INTRODUCTION TO DATA STRUCTURES AND ALGORITHMS

COMP 2230-02 | WINTER 2026

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Learning Objectives

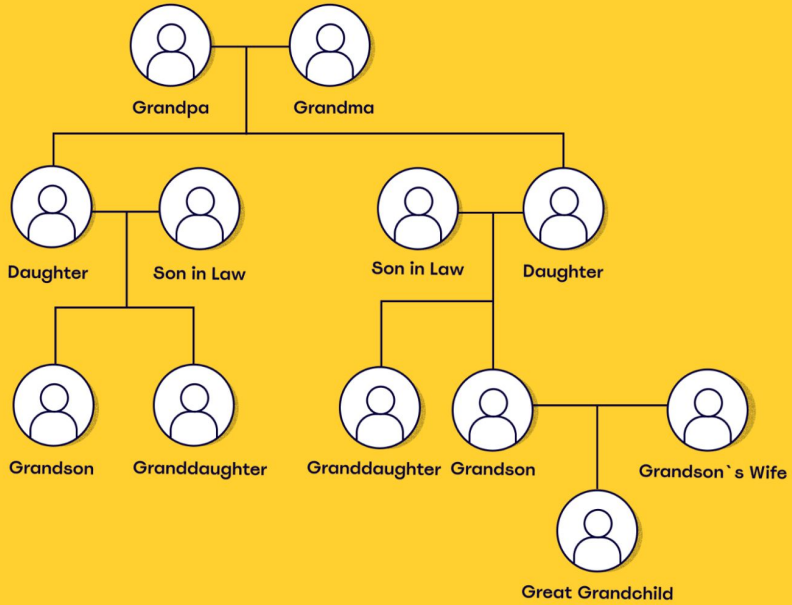
1. Data Structures
2. Algorithms
3. Data Structures together with Algorithms
4. Where is Data Structures and Algorithms Needed?

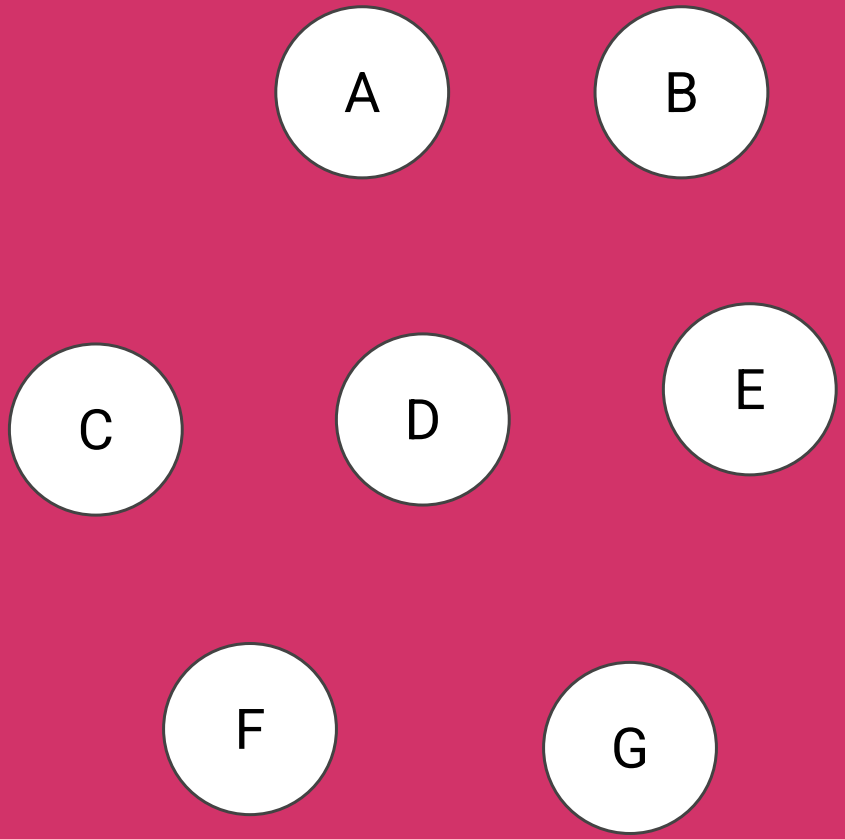
Understanding and using the right data structure for a specific problem is a key skill for any software developer.

