University of Waterloo
CS240 Spring 2023
Assignment 5 Post-Mortem

This document goes over common errors and general student performance on the assignment questions. We put this together using feedback from the graders once they are done marking. It is meant to be used as a resource to understand what we look at while marking and some common areas where students can improve in.

General

- Please make sure that your work is nice and clear for the reader to follow. Poor presentation (illegible handwriting, scanning not done clearly) may lead to deduction.

Question 1 [3+3+3+3+1 marks]

- This question was well done overall.
- With part e), some students mentioned that potential of entering into infinite loop may be a problem. However, this is not a necessarily a serious issue as our algorithm already has emergency break. Such answer did receive deduction.

Question 2 [3+4 marks]

- With part c), some students set up indicator variable incorrectly. That is, $I_j = 1$ if $T[j]$ is NOT empty. Then, adding all indicator variable gives expected number of non-empty slots. Such approach requires different mathematical steps to sample solution.

Question 3 [4+4+4 marks]

- With part b), some students directly concluded that having an empty spot is equivalent to the fact that this algorithm always terminates. Having an empty slot does not directly imply the termination of algorithm since there may be sequence of kicking element out each other that continues.
- The main idea is that we may insert largest key and largest key will behave as normal linear probing. To justify it, one had to observe that we insert an element that is larger than current one which leads to the fact that keys being inserted is strictly increasing. Missing such detail received deduction.
- With part c), some students gave an example with some fixed value of n and M. Then, they showed that number of probes being done is in form of some summation

and directly concluded $\Omega(n^2)$. However, the question was explicitly stating to prove the statement for arbitrary n value. Hence, if one did not provide formula for each key in terms of n, they received deduction.

- Some students showed that sequence of insertion cause $\Omega(n^2)$ probings. Question was explicit to find a scenario where one insertion causes $\Omega(n^2)$ probings, hence, such solution received deduction.

Question 4 [4+6+5 marks]

- In part a), some students included points like (64, 64). Due to our convention of assigning points to the upper-right box, this will result in the overall bounding box increasing to 128 by 128.
- It is assumed that the bounding box starts from (0,0), unless otherwise specified.
- For part b), some students missed the fact that the larger circle must have a radius of $\frac{d_{max}+d_{min}}{2}$ in order to properly enclose the full area of all d_{min} circles. See sample solution for details.
- Some students omitted justification for worst case geometric layout. Solutions involving quadtree or square constructions will require justification in order to bound the spread.
- Part c) was done well for those students who attempted.

Question 5 [4+2+8 marks]

- Part a) was done well.
- For part b), some students omitted the simplification to $O(n^{\frac{1}{3}})$ was omitted.
- With part c), many students did not explain space complexity of their algorithm. Missing brief analysis on space complexity received deduction.
- The key idea for part c) was to use the KD-Tree for the boundary subsets and Range Search (or any method from part a)) as needed. Some students did not take advantage of part a).