DATA STRUCTURES & ALGORITHMS

NATIONAL UNIVERSITY OF TECHNOLOGY (NUTECH)

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LECTURE # 1

INTRODUCTION

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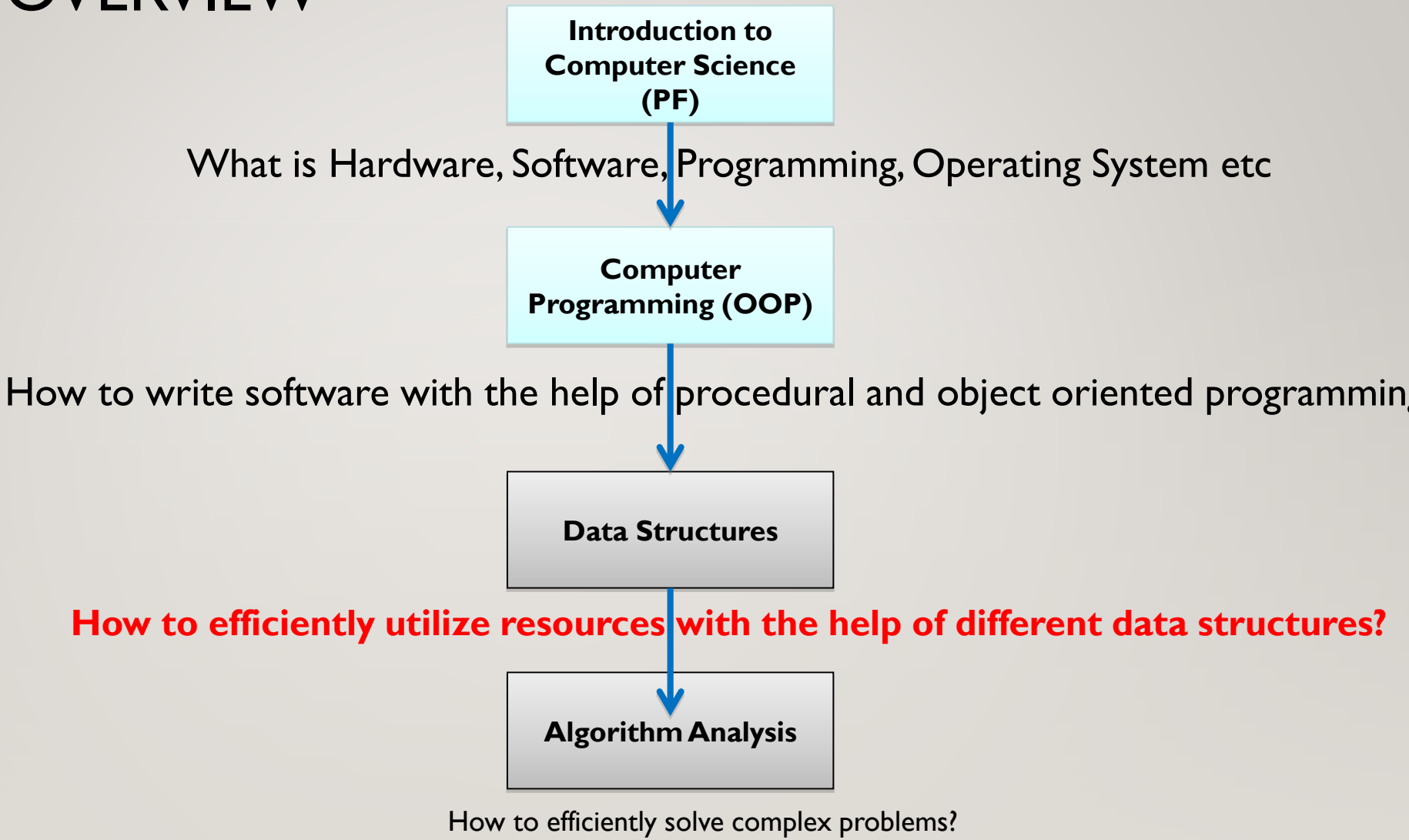
GENERAL OVERVIEW



COURSE CONTENTS

• Introduction
• Simple Data Types and Abstract Data Types
• Array
  • Searching techniques
  • Sorting techniques
• List
• Stack
• Queue
	FIRST SESSION

• Tree • Heap	**SECOND SESSION**
• Graph • Hashing	**FINAL SESSION**

WHAT IS A DATA STRUCTURE?