Tech giants like **FAANG (Facebook, Apple, Amazon, Netflix, Google)** and other top-tier companies place a strong emphasis on **Data Structures & Algorithms (DSA)** in their hiring process.

What are Data Structures?

A data structure is a way to store data.





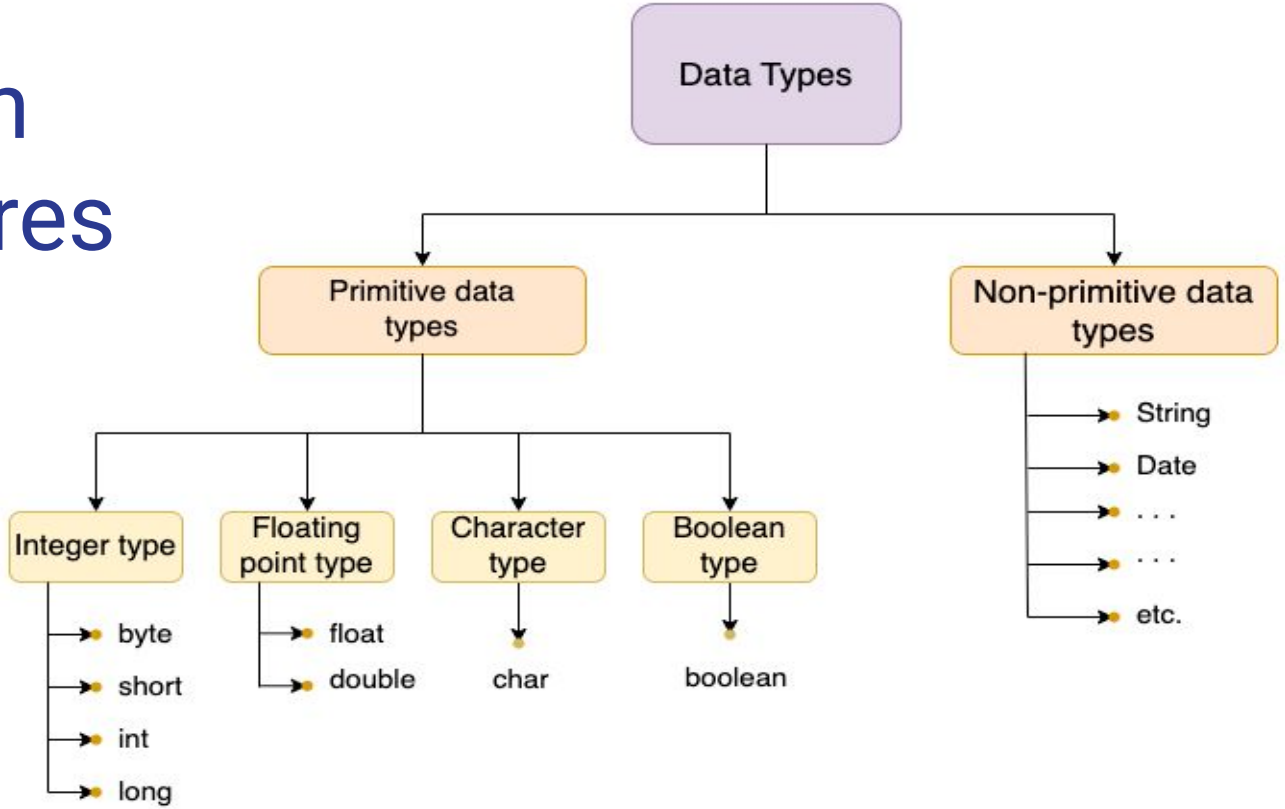
What is E’s mother name?

What is a Data Structure(DS) ?

- A **data structure** is a way of arranging data on a computer so that it can be accessed and updated efficiently.
- **Data structures** are the fundamental building blocks of computer programming.
- They define how data is organized, stored, and manipulated within a program.
- DS is also used for processing, retrieving, and storing data.
- There are different basic and advanced types of data structures that are used in almost every program or software system that has been developed.

