due 10/14/20

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Hashing Lab

1. Given the following key values, show what the data structures would look like after insertions
   27 53 13 10 138 109 49 174 26 24
   (no preprocessing necessary: p_k = key)

a. Linear array of 10 elements using division hashing and the linear-quotient collision path algorithm
N = 13, 4k+3 prime = **19**

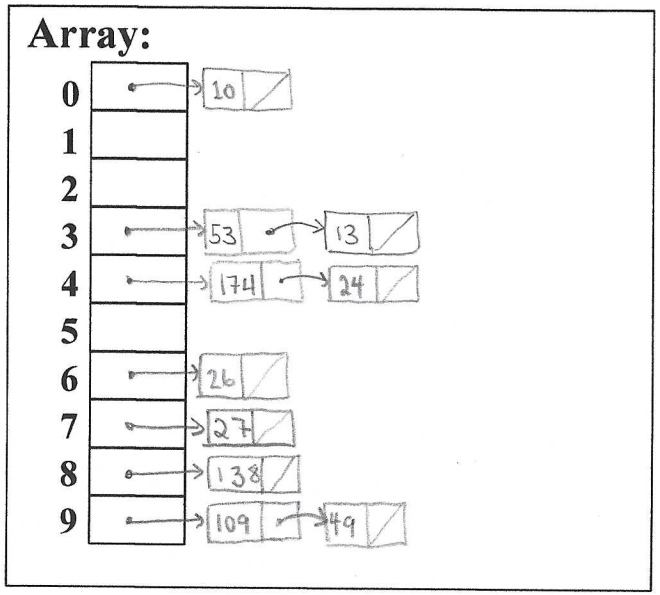
LQHashing:
1. i_p = pk % N
2. q=pk/N
   if (q%N != 0)
      offset = q
   else
      offset = 4k+3 prime
3. While collisions:
      i_p' = (i_p + offset) % N
4. Set Array[i_p]=key

Array:

0	13
1	27
2	26
3	109
4	
5	53
6	49
7	
8	138
9	
10	10
11	174
12	24

b. Bucket hashing of 10 elements (N=10)
i_p = (p_k) % N

Array:



LQ Hashing:

27: i_{27} = 27 % 13 = 1
q = 27/13 = 2
offset = 2
no collision ∴
Array[1] = 27

53: i_{53} = 53 % 13 = 1
q = 53/13 = 4
offset = 4 (collision at 1)
i_{53} = (i_{53} + offset) % N
= (1 + 4) % 13
= 5
Array[5] = 53

13: i_{13} = 13 % 13 = 0
q = 13/13 = 1
offset = 1
no collision ∴
Array[0] = 13

10: i_{10} = 10 % 13 = 10
q = 10/13 = 0
offset = 19
Array[10] = 10

2. Fill in the table based on exercise 1

Number of comparisons to retrieve this element

Key	Linear array - (Length of Collision Path +1)	Buckets - (# of elements in linked list compared)
53	2	1
138	1	1
109	4	1
49	4	2
174	2	1
26	2	1

if it's first in line, does that mean 1 comparison?

LQ Hashing (continued)

138: $138 \% 13 = 8$

$q = 138/13 = 10$

~~offset~~ = 10

no collision ∴

Array[8] = 138

109: $109 \% 13 = 5$

$q = 109/13 = 8$

offset = 8

collision at 5

∴ $i_p = (5+8) \% 13$

$= 13 \% 13 = 0$

collision at 0

∴ $i_p = (0+8) \% 13$

$= 8 \% 13 = 8$

collision at 8

∴ $i_p = (8+8) \% 13$

$= 16 \% 13 = 3$

Array[3] = 109

49: $49 \% 13 = 10$

$q = 49/13 = 3$

offset = 3

Collision at 10

∴ $i_p = (10+3) \% 13$

$= 13 \% 13 = 0$

Collision at 0

∴ $i_p = (0+3) \% 13$

$3 \% 13 = 3$

Collision at 3

∴ $i_p = (3+3) \% 13$

$= 6 \% 13 = 6$

Array[6] = 49

174: $174 \% 13 = 5$

$q = 174/13 = 13$

Since $13 \% 13 = 0$

offset = 19

collision at 5

∴ $i_p = (5+19) \% 13$

$= 24 \% 13 = 11$

Array[11] = 174

26: $26 \% 13 = 0$

$q = 26/13 = 2$

~~offset~~ = 2

collision at 0

∴ $i_p = (0+2) \% 13$

$= 2 \% 13 = 2$

Array[2] = 26

24: $24 \% 13 = 11$

$q = 24/13 = 1$

offset = 1

collision at 11:

∴ $i_p = (11+1) \% 13$

$12 \% 13 = 12$

Array[12] = 24

Bucket Hashing (N=10) 27, 53, 13, 10, 138, 109, 49, 174, 26, 24

$i_p = (p_k) \% N$

$i_{27} = 27 \% 10 = 7$

$i_{53} = 53 \% 10 = 3$

$i_{13} = 13 \% 10 = 3$

$i_{10} = 10 \% 10 = 0$

$i_{138} = 138 \% 10 = 8$

$i_{109} = 109 \% 10 = 9$

$i_{49} = 49 \% 10 = 9$

$i_{174} = 174 \% 10 = 4$

$i_{26} = 26 \% 10 = 6$

$i_{24} = 24 \% 10 = 4$