Artificial Intelligence (AI) and Machine Learning (ML)

Satchidananda Dehuri, Professor,

Dept. of Computer Science,

Fakir Mohan University, Vyasa Vihar,

Balasore-756019, ORISSA, INDIA.

Scope of AI

Artificial Intelligence:

- Introduction to AI
  - Solving Problems by Searching
    - Uninformed Search:
      - DFS, BFS, UCS, DLS, ID, Bidirectional
    - Informed Search:
      - GBFS, A*, HC, SA
- Constraint Satisfaction Problems:
  - Forward and Backward Chaining
  - Knowledge Representation
  - Bayesian Networks

Scope of ML

- Learning and Types of Learning
    - Regression: LSE, MR, RR, LDA, LR
    - Classification: Naïve Bayes Classifiers
- Dimensionality Reduction
    - PCA, ICA, FS, FE
- SVM for Classification
- SVM for Regression
- Knn Classifiers
- Cluster Analysis

Books not Limited to

- S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 3rd Edition, PEI, 2015.
- T. Mitchel, *Machine Learning*, McGraw-Hill Science, 19197.

What is AI?

➢ AI is the study of agents that receive percepts from the environment and perform actions.

➢ Each such agent implements a function that maps percept sequences to actions.

Rational Agents

- An agent is an entity that perceives and acts.
- The goal is about designing rational agents.
- Abstractly, an agent is a function from percept histories to actions:

$$[f\colon \mathcal{P}^{\star} \rightarrow \mathcal{A}]$$

- For any given class of environments and tasks, we seek the agent (or class of agents) with the best performance.
- Caveat: computational limitations make perfect rationality unachievable
  - → design best program for given machine resources

Turing Test

- Turing (1950) "Computing machinery and intelligence":
- "Can machines think?" → "Can machines behave intelligently?"
- Operational test for intelligent behavior: the Imitation Game
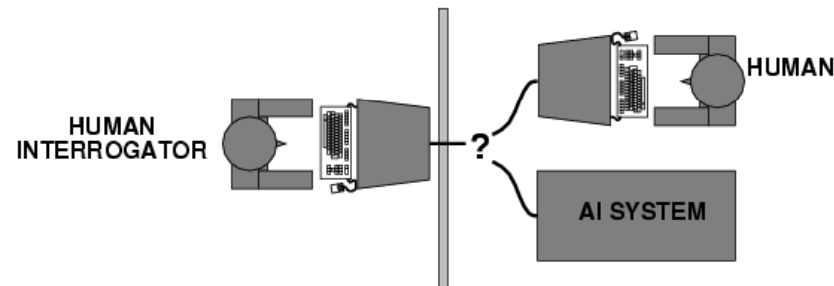
- Suggested major components of AI: knowledge, reasoning, language understanding, learning.

Problems in State Space Search

Solving Problems by Searching

- A wide range of problems can be formulated as *searches*.
  - more precisely, as the process of searching for a *sequence of actions* that take you from an *initial state* to a *goal state*
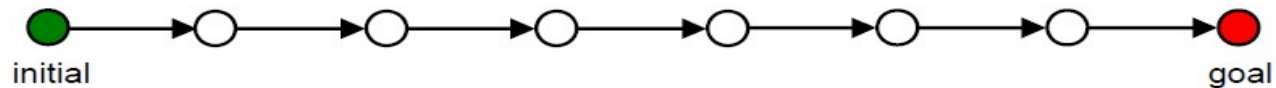
- Examples:
  - n-queens
    - initial state: an empty n x n chessboard
    - actions (also called *operators*): place or remove a queen
    - goal state: n queens placed, with no two queens on the same row, column, or diagonal
  - map labeling, robot navigation, route finding, *many others*

