FIT1045 – SAMPLE EXAM 2

2 hours writing time

10 minutes reading

Closed book

Monash University
Faculty of computer science

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Important Information

All Python code you write for this exam must satisfy the following requirements:

- Syntax should satisfy Python 3 requirements
- Use syntax, modules, structures and constructs presented in lectures.
- Avoid using in built libraries that are performing non-trivial operations
- to have the most realistic exam experience, you should avoid actually running any of the code given (or that you produce) until after you have finished everything

Write down any assumptions you make.
The table below is included for your convenience

Question	Points	Score
1	1	
2	1	
3	1	
4	1	
5	7	
6	5	
7	9	
8	6	
9	8	
10	8	
11	7	
Total:	54	

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Question 1: [1 marks]

what will the following code output?

```
def doThing(n):
        S = 0
        for i in range(n,0,-3):
                S+=i
        print(S)

doThing(9)
```

A. 9

B. 18

C. 27

D. the code will not run or will run indefinitely

Question 2: [1 marks]

what will the following code output?

```
def doSomethingElse(x):
        if x > 0:
                x = -x
        while x < 0:
                if abs(x)>1:
                        x *= abs(x)
                else:
                        x += 1
        return x

print(doSomethingElse(10))
```

A. 10

B. -10

C. -100

D. 0

E. the code will not run or will run indefinitely

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Question 3: [1 marks]

Which of the following principles does merge sort use to sort a list?

A. greedy

B. backtracking

C. divide and conquer

D. brute force

Question 4: [1 marks]

What is the relationship between a heap and heapsort?

A. heapsort is done by successively extracting the minimum from a heap

B. heapsort is the act of successively inserting items into a heap; this heap is then a sorted list

C. a heap can only be constructed via heapsort

D. there is no relationship, their naming is coincidental

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Question 5: [7 marks]

Imagine a problem of finding a subset of a graph where each vertex in this subset has a different number of edges. Let's call this problem the *uniqueDegree problem*. You are given the decision problem variant of this where a set must be found of size k

(a) (1 mark) Describe what the certificate to this problem might include?

(b) (4 marks) Provide a python function which (given a graph in adjacency Matrix format, a certificate to this problem, and a value of k) can determine whether this certificate is a solution to the problem for the given value of k.

(c) (2 marks) Based on your previous function; in what class of problem is the *uniqueDegree* problem? Explain your answer.

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Question 6: [5 marks]

This question is about Binary Search Trees:

(a) (2 marks) given the following list of items `[1,7,4,6,2,5,3]`, create a Binary Search Tree by inserting each into the tree in the order they appear in the list given

(b) (1 mark) give a new ordering of these values in the list such that when inserted into a binary search tree in the order they appear, the BST is balanced

(c) (2 marks) Explain what impact the balance of a binary search tree has on the complexity of its find operation and why.

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Question 7: [9 marks]

Consider the undirected graph G which includes the following edges:

Table 1: edges in graph

start vertex	**end vertex**	**cost**
1	3	20
2	3	7
2	4	1
2	5	1
3	6	2
4	5	9
4	7	2
5	7	3
6	7	15

(a) (2 marks) draw the graph that corresponds to this set of edges (including the weights)

(b) (2 marks) produce an adjacency list that represents this graph; please put weights in brackets

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(c) (4 marks) Using prim's algorithm, find the minimal spanning tree of this graph. Make sure you show the result after selecting each edge; you should start with vertex 3.

(d) (1 mark) Suggest a useful invariant of Prim's algorithm for the kth iteration of the outer loop.

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Question 8: [6 marks]

consider the NQueens problem for a N of 4

(a) (1 mark) what form would partial solutions take?

(b) (1 mark) How would one be able to tell that a partial solution is in fact a complete solution?

(c) (4 marks) Draw a backtracking tree for this problem using the single list representation for N Queens

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Question 9: [8 marks]

This question is about sorting

(a) (2 marks) Explain how insertion sort sorts a list

(b) (2 marks) Give an example of list of numbers for which insertion sort would take the most time, and an example of a list of numbers for which insertion sort would take the least time. Make sure both lists are of the same size and identify which corresponds to which situation.
you may assume this version of insertion sort produces something in ascending order

(c) (1 mark) Given the following list of numbers, show what quicksort would partition this list into:
`[10,6,2,73,2,8,7]`
you may assume a pivot of 7

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(d) (1 mark) What is the base case for quick sort?

(e) (2 marks) how does quicksort use the results of the partition function to continue sorting the list?

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Question 10: [8 marks]

(a) (4 marks) Write a python function to **recursively** find the minimum value in a list; this should accept a list as an argument and return the index of the smallest item.
For example given the list as follows: `[9,-2,6,1,80,9,-2]`, your function should return either 1 or 6 (which are the indices of -2).

(b) (4 marks) Write a python function that uses your previous function to make a list of the k smallest items in a list.
For example, given the list `[9,-2,6,1,80,9,-2]` and a k of 4, your function should print (or return) `[-2,-2,1,6]`

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Question 11: [7 marks]

(a) (1 mark) give an example of an algorithm.

(b) (5 marks) explain why your example is an algorithm.

(c) (1 mark) how does an algorithm differ from a process?

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