Tutorial 4

Question 1

Show in the style of the example trace with selection sort, how selection sort sorts the array

E A S Y Q U E S T I O N

Note: An example of a trace is given in the appendix.

An example trace of selection sort

Iteration	Array
	S O R T E X A M P L E
0	A O R T E X S M P L E
1	A E R T O X S M P L E
2	A E E T O X S M P L R
3	A E E L O X S M P T R
...	

Answer:

Solution 1

E1	A	S1	Y	Q	U	E2	S2	T	I	O	N
5	1	19	25	17	21	5	19	20	9	15	14

The numbering can be seen in the table above.

E1	A	S1	Y	Q	U	E2	S2	T	I	O	N
A	E1	S1	Y	Q	U	E2	S2	T	I	O	N
A	E1	E2	Y	Q	U	S1	S2	T	I	O	N
A	E1	E2	I	Q	U	S1	S2	T	Y	O	N
A	E1	E2	I	N	U	S1	S2	T	Y	O	Q
A	E1	E2	I	N	O	S1	S2	T	Y	U	Q
A	E1	E2	I	N	O	Q	S2	T	Y	U	S1
A	E1	E2	I	N	O	Q	S2	T	Y	U	S1

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E1	A	S1	Y	Q	U	E2	S2	T	I	O	N
A	E1	E2	I	N	O	Q	S2	S1	Y	U	T
A	E1	E2	I	N	O	Q	S2	S1	T	U	Y
A	E1	E2	I	N	O	Q	S2	S1	T	U	Y
A	E1	E2	I	N	O	Q	S2	S1	T	U	Y

Question 2

What is the maximum number of exchanges involving any particular item during selection sort? What is the average number of exchanges involving an item?

Answer:

Selection Sort Key points

- From the array, you pick the ith smallest element to be swapped with the index
- At any point of time, you have the ith sorted array
- Selection sort is not stable. S1 comes before S2 in the original array but in the sorted array S2 comes first.
- Maximum number of swaps is n-1
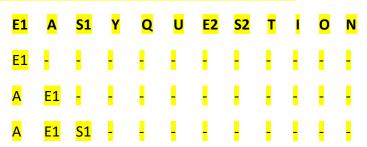- Average number of swaps is (n-1) / 2

Question 3

Show in the style of the example trace with insertion sort, how insertion sort sorts the array

E A S Y Q U E S T I O N

Answer:

E1	A	S1	Y	Q	U	E2	S2	T	I	O	N
5	1	19	25	17	21	5	19	20	9	15	14

The numbering can be seen in the table above

E1	A	S1	Y	Q	U	E2	S2	T	I	O	N
E1	-	-	-	-	-	-	-	-	-	-	-
A	E1	-	-	-	-	-	-	-	-	-	-
A	E1	S1	-	-	-	-	-	-	-	-	-

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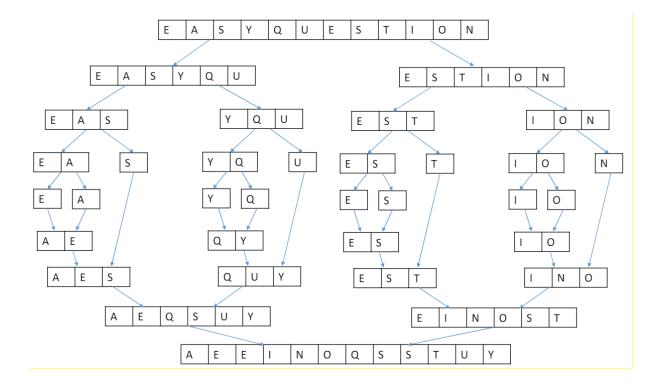| E1	A	S1	Y	Q	U	E2	S2	T	I	O	N
A	E1	S1	Y	-	-	-	-	-	-	-	-
A	E1	S1	Q	Y	-	-	-	-	-	-	-
A	E1	S1	Q	U	Y	-	-	-	-	-	-
A	E1	E2	S1	Q	U	Y	-	-	-	-	-
A	E1	E2	S1	S2	Q	U	Y	-	-	-	-
A	E1	E2	S1	S2	Q	T	U	Y	-	-	-
A	E1	E2	I	S1	S2	Q	T	U	Y	-	-
A	E1	E2	I	O	S1	S2	Q	T	U	Y	-
A	E1	E2	I	N	O	S1	S2	Q	T	U	Y

Insertion Sort Key points

- From the array, you increasingly increase the sorted part of the array.
- Insertion sort is stable. S1 comes before S2 in the original array and here in the sorted array S1 comes first. (as compared to selection sort)

Question 4

Give traces, in the style of the trace given in the appendix, showing how the keys E A S Y Q U E S T I O N are sorted with merge sort.

Answer:

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E A S Y Q U E S T I O N

E A S Y Q U   E S T I O N

E A S   Y Q U   E S T   I O N

E A   S   Y Q   U   E S   T   I O   N

E A   Y Q   E S   I O

A E   Q Y   E S   I O

A E S   Q U Y   E S T   I N O

A E Q S U Y   E I N O S T

A E E I N O Q S S T U Y

Question 5

Show, in the style of the quicksort trace, how quicksort sorts the array

E A S Y Q U E S T I O N

Note that the first element is chosen as the pivot. In the trace, only show the output of partition. You do not need to show the trace for the partition process.

Answer:

Index	Pivot Index	E	A	S	Y	Q	U	E	S	T	I	O	N
-	0	E	-	-	-	-	-	-	-	-	-	-	-
1	1	E	A	S	Y	Q	U	E	S	T	I	O	N
2	1	E	A	S	Y	Q	U	E	S	T	I	O	N
3	1	E	A	S	Y	Q	U	E	S	T	I	O	N
4	1	E	A	S	Y	Q	U	E	S	T	I	O	N
5	1	E	A	S	Y	Q	U	E	S	T	I	O	N
6	1	E	A	S	Y	Q	U	E	S	T	I	O	N
7	1	E	A	S	Y	Q	U	E	S	T	I	O	N

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Index	Pivot Index	E	A	S	Y	Q	U	E	S	T	I	O	N
8	1	E	A	S	Y	Q	U	E	S	T	I	O	N
9	1	E	A	S	Y	Q	U	E	S	T	I	O	N
10	1	E	A	S	Y	Q	U	E	S	T	I	O	N
11	1	E	A	S	Y	Q	U	E	S	T	I	O	N
-	1	A	E	S	Y	Q	U	E	S	T	I	O	N

The next iteration will be:

Index	Pivot Index	S	Y	Q	U	E	S	T	I	O	N
-	0	S	-	-	-	-	-	-	-	-	-
1	0	S	Y	-	-	-	-	-	-	-	-
2	1	S	Q	Y	-	-	-	-	-	-	-
3	1	S	Q	Y	U	-	-	-	-	-	-
4	2	S	Q	E	U	Y	-	-	-	-	-
5	2	S	Q	E	U	Y	S	-	-	-	-
6	2	S	Q	E	U	Y	S	T	-	-	-
7	3	S	Q	E	I	Y	S	T	U	-	-
8	4	S	Q	E	I	O	S	T	U	Y	-
9	5	S	Q	E	I	O	N	T	U	Y	S
-	-	N	Q	E	I	O	S	T	U	Y	S