Selection Sort – Data Structure and Algorithm Tutorials

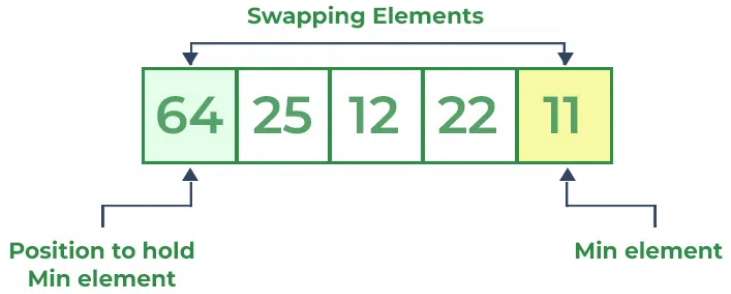
> ***Selection sort*** *is a simple and efficient sorting algorithm that works by repeatedly selecting the smallest (or largest) element from the unsorted portion of the list and moving it to the sorted portion of the list.*

The algorithm repeatedly selects the smallest (or largest) element from the unsorted portion of the list and swaps it with the first element of the unsorted part. This process is repeated for the remaining unsorted portion until the entire list is sorted.

How does Selection Sort Algorithm work?

> *Lets consider the following array as an example:* ***arr[] = {64, 25, 12, 22, 11}***
>
> ***First pass:***

- *For the first position in the sorted array, the whole array is traversed from index 0 to 4 sequentially. The first position where **64** is stored presently, after traversing whole array it is clear that **11** is the lowest value.*
- *Thus, replace 64 with 11. After one iteration **11**, which happens to be the least value in the array, tends to appear in the first position of the sorted list.*

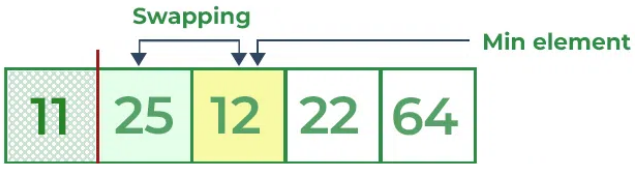


Selection Sort Algorithm | Swapping 1st element with the minimum in array

Second Pass:

- *For the second position, where 25 is present, again traverse the rest of the array in a sequential manner.*

- *After traversing, we found that **12** is the second lowest value in the array and it should appear at the second place in the array, thus swap these values.*



Selection Sort Algorithm | swapping i=1 with the next minimum element

Third Pass:

- *Now, for third place, where **25** is present again traverse the rest of the array and find the third least value present in the array.*
- *While traversing, **22** came out to be the third least value and it should appear at the third place in the array, thus swap **22** with element present at third position.*

Selection Sort Algorithm | swapping i=2 with the next minimum element

Fourth pass:

- *Similarly, for fourth position traverse the rest of the array and find the fourth least element in the array*
- *As **25** is the 4th lowest value hence, it will place at the fourth position.*

Selection Sort Algorithm | swapping i=3 with the next minimum element

Fifth Pass:

- *At last the largest value present in the array automatically get placed at the last position in the array*
- *The resulted array is the sorted array.*

Selection Sort Algorithm | Required sorted array

Recommended Practice

Selection Sort

Try It!

Below is the implementation of the above approach:

C++

```
// C++ program for implementation of
// selection sort
#include <bits/stdc++.h>
using namespace std;

// Function for Selection sort
void selectionSort(int arr[], int n)
{
    int i, j, min_idx;

    // One by one move boundary of
```

```
    // unsorted subarray
    for (i = 0; i < n - 1; i++) {

        // Find the minimum element in
        // unsorted array
        min_idx = i;
        for (j = i + 1; j < n; j++) {
            if (arr[j] < arr[min_idx])
                min_idx = j;
        }

        // Swap the found minimum element
        // with the first element
        if (min_idx != i)
            swap(arr[min_idx], arr[i]);
    }
}

// Function to print an array
void printArray(int arr[], int size)
{
    int i;
    for (i = 0; i < size; i++) {
        cout << arr[i] << " ";
        cout << endl;
    }
}

// Driver program
int main()
{
    int arr[] = { 64, 25, 12, 22, 11 };
    int n = sizeof(arr) / sizeof(arr[0]);

    // Function Call
    selectionSort(arr, n);
    cout << "Sorted array: \n";
    printArray(arr, n);
    return 0;
}

// This is code is contributed by rathbhupendra
```

C

```c
// C program for implementation of selection sort
#include <stdio.h>

void swap(int *xp, int *yp)
{
    int temp = *xp;
    *xp = *yp;
    *yp = temp;
}

void selectionSort(int arr[], int n)
{
    int i, j, min_idx;

    // One by one move boundary of unsorted subarray
    for (i = 0; i < n-1; i++)
    {
        // Find the minimum element in unsorted array
        min_idx = i;
        for (j = i+1; j < n; j++)
          if (arr[j] < arr[min_idx])
            min_idx = j;

        // Swap the found minimum element with the first elem
           if(min_idx != i)
            swap(&arr[min_idx], &arr[i]);
    }
}

/* Function to print an array */
void printArray(int arr[], int size)
{
    int i;
    for (i=0; i < size; i++)
        printf("%d ", arr[i]);
    printf("\n");
}

// Driver program to test above functions
int main()
```

```
{
    int arr[] = {64, 25, 12, 22, 11};
    int n = sizeof(arr)/sizeof(arr[0]);
    selectionSort(arr, n);
    printf("Sorted array: \n");
    printArray(arr, n);
    return 0;
}
```

