

Due date: October 21 at 7:30 AM. You will need to submit this via GradeScope.

For this assignment, each answer must be contained within a single piece of paper. When you submit to GradeScope, you will need to inform the system which page of your scanned PDF contains the answer. *Do this even if your submission is a single page.*

Please review the syllabus and course reference for the expectations of assignments in this class. Remember that problem sets are not online treasure hunts. You are welcome to discuss matters with classmates, but remember the Kenny Loggins rule. Remember that you may not seek help from any source where not all respondents are subject to UC Irvine's academic honesty policy.

The goal of these problem sets is to get you to explore concepts from class. This should help prepare you for the exams and, more importantly, for understanding the big ideas from ICS 46.

1. Suppose I have a `std::vector<unsigned> A`. This vector has only values in the range of 0 to `A.size()`, inclusive. For example, if there are 5 values in `A`, then the only values it can have are  $\{0, 1, 2, 3, 4, 5\}$ , although not necessarily in that order. Duplicate values might be present too.

Obviously, at least one value is missing. Using  $\mathcal{O}(n)$  time and  $\mathcal{O}(n)$  space, where  $n$  is `A.size()`, determine which value(s) are missing from the vector. You may not use any standard library data structure other than `std::vector`. For full credit, you should not use any more space than is necessary to solve this problem, other than basic overhead (a `std::vector` is still preferred to a C-style array and won't be penalized, even though it does take some additional space, for example).

2. What is the worst-case running time for inserting  $n$  items into an initially empty hash table,
  - (a) Where collisions are resolved by chaining?
  - (b) Where collisions are resolved by chaining, and each list is stored in sorted order?
  - (c) Where collisions are resolved by linear probing?

For each part, justify your answer briefly. If you need to make a reasonable assumption about the problem statement in order to do so, state that assumption explicitly in your answer.