The way data are organized in a computer memory is said to be **Data Structure.**

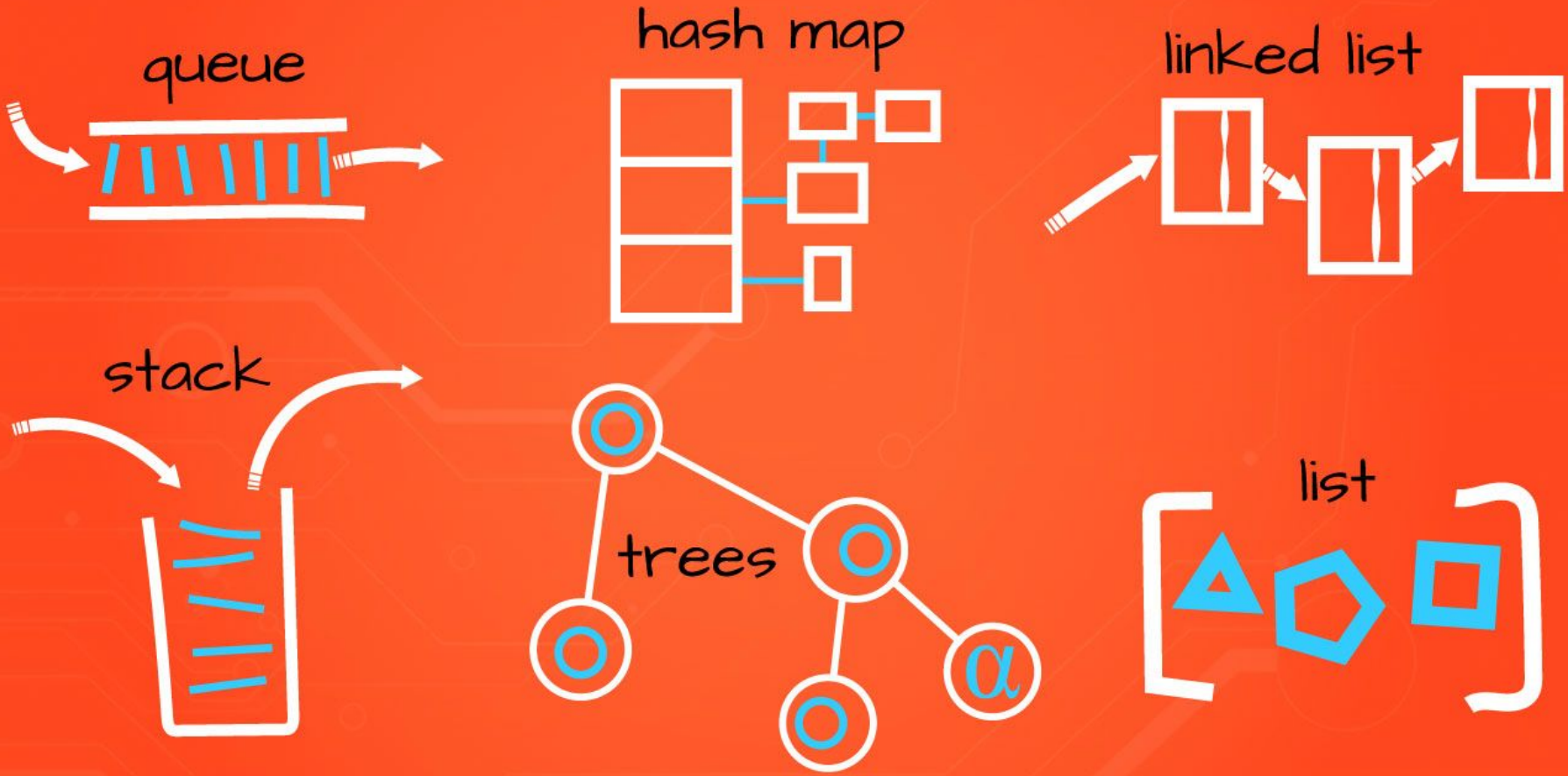
Data Types in Data Structures



Data Types in Data Structures

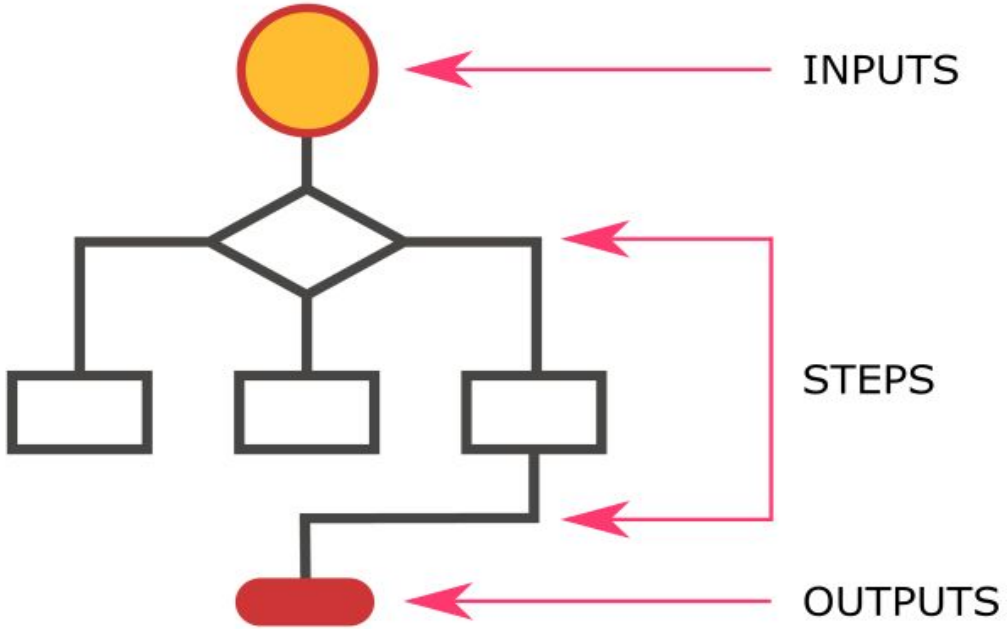
1. **Primitive Data Type :** are basic data structures provided by programming languages to represent single values, such as integers, floating-point numbers, characters, and booleans.

2. **Abstract Data Type :** are higher-level data structures that are built using primitive data types and provide more complex and