- State space = all states reachable from the initial state by taking some sequence of actions.
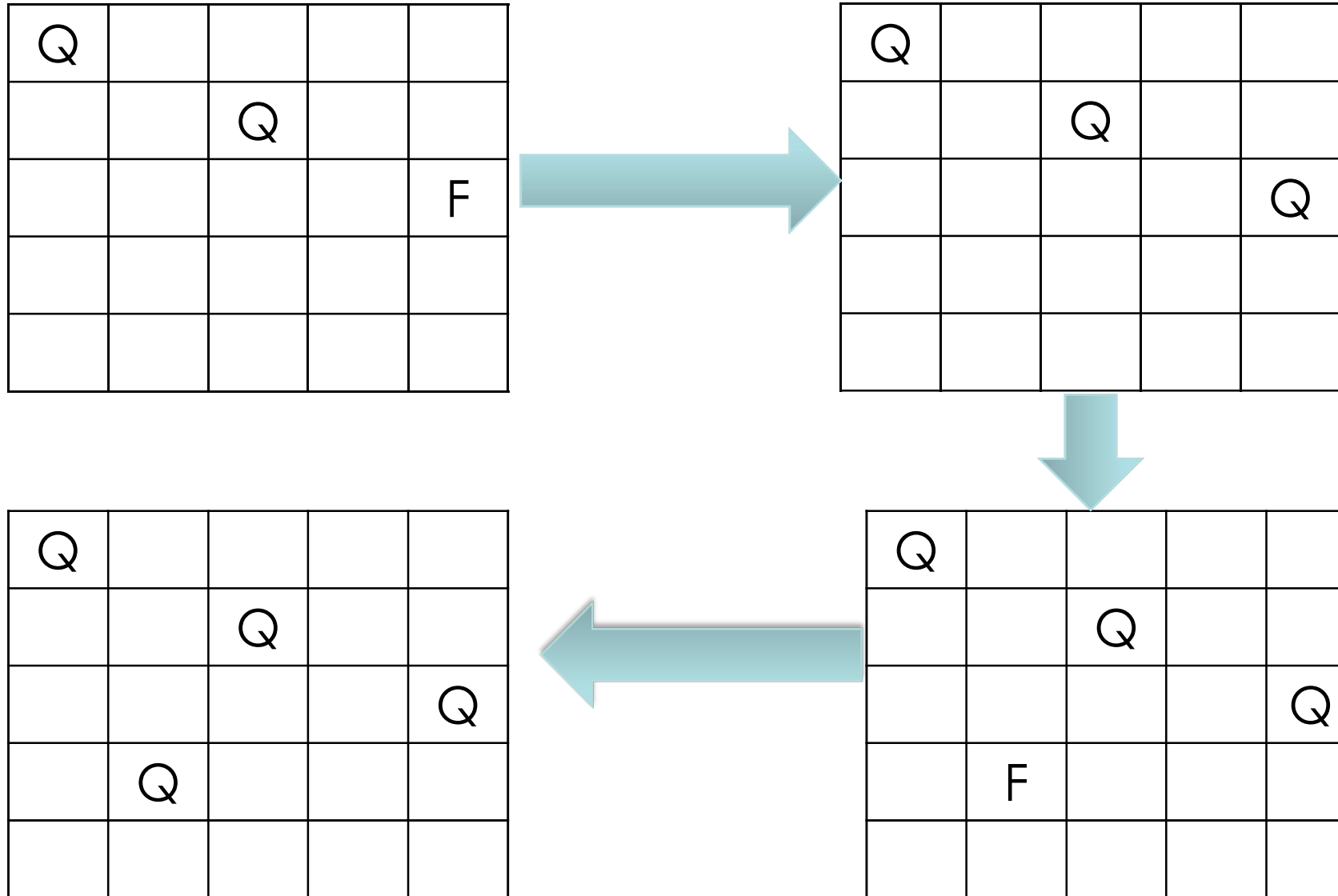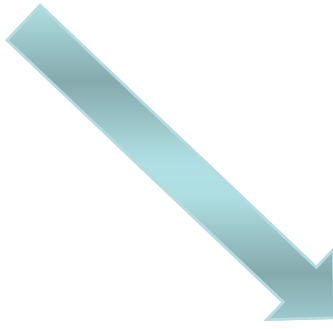
Solution for N-Queens

