SCHOOL OF
INTERNATIONAL & INTERDISCIPLINARY
ENGINEERING PROGRAMS
King Mongkut's Institute of Technology Ladkrabang

Introduction to Data Structures and Algorithms

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Outline

1. Resources
2. What is a “Data Structure”?
3. What is an “Algorithm”?
4. Prerequisites
5. Topics
6. Grading

Resources

1. Course Website:
   https://github.com/noswolf/DSA_BIT/tree/DSA_23
2. Google Colaboratory
   - Interactive notebooks

What is a “Data Structure” ?

How do we store, organise, and retrieve data on a computer?

What is a “Data Structure” ?

- Way to **store** and **organise** data
- Enable efficient **access** and **modification** of data
- Designed for a specific algorithm
  - Strengths and limitations
  - Time and space complexity

Abstract Data Type

- A data type where only **behavior** is defined but not implementation.
- Examples: Array, List, Map, Queue, Set, and etc.

Common vs Abstract Data Type

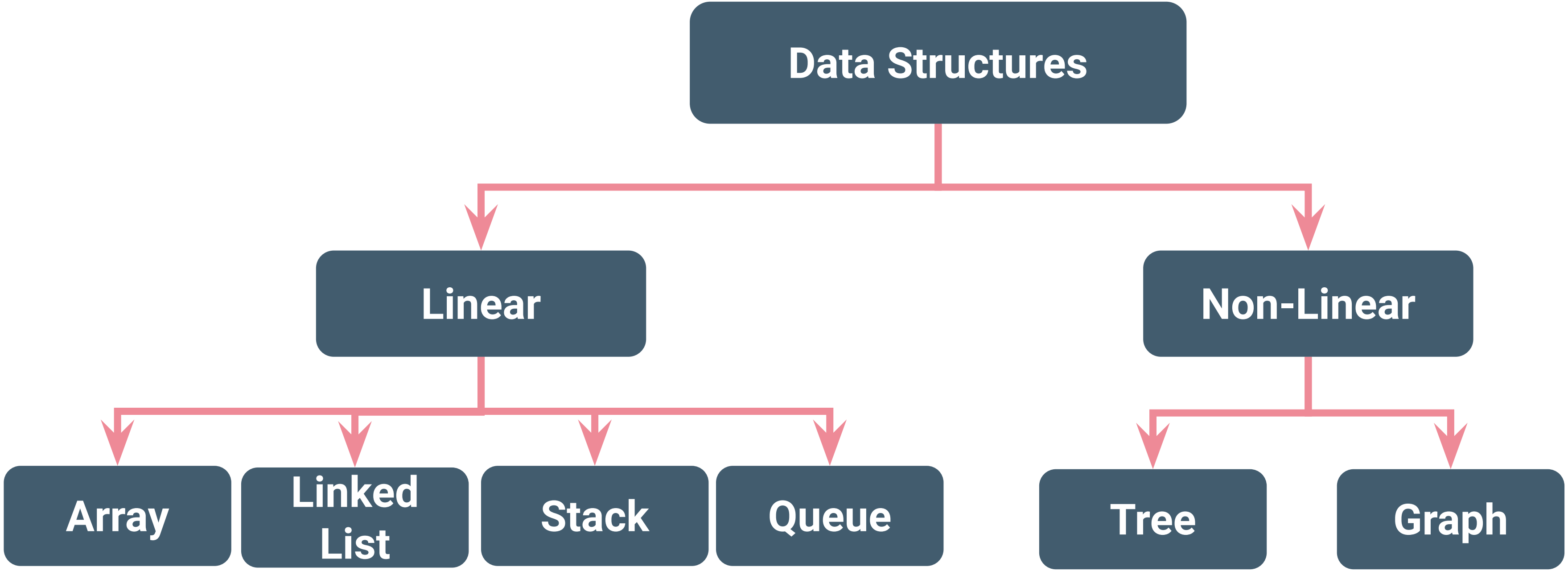
Common

- Integer
- Floating-point number
- Character
- String
- Boolean
- etc.

Abstract

- Array
- List
- Map
- Queue
- etc.

Type of Data Structure



Check out for a comprehensive list of data structures at https://en.wikipedia.org/wiki/List_of_data_structures

What is an “Algorithm” ?

- Well-defined procedure or set of instructions to
  - transform input to output or
  - accomplish a task or
  - solve a computational problem

Why care about an “Algorithm” ?

How can we efficiently (in space/time) carry out some typical data processing operations?

How do we analyze and describe their performance?

Example: Sorting numbers

1. Input:

2. Sorting Algorithms

3. Output:

What kind of problems are solved by algorithms?

