UNIVERSITY OF BRISTOL

January 2018

FACULTY OF ENGINEERING

Examination for the Degrees of
Bachelor of Engineering
Master of Engineering

COMS10001
PROGRAMMING AND ALGORITHMS II

TIME ALLOWED:
2 Hours.

This paper contains *four* questions.
Each question is worth *30 marks*.
***Three* answers will be used for assessment.**
THIS IS A SAMPLE PAPER
The maximum for this paper is 90 marks.

<u>Other instructions</u>

1. **Calculators must have the Engineering Faculty seal of approval.**

TURN OVER ONLY WHEN TOLD TO START WRITING

Q1: This question is about algorithmic complexity and merge sort.

(a) Use merge sort to sort (12,5,65,4,9,76,1,5) describing all the steps.

(10 marks)

(b) What is the big-O algorithmic complexity of merge sort.

(10 marks)

(c) Explain how the big-O complexity of merge sort and quicksort differ.

(10 marks)

Q2: This question is about algorithmic complexity and recursion relations.

(a) An algorithm is $O(n^2)$, a second algorithm is $O(n)$; a new, third algorithm involves running the first algorithm and then the second. What is its complexity? Why?

(10 marks)

(b) An algorithm is $O(n \log n)$, a second algorithm uses this algorithm inside a loop which if performed $3n + 2$ times. What is its complexity? Why?

(10 marks)

(c) Find big-Theta for the recursion relation

$$T(n) = 3T(n-1) + 1$$

with $T(1) = 4$.

(10 marks)

Q3: This question is about heap sort.

(a) Define a binary heap. When might a heap be useful?

(5 marks)

(b) Heapify $(3, 5, 1, 6, 23, 2, 24, 14)$ so that the largest element is on top.

(10 marks)

(c) Remove the largest element from the heap and re-heapify.

(10 marks)

Q4: This question is about minimization.

(a) What problem with gradient flow is solved by conjugate gradients?

(5 marks)

(b) Why might it not be possible to use gradient flow?

(5 marks)

(c) Describe the downhill simplex algorithm detailing the different moves and when they are employed?

(15 marks)

(d) When might simulated annealling or the genetic algorithm be used instead of downhill simplex?

END OF EXAM PAPER