Raymond Karyshyn
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CMSC-204-33085

CMSC 204 - Hashing Lab: Calculations
Module 13 - "Searching & Hashing"

Key Values:

15   54   13   10   135   114   49   174   27   24

Linear Probing:

N = 13

Array Index	Key Value	Reasoning
0	13	13 % 13 = **0**
1	27	27 % 13 = **1**
2	15	15 % 13 = **2**
3	54	54 % 13 → (2 + (1 *collision*)) % 13 = **3**
4	24	24 % 13 → (11 + (6 *collisions*)) % 13 = **4**
5	135	135 % 13 = **5**
6	174	174 % 13 → (5 + (1 *collision*)) % 13 = **6**
7		
8		
9		
10	10	10 % 13 = **10**
11	114	114 % 13 → (10 + (1 *collision*)) % 13 = **11**
12	49	49 % 13 → (10 + (2 *collisions*)) % 13 = **12**

Key Values:

15   54   13   10   135   114   49   174   27   24

Quadratic Probing:

N = 13

Array Index	Key Value	Reasoning
0	13	13 % 13 = **0**
1	49	49 % 13 = 10 → (10 + (2 *collisions*)^2) % 13 = **1**
2	15	15 % 13 = **2**
3	54	54 % 13 = 2 → (2 + (1 *collision*)^2) % 13 = **3**
4	27	27 % 13 = 1 → (1 + (4 *collisions*)^2) % 13 = **4**
5	135	135 % 13 = **5**
6	174	174 % 13 = 5 → (5 + (1 *collision*)^2) % 13 = **6**
7		
8		
9		
10	10	10 % 13 = **10**
11	114	114 % 13 = 10 → (10 + (1 *collision*)^2) % 13 = **11**
12	24	24 % 13 = 11 → (11 + (1 *collision*)^2) % 13 = **12**

Key Values:

15   54   13   10   135   114   49   174   27   24

Linear-Quotient:

N = 13, 4k + 3 = 19

Array Index	Key Value	Reasoning
0	13	13 % 13 = **0**
1	27	27 % 13 = **1**
2	15	15 % 13 = **2**
3	49	49 % 13 = 10 → q = 49 / 13 = 3 → (10 + 3) % 13 = 0 → (0 + 3) % 13 = **3**
4		
5	135	135 % 13 = 5
6	54	54 % 13 = 2 → q = 54 / 13 = 4 → (2 + 4) % 13 = **6**
7		
8	114	114 % 13 = 10 → q = 114 / 13 = 8 → (10 + 8) % 13 = 5 → (5 + 8) % 13 = 0 → (0 + 8) % 13 = **8**
9		
10	10	10 % 13 = **10**
11	174	174 % 13 = 5 → q = 174 / 13 = 13 → q % 13 = 0 → offset = 4k + 3 = 19 → (5 + 19) % 13 = **11**
12	24	24 % 13 = 11 → q = 24 / 13 = 1 → (11 + 1) % 13 = **12**

Key Values:

```
15   54   13   10   135   114   49   174   27   24
```

Bucket Hashing:

$N = 10, i_p = p_k \% N$

Array Index	Key Value
0	10
1	
2	
3	13
4	54 → 114 → 174 → 24
5	10 → 135
6	
7	27
8	
9	49

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Key Values:

15 20 42 35 16 26 21 78 50 30 17 58 46 120 152

Linear-Quotient (self-challenge):

N = 21, 4k + 3 = 7

Array Index	Key Value	Reasoning
0	42	42 % 21 = **0**
1	58	58 % 21 = 16 → q = 58 / 21 = 2 → (16 + 2) % 21 = 18 → (18 + 2) % 21 = 20 → (20 + 2) % 21 = **1**
2		
3		
4	46	46 % 21 = **4**
5	26	26 % 21 = **5**
6		
7	21	21 % 21 = 0 → q = 21 / 21 = 0 → q % 21 = 0 → offset = 4k + 3 = 7 → (0 + 7) % 21 = **7**
8	50	50 % 21 = **8**
9	30	30 % 21 = **9**
10		
11		
12	152	152 % 21 = 5 → q = 152 / 21 = 7 → (5 + 7) % 21 = **12**
13		
14	35	35 % 21 = **14**
15	15	15 % 21 = **15**
16	16	16 % 21 = **16**

17	17	`16 % 21 = `**`17`**
18	78	`78 % 21 = 15 → q = 78 / 21 = 3 →` `(15 + 3) % 21 = `**`18`**

19	120	`120 % 21 = 15 → q = 120 / 21 = 5 →`
		`(15 + 5) % 21 = 20 → (20 + 5) % 21 = 4 →`
		`(4 + 5) % 21 = 9 → (9 + 5) % 21 = 14 →`
		`(14 + 5) % 21 = `**`19`**

20	20	`20 % 21 = `**`20`**