

History of AI

Event	Year
First electronic computer	1941
McCulloch & Pitts artificial neuron	1943
First neural network (Minsky & Edmonds)	1951
Birth of AI. Coined by McCarthy Dartmouth conference	1956
Eliza	1965
Prolog	1972
MYCIN (Formally termed first expert system)	1974
Blackboard model for speech understanding	1980
Backprop for neural nets	Mid 80
Data mining and virtual reality	90s
Deep Blue AI system beats human chess master	1997

Applications of AI

- E-Commerce
    1. Personalized shopping using recommendation engines.
        - Recommendation engines use browsing history, preferences, and intersts.
    2. AI-Powered Assistants
        - Chatbots use Natural Language Processing (NLP)
        - Amazon will soon be handled by chatbots.
    3. Credit card frauds and Fake reviews
        - The two are most serious issues E-commerce companies deal with.
        - AI can help reduce card frauds and handle fake reviews by considering the usage patterns.

Applications of AI

- Education
  1. Automated administrative tasks to aid educators.
     - Grading paper work, managing enrollment of courses etc. Coursera
  2. Digitization of contents like videos, conferences and online portals
  3. Voice assistants→ Answers to very common questions
  4. Personalized learning
     - Using AI technology, hyper-personalization techniques can be used to monitor students' data thoroughly, and habits, lesson plans, reminders, study guides, flash notes, frequency or revision, etc., can be easily generated.

Applications of AI

- Lifestyle
  1. Autonomous Vehicles
     - companies like Toyota, Audi, Volvo, and Tesla use machine learning to train computers to think and evolve like humans when it comes to driving in any environment and object detection to avoid accidents.
  2. Spam Filters
     - Email providers use AI based spam filters
     - Gmail manage to reach filtration capacity of 99.9%
  3. Facial recognition
     - In devices like phones, laptops and gadgets.
     - High security related areas in several industries.
  4. Recommendation systems
     - e-commerce, entertainment websites, social media, video sharing platforms, like youtube, etc.

Applications of AI

- Navigation
  - GPS technology can provide users with accurate, timely, and detailed information to improve safety.
  - Convolutional network and graph neural network is used.
  - Heavily used by Uber and many logistics companies to improve operational efficiency, analyze road traffic, and optimize routes.

Applications of AI

- Robotics
  - Robots powered by AI use real-time updates to sense obstacles in its path and pre-plan its journey instantly.
  - Usage:
    - Carrying goods in hospitals, factories, and warehouses
    - Cleaning offices and large equipment
    - Inventory management (Amazon)
    - Medical arms for operations

Application of AI

- Human Resource
  - AI helps with blind hiring.
  - AI drive systems can scan job candidates' profiles, and resumes to provide recruiters an understanding of the talent pool they must choose from.

Applications of AI

- Health Care
    - Diverse applications.
    - Sophisticated machines that can detect diseases and identify cancer cells.
    - AI can help analyze chronic conditions with lab and other medical data to ensure early diagnosis.
    - AI uses the combination of historical data and medical intelligence for the discovery of new drugs.

Applications of AI

- Agriculture
  - Identify defects and nutrient deficiencies in the soil.
  - This is done using computer vision, robotics, and machine learning applications.
  - AI bots can help to harvest crops at a higher volume and faster pace than human laborers.

Applications of AI

- Automobiles
  - AI is used to build self driving vehicles.
  - AI uses vehicle's camera, radar, cloud services, GPS and control signals.
  - Emergency braking and blind spot monitoring.

Applications of AI

- Social Media
  - Instagram:
    - AI considers your likes and the accounts you follow to determine what posts you are shown on your explore tab.
  - Facebook:
    - AI is used along with a tool called deep text.
    - With this tool, Facebook can understand conversations better. Also does translation.
  - Twitter:
    - AI is used by Twitter for fraud detection, removing propaganda, and hateful content.
    - Twitter also uses AI to recommend tweets that users might enjoy, based on what type of tweets they engage with.

Applications of AI

- Marketing
  - Highly targeted and personalized ads with the help of behavioral analysis, pattern recognition, etc.
  - Retargeting the audience in right time to reduce annoyance.

