

Degree in Computer Science Engineering

Practical 2

Submission deadline: Saturday, 23th October, 23:59

Selection sort and Shell sort: The problem consists in sorting an array of n integers in ascending order. *Selection sort* and *Shell sort* will be used as sorting algorithms:

```

procedure Selection Sort (var v[1..n])
  for i := 1 to n-1 do
    minj := i ; minx := v[i] ;
    for j := i+1 to n do
      if v[j] < minx then
        minj := j ; minx := v[j]
      end if
    end for;
    v[minj] := v[i] ; v[i] := minx
  end for
end procedure

procedure Shell Sort (var v[1..n])
  increment := n;
  repeat
    increment := increment div 2;
    for i := increment+1 to n do
      tmp := v[i];
      j := i;
      keepgoing := true;
      while j-increment > 0 and keepgoing do
        if tmp < v[j-increment] then
          v[j] := v[j-increment];
          j := j-increment
        else keepgoing := false
        end if
      end while;
      v[j] := tmp
    end for
  until increment = 1
end procedure

```

1. Implement the selection sort and Shell sort algorithms.

```

void sel_sort (int v [], int n);
void shell_sort (int v [], int n);

```

2. Validate the correct functioning of the implementation.

```

> ./test
Random initialization
3, -3, 0, 17, -5, 2, 11, 13, 6, 1, 7, 14, 1, -2, 5, -14, -2
sorted? 0
Selection sort
-14, -5, -3, -2, -2, 0, 1, 1, 2, 3, 5, 6, 7, 11, 13, 14, 17
sorted? 1

```

```

Descending initialization
10, 9, 8, 7, 6, 5, 4, 3, 2, 1
sorted? 0
Selection sort
1, 2, 3, 4, 5, 6, 7, 8, 9, 10
sorted? 1

```

3. Determine the execution times for different values of n and for three different initial scenarios: (a) the array is already sorted in ascending order, (b) the array is already sorted in descending order, and (c) the array is initially disordered. (see Figure 1).

```

void ascending_init(int v [], int n) {
    int i;
    for (i=0; i < n; i++)
        v[i] = i;
}

```

Figure 1: Ascending initialization

4. Empirically calculate the complexity of each of the algorithms for each of the initial scenarios of the array (i.e., 6 tables) (figure 2).
5. Submit the C code files and the .txt file with the report using the task *Practical 2 Submission* at the Algorithms page in <https://campusvirtual.udc.gal>. We remind you that the deadline to complete the task is on Saturday, 23th of October, at 23:59, and once submitted, the files cannot be changed. **All the students in a team must submit the work.**

```

Selection sort with descending initialization

```

	n	t (n)	t (n) / n ^{1.8}	t (n) / n ²	t (n) / n ^{2.2}
(*)	500	247.03	0.003425	0.000988	0.000285
	1000	953.00	0.003794	0.000953	0.000239
	2000	3818.00	0.004365	0.000955	0.000209
	4000	15471.00	0.005079	0.000967	0.000184
	8000	69474.00	0.006550	0.001086	0.000180
	16000	257089.00	0.006961	0.001004	0.000145
	32000	1023540.00	0.007959	0.001000	0.000126

Figure 2: Part of the possible output to screen of the main program's execution