Selection Sort Algorithm

Selection sort is a simple sorting algorithm. This sorting algorithm, like insertion sort, is an in-place comparison-based algorithm in which the list is divided into two parts, the sorted part at the left end and the unsorted part at the right end. Initially, the sorted part is empty and the unsorted part is the entire list.

The smallest element is selected from the unsorted array and swapped with the leftmost element, and that element becomes a part of the sorted array. This process continues moving unsorted array boundaries by one element to the right.

This algorithm is not suitable for large data sets as its average and worst case complexities are of **$O(n^2)$**, where **n** is the number of items.

Selection Sort Algorithm

This type of sorting is called Selection Sort as it works by repeatedly sorting elements. That is: we first find the smallest value in the array and exchange it with the element in the first position, then find the second smallest element and exchange it with the element in the second position, and we continue the process in this way until the entire array is sorted.

```
1. Set MIN to location 0.
2. Search the minimum element in the list.
3. Swap with value at location MIN.
4. Increment MIN to point to next element.
5. Repeat until the list is sorted.
```

Pseudocode

```
Algorithm: Selection-Sort (A)
fori← 1 to n-1 do
   min j ←i;
   min x ← A[i]
   for j ←i + 1 to n do
      if A[j] < min x then
         min j ← j
         min x ← A[j]
   A[min j] ← A [i]
   A[i] ← min x
```

Analysis

Selection sort is among the simplest of sorting techniques and it works very well for small files. It has a quite important application as each item is actually moved at the most once.

Section sort is a method of choice for sorting files with very large objects (records) and small keys. The worst case occurs if the array is already sorted in a descending order and we want to sort them in an ascending order.

Nonetheless, the time required by selection sort algorithm is not very sensitive to the original order of the array to be sorted: the test if $A[j] <$ **A[j] < min x** is executed exactly the same number of times in every case.

Selection sort spends most of its time trying to find the minimum element in the unsorted part of the array. It clearly shows the similarity between Selection sort and Bubble sort.

- Bubble sort selects the maximum remaining elements at each stage, but wastes some effort imparting some order to an unsorted part of the array.
- Selection sort is quadratic in both the worst and the average case, and requires no extra memory.

For each **i** from **1** to **n - 1**, there is one exchange and **n - i** comparisons, so there is a total of **n - 1** exchanges and

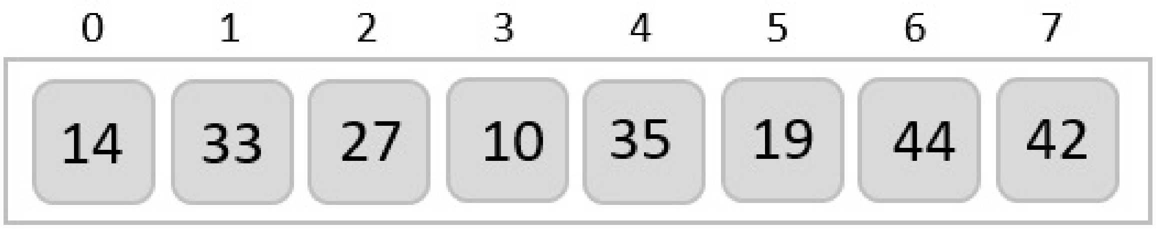
(n − 1) + (n − 2) + ...+2 + 1 = n(n − 1)/2 comparisons.

These observations hold, no matter what the input data is.

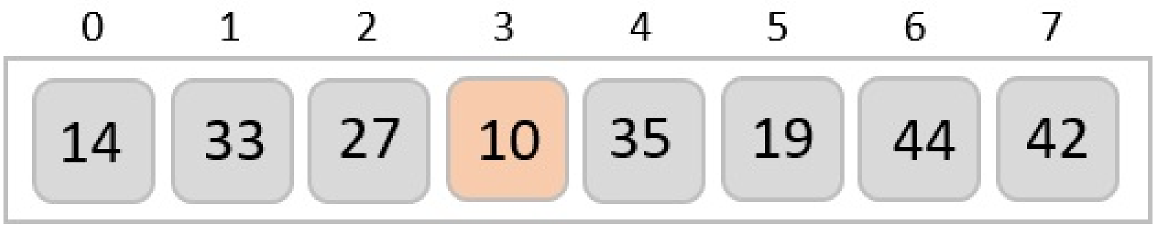
In the worst case, this could be quadratic, but in the average case, this quantity is **O(n log n)**. It implies that the **running time of Selection sort is quite insensitive to the input**.

