University of Waterloo
CS240 Winter 2023
Assignment 2 Post Mortem

Question 1 [2+2+3+3+5=15 Marks]

- Parts (a), (b), and (c) were generally done well.
- For Part (d), some students provided incorrect reasoning (and subsequently the incorrect answer) for the minimum value of $H[3]$.
- Part (e):
  - Many students who lost marks did not justify the correctness of their algorithm or that their runtime was in $O(n)$.
  - Some students wrote answers that involved traversing the heap, which didn't meet the runtime requirements.

Question 2 [1+1+5=7 Marks]

- This question was done well overall; the only common error noticed was in part (c), where some students got incorrect values for the number of instances that would lead to each runtime case.

Question 3 [2+2+4=8 Marks]

- Part (a): A common error that was noticed here was that some students only restricted the runtime to a single recursive call ($O(1)$) rather than considering all recursive calls ($O(n)$).
- Part (b): While this part was generally done well, some students did not recognize that the array decreases in size by 1, and not 2, at each recursive call.
- Part (c):
  - Many answers that lost a significant amount of marks were those that did not provide a sufficiently formal proof. The answer in the A2 solutions is an example of how formal the proof should be.
  - Many answers also did not bound the worst case expected runtime above by the maximum expected runtime over all instances. See the solutions for an example.

Question 4 [4 Marks]

- Some students did not use an in-place method to solve this problem.
- A few answers did not meet the runtime complexity.

Question 5 [5 Marks]

- Many incorrect responses included descriptions of specific algorithms and attempts to argue that their runtimes have to be bounded by $O(n \log \frac{n}{k})$ by virtue of it being a comparison-based algorithm.
- Many students tried to use algorithm-specific approaches to solve this problem (for example, using `merge` and `mergesort`). This question required a more general, decision-tree-based approach.
- Some students did not identify the correct number of leaves in the decision tree.
- For students who did identify the correct number of distinct leaves, common errors included writing incorrect intermediate steps (for which the inequality no longer holds) or mistakes in their simplifications steps.

Question 6 [2+2+3+3=10 Marks]

- Part (a): This part was generally done well.
- Part (b): Many incorrect answers had underlined the wrong digits and/or did not show the final sorted array.
- Part (c): This part was done very well; the only mistake that a significant number of students made was not taking into account the time to convert each number from base 10 to base n.
- Part (d): Many students who lost marks here did not recognize that the shortest height of the recursion tree is found when each subarray is divided equally.
- Part (d): Many other solutions which had lost marks did so because of insufficient justification.