ALGORITHM

Project number : 2023-2-IT03-KA220-YOU-000179130

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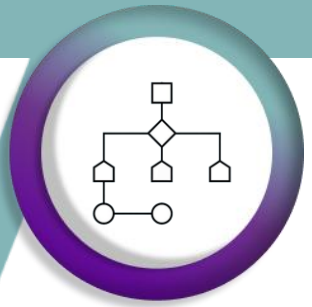
Advanced Lesson Plan



- Define an algorithm in a technical sense and explain it simply.
- Understand algorithm efficiency: know what “time complexity” and “space complexity” mean.
- Identify common types of algorithms: sorting, searching, recursive, iterative, greedy, etc.
- Analyze an algorithm step by step to check correctness and efficiency.
- Write simple algorithms in pseudocode or flowcharts.

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What is an Algorithm?

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Technical Definition:

An algorithm is a finite sequence of well-defined instructions to solve a problem.

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Key Characteristics

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1. Input: The data you start with.
2. Output: The result or solution.
3. Finiteness: Must finish after a limited number of steps.
4. Definiteness: Each step is clearly defined.
5. Effectiveness: Each step can be performed in a reasonable amount of time.

Algorithms basics

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How Algorithms Work

- **Define the problem clearly** → What do we want to solve?
- **Design a step-by-step procedure** → What are the instructions to reach a solution?
- **Test with examples** → Check if the algorithm works with sample inputs.
- **Analyze efficiency** → How fast is it? How much memory does it use?
- **Refine and optimize** → Can it be faster or use less memory?

Algorithm Diagram (Flowchart)

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A flowchart is a visual way to show an algorithm step by step.
It helps you see the logic, not just read it.

Element	Symbol	Function	Example
Start / End	Oval 	Shows where the algorithm begins or ends	“Start” / “End”
Process / Step	Rectangle 	An action or instruction	“Add two numbers”
Decision / Condition	Diamond 	A question that changes the flow (Yes/No)	“Is a > b?”
Input / Output	Parallelogram 	Data that goes in or comes out	“Input numbers” / “Output result”
Arrow	→ 	Shows the direction of the flow	
Loop / Connector	Curved arrow or label 	A step that repeats until a condition is met	“Repeat until sorted”

Algorithm Diagram (Flowchart)

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How to Read a Flowchart

- Start → Find the “Start” oval.
- Input → Look at what information enters the system (for example: numbers, text).
- Process → Follow each rectangle. These are actions or steps.
- Decision → When you reach a diamond, it asks a Yes/No question.
  - If “Yes,” follow one arrow.
  - If “No,” follow the other.
- Loop → When an arrow goes back to an earlier step, it means “repeat.”
- Output → At the end, see the result or answer.
- End → The process stops.

Examples: Sorting Numbers

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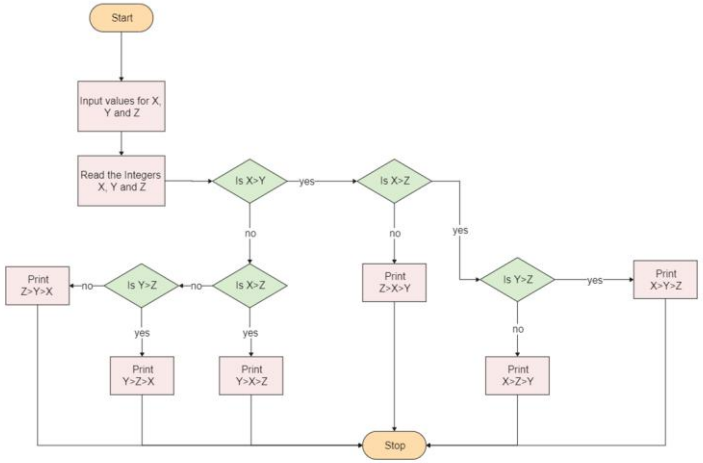
Problem: Sort the numbers [4, 2, 7] from smallest to largest