Example

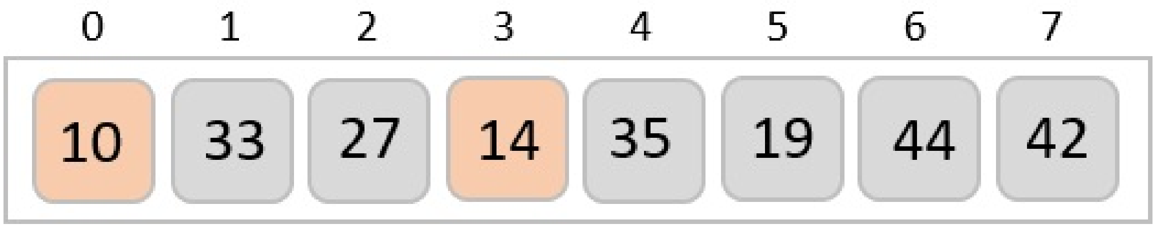
Consider the following depicted array as an example.



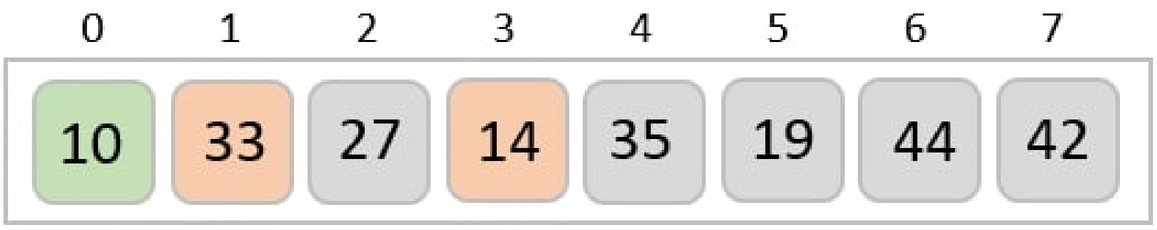
For the first position in the sorted list, the whole list is scanned sequentially. The first position where 14 is stored presently, we search the whole list and find that 10 is the lowest value.



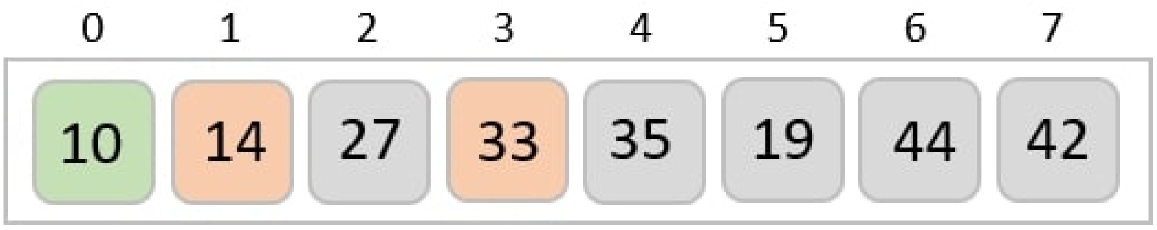
So we replace 14 with 10. After one iteration 10, which happens to be the minimum value in the list, appears in the first position of the sorted list.



For the second position, where 33 is residing, we start scanning the rest of the list in a linear manner.



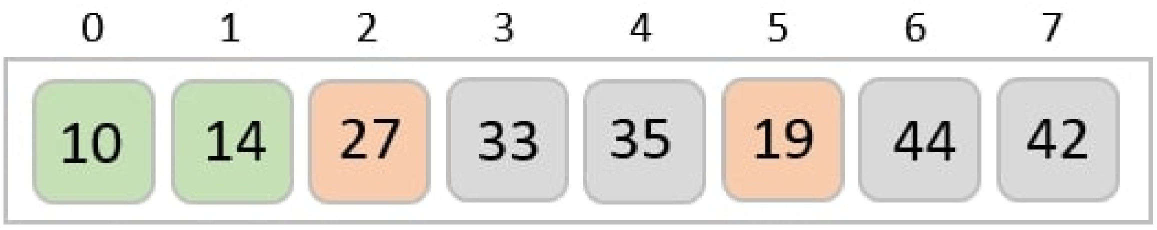
We find that 14 is the second lowest value in the list and it should appear at the second place. We swap these values.