Python3

```
# Python program for implementation of Selection
# Sort
import sys
A = [64, 25, 12, 22, 11]

# Traverse through all array elements
for i in range(len(A)):

    # Find the minimum element in remaining
    # unsorted array
    min_idx = i
    for j in range(i+1, len(A)):
        if A[min_idx] > A[j]:
            min_idx = j

    # Swap the found minimum element with
    # the first element
    A[i], A[min_idx] = A[min_idx], A[i]

# Driver code to test above
print ("Sorted array")
for i in range(len(A)):
    print("%d" %A[i],end=" , ")
```

Java

```
// Java program for implementation of Selection Sort
import java.io.*;
```

```java
public class SelectionSort
{
    void sort(int arr[])
    {
        int n = arr.length;

        // One by one move boundary of unsorted subarray
        for (int i = 0; i < n-1; i++)
        {
            // Find the minimum element in unsorted array
            int min_idx = i;
            for (int j = i+1; j < n; j++)
                if (arr[j] < arr[min_idx])
                    min_idx = j;

            // Swap the found minimum element with the first
            // element
            int temp = arr[min_idx];
            arr[min_idx] = arr[i];
            arr[i] = temp;
        }
    }

    // Prints the array
    void printArray(int arr[])
    {
        int n = arr.length;
        for (int i=0; i<n; ++i)
            System.out.print(arr[i]+" ");
        System.out.println();
    }

    // Driver code to test above
    public static void main(String args[])
    {
        SelectionSort ob = new SelectionSort();
        int arr[] = {64,25,12,22,11};
        ob.sort(arr);
        System.out.println("Sorted array");
        ob.printArray(arr);
    }
}
```

```
/* This code is contributed by Rajat Mishra*/
```

C#

```
// C# program for implementation
// of Selection Sort
using System;

class GFG
{
    static void sort(int []arr)
    {
        int n = arr.Length;

        // One by one move boundary of unsorted subarray
        for (int i = 0; i < n - 1; i++)
        {
            // Find the minimum element in unsorted array
            int min_idx = i;
            for (int j = i + 1; j < n; j++)
                if (arr[j] < arr[min_idx])
                    min_idx = j;

            // Swap the found minimum element with the first
            // element
            int temp = arr[min_idx];
            arr[min_idx] = arr[i];
            arr[i] = temp;
        }
    }

    // Prints the array
    static void printArray(int []arr)
    {
```



```
            Console.Write(arr[i]+" ");
        Console.WriteLine();
    }

    // Driver code
```

```
    public static void Main()
    {
        int []arr = {64,25,12,22,11};
        sort(arr);
        Console.WriteLine("Sorted array");
        printArray(arr);
    }

}
// This code is contributed by Sam007
```

PHP

```
<?php
// PHP program for implementation
// of selection sort
function selection_sort(&$arr, $n)
{
    for($i = 0; $i < $n ; $i++)
    {
        $low = $i;
        for($j = $i + 1; $j < $n ; $j++)
        {
            if ($arr[$j] < $arr[$low])
            {
                $low = $j;
            }
        }

        // swap the minimum value to $ith node
        if ($arr[$i] > $arr[$low])
        {
            $tmp = $arr[$i];
            $arr[$i] = $arr[$low];
            $arr[$low] = $tmp;
        }
    }
}

// Driver Code
$arr = array(64, 25, 12, 22, 11);
```

```php
$len = count($arr);
selection_sort($arr, $len);
echo "Sorted array : \n";

for ($i = 0; $i < $len; $i++)
    echo $arr[$i] . " ";

// This code is contributed
// by Deepika Gupta.
?>
```

Javascript

```javascript
<script>
// Javascript program for implementation of selection sort
function swap(arr,xp, yp)
{
    var temp = arr[xp];
    arr[xp] = arr[yp];
    arr[yp] = temp;
}

function selectionSort(arr,  n)
{
    var i, j, min_idx;

    // One by one move boundary of unsorted subarray
    for (i = 0; i < n-1; i++)
    {
        // Find the minimum element in unsorted array
        min_idx = i;
        for (j = i + 1; j < n; j++)
        if (arr[j] < arr[min_idx])
            min_idx = j;

        // Swap the found minimum element with the first elem
        swap(arr,min_idx, i);
    }
}

function printArray( arr,  size)
{
```

```
    var i;
    for (i = 0; i < size; i++)
        document.write(arr[i] + " ");
    document.write(" <br>");
}

var arr = [64, 25, 12, 22, 11];
    var n = 5;
    selectionSort(arr, n);
    document.write("Sorted array: <br>");
    printArray(arr, n);

// This code is contributed by akshitsaxenaa09.
</script>
```

Output

```
Sorted array:
11 12 22 25 64
```

Complexity Analysis of Selection Sort

Time Complexity: The time complexity of Selection Sort is **$O(N^2)$** as there are two nested loops:

- One loop to select an element of Array one by one = O(N)
- Another loop to compare that element with every other Array element = O(N)
- Therefore overall complexity = O(N) * O(N) = O(N*N) = $O(N^2)$

Auxiliary Space: O(1) as the only extra memory used is for temporary variables while swapping two values in Array.