

## MA U34605 Quiz 01 w/e 9/10/20

Answer any 3 questions. Submit them using the submit-work program as pdfs, either handwritten and scanned, or typeset. They should be submitted before 1pm on Tuesday 13 October. All questions carry 20 marks.

(1) Show that  $an + b$  is  $O(n)$ .

(2) Binary search works on a sorted array — but ‘sorted’ was deliberately left undefined. What should the definition be, and what are the implications?

(3) Estimate the runtime of the ‘inefficient’ sorting method (and prove that it always halts). Hint: if  $a[0..n-1]$  is an array, an *inversion* for that data is a pair  $i, j$  where  $0 \leq i < j \leq n-1$  and  $a[i] > a[j]$ .

(4) Give a proportionate (e.g.,  $\sim n^4$ , which is wrong) lower bound for the performance of the inefficient sorting method.

(5) The analysis of mergesort was simplified, replacing  $an + bS$  by  $(a + b)n$ . Of course in the  $O()$  notation it makes no difference, but this question is: calculate a sharper estimate.

(6) We know that one can reconstruct a binary tree given its inorder and postorder rankings. Is it possible to reconstruct the tree from preorder and postorder rankings? Give reasons, of course.