F	F	F	F	F

Q				

Q				
		F	F	F

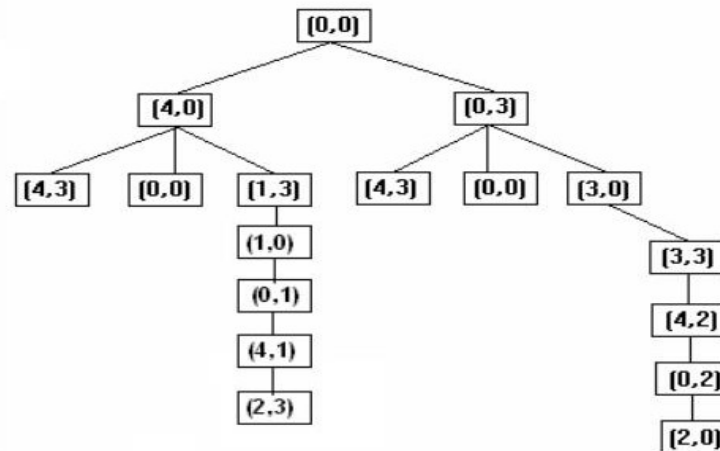| Q				
		Q		

Solution for N-Queens

Solution for N-Queens

Solution for Water Jug Problem

You are given two jugs, a 4-gallon one and a 3-gallon one, a pump which has unlimited water which you can use to fill the jug, and the ground on which water may be poured. Neither jug has any measuring markings on it. How can you get exactly 2 gallons of water in the 4-gallon jug?

Solution for Crypt-arithmetic Puzzle

S E N D

+ M O R E

M O N E Y

Variables: S, E, N, D, M, O, R, Y

Domains:
[0..9] for S, M, E, N, D, O, R, Y

Search space: 1,814,400
Aside: could have [1..9] for S and M

Solution.:9567
1085
====
10652

What is ML?

- "Learning is any process by which a system improves performance from experience."
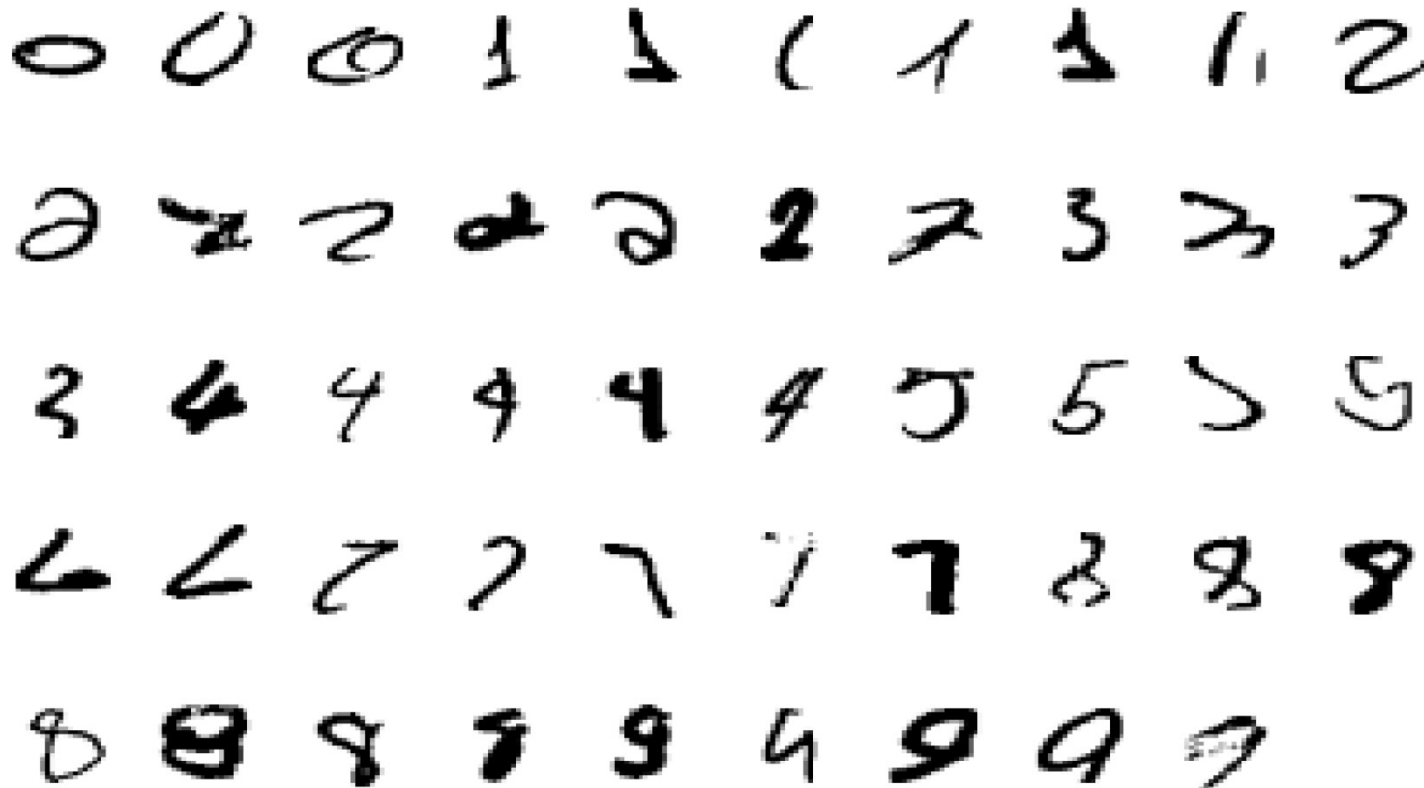
  - Herbert Simon

