University of Waterloo
CS240 Winter 2023
Assignment 1 Post-Mortem

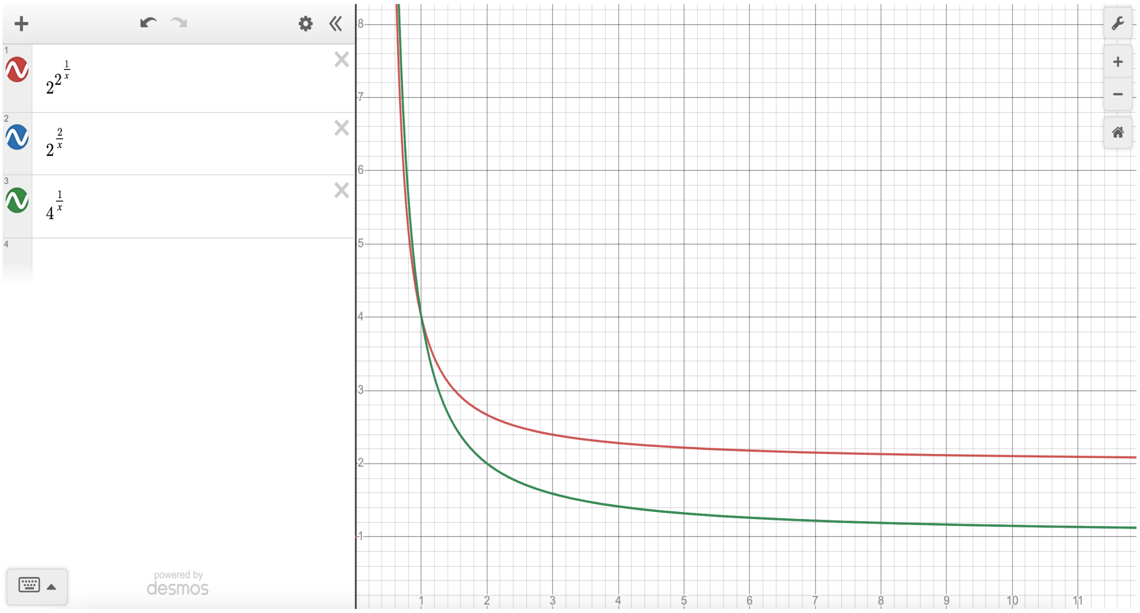
This document goes over common errors and general student performance on the assignment questions. We put this together using feedback from the graders once they are done marking. It is meant to be used as a resource to understand what we look at while marking and some common areas where students can 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. Otherwise, if we deem it illegible, we deduct full marks.
- 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 very generous with grading and we will not be with future assignments.

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

- Overall, this question was well done except for some minor but yet important details.
- Some students incorrectly derived intermediary inequality expressions. For example, if we have $n - \frac{log(n)}{n} \geq log(c)$, it is valid to show that $n - \frac{log(n)}{n} \geq n - 1 \geq log(c)$ and use $n - 1$ to show n_0, as the value for n_0 will satisfy the original statement $n - \frac{log(n)}{n}$. However, if we chose $n \geq n - \frac{log(n)}{n} \geq log(c)$, this is not sufficient, because knowing an n_0 value that satisfies $n \geq log(c)$ does not tell us anything about $n - \frac{log(n)}{n} \geq c$.
- For proving either ω or o, lots of students had an expression of n_0 that is not positive for all c. From the module, however, we see that $n_0 \geq 0$ itself. You could go around with this trick by doing something like $max(1, some\ expression)$ to ensure that your n_0 is positive fol all n.
- If you have a function where its limit is ∞ for $n \to \infty$, it is correct that this function reaches 0, but it does not mean that it is actually 0 at some point.
- Some students struggled with evaluating expressions that include log and exponents. In particular we note that
$$2^{2^{\frac{1}{c}}} \neq 2^{\frac{2}{c}} \neq 4^{\frac{1}{c}}$$
We also note that we can illustrate this fact with a graph.



- Some students expressed n_0 in terms of n, which is not valid.
- Some students overlooked the fact that c can be any value above 0, meaning that c can be some value between 0 and 1.

Question 2 [3+3+3 marks]

- This question was well done overall. Some students have not provided enough details on how they were evaluating L value.

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

- Some students chose to go with splitting O and Ω bound and made a mistake when overestimating the summation or underestimating summation.
- Some students omitted the final Θ bound for O and Ω they have proven.

Question 4 [2+6 marks]

- When you are given Θ bound, it does not mean that you can choose c_1, c_2 values as you want. Similarly, you need to take the maximum n_0 value of different inequalities if you need to combine them.

Question 5 [5+5 marks]

- Given $\frac{c_1}{c_2} \leq \frac{c_3}{c_4}$ does not imply $c_1 \leq c_3$ or $c_2 \leq c_4$. We can only deduce that $\frac{c_1}{c_4} \leq \frac{c_3}{c_2}$.

- There are counter-examples to the statement if limit of $f(n)$ or $g(n)$ are not ∞. However, this condition was given in the question and some students forgot to take this account into.
- Result after evaluating limit is *sufficient, but not necessary* condition to make conclusion about order notation.