specialized operations. Some common examples of abstract data structures include arrays, linked lists, stacks, queues, trees, and graphs.

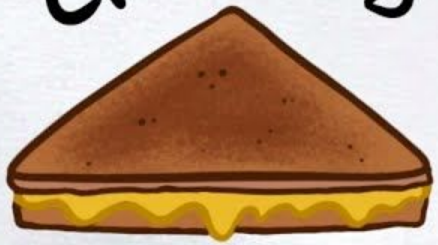

queue
hash map
linked list
stack
trees
list

What is an Algorithm?

An algorithm is a set of step-by-step instructions to solve a given problem or achieve a specific goal.



How is an Algorithm like a recipe for making GRILLED CHEESE?

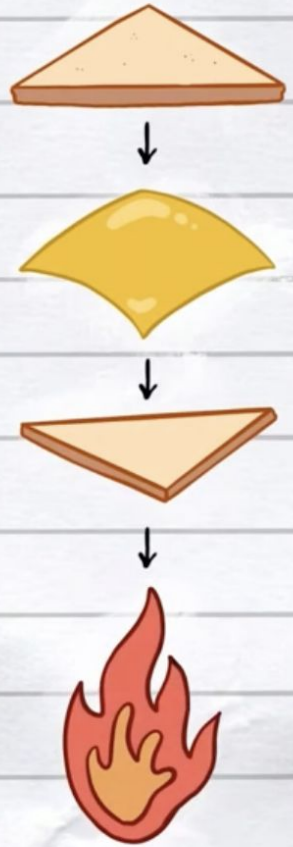


Ingredients

An algorithm is just a set of instructions.

It's just like a recipe.

