

COSC 240                      Spring 2019  
Problem Set 4                Maximum Points 40 (10 points for each question)  
Due by class time on March 21, 2019

Slides used for lectures on hashing are those corresponding to Lectures 7 and 8 at

<https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-046j-introduction-to-algorithms-sma-5503-fall-2005/video-lectures/>

The PDF slides are available from the “Related Resources” tab for each lecture above.

1. This question relates to hashing with chaining using the following hash function. Suppose that we want to insert 6 keys into the hash table. Determine a set of 6 keys that results in the “worst-case” for chaining. The key may take any integer value between 0 and 999.

$$h(k) = k \text{ modulo } 100$$

In what sense is your set of keys the “worst-case”?

2. This question relates to *open addressing* for resolving collision. In particular, consider linear probing. For key  $k$  and probe  $i$ , define

$$h(k,i) = (k+i) \text{ mod } 100$$

Suppose that we want to insert 6 keys into the hash table. Determine a set of 6 keys that results in the “worst-case” for the above scheme. The key may take any integer value between 0 and 999.

In what sense is your set of keys the “worst-case”?

3. In the above two schemes, knowing the hashing algorithm, an adversary is able to choose a set of keys that leads to a worst-case behavior.

For universal hashing, is it possible for an adversary to choose a set of keys that will necessarily leads to a worst-case behavior? Briefly explain your answer.

4. Suppose that we change the hash function in Question 2 to the following:

$$h(k,i) = (k + 25*i) \text{ mod } 100$$

What is the shortcoming of this hash function when compared to the hash function in Question 2?

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RECOMMENDED EXERCISES:

- (a) Choose a set of keys. Find a perfect hashing scheme for the chosen keys.
- (b) Perfect hashing is not designed to allow key insertion. Why?