

**CMSC 204 - Hashing Lab**  
**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	$54 \% 13 \rightarrow (2 + (1 \text{ collision})) \% 13 = 3$
4	24	$24 \% 13 \rightarrow (11 + (6 \text{ collisions})) \% 13 = 4$
5	135	$135 \% 13 = 5$
6	174	$174 \% 13 \rightarrow (5 + (1 \text{ collision})) \% 13 = 6$
7		
8		
9		
10	10	$10 \% 13 = 10$
11	114	$114 \% 13 \rightarrow (10 + (1 \text{ collision})) \% 13 = 11$
12	49	$49