Algorithms

- Combinatorial Algorithms: Manipulates discrete objects like arrays, lists, trees, …
- Writing Algorithms:
  - Not a program, but similar to comments
  - Computational techniques for all programming languages
  - Pseudocode

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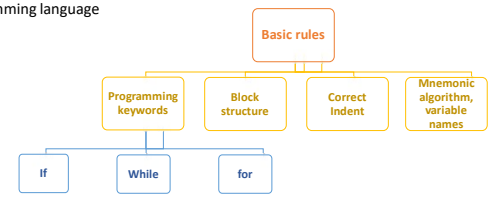
Pseudocode

- Structure of formal programming language
- Plain English
- One-sentence steps



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Design and Analysis of Algorithms

- ***Design***: Minimize the cost
- ***Analysis***: Predict the cost in terms of resources and performance
- Goal of an algorithm:
  - Always correct
  - Always terminate
  - Performance
    - Decide what is possible and what is not

3

Design and Analysis of Algorithms

- Big Oh notation.
- Greedy
- Divide-and-conquer.
- Dynamic programming.
- Intractability.

Emphasizes critical thinking, problem-solving, and rigorous analysis.

4

The problem of sorting

- **Input** : sequence $\langle a_1, a_2, \ldots, a_n \rangle$ of numbers
- **Output** : permutation $\langle a'_1, a'_2, \ldots, a'_n \rangle$ such that $a'_1 \le a'_2 \le \cdots \le a'_n$.
- Example :

  Input: 8 7 1 5 9 2

  Output: 1 2 5 7 8 9

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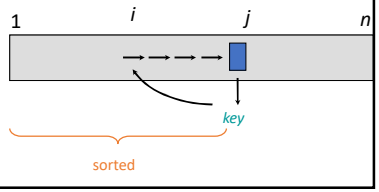
Insertion sort

INSERTION-SORT (A, n)

```
1: for j ← 2 to n
2:     do key ← A[j]
3:        i ← j – 1
4:        while i > 0 and A[i] > key do
5:              A[i+1] ← A[i]
6:              i ← i – 1
7:        end while
8:        A[i+1] = key
9: end for
```



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Example of insertion sort

8 7 1 5 9 2

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Example of insertion sort

8 7 1 5 9 2

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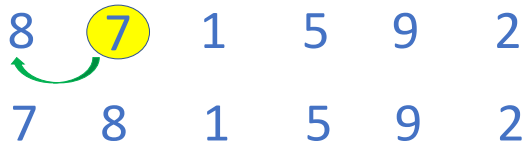
Example of insertion sort



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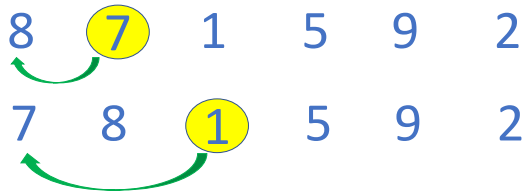
Example of insertion sort



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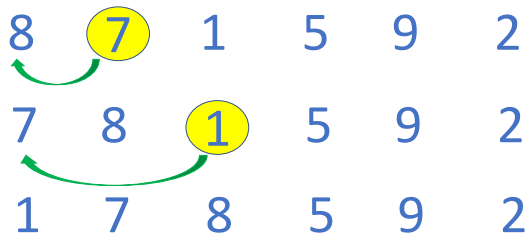
Example of insertion sort



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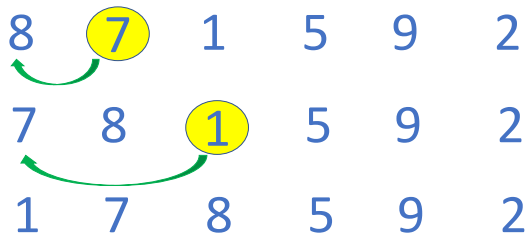
Example of insertion sort



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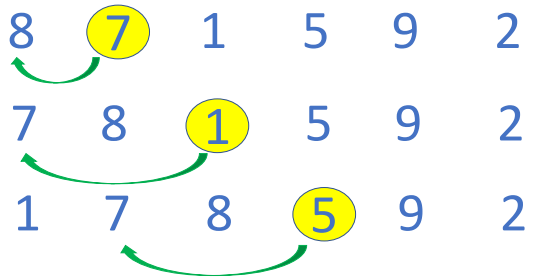
Example of insertion sort



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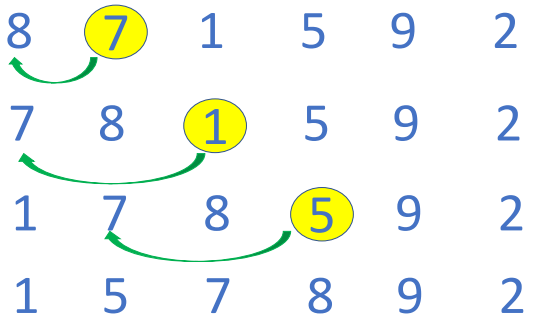
Example of insertion sort



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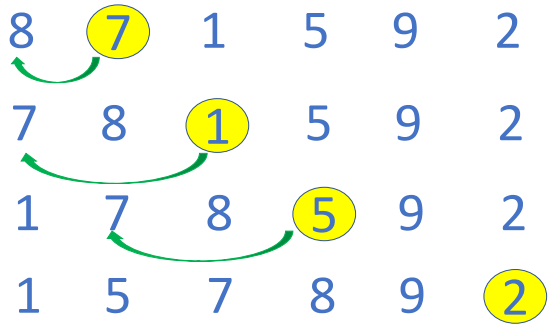
Example of insertion sort



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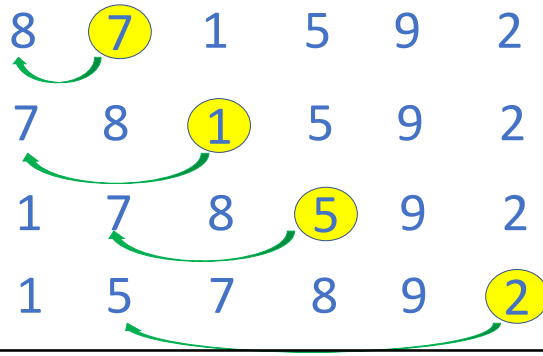
Example of insertion sort



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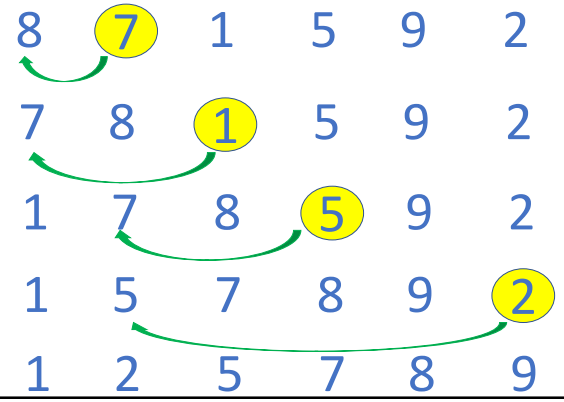
Example of insertion sort



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Example of insertion sort

1 2 5 7 8 9

Sorted

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