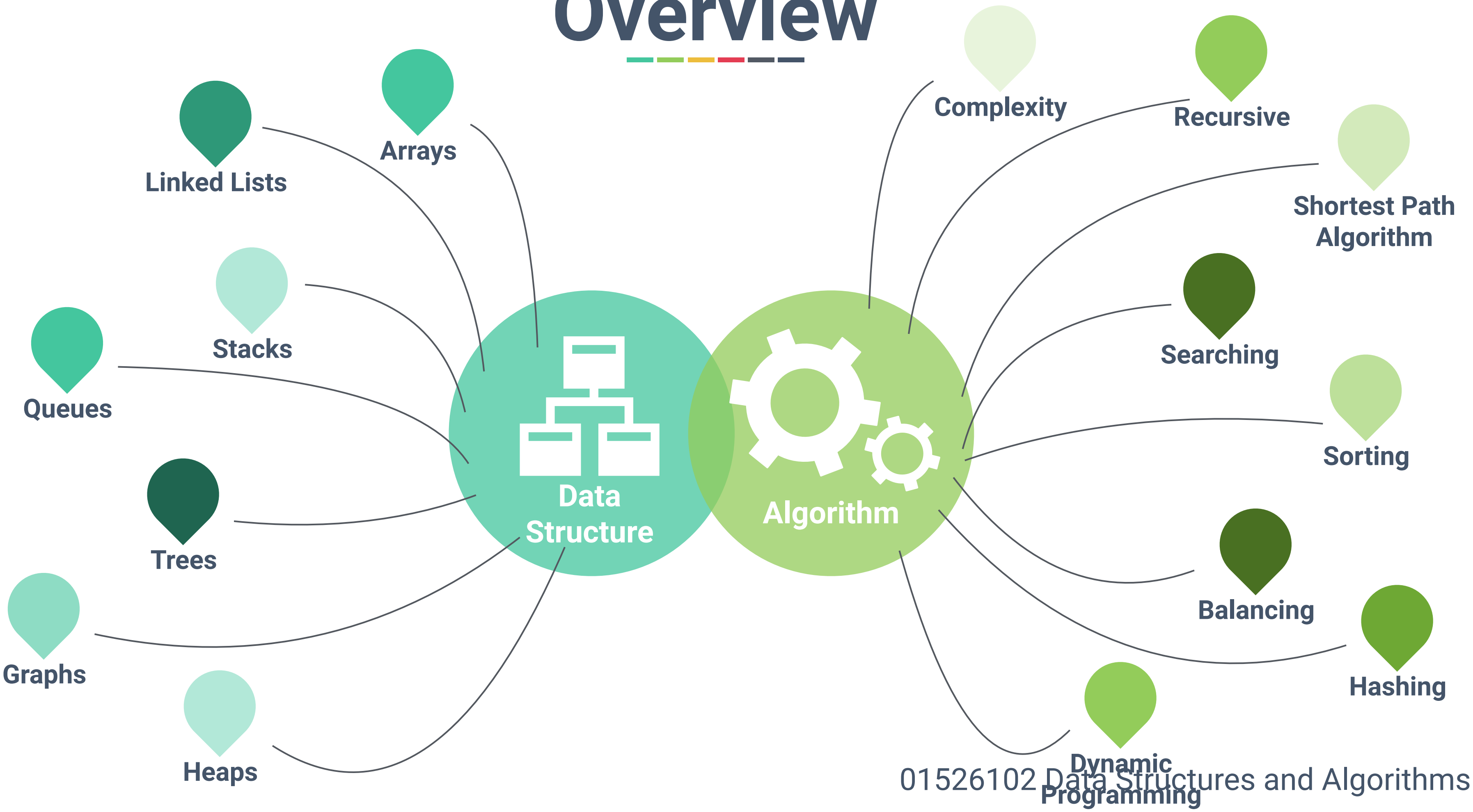
- Human Genome Project
    - identifying all genes of human beings
- Internet: Routing, searches, and security
    - **Shortest path**, search engines, encrypted communication
- E-commerce
    - Ads, recommendations, authentications
- Commercial enterprises
    - Resource allocation:
        - crew assignment on flights, package delivery route

Overview

Data Structures

Algorithms

Overview


Data Structure
Arrays
Linked Lists
Stacks
Queues
Trees
Graphs
Heaps
Algorithm
Complexity
Recursive
Shortest Path Algorithm
Searching
Sorting
Balancing
Hashing
Dynamic Programming

Summary

- Data Structure
  - Way to store and organise data, allowing operations to be performed efficiently.
- Algorithm
  - Step-by-step procedure, which performs on data structure, to be followed to solve a problem/accomplish a task.

Prerequisites

- Fluent in Python Programming
- Comfortable with development processes
    - Writing a function
    - Debugging and testing a code

Lesson Plan (till Midterm)

Week	Topics
04/07/2023	Python Crash Course
11/07/2023	Algorithm Analysis
18/07/2023	Arrays
25/07/2023	Stacks [VDO]
01/08/2023	Queues [VDO]
08/08/2023	Linked Lists
15/08/2023	Linked Lists (Cont.)
22/08/2023	Trees

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Lesson Plan (after Midterm)

Week	Topics
05/09/2023	Search Trees
12/09/2023	Search Trees (Cont.)
19/09/2023	Searching and Hashing
26/09/2023	Sorting
03/10/2023	Recursion and Sorting
10/10/2023	Graphs
17/10/2023	Graphs (Cont.)
24/10/2023	-
	Final Exam

Grading

Attendance	10%
Lab Assignment	30%
Midterm Exam	30%
Final Exam	30%

Reading List

Essential

Goodrich, M.T., Tamassia, R. and Goldwasser, M.H., 2013. ***Data structures and algorithms in Python***. John Wiley & Sons Ltd.

Recommended

Cormen, T.H., Leiserson, C.E., Rivest, R.L. and Stein, C., 2022. ***Introduction to algorithms***. MIT press.

Miller, B.N. and Ranum, D.L., 2011. ***Problem solving with algorithms and data structures using python***, 2nd ed. Franklin, Beedle & Associates Inc.