Applications of AI

- Finance
  - 80% of banks recognize the benefits of using AI.
  - Customers get help through sms or online all AI-powered.
  - AI also detects changes in transaction patterns to avoid frauds.
  - AI can also predict and assess loan risks.

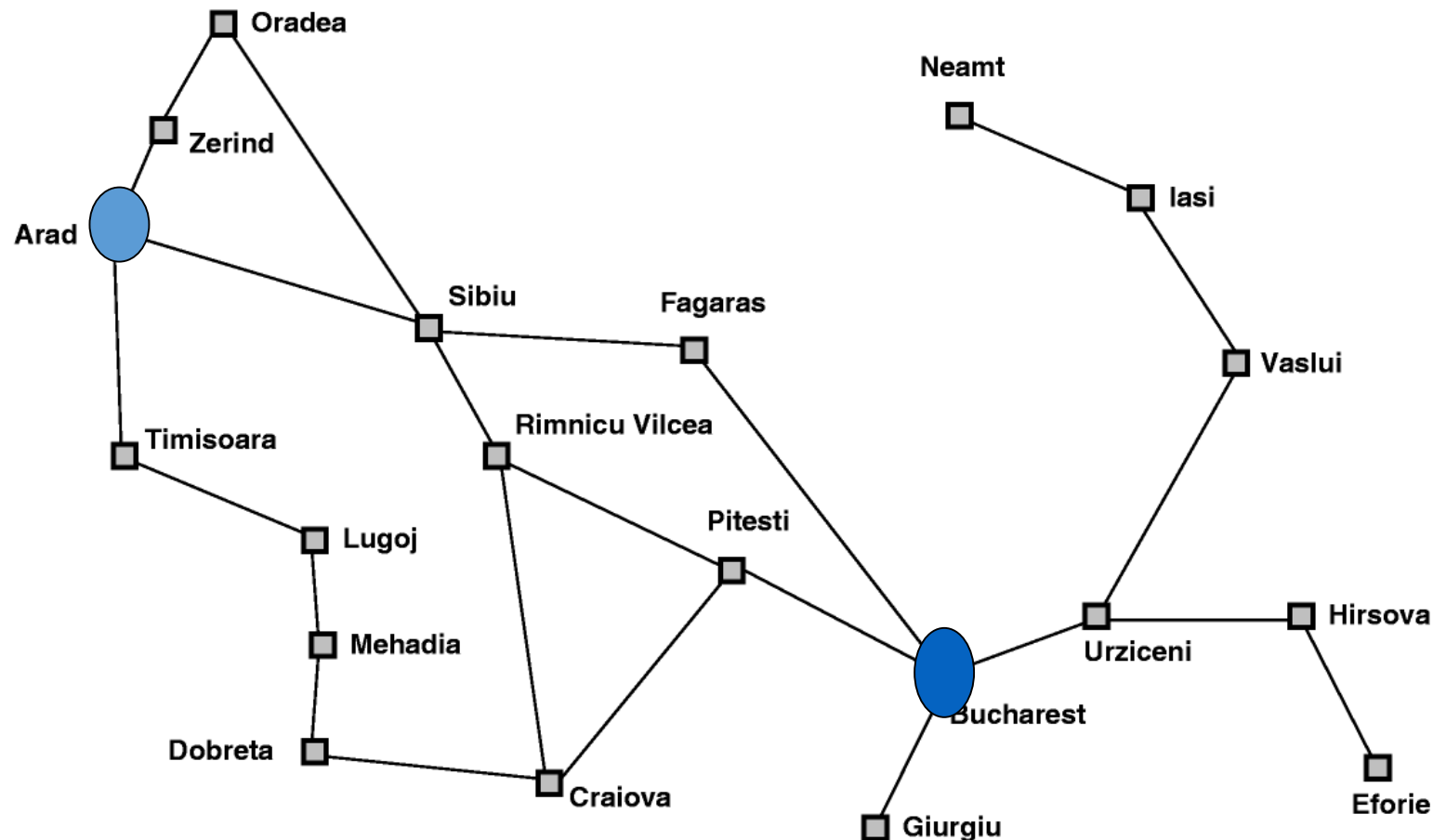# AI Topics: A Quick Introductory Overview

Problem Solving by Searching

Why search ?