- In a general sense, any representation that is used for storing information is a data structure

- Example: An integer, structures, classes, linked lists, etc

- More typically, a *data structure* provides a way of *organization for a collection of data items*

WHERE DATA STRUCTURE IS HELPFUL?

- The choice of efficient data structure makes the difference between a program running in a few seconds or many days

WHAT IS DATA STRUCTURE EFFICIENCY?

- A solution is said to be efficient if it solves the problem within its resource constraints in a reasonable amount of time.
  - Space
  - Time

- The cost of a solution is the amount of resources that the solution consumes.

COSTS AND BENEFITS

- Each data structure has costs and benefits.
- It is very difficult to find a data structure that is better than others in all situations.
- A data structure requires:
  - space for each data item it stores,
  - time to perform each basic operation,
  - programming effort.

GOALS OF THIS COURSE

1. Learn the commonly used data structures.
   - These form a programmer's basic data structure "toolkit"

2. Case Studies of Data Structures.

3. We will examine the costs and benefits of every data structure or program.

EXAMPLE

- A cellular service company provides contracts to its 10 million users
- Due to new security enforcements, the company wants to **prevent issuing of multiple contracts to users**

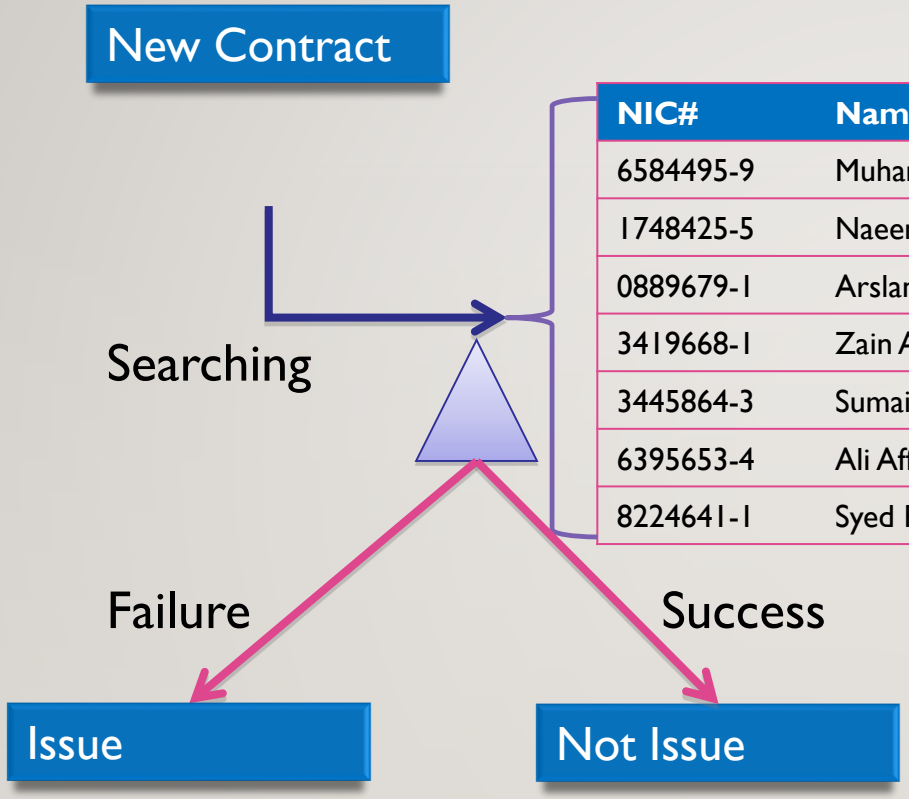
- Method of Detecting Multiple Contracts
  - Before issuing a new contract to user
  - First search the ***id of user*** in existing contracts database
  - In case of failure, issue a new contract
  - In case of success, do not issue a new contract to user