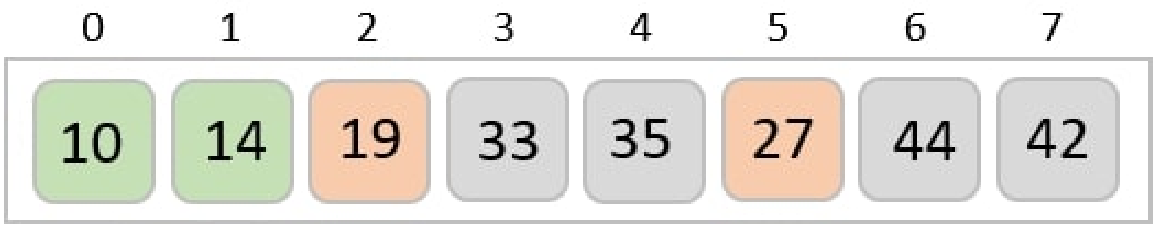


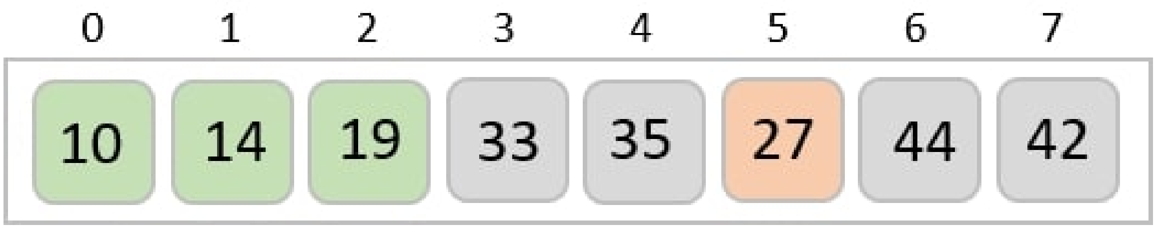
After two iterations, two least values are positioned at the beginning in a sorted manner.