❑ **Early works of AI was mainly towards**

- proving theorems
- solving puzzles
- playing games

- All AI is search!

    - Not totally true (obviously) but more true than you might think.
    - Finding a good/best solution to a problem amongst many possible solutions.
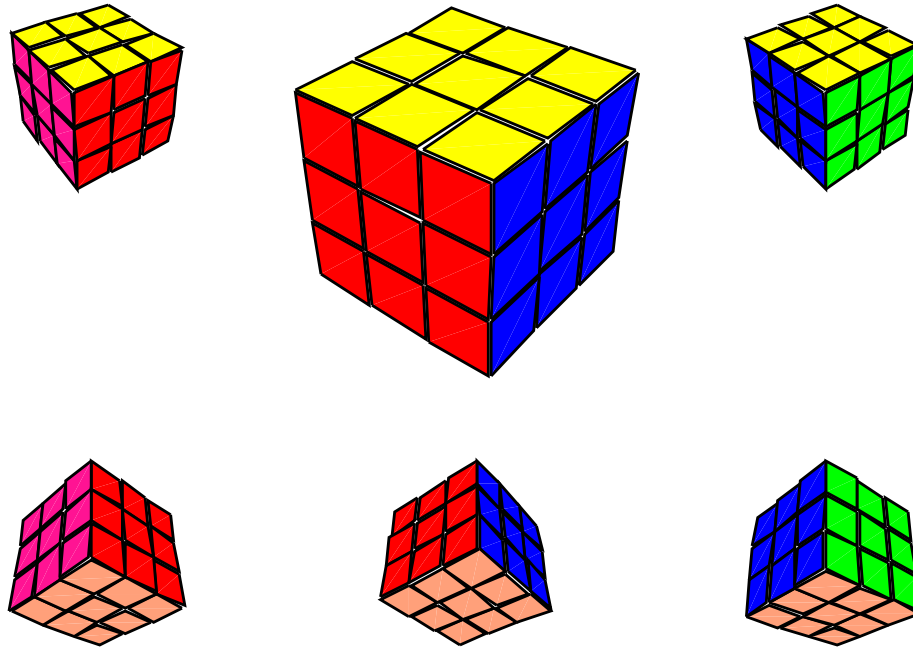
AI Topics: A Quick Introductory Overview

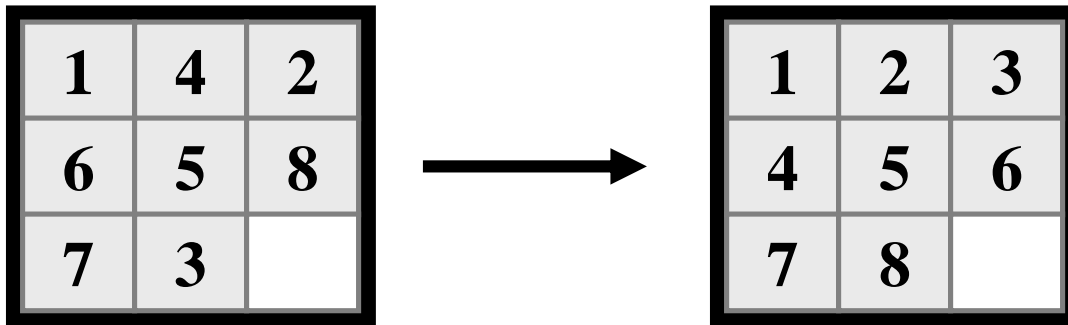Classic AI search problems: Map searching (navigation) (Romania)

AI Topics: A Quick Introductory Overview

- Classic AI search problems
  - 3*3*3 Rubik's Cube

Classical AI Search Problems

- 8-Puzzle

1	4	2
6	5	8
7	3	

→

1	2	3
4	5	6
7	8	

1	4	2
6	5	8
7	3	

Classical AI Search Problems