

Comp 160: Algorithms, **Recitation 5**

This is a short recitation so that you can prepare for first exam.

1. The list of keys AMY, BOB, CAZ, DAN, EVA, FAN, GIA is to be stored in a hash table of size 9 using the simple hashing function $H(key) = k(key) \bmod 9$, where the mappings $k(key)$ are:

$k(AMY) = 3$, $k(BOB) = 52$, $k(CAZ) = 45$, $k(DAN) = 28$, $k(EVA) = 43$, $k(FAN) = 57$, $k(GIA) = 69$

Suppose that if $H(key) = h$, and slot h is occupied, we probe in succession slots $P(i) = (h + i \cdot C(key)) \bmod 9$, $i = 1, 2, \dots$ where $C(key) = (k(key) \bmod 5) + 1$, until an unoccupied slot is found.

- (a) What is this hashing scheme called?

We are doing hashing that resolves collisions with open addressing. The hashing scheme itself is called double hashing.

- (b) Sketch the resulting data structure after inserting the keys in alphabetical order (ie: insert AMY, then BOB, ...)

0 _____	5 _____
1 _____	6 _____
2 _____	7 _____
3 _____	8 _____
4 _____	

0 <i>CAZ</i>	5 <i>---</i>	
1 <i>DAN</i>	6 <i>FAN</i>	
2 <i>EVA</i>	7 <i>BOB</i>	
3 <i>AMY</i>	8 <i>GIA</i>	
4 <i>---</i>		

- (c) What is the average number of key comparisons required to successfully retrieve a key in this table? Assume equal retrieval frequencies. Show the computation.

The number of comparisons required to find:

<i>AMY</i>	1
<i>BOB</i>	1
<i>CAZ</i>	1
<i>DAN</i>	1
<i>EVA</i>	2
<i>FAN</i>	2
<i>GIA</i>	5

Therefore the average number of key comparisons required to successfully retrieval from this table is $13/7 = 1.86$, that is almost 2 comparisons.

- (d) Say we now use hashing with chaining for collision resolution. That is, each table entry is the head pointer (possibly NIL) to a linked list of keys. Answer the previous two questions with this scheme instead

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0    -- > CAZ -- > NIL
1    -- > DAN -- > NIL
2    NIL
3    -- > FAN -- > AMY -- > NIL
4    NIL
5    NIL
6    -- > GIA -- > NIL
7    -- > EVA -- > BOB -- > NIL
8    NIL

```

The number of comparisons required to find:

<i>AMY</i>	2
<i>BOB</i>	2
<i>CAZ</i>	1
<i>DAN</i>	1
<i>EVA</i>	1
<i>FAN</i>	1
<i>GIA</i>	1

Therefore the average number of key comparisons required to successfully retrieval from this table is $9/7 = 1.33$.

- (e) Go back to practice questions of previous weeks. Is there any question you would like to know the answer to?