

University of Waterloo
CS240E, Winter 2025
Written Assignment 4 Post-Mortem

This document goes over common errors and general performance on the assignment. We create it using feedback from the graders, and it is meant to be used as a resource to understand common areas that we can improve in.

Question 1 [2+4=6 marks]

- This question was done well.

Question 2 [1+2+2+5=10 marks]

- Parts (a) and (b) were done well.
- In part (c), many solutions went directly from an equivalence mod M directly to an equivalence mod $2M$. While mathematically valid, this was not one of the modular arithmetic rules that we could use without proof, so it required a brief explanation or intermediate step(s).
- Part (d) was mostly done well, but a few solutions did the case analysis of $i - j$ and $i + j + 1$ incorrectly.

Question 3 [2+4+5=11 marks]

- In part (a), many solutions made an error when converting to base 10 (eg. saying $010_2 \mapsto 4$ instead of 2), but this was not penalized.
- Some solutions also did not give the final answer as an integer, which was not penalized either, but it is important to understand why we are doing this operation in the first place (to find the hash of a key, which is an integer).
- Part (b) was done well.
- In part (c), many solutions made claims about the distribution of x_1 and x_2 (e.g. that each of their entries is equally likely to be 0 or 1). This is not true because they are given to us, so we cannot make any assumptions about their distribution.

Question 4 [2+3+6=11 marks]

- Parts (a) and (b) were done well.
- In part (c), a few solutions returned the length of the interval instead of the interval itself. (Notice that we gave an example to show that we are returning an interval).

Question 5 [2+3+3+4=12 marks]

- In part (a), many solutions did not deduplicate the endpoints when calculating the median for (a), resulting in an incorrect tree. It was implied that this should be done by the fact that we wrote $p_0 < p_1 < \dots$ with strict inequality, and $N \leq 2n$ rather than $N = 2n$.
- In part (b), many solutions said that each subtree has at most $n/2$ segments because the split-coordinate is the median. This makes sense intuitively, but is in fact false - one counterexample is obtained by changing $[1, 3]$ to $[1, 2.9]$ in (a). The correct approach was to argue that the number of endpoints in each subtree is at most $N/2$.
- In part (c), a few solutions gave an algorithm for pierce-query and showed that its runtime was in $O(\log n)$, but this was not what the question asked for.
- Part (d) was done well.