1. Flowchart (Step-by-Step Visual)

```
Start
  |
  v
Input numbers: 4, 2, 7
  |
  v
Compare first two numbers:
Is 4 > 2? Yes → Swap
  |
  v
Numbers now: 2, 4, 7
  |
  v
Compare next numbers: 4 and 7
Is 4 > 7? No → Keep order
  |
  v
Output sorted numbers: 2, 4, 7
  |
  v
End
```



Tip for Deaf Learners:

- Use arrows and boxes for each step.
- Highlight the swap action with a different color.
- Show input → process → output clearly.

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Examples: Sorting Numbers

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Problem: Sort the numbers [4, 2, 7] from smallest to largest

2. Pseudocode (Simple Text Version)

```
Algorithm SortThreeNumbers:
  Input: a, b, c
  If a > b then
      Swap a and b
  If b > c then
      Swap b and c
  If a > b then
      Swap a and b
  Output: a, b, c
End Algorithm
```

Notes:

- **Pseudocode is like English instructions, not programming language.**
- **Step-by-step clarity is key.**

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Examples: Sorting Numbers

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Problem: Sort the numbers [4, 2, 7] from smallest to largest

3. Diagram (Visual Overview)

```
[Input: 4,2,7]
      |
      v
[Compare 4 and 2]
      |
      v
[Swap if needed] ---> [Numbers now: 2,4,7]
      |
      v
[Compare 4 and 7]
      |
      v
[Swap if needed] ---> [Numbers now: 2,4,7]
      |
      v
[Output: 2,4,7]
```

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Key Points

- Flowchart = detailed, step-by-step map of the algorithm.
  - Includes decisions, loops, inputs, outputs.
  - Great for writing pseudocode or coding later.
- Diagram = big-picture visual, simple overview.
  - Shows main actions and flow without all steps.
  - Helps understand the logic quickly, especially for visual learners.

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Algorithm Theory Important

- **Time Complexity (Big O notation): Measures how fast an algorithm runs as input size grows.**
- **Space Complexity: Measures how much memory an algorithm uses.**
- **Common Algorithm Types:**
  - Sorting: Bubble sort, merge sort, quicksort.
  - Searching: Linear search, binary search.
  - Recursion: Algorithm calls itself (e.g., factorial).
  - Greedy Algorithms: Make the best choice at each step (e.g., shortest path).
  - Dynamic Programming: Break problems into smaller subproblems.
- **Data Structures: Algorithms often need lists, arrays, trees, or graphs.**

