University of Waterloo
CS240 Fall 2022
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.

Question 1 [3+3+3+3+3=15 marks]

- When proving order notation from first principles, **explicit** values for c and n_0 that satisfy the relationship must be given, not a range.
- For a) and b):
  - Some students set $n_0 = 0$ when first principles indicate that $n_0 > 0$.
- For d) and e):
  - The n_0 students provide should be an integer (by using the floor or ceiling function on an original expression).
  - Many students used the o- and ω-notation definition with the $\leq$ sign instead of the $<$ sign. (i.e. Using the expression $0 \leq f(n) \leq cg(n)$ instead of $0 \leq f(n) < cg(n)$ for o-notation)
  - Some students did not give n_0 in terms of c.

Question 2 [4+4=8 marks]

- Some students made mistakes and/or skipped many steps while applying L'Hopital's rule.
- Some students did not prove the upper bound for Θ-notation.

- For b):
  - Some students set up the limit incorrectly.
  - Some students attempted to prove the (false) ω- or o-notation.

Question 3 [6+6=12 marks]

- For a):
  - Many students incorrectly assumed that $\notin o$ implies $\in \Omega$, and that $\notin \omega$ implies $\in O$ to prove that the statement is true.
  - Some students' (correct) disproof by counterexample was not justified fully.
- For b):
  - Some students only proved only one of either the upper or lower bound for Θ-notation.

Question 4 [6 marks]

- Many students forgot to add 1 to $\log n$ for both the $\theta = 2$ and $2 < \theta \leq 3$ cases, as the bounds of summation begin at 0, not 1.
- Some students applied the sum of the geometric sequence formula incorrectly.

Question 5 [2+2+4+4=12 marks]

- For a), many students mistakenly counted 1 vector (an instance of the input vector) instead of all 2^n possible vectors.
- For c):
  - Some students incorrectly used combinatorics to count the number of inputs, mistakenly assuming that the order of elements does not matter.
  - Many students incorrectly described the position of the 0's in the vector and/or the number of them.
- For d), some students did not include the case where $n + 1$ calls to print occurs.

Question 6 [5 marks]

- Many students did not provide enough details in their proof, and/or lacked formality.
- Some students did not discuss both the cases where s is odd and s is even.
- Some students did not prove that s will eventually converge to 0, which provides the key to proving the while loop terminates.

Question 7 [5 marks]

- Many students only gave a verbal proof instead of a more rigorous proof involving nested summations for the loops.