
Decision 1: Sorting Algorithms

Past Paper Questions
2006 - 2013

Name:

January 2006

- 2 Use the quicksort algorithm to rearrange the following numbers into ascending order. Indicate clearly the pivots that you use.

18 23 12 7 26 19 16 24

(5 marks)

June 2006

- 2 (a) Use a shuttle sort to rearrange the following numbers into ascending order.

18 2 12 7 26 19 16 24

(5 marks)

- (b) State the number of comparisons and swaps (exchanges) for each of the first three passes.

(3 marks)

January 2007

- 4 (a) A student is using a bubble sort to rearrange seven numbers into ascending order.

Her correct solution is as follows:

Initial list	18	17	13	26	10	14	24
After 1st pass	17	13	18	10	14	24	26
After 2nd pass	13	17	10	14	18	24	26
After 3rd pass	13	10	14	17	18	24	26
After 4th pass	10	13	14	17	18	24	26
After 5th pass	10	13	14	17	18	24	26

Write down the number of comparisons and swaps on each of the five passes.

(6 marks)

- (b) Find the maximum number of comparisons and the maximum number of swaps that might be needed in a bubble sort to rearrange seven numbers into ascending order.

(2 marks)

- 2 (a) Use a Shell sort to rearrange the following numbers into ascending order, showing the new arrangement after each pass.
- 28 22 20 17 14 11 6 5
- (5 marks)*
- (b) (i) Write down the number of comparisons on the first pass. *(1 mark)*
- (ii) Write down the number of swaps on the first pass. *(1 mark)*
- (c) Find the total number of comparisons needed to rearrange the original list of 8 numbers into ascending order using a shuttle sort.
- (1 mark)*
- (You do not need to perform a shuttle sort.) *(1 mark)*

- 7 The numbers 17, 3, 16 and 4 are to be sorted into ascending order.

The following four methods are to be compared: bubble sort, shuttle sort, Shell sort and quick sort (with the first number used as the pivot).

A student uses each of the four methods and produces the correct solutions below. Each solution shows the order of the numbers after each pass.

Solution 1 17 3 16 4
 3 17 16 4
 3 16 17 4
 3 4 16 17

Solution 2 17 3 16 4
 16 3 17 4
 3 4 16 17

Solution 3 17 3 16 4
 3 16 4 17
 3 16 4 17
 3 4 16 17

Solution 4 17 3 16 4
 3 16 4 17
 3 4 16 17
 3 4 16 17

- (a) Write down which of the four solutions is the bubble sort, the shuttle sort, the Shell sort and the quick sort. *(3 marks)*
- (b) For each of the four solutions, write down the number of comparisons and swaps (exchanges) on the first pass. *(8 marks)*

June 2008

- 2 (a) Use a quick sort to rearrange the following letters into alphabetical order. You must indicate the pivot that you use at each pass.

P B M N J K R D (5 marks)

- (b) (i) Find the maximum number of swaps needed to rearrange a list of 8 numbers into ascending order when using a **bubble** sort. (1 mark)
- (ii) A list of 8 numbers was rearranged into ascending order using a **bubble** sort. The maximum number of swaps was needed. What can be deduced about the original list of numbers? (1 mark)

June 2009

- 2 A student is using a shuttle sort to rearrange a set of numbers into ascending order.

Her correct solution is as follows.

Initial list	5	6	3	9	4	13	1
After 1st pass	5	6	3	9	4	13	1
After 2nd pass	3	5	6	9	4	13	1
After 3rd pass	3	5	6	9	4	13	1
After 4th pass	3	4	5	6	9	13	1
After 5th pass	3	4	5	6	9	13	1
After 6th pass	1	3	4	5	6	9	13

Write down the number of comparisons and swaps on each of the passes. (6 marks)

January 2010

- 2 (a) Use a bubble sort to rearrange the following numbers into ascending order.

