7. Sorting Algorithms

What is sorting?

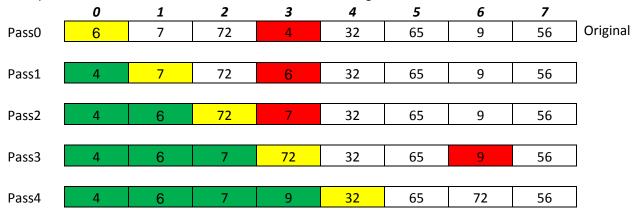
Arranging items in ascending or descending order is called as sorting.

There are different types of sorting techniques each of which is good for some cases such as nearly sorted, reversed, random, etc.

Selection Sort Algorithm:

Here we repeatedly find the next largest (or smallest) element in the array and move it to its final position in the sorted array.

Example: Sort the numbers 6, 7,72, 4, 32, 65, 9, 56 using selection sort.



Pass5

```
void swap(int *x,int *y)
  int t;
 t=(*x);
  *x=(*y);
  *y=t;
void selectionSort (int *a, int n)
  int i, j, m, t;
 for (i = 0; i < n-1; i++)
   m = i;
   for (j = i+1; j < n; j++)
        if (a[j] < a[m]) m = j;
    swap(&a[i],&a[m]);
}
void main ()
  clrscr();
  int a[] = \{4, 65, 2, -31, 0, 99, 2, 83, 782, 1\};
  int n = 10;
  displayArray(a,n);cout<<endl;
  selectionSort(a, n);
  displayArray(a,n);
}
Output:
4 65 2 -31 0 99 2 83 782 1
-31 0 1 2 2 4 65 83 99 782
```

Bubble Sort Algorithm:

Here we repeatedly move the largest element to the highest index position of the array. Example: Sort the numbers 6, 7,72, 4, 32, 65, 9, 56 using bubble sort.

	0	1	2	<i>3</i>	4	5	6	7	_
Pass0	6	7	72	4	32	65	9	56	Original
									_
Pass1	6	7	4	32	65	9	56	72	
									_
Pass2	6	4	7	32	9	56	65	72	
									_
Pass3	4	6	7	9	32	56	65	72	
									_
Pass4	4	6	7	9	32	56	65	72	
									_
Pass5	4	6	7	9	32	56	65	72	Sorted

Pseudo Code:

```
bubbleSort(a[],n) //Let 'a' be an array containing 'n' items
  max = n-2
  swapped = true
  while (max>0 AND swapped=true)
    swapped = false
  for j = 0 to max
```

```
if (a[j] > a[j + 1])
       swap(&a[j],&a[j+1])
       swapped = true
     end if
   next j
   max=max-1
  end while
C++ Code:
void bubbleSort(int *a, int n)
{
 int j;
 int max = n-2;
 int swapped = 1;
 while (max>0 && swapped)
   swapped = 0;
   for (j = 0; j \le max; j++)
     if (a[j] > a[j + 1])
       swap(&a[j],&a[j+1]);
       swapped = 1;
   }
   max--;
 }
```

Efficiency of the Sort Algorithms (Best, Worst and Average Case Comparison):

Name ♦	Best ♦	Average ♦	Worst ♦	
Quicksort		$n \log n$	n^2	
Merge sort	$n \log n$	$n \log n$	$n \log n$	
In-place merge sort	_	_	$n\left(\log n\right)^2$	
Heapsort	$n \log n$	$n \log n$	$n \log n$	
Insertion sort	n	n^2	n^2	
Introsort	$n \log n$	$n \log n$	$n \log n$	
Selection sort	n^2	n^2	n^2	
Timsort	n	$n \log n$	$n \log n$	
Shell sort	n	$n(\log n)^2$	Depends on gap sequence; best known is $n(\log n)^2$	
Bubble sort	n	n^2	n^2	
Binary tree sort	n	$n \log n$	$n \log n$	