University of Waterloo
CS240 Winter 2023
Assignment 1 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]

- A few students submitted handwritten answers that were hard to read. Please use LaTeX for your assignment submissions in the future if that is the case.
- Some proofs were not sufficiently detailed, or many steps were skipped along the way. Your work should give a clear idea of what is being done, with justification for non-obvious steps. We were generous on this assignment. We will not be in the future.

Question 1 [3+3+3+4+4=17 marks]

- This question was well done overall, with only minor and infrequent errors in parts (a) and (b). (The most common of which was giving an incorrect n_0 value.)
- Some students used the limit rule for parts (c) to (e) – the question gave an explicit requirement to prove the statements from first principles.
- Some students did not use the correct procedure to prove the statements in parts (d) and (e). (Either they found a single c and n_0 that worked, or they did not justify sufficiently why their bound for n in terms of c actually works.)

Question 2 [4+4=8 marks]

- For part (a), some students proved that $f(n) + g(n) \in \Theta(g(n))$ instead of $\Theta(f(n))$. The steps were similar, but the final answer was incorrect.
- For part (a), some students who got this question incorrect made errors in simplifying the expressions, or made claims that were either untrue or required proof.
- Part (b) was generally answered well. The most common error here was giving a verbal explanation instead of using the definitions of Θ and little-o. Students who got this question fully or partially incorrect are recommended to look at the solutions, which provides a sketch of how this problem could have been approached.

Question 3 [3+3+3+3=12 marks]

- In general, some students did not show enough steps for solving the limit when they used the Limit Rule.
- For part (b), many students only showed one of the bounds when using squeeze theorem.

Question 4 [3+3+3+3=12 marks]

- Parts (a) and (b) were well done – no common errors were found.
- For part (c), many students made mathematical errors when summing i^2 (the formula is different than for summing just i)
- For part (d), some students did not sum over the outer loop
- For part (d), some students did not provide full steps, which resulted in a deduction.

Question 5 [4+4=8 marks]

- Part (a) was mostly well done – students were generally correct, with minor errors (like forgetting $c_1, c_2 > 0$).
- Many students attempted to prove that part (b) was true. Commonly, students used part (a) as a base case, which does not work for all values.
- Many students chose specific values of n and c for part (b). This is not the correct way to formally prove that part (b) is false.
- For part (b), some incorrect answers also included raising both sides to the power of n, resulting in c_1^n and c_2^n, which are no longer constants.

Question 6 [3 marks (+3 Bonus)]

- Many students did not include a base case when using the induction method.
- Some students misinterpreted the question, and attempted to find a Θ bound on the *runtime*, instead of $T(n)$
- Many students did not show their simplification steps for the bonus question, or showed incorrect steps.