13 16 10 11 4 12 6 7 (5 marks)

- (b) State the number of comparisons and the number of swaps (exchanges) for each of the first three passes. (3 marks)

June 2010

- 2 (a) (i)** Use a bubble sort to rearrange the following numbers into ascending order, showing the list of numbers after each pass.
- 6 2 3 5 4 *(3 marks)*
- (ii)** Write down the number of comparisons on the first pass. *(1 mark)*
- (b) (i)** Use a shuttle sort to rearrange the following numbers into ascending order, showing the list of numbers after each pass.
- 6 2 3 5 4 *(4 marks)*
- (ii)** Write down the number of comparisons on the first pass. *(1 mark)*

January 2011

- 2** A student is using a quicksort algorithm to rearrange a set of numbers into ascending order. She uses the first number in each list (or sublist) as the pivot.
- Her correct solution for the first three passes is as follows.
- | | | | | | | | | |
|----------------|----|---|---|----|----|----|----|----|
| Initial list | 10 | 7 | 4 | 22 | 13 | 16 | 19 | 5 |
| After 1st pass | 7 | 4 | 5 | 10 | 22 | 13 | 16 | 19 |
| After 2nd pass | 4 | 5 | 7 | 10 | 13 | 16 | 19 | 22 |
| After 3rd pass | 4 | 5 | 7 | 10 | 13 | 16 | 19 | 22 |
- (a)** State the pivots used for the 2nd pass. *(2 marks)*
- (b)** Write down the number of comparisons on each of the three passes. *(3 marks)*
- (c)** Explain whether the student has completed the algorithm. *(1 mark)*

June 2011

- 2** Five different integers are to be sorted into ascending order.
- (a)** A bubble sort is to be used on the list of numbers 6 4 x 2 11.
- (i)** After the first pass, the list of numbers becomes
- 4 x 2 6 11
- Write down an inequality that x must satisfy. *(1 mark)*
- (ii)** After the second pass, the list becomes
- x 2 4 6 11
- Write down a new inequality that x must satisfy. *(1 mark)*

(b) The five integers are now written in a different order. A shuttle sort is to be used on the list of numbers 11 x 2 4 6.

(i) After the first pass, the list of numbers becomes

$$x \quad 11 \quad 2 \quad 4 \quad 6$$

Write down an inequality that x must satisfy. (1 mark)

(ii) After the second pass, the list becomes

$$2 \quad x \quad 11 \quad 4 \quad 6$$

Write down a further inequality that x must satisfy. (1 mark)

(c) Use your answers from parts (a) and (b) to write down the value of x . (2 marks)

January 2012

1 Use a Shell sort to rearrange the following numbers into ascending order, showing the new arrangement after each pass.

$$37 \quad 25 \quad 16 \quad 12 \quad 36 \quad 24 \quad 13 \quad 11 \quad (5 \text{ marks})$$

8 Four distinct positive integers are $(3x - 5)$, $(2x + 3)$, $(x + 1)$ and $(4x - 13)$.

(a) Explain why $x \geq 4$. (2 marks)

(b) The four integers are to be sorted into ascending order using a bubble sort.

The original list is $(3x - 5) \quad (2x + 3) \quad (x + 1) \quad (4x - 13)$

After the first pass, the list is $(3x - 5) \quad (x + 1) \quad (4x - 13) \quad (2x + 3)$

After the second pass, the list is $(x + 1) \quad (4x - 13) \quad (3x - 5) \quad (2x + 3)$

After the third pass, the list is $(4x - 13) \quad (x + 1) \quad (3x - 5) \quad (2x + 3)$

(i) By considering the list after the first pass, write down three inequalities in terms of x . (3 marks)

(ii) By considering the list after the second pass, write down two further inequalities in terms of x . (2 marks)

(iii) By considering the list after the third pass, write down one further inequality in terms of x . (1 mark)

(c) Hence, by considering the results above, find the value of x . (2 marks)

June 2012

2 A student is using a shuttle sort algorithm to rearrange a set of numbers into ascending order.

Her correct solution for the first three passes is as follows.

Initial list	10	7	4	22	23	26
After 1st pass	7	10	4	22	23	26
After 2nd pass	4	7	10	22	23	26
After 3rd pass	4	7	10	22	23	26

- (a) Write down the number of comparisons on each of the three passes. *(2 marks)*
- (b) Write down the number of swaps on each of the three passes. *(2 marks)*
- (c) Explain whether or not the student has completed the algorithm. *(1 mark)*

January 2013

2 (a) Use a Shell sort to arrange the following numbers into ascending order.

7 8 1 6 3 4 5 2 *(4 marks)*

(b) Write down the number of comparisons on the first pass. *(1 mark)*

June 2013

2 (a) Use the quicksort algorithm to rearrange the following numbers into ascending order, showing the new arrangement after each pass. You must indicate the pivot(s) being used on each pass.

2, 12, 17, 18, 5, 13 *(4 marks)*

(b) For the **first** pass, write down the number of comparisons. *(1 mark)*