A Level · OCR · Computer Science

49 mins 12 questions

Exam Questions

8.1 Algorithms

Suitability of Algorithms / Big O Notation / Binary Search / Linear Search / Bubble Sort / Insertion Sort / Merge Sort / Quick Sort / Dijkstra's Shortest Path Algorithm / A* Algorithm

Easy (4 questions)	/7
Medium (4 questions)	/13
Hard (4 questions)	/29
Total Marks	**/49**

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Easy Questions

1 A computer program stores data in an array named words.

The data in the array needs to be searched for a value that the user inputs.

One example of a searching algorithm is a binary search.

Identify the **precondition** for a binary search.

.....

(1 mark)

2 A second example of a searching algorithm is a linear search.

Describe how a linear search works.

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.....

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(4 marks)

3 The pseudocode function binarySearch() performs a binary search on the array dataArray that is passed as a parameter. The function returns the array index of searchValue within the array, and -1 if it is not in the array.

Identify one situation where a linear search is **more appropriate** than a binary search.

.....

(1 mark)

4 Hugh has written a recursive function called thisFunction() using pseudocode.

```
01 function thisFunction(theArray, num1, num2, num3)
02 result = num1 + ((num2 - num1) DIV 2)
03  if num2 < num1 then
04   return -1
05  else
06   if theArray[result] < num3 then
07    return thisFunction(theArray, result + 1, num2, num3)
08   elseif theArray[result] > num3 then
09    return thisFunction(theArray, num1, result - 1, num3)
10   else
11    return result
12   endif
13  endif
14 endfunction
```

The function DIV calculates integer division, e.g. 5 DIV 3 = 1

State the name of the standard algorithm thisFunction() performs.

.....

(1 mark)

Medium Questions

1 The programmer needs to use a merge sort in one part of the problem to sort items in ascending order.

Give one benefit and **one drawback** of the programmer using a merge sort instead of a bubble sort.

.....

.....

(2 marks)

2 **Explain** why a quicksort is known as a divide and conquer algorithm.

.....

.....

(2 marks)

3 The following pseudocode procedure performs an insertion sort on the array parameter.

```
01 procedure insertionSort(dataArray:byRef)
02  for i = 1 to dataArray.Length - 1
03   temp = dataArray[i]
04   tempPos = i – 1
05   exit = false
06   while tempPos >= 0 and exit == false
07    if dataArray[tempPos] < temp then
08     dataArray[tempPos + 1] = dataArray[tempPos]
09     tempPos = tempPos - 1
10    else
11     exit = true
12    endif
13   endwhile
14   dataArray[tempPos + 1] = temp
15  next i
16 endprocedure
```

State whether the procedure insertionSort sorts the data into ascending or descending order and **explain** your choice.

.....

.....

.....

(3 marks)

4 A fourth sorting algorithm is a bubble sort.

Describe how a bubble sort will sort an array of **10 elements**.

(6 marks)

Hard Questions

1 The programmer needs to use a merge sort in one part of the problem to sort items in ascending order.

Describe how a merge sort works.

(5 marks)

2 A program designer needs to decide on an algorithm to use from a choice of three. The table shows the worst-case Big O complexities for each algorithm.

Algorithm	Time Complexity	Space Complexity
1	Linear	Exponential
2	Exponential	Constant
3	Logarithmic	Logarithmic

The program will be used to analyse data that can range from 2 items to 2 billion items.

Compare the use of all three algorithms and suggest which the programmer should use.

You should include the following in your answer:

- the meaning of constant, logarithmic, linear and exponential complexity
- how well each algorithm scales as the amount of data increases
- which algorithm is the most suitable for the given task.

(9 marks)

3 A tree is one example of a data structure.

A graph is another type of data structure.

An example graph is shown in Fig. 1.

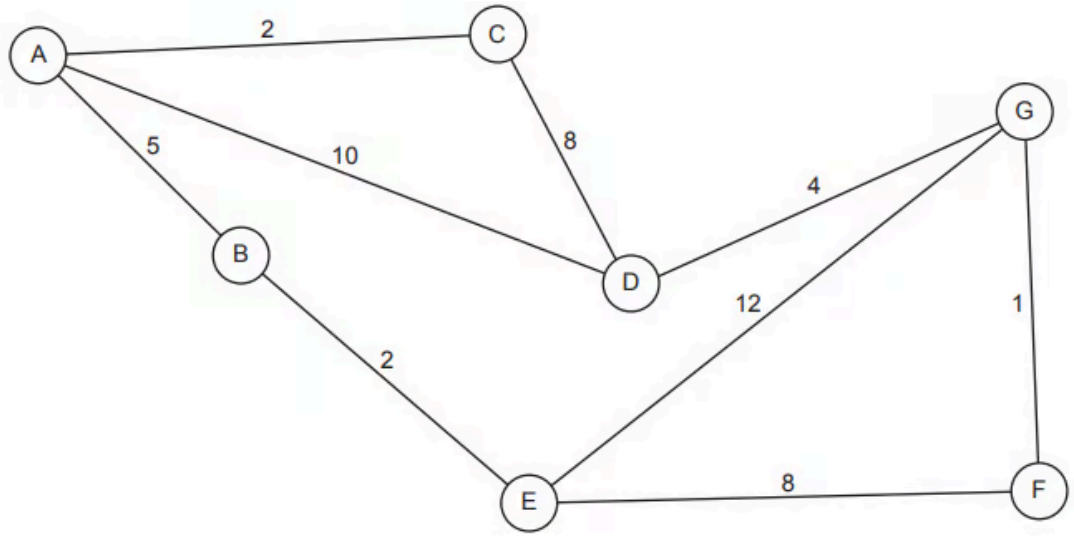

Fig. 1

Show how Dijkstra's algorithm can be used on the graph shown in **Fig. 1** to find the shortest path from start node A to end node G.

You **must** state the nodes on the final path and the distance of this path. Show your working.

You **may** use the table below to give your answer.

Node	Distance travelled	Previous node

Final path: .....

Distance: .....

(6 marks)

4 **Compare** the use of merge sort, quick sort and insertion sort on an array with a small number of elements, and on an array with a very large number of elements.

You **should** make reference to the time complexities of each algorithm using the Big O notation in your answer.

(9 marks)