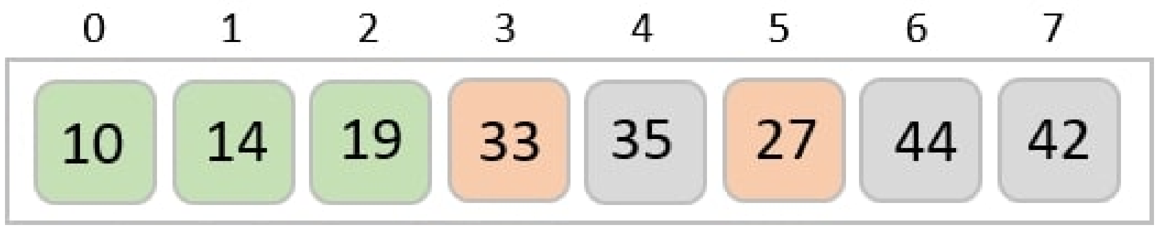
After_two_iterations

The same process is applied to the rest of the items in the array −





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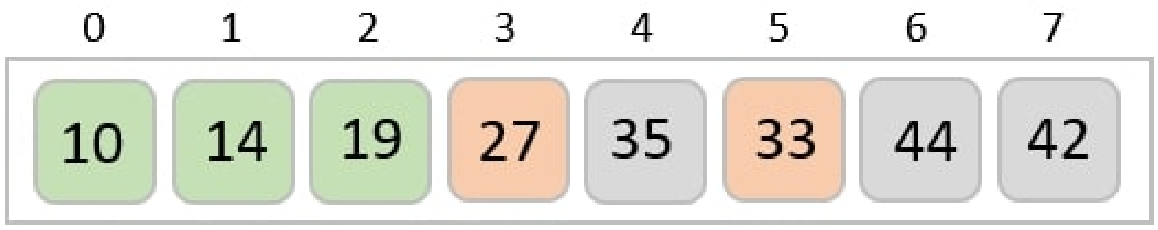
10 14 19 33 35 27 44 42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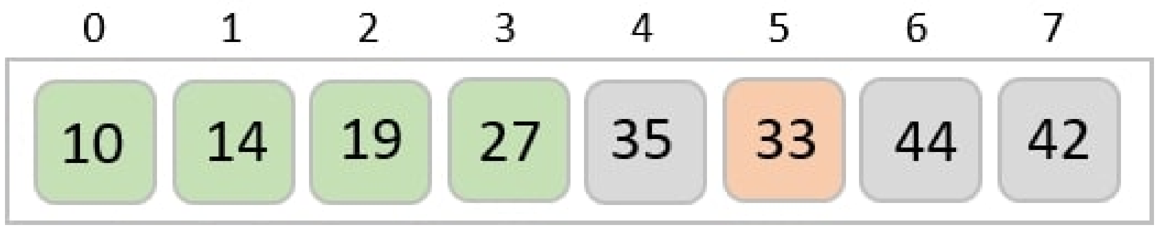
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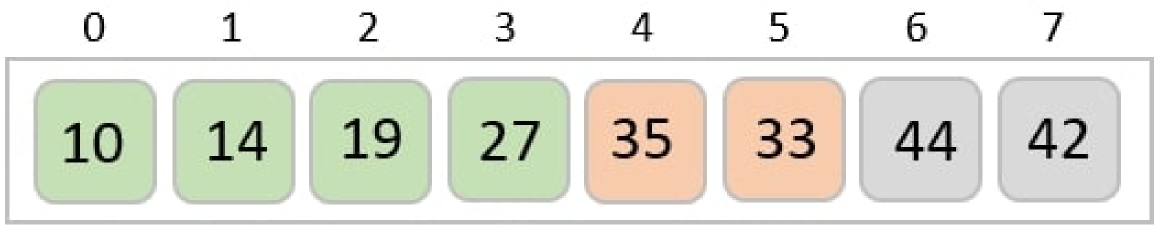
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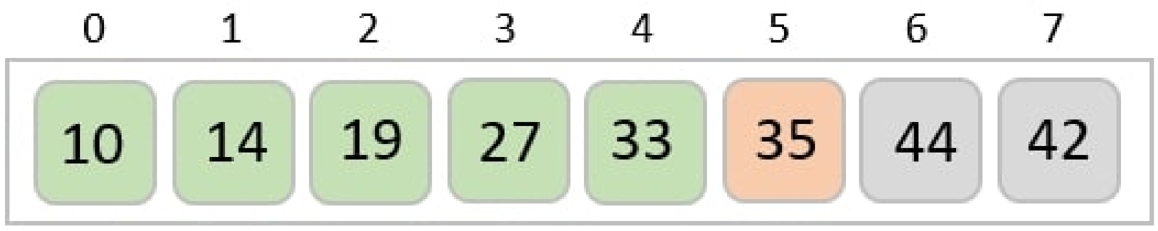
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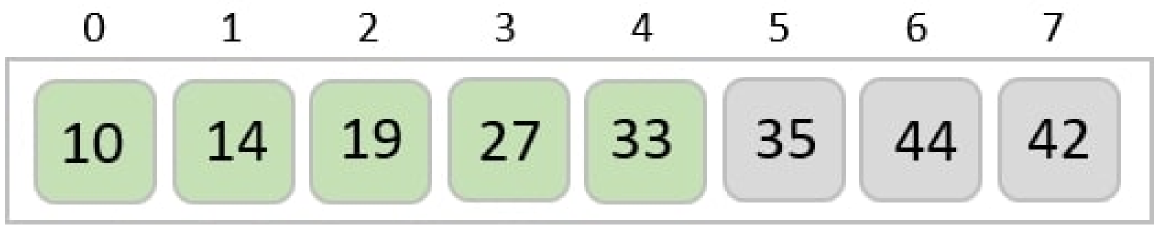
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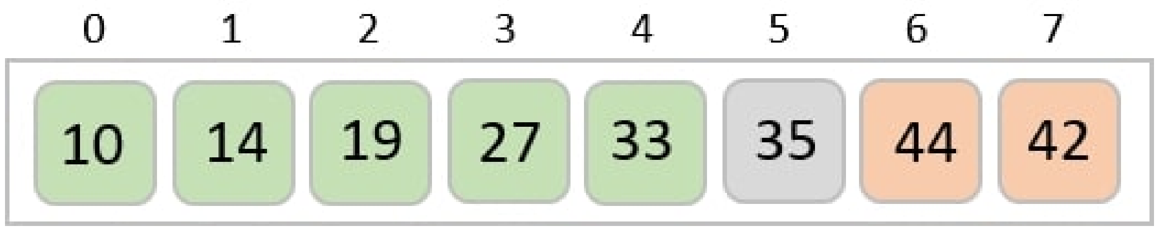
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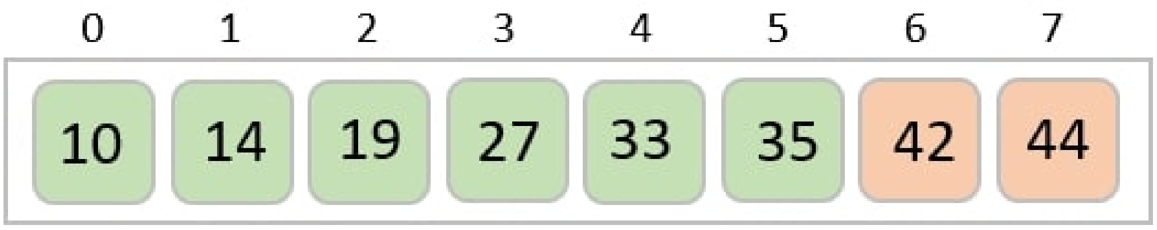
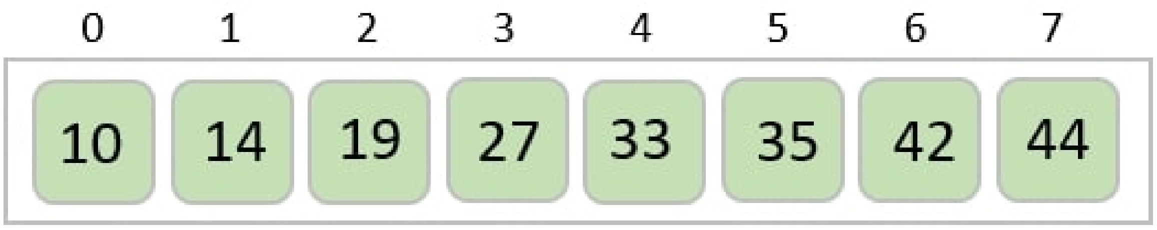
10 14 19 27 33 35 44 42





Implementation

The selection sort algorithm is implemented in four different programming languages below. The given program selects the minimum number of the array and swaps it with the element in the first index. The second minimum number is swapped with the element present in the second index. The process goes on until the end of the array is reached.

C | C++ | Java | Python

```c
#include <stdio.h>
void selectionSort(int array[], int size){
   int i, j, imin;
   for(i = 0; i<size-1; i++) {
      imin = i; //get index of minimum data
      for(j = i+1; j<size; j++)
         if(array[j] < array[imin])
            imin = j;

      //placing in correct position
      int temp;
      temp = array[i];
      array[i] = array[imin];
      array[imin] = temp;
   }
}
int main(){
   int n;
   n = 5;
   int arr[5] = {12, 19, 55, 2, 16}; // initialize the array
   printf("Array before Sorting: ");
   for(int i = 0; i<n; i++)
      printf("%d ",arr[i]);
   printf("\n");
   selectionSort(arr, n);
   printf("Array after Sorting: ");
   for(int i = 0; i<n; i++)
      printf("%d ", arr[i]);
   printf("\n");
}
```

Output

```
Array before Sorting: 12 19 55 2 16
Array after Sorting: 2 12 16 19 55
```