Steps



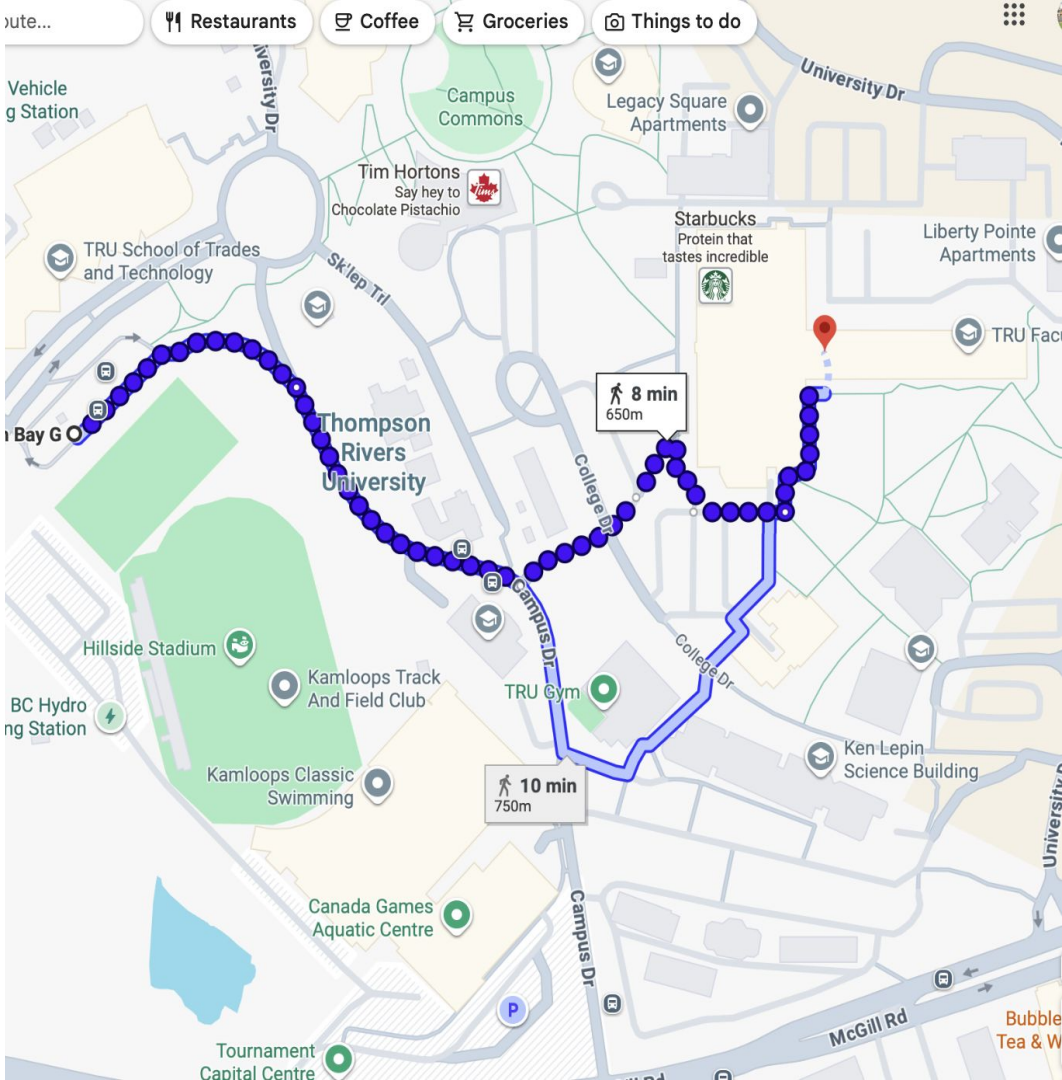
Algorithms are fundamental to computer programming as they provide step-by-step instructions for executing tasks.

An efficient algorithm can help us to find the solution we are looking for, and to transform a slow program into a faster one.

Example : Calculating Path

Finding the best path from OM building to TRU Exchange.

