This will help you **score full marks** in practical + viva.

📝 AIM

To write a Python program to implement **Selection Sort** to arrange a list of numbers in ascending order.

📘 THEORY (Very Detailed & Easy)

🔷 What is Sorting?

Sorting means arranging data in a **specific order**, usually:

- Ascending (small → large)
- Descending (large → small)

Sorting helps in:

- Searching faster
- Organizing data
- Improving algorithm efficiency

🔷 What is Selection Sort? (Deep Explanation)

Selection Sort is one of the simplest sorting algorithms.

✔ Main idea:

In each pass, find the smallest element and place it at the correct position.

✔ How does it work (conceptually)?

1. Take the entire list.
2. Search through the list to find the **smallest element**.
3. Move this smallest element to the **front of the list**.
4. Now ignore the first element (because it is now sorted).
5. Repeat the same steps for the remaining part of the list.

✔ Example:

Suppose the list is:

[7, 4, 5, 2]

Step-by-step:

- Pass 1: Smallest = 2 → put 2 at index 0
  New List: [2, 4, 5, 7]
- Pass 2: Smallest from remaining [4, 5, 7] = 4
  List remains: [2, 4, 5, 7]
- Pass 3: Smallest from [5, 7] = 5
  List remains: [2, 4, 5, 7]

DONE.

🔷 **Important Properties (Exam Points)**

✔ **Time Complexity:**

- Best Case: O(n^2)
- Worst Case: O(n^2)
- Average Case: O(n^2)

✔ **Space Complexity:**

- O(1) → Uses constant space.

✔ **Stable?**

❌ No
(Because it may swap non-adjacent equal values)

✔ **Adaptive?**

❌ No
(Does not become faster even if the list is partially sorted)

✔ **In-place?**

✔ Yes
(Does not need extra memory)

🧩 **ALGORITHM (Step-by-step)**

1. Start

2. Let i = 0
3. Assume i is the index of the smallest element
4. Compare element at i with every element after it
5. If any element is smaller → update smallest
6. After inner loop ends → swap value at i with smallest
7. Increase i
8. Repeat until i = n-2
9. Stop

💻 PROGRAM CODE (Given by you)

```
def selection_sort(alist):
    for i in range(0, len(alist) - 1):
        smallest = i
        for j in range(i + 1, len(alist)):
            if alist[j] < alist[smallest]:
                smallest = j
        # Swap the found minimum element with the first element
        alist[i], alist[smallest] = alist[smallest], alist[i]



# Take input from user
alist = input("Enter the list of numbers: ").split()
alist = [int(x) for x in alist]


# Call the selection sort function
selection_sort(alist)


# Print sorted list
```

```
print("Sorted list:", alist)
```

🔍 LINE-BY-LINE EXPLANATION (VERY DETAILED – Even a child can explain)

🔵 Function Definition

```
def selection_sort(alist):
```

- def → keyword to define a function
- selection_sort → function name
- alist → input list that we want to sort

Meaning: "Define a function that sorts a list using selection sort algorithm."

🔵 Outer Loop

```
for i in range(0, len(alist) - 1):
```

- for i in range(...) → loop from 0 to (n-2)
- len(alist) → total number of elements
- len(alist) - 1 → last index we need to consider

Meaning:
We will fix the position i and find the smallest element to place there.

🔵 Assume the first element is smallest

```
smallest = i
```

- We assume current index i is the smallest.
- Later, we will compare it with others to find the actual smallest.

🔵 Inner Loop

```
for j in range(i + 1, len(alist)):
```

- j starts from the next element
- We compare all elements after position i

Used to search for the smallest value in the unsorted part.

🔵 Compare Values

```
if alist[j] < alist[smallest]:
  smallest = j
```

- If element at j is smaller than the current smallest
- Update smallest with j

Meaning:
We found a new smallest number! Remember its index.

🔵 Swap

```
alist[i], alist[smallest] = alist[smallest], alist[i]
```

- This swaps the value at index i with the smallest value found.
- Sorting happens because smallest element is brought to correct position.

🔵 Taking Input

```
alist = input("Enter the list of numbers: ").split()
```

- .split() → breaks input string into a list of words/numbers
- Example: "5 3 9 1" → ["5", "3", "9", "1"]

🔵 Convert Strings to Integers

```
alist = [int(x) for x in alist]
```

- Converts each element from string → integer
- This is list comprehension

🔵 Call the Function

```
selection_sort(alist)
```

Runs the sorting function.

🔵 Output

print("Sorted list:", alist)

Displays the final sorted list.

📊 DRY RUN (Step-by-step Example)

Input:

10 3 7 2

Initial list:

[10, 3, 7, 2]

Pass 1: i = 0

- Compare 10 with 3 → smallest = 1
- Compare 3 with 7 → no change
- Compare 3 with 2 → smallest = 3
  Swap 10 with 2
  List becomes:

[2, 3, 7, 10]

Pass 2: i = 1

- Compare 3 with 7 → no change
- Compare 3 with 10 → no change
  (No swap needed)

Pass 3: i = 2

- Compare 7 with 10 → no change

Final sorted list:

[2, 3, 7, 10]

🎤 VIVA QUESTIONS WITH POINT-WISE ANSWERS (Very Important)

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1. What is Selection Sort?

1. A simple comparison-based sorting technique.
2. Finds smallest element, places it at correct position.
3. Repeats this for all positions.

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2. Why is it called "Selection" Sort?

1. Because it *selects* the smallest (or largest) element
2. And places it in the correct sorted position.

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3. Time complexity of Selection Sort?

1. Best case: $O(n^2)$
2. Average case: $O(n^2)$
3. Worst case: $O(n^2)$
4. Because of two nested loops.

---

4. Is Selection Sort stable?

❌ No
Reason:

1. It swaps non-adjacent elements.
2. Equal elements may change order.

---

5. Is Selection Sort adaptive?

❌ No
Because:

1. Even if list is already sorted

2. It still checks all elements.

---

6. Space Complexity?

✔ O(1)
Because:

1. It requires no extra memory.
2. Swapping happens within the list.

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7. Difference between Selection Sort & Bubble Sort?

Selection Sort	Bubble Sort
Finds min & places correctly	Repeatedly swaps adjacent
Less swapping	More swapping
Slow but predictable	Faster only for nearly sorted lists

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8. Why do we use two loops?

1. Outer loop fixes the position.
2. Inner loop finds the smallest element.

---

9. Can Selection Sort be used for large data?

❌ No
Because:

1. Very slow
2. Time complexity O(n^2)

---

10. What happens if two equal numbers exist?

1. Program works fine
2. But their original order may change (not stable)

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me flowchart” or **“give me file format”**.