CS60020: Foundations of Algorithm Design and Machine Learning

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COURSE ORGANISATION

Resources

Teaching Assistants:

- Soumi Das
- Mainul Islam
- Shriti Raj

- Website: http://cse.iitkgp.ac.in/~sourangshu/coursefiles/cs60020_21S.html

- Assignment submission / Test: https://moodlecse.iitkgp.ac.in/moodle/login/index.php

Resources

Text Books:

- Introduction to Algorithms (Third Edition) Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein

- Pattern recognition and machine learning. Christopher M. Bishop springer, 2006.

- Latest Papers / Tutorials

Pre-requisites

- Basic Programming and Data Structures.
  - For C Programming: Book by Kernigham and Richie.
  - For Data Structures: Section 10.1 of book by Cormen et al.
- Mathematics: functions, matrix algebra, optimization.
  - Practical Methods of Optimization. R. Fletcher. 2nd Edition
- Discrete Maths: Graphs, Trees, etc.
  - Introduction to Graph Theory by Douglas West
- Logical thinking and Hard work !!

Evaluation

- Grades:
  - Assignments: 40
  - Tests: 60

SYLLABUS AND LECTURE SCHEDULE

Algorithms

- An algorithm is an unambiguous specification of a sequence of steps to solve a problem.
- Important Aspects:
  - Application
  - Analysis
  - Design

- Example: Euclid's algorithm for finding the greatest common divisor.

Algorithms

- Example: Euclid's algorithm for finding the greatest common divisor.

```
EUCLID(a, b)
1  if b == 0
2        return a
3  else return EUCLID(b, a mod b)
```

$$\begin{aligned}\text{EUCLID}(30, 21) &= \text{EUCLID}(21, 9)\\ &= \text{EUCLID}(9, 3)\\ &= \text{EUCLID}(3, 0)\\ &= 3\ .\end{aligned}$$

Algorithm Design

Date	Day	Topic
2021-03-15	Monday	Introduction
2021-03-18	Thursday	Searching, BST
2021-03-22	Monday	Balanced BST
2021-03-25	Thursday	Balanced BST
2021-03-29	Monday	Holiday
2021-04-01	Thursday	Test 1
2021-04-05	Monday	Sorting, Insertion
2021-04-08	Thursday	Bubble, Selection Sort
2021-04-12	Monday	Divide & Conquer - Mergesort
2021-04-15	Thursday	Divide & Conquer - Mergesort
2021-04-19	Monday	Quicksort

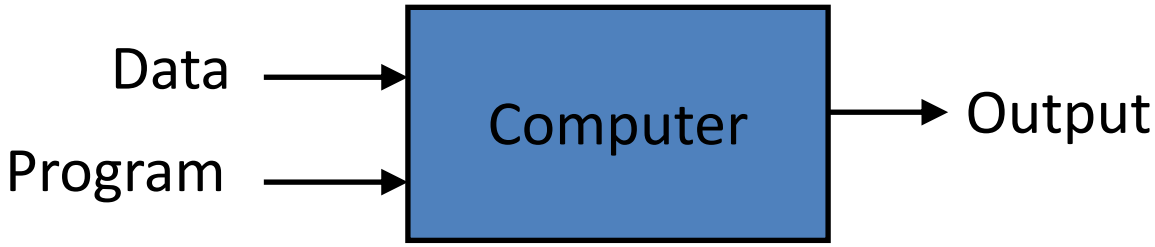
Algorithm Design

Date	Day	Topic
2021-04-22	Thursday	Heapsort
2021-04-26	Monday	Discussion
2021-04-29	Thursday	Test 2
2021-05-03	Monday	Priority queue
2021-05-06	Thursday	Hashing
2021-05-10	Monday	Discussion / Test
2021-05-13	Thursday	Graphs, MST
2021-05-17	Monday	Dijkstra, Bellman-ford
2021-05-20	Thursday	Floyd Warshall
2021-05-24	Monday	Discussion
2021-05-27	Thursday	Test 3
2021-05-31	Monday	Dynamic Programming, LCS
2021-06-03	Thursday	Discussion

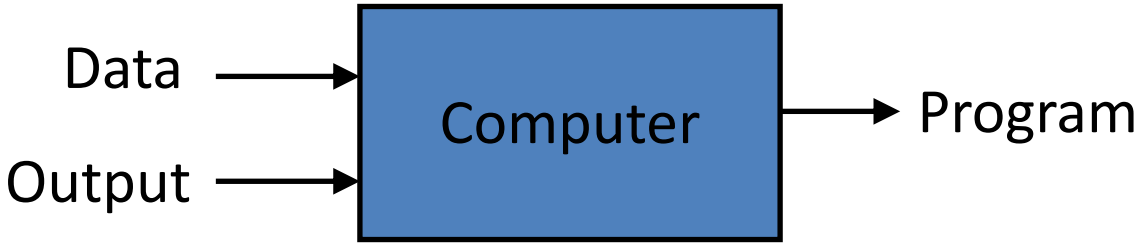
Machine Learning

- Machine learning is a field of computer science that gives computers the ability to learn [from data] without being explicitly programmed.
- Example: Bayesian classifier for automatically filtering email spams.
- Aspects:
  - Application
    Modeling
  - Inference and learning

Traditional Programming



Machine Learning



Magic?

No, more like gardening

- **Seeds** = Algorithms
- **Nutrients** = Data
- **Gardener** = You
- **Plants** = Programs

Sample Applications

- Web search
- Computational biology
- Finance
- E-commerce
- Space exploration
- Robotics
- Information extraction
- Social networks
- Debugging
- [Your favorite area]