

Recitation 9: Hashing

1. Answer the following and explain **(5 minutes)**

- I. What is the time complexity of insertion in a hash table?
- II. What is the time complexity of searching in a hash table?
- III. What is the time complexity of deletion in a hash table?
- IV. Is chained hashing best used when there is a low load factor or high load factor?
- V. Is linear probing best used when there is a low load factor or high load factor?

2. Insert the following numbers into this hash table below, using the specified probing method and the given hash function. **(10 minutes)**

$$h(k) = (2k) \bmod 11$$

Values = {19, 65, 09, 17, 01, 99, 12, 4, 6, 23, 22}

Index	0	1	2	3	4	5	6	7	8	9	10
Value											

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Value											

3. Given a hash table with size 48 with 12 elements in it, what is the load factor? Is it possible to have more than 48 elements in this hash table? **(5 minutes)**

4. Consider the following hash function: **(5 minutes)**

$$h(k) = k \bmod 4$$

Values = {33, 17, 9, 40, 44, 59, 12, 19, 38}

Which values will have $h = 0$? $h = 1$? $h = 2$? $h = 3$?

Is this an efficient hash function? Explain why or why not.

5. Consider a hash table of size 11 with the following hash functions:

$$h_1(k) = k \bmod 11$$

$$h_2(k) = 5 - (k \bmod 5)$$

Values = {32, 43, 26, 38, 17, 3, 80, 55}

Draw the table that results after inserting, in the given order, the values. **(10 minutes)**

Hash Table Index	0	1	2	3	4	5	6	7	8	9	10
Hash Table Entries											

6. Given an array of integers and a target value, write a method that returns an array of length 2 containing the indices of two numbers which sum up to the target (hint: this can be done in $O(n)$ time using a HashMap. Can you even do it in one pass through the array?) **(10 minutes)**

```
public int[] getPair(int[] arr, int target) {
```

7. Given an array of integers, find the mode of the array using a hash map **(10 minutes)**

```
public int mode(int[] arr) {
```