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Comparison-Based Sorting

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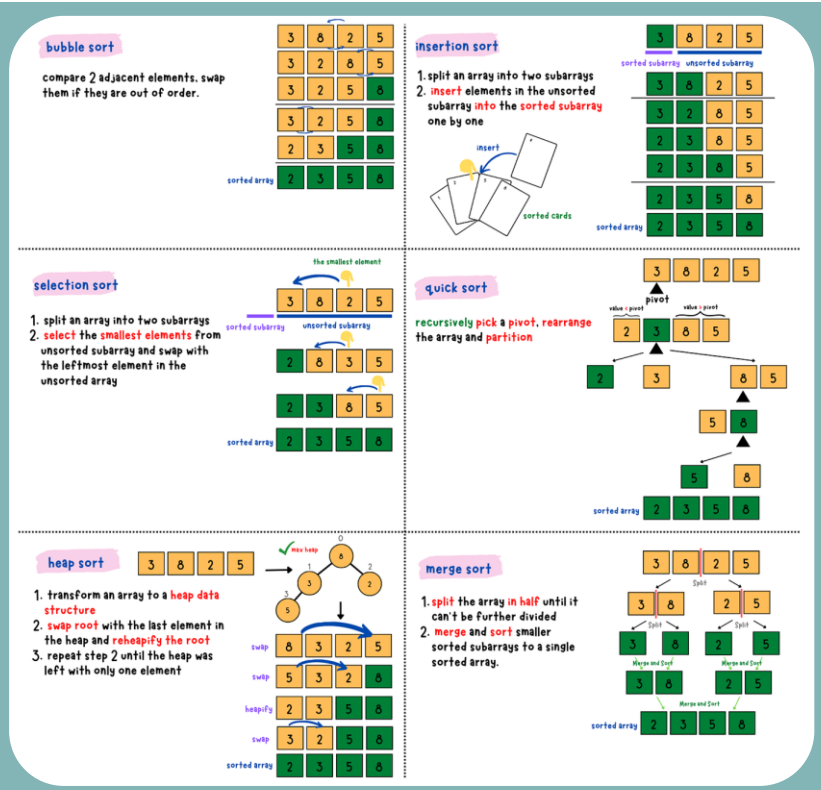
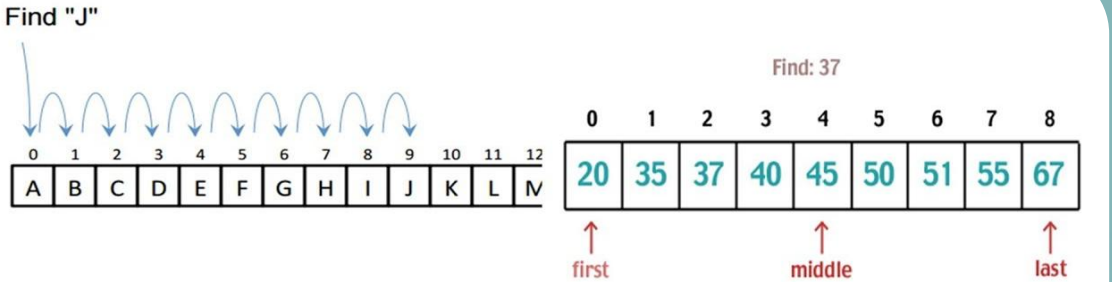
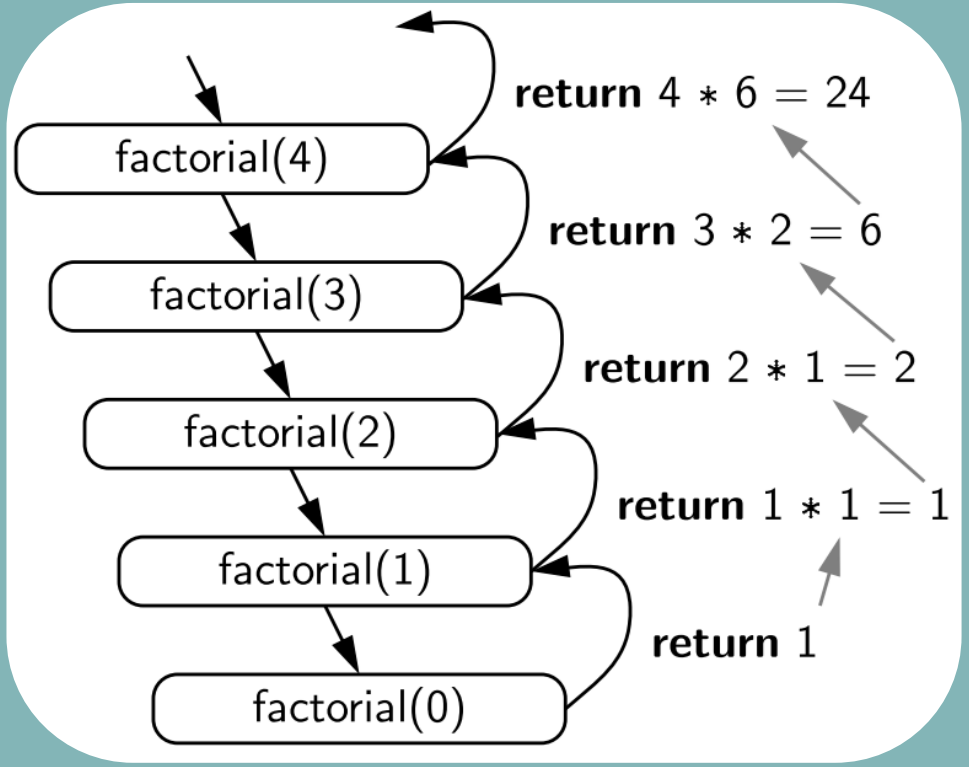