EXAMPLE

NIC#	Name	Address
6584495-9	Muhammad Faheem	House No 3 Gulshan Bahar Sec 16
1748425-5	Naeem Alam	A-11 Shams Plaza Block-B N.Nazimabad
0889679-1	Arslan Akhtar	H No 152 Bostang Colony
3419668-1	Zain Ahmed	Sharfabad Street Gulshan Karachi
3445864-3	Sumair Farooq	Post Office Tayyar, Multan
6395653-4	Ali Affan	H.No. 425, Sector F-11/4, Islamabad
8224641-1	Syed Faraz	Sharfabad Street Gulshan, Faisalabad

- Linear Array (with 10 million entries)
  - 3 arrays (NIC, name, address),
  - structure array,
  - class's object array

EXAMPLE



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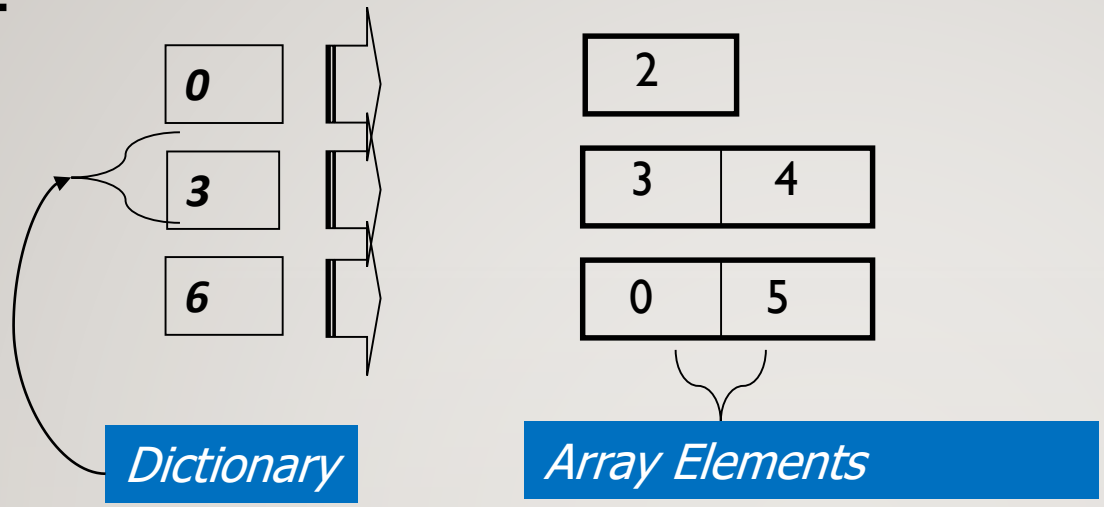
- Any disadvantage of Linear Array (Data Structure)?
- How to improve?

EXAMPLE

- Improved Data Structure
  - Create a dictionary data structure
  - Group all those records together that start with similar NIC (first digit) numbers, and add a dictionary entry for each distinct digit (0-9)
  - Example: 3419668-1, 3445864-3, 1748425-5.
    - 3 and 1 are dictionary entries
  - In case of searching, first search the dictionary entry, and then proceed to searching contracts

EXAMPLE



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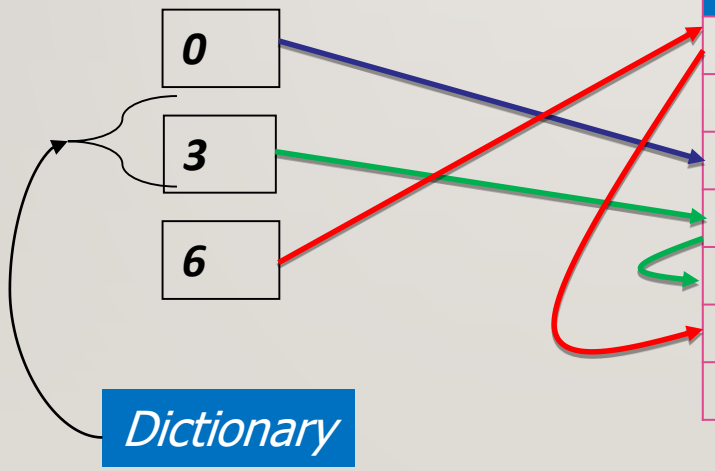
EXAMPLE

- Another Data Structure
  - Maintain pointers with records
  - Non NULL pointer indicates presence of next record



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