- Definition by Tom Mitchell (1998): Machine Learning is the study of algorithms that
  - improve their performance P
  - at some task T
  - with experience E.

A well-defined learning task is given by <P, T, E>

Machine Learning for Recognizing Hand-Written Digits

A classic example of a task that requires machine learning:
It is very hard to say what makes a 2

Machine Learning can Play Pivotal Role

- Recognizing patterns:
    - Facial identities or facial expressions
    - Handwritten words
    - Medical images

- Generating patterns:
    - Generating images or motion sequences

- Recognizing anomalies:
    - Unusual credit card transactions

- Prediction:
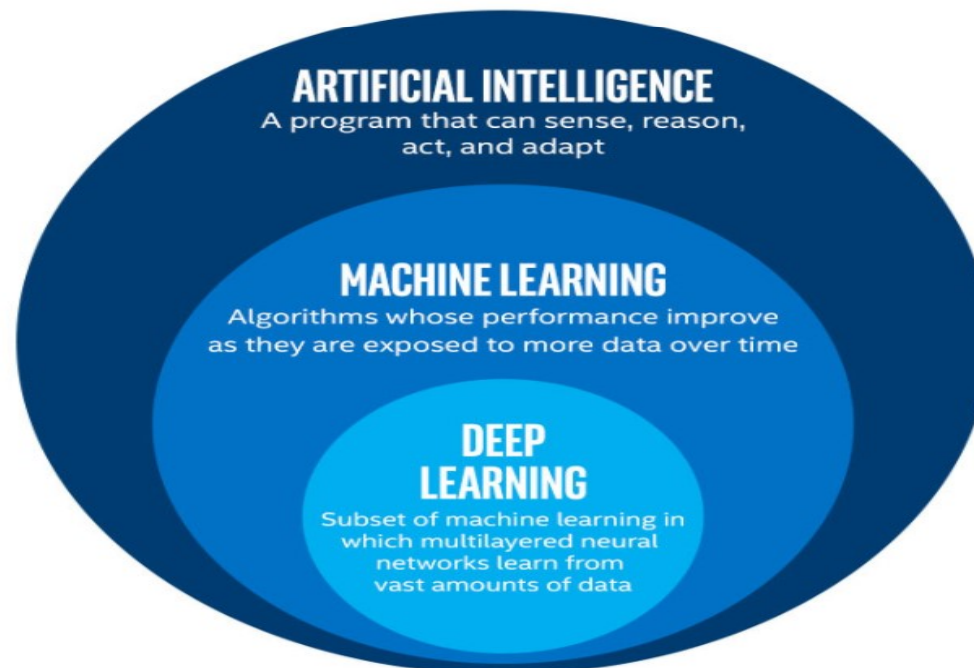   - Future stock prices or currency exchange rates

TP vs ML

Relationship between AI and ML

- ML is a subset of AI which allows a machine to automatically learn from past data without programming explicitly.

Useful Resources

- http://mleg.cse.sc.edu/edu/csce883/index.php?n=Main.LectureNotes

Thank You