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Worksheet #4

1

$K = 5, 28, 19, 15, 20, 33, 21, 17, 10$

table size = 9  $h(K) = K \bmod 9$

0	
1	28, 19, 10
2	20
3	21
4	
5	5
6	15, 33
7	
8	17

$$5 \bmod 9 = 5 \quad 28 \bmod 9 = 1$$

$$19 \bmod 9 = 1 \quad 15 \bmod 9 = 6$$

$$20 \bmod 9 = 2 \quad 33 \bmod 9 = 6$$

$$21 \bmod 9 = 3 \quad 17 \bmod 9 = 8$$

$$10 \bmod 9 = 1$$

2

$m = 1000$

$$h(K) = \lfloor m (K A \bmod 1) \rfloor \quad \text{for } A = \frac{\sqrt{5}-1}{2}$$

61	700
62	318
63	936

$$h(61) = \lfloor 1000 (61 \cdot \frac{\sqrt{5}-1}{2} \bmod 1) \rfloor$$

$$= \lfloor 1000 (61 (0.618) \bmod 1) \rfloor$$

$$= \lfloor 1000 (37.7 \bmod 1) \rfloor$$

$$= \lfloor 1000 (0.7) \rfloor = 700$$

64	554
65	172

$$h(62) = \lfloor 1000 (62 (.618) \bmod 1) \rfloor$$

$$= 318$$

$$h(63) = 936$$

$$h(64) = 554$$

$$h(65) = 172$$

3  $K = 10, 22, 31, 4, 15, 28, 17, 88, 59$   
 $m = 11 \quad h(K) = K \bmod m$

### i Linear Probing

0	22
1	88
2	
3	
4	4
5	15
6	28
7	17
8	59
9	31
10	10

$$10 \bmod 11 = 10$$

$$22 \bmod 11 = 0$$

$$31 \bmod 11 = 9$$

$$4 \bmod 11 = 4$$

$$15 \bmod 11 = 4 + 1 = 5$$

$$28 \bmod 11 = 6$$

$$17 \bmod 11 = 6 + 1 = 7 \quad 88 \bmod 11 = 0 + 1 = 1$$

$$59 \bmod 11 = 4 + 1 + 1 + 1 + 1 = 8$$

### ii Quadratic Probing

$$h'(x, i) = h(x) + C_1 i + C_2 i^2 \quad C_1 = 1 \quad C_2 = 3$$

0	22
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$$10 \bmod 11 = 10$$

$$22 \bmod 11 = 0$$

1	
2	88
3	17
4	4
5	
6	28
7	59
8	15
9	31
10	10

$$31 \bmod 11 = 9$$

$$4 \bmod 11 = 4$$

$$15 \bmod 11 = 4$$

$$28 \bmod 11 = 6$$

$$i=1 \mid 4 + 1(1) + 3(1)^2 = 8$$

$$17 \bmod 11 = 6$$

$$i=1 \mid 6 + 1(1) + 3(1)^2 = 10$$

$$i=2 \mid 6 + 1(2) + 3(2)^2 = 20 \bmod 11 = 9$$

$$i=3 \mid 6 + 1(3) + 3(3)^2 = 36 \bmod 11 = 3$$

$$88 \bmod 11 = 0$$

$$i=1 \mid 0 + 1(1) + 3(1)^2 = 4$$

$$i=2 \mid 0 + 1(2) + 3(2)^2 = 14 \bmod 11 = 3$$

$$i=3 \mid 0 + 1(3) + 3(3)^2 = 30 \bmod 11 = 8$$

$$i=4 \mid 0 + 1(4) + 3(4)^2 = 48 \bmod 11 = 4$$

$$i=5 \mid 0 + 1(5) + 3(5)^2 = 80 \bmod 11 = 3$$

$$i=6 \mid 0 + 1(6) + 3(6)^2 = 114 \bmod 11 = 4$$

$$i=7 \mid 0 + 1(7) + 3(7)^2 = 154 \bmod 11 = 0$$

$$i=8 \mid 0 + 1(8) + 3(8)^2 = 200 \bmod 11 = 2$$

$$59 \bmod 11 = 4$$

$$i=1 \mid 4 + 1(1) + 3(1)^2 = 8$$

$$i=2 \mid 4 + 1(2) + 3(2)^2 = 18 \bmod 11 = 7$$

### iii Double Hashing

$$h_1(k) = k \bmod m \quad h_2(k) = 1 + (k \bmod (m-1))$$

$$h(k) = h_1(k) + i h_2(k)$$

0	22
---	----

k

$h_1$

$h_2$

1	
2	59
3	17
4	4
5	15
6	28
7	88
8	
9	31
10	10

10

(10)

1

22

(0)

3

31

(9)

2

4

(4)

5

15

4

$$+ (1) 6 = 10$$

15

4

$$+ (2) 6 = 16 \bmod 11 = (5)$$

28

(6)

9

17

6

$$+ (1) 8 = 14 \bmod 11 = (3)$$

88

0

$$+ (1) 9 = 9$$

88

0

$$+ (2) 9 = 18 \bmod 11 = (7)$$

59

4

$$+ (1) 10 = 14 \bmod 11 = 3$$

59

4

$$+ (2) 10 = 24 \bmod 11 = (2)$$