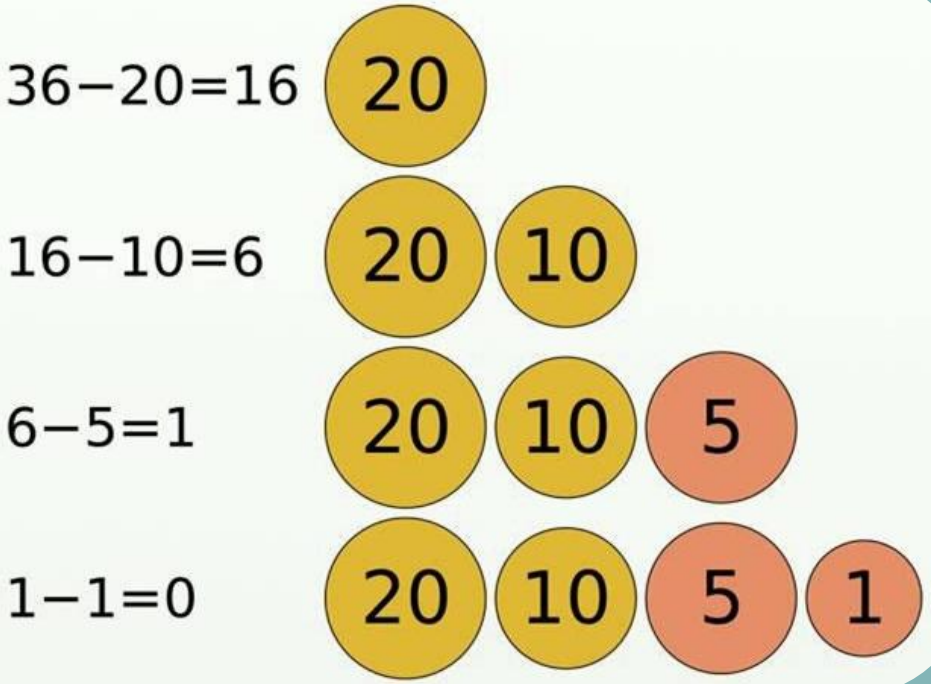
Comparison-Based Sorting



Comparison-Based Sorting



Comparison-Based Sorting



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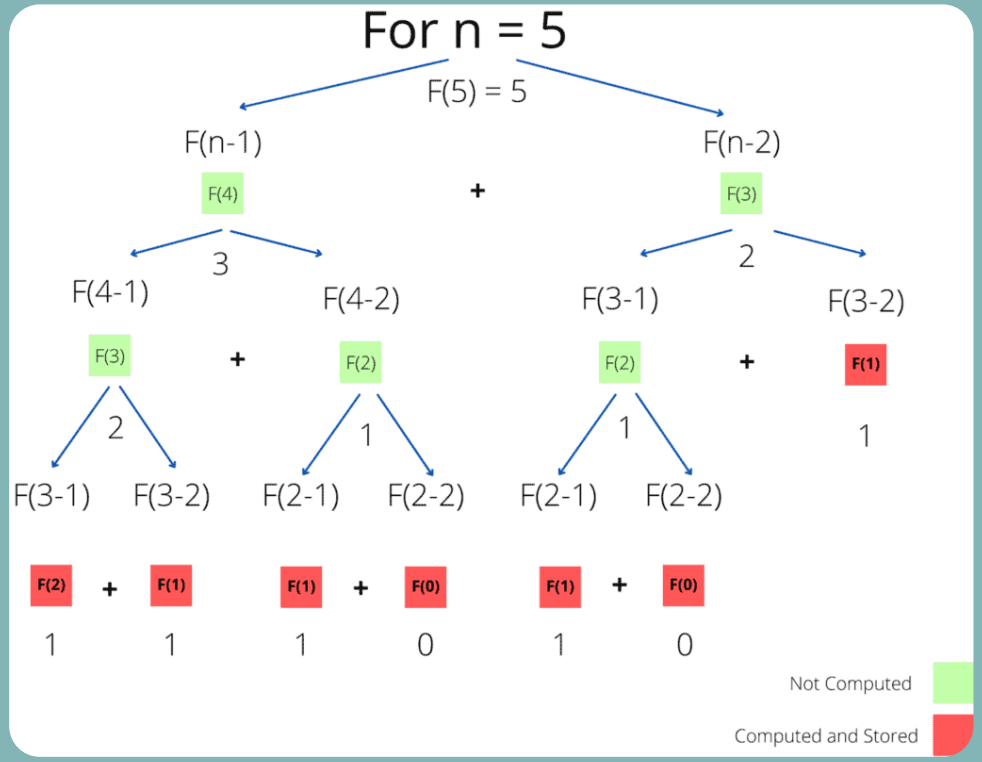
Comparison-Based Sorting



Interactive Exercise Idea (Hands-On Learning)

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Objective

- Help students practice algorithm design in a fun and visual way.
- Reinforce understanding of steps, decisions, loops, and efficiency.

Interactive Exercise Idea (Hands-On Learning)

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Step 1: Choose a Simple Task

- Examples of everyday tasks:
- Making tea
- Sorting books by height
- Morning routine (wake up → brush teeth → eat breakfast → get dressed)
- Packing a backpack
- Ordering fruits by size

Interactive Exercise Idea (Hands-On Learning)

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Step 2: Draw a Flowchart

- Instructions for students:
- Start → Draw the start symbol (oval).
- Input / Output → Show the data or result (parallelogram).
- Actions / Steps → Use rectangles for each action.
- Decision Points → Use diamonds for Yes/No questions.
- Loops → Draw arrows that go back to repeat steps if needed.
- End → Show the final result or completion (oval).
- Tip: Use colors or sticky notes for actions, decisions, and outputs.

Interactive Exercise Idea (Hands-On Learning)

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Step 3: Share and Compare

- Ask each student or group to present their flowchart.

Discuss:

- Did they include all important steps?
- Are there unnecessary steps that can be removed?
- Can the task be done faster or more efficiently?

Interactive Exercise Idea (Hands-On Learning)

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Step 4: Optional Challenge (Efficiency)

- Introduce the idea of algorithm efficiency:
  - Fewer steps = faster algorithm
  - Repeating unnecessary steps = slower algorithm

Interactive Exercise Idea (Hands-On Learning)

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Step 4: Optional Challenge (Efficiency)

- Example: Sorting 3 books
  - **Student A:** Checks all pairs twice → 6 steps
  - **Student B:** Smart swaps only → 3 steps
- Ask: **Which algorithm is better? Why?**
- Show that **even simple everyday tasks** can have “more efficient” algorithms.

Interactive Exercise Idea (Hands-On Learning)

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Step 5: Hands-On Bonus (Kinesthetic Learning)

- Use **real objects**: books, cups, sticky notes.
- Students **act out the steps** physically, following their own flowchart.
- Helps **visual and tactile learners** understand sequence, loops, and decisions.

Thank you for your attention!

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Stay tuned for the next presentation!

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Project number : 2023-2-IT03-KA220-YOU-000179130

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