University of Waterloo
CS240 - Winter 2021
Midterm Post Mortem

Problem 1 [6+4 marks]

- For part a) ii), many students gave the incorrect answer o.

Problem 2 [4+3 marks]

- for part a), a few students consider that the left subtree has height 3. If height is 3, the minimum number of nodes is 7.
- for part b), many students do not say "frequencies should be decreasing".

Problem 3 [5+6 marks]

- for part a), some students enlarge the range for n_0 by taking a wrong direction to simplify the inequality. Some students messed up with the small-o definition.
- for part b), some students analyse inner loop isolated. The inner loop should depends on i.
- for part b), some students wrote too few steps to prove their results. Some students cannot simplify the summation for $\log i$ from 1 to n^2.

Problem 4 [6 marks]

- Some student use $A[i] < A[i-1]$ to sort out the incorrect element.
- Some student fail to find out consecutively decreased numbers.
- Some student directly use a sorting algorithm on the array.

Problem 5 [(2+2)+(2+2)+5 (+3 Bonus) marks]

- for part a), students got part i) right, except some did not use the original heap for part ii).
- for part b), some students don't apply heap-order property correctly. They think on the same level and below can be less only.
- for part b) i), many did not exclude k in their calculation.

- for part b) ii), some students said no child.
- for part c), some students modify the original heap.
- for part c), some students use binary search on the heap, but the heap is not sorted.
- for part c), many students that used a min-heap to maintain the k largest elements then tried to call deleteMax on the min-heap, but min-heaps do not have a deleteMax operation.
- for part c), many students that attempted the BONUS approach described that nodes are deleted from an auxiliary heap, and then mentioned inserting the children of the deleted node from the input heap without explaining how to find such children. The default assumption would be to search the heap for such nodes, but this results in an overall worst-case time of $\Theta(kn)$, which violates even the non-BONUS objective.
- for part c), several students attempted to maintain two pointers for the candidates of the next largest element, but this is incorrect since the 3rd largest element onwards would have more than two possible candidates (with each step having more candidates than the previous).
- for part c), in general, students should not attempt the BONUS challenge for a regular problem unless they are confident that they presented a complete and correct answer without missing important details. Otherwise, they would be better off with a non-BONUS solution.

Problem 6 [2+2 marks]

- for part a), some of them will say 46 buckets. But bucket array is used one time, it's reused for all rounds.
- for part b), some of them will say 61 buckets. But bucket array is used one time, it's reused for all rounds.

Problem 7 [2+3+3 marks]

- Incorrect AVL tree after inserting a new node.

Problem 8 [3+3 marks]

- for part b), some students did not specify alternative search pattern for key $k1, k2$ in the worst case.

Problem 9 [3+3 marks]

- for part a), some students answer incorrect height for 6 and 20
- for part a), some students give incorrect order.
- for part b), some students give incorrect answer $(1/4)^n$.

Problem 10 [3 marks]

- most students got it right. Only a few miss drawing 1\$ or 01\$.