- Distance
- Time

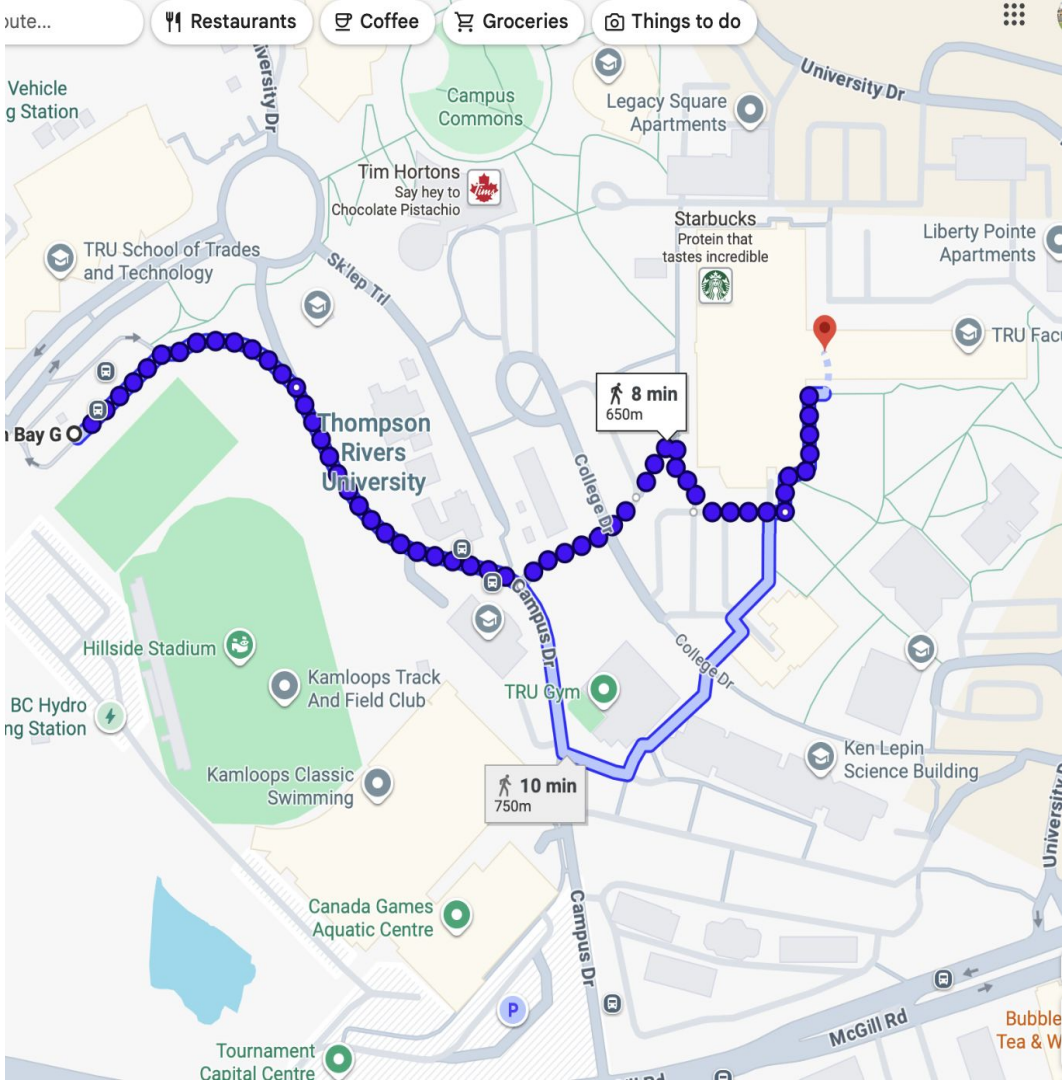


Example : Calculating Path

Finding the best path from OM building to TRU Exchange.

- Distance
- Time

In terms of programs/ algorithm, we have space & time complexity.



DS together with Algorithms

A data structure is not worth much if you cannot search through it or manipulate it efficiently using algorithms, and the algorithms are not worth much without a data structure to work on.

Data Structure & Algorithm (DSA) is about finding efficient ways to store and retrieve data, to perform operations on data, and to solve specific problems.

By understanding DSA, we can:

- Decide which data structure or algorithm is best for a given situation.
- Make programs that run faster or use less memory.
- Understand how to approach complex problems and solve them in a systematic way.

Where is Data Structures & Algorithms Needed?

Data Structures and Algorithms (DSA) are used in virtually every software system, from operating systems to web applications:

- For managing large amounts of data, such as in a social network or a search engine.
- For scheduling tasks, to decide which task a computer should do first.
- For planning routes, like in a GPS system to find the shortest path from A to B.
- For optimizing processes, such as arranging tasks so they can be completed as quickly as possible.
- For solving complex problems: From finding the best way to pack a truck to making a computer 'learn' from data.

Where is Data Structures & Algorithms Needed?

DSA is fundamental in nearly every part of the software world:

- Operating Systems
- Database Systems
- Web Applications
- Machine Learning
- Video Games
- Cryptographic Systems
- Data Analysis
- Search Engines

Conclusion

1. **Data Structures** is about how data can be stored in different structures.
2. **Algorithms** is about how to solve different problems, often by searching through and manipulating data structures.
3. Learning about **Data Structures and Algorithms (DSA)** will help us to use large amounts of data to solve problems efficiently.

References

1. Introduction to Data Structures and Algorithms
2. Data structures & Algorithms - Explained with examples
3. Best Data Structures and Algorithms Books
    a. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein
    b. Data Structures and Algorithms Made Easy by Narasimha Karumanchi
    c. Data Structures and Algorithm Analysis in Java by Mark Allen Weiss
    d. Lewis, DePasquale and Chase; Java Foundations, An Introduction to Program Design and Data Structures,5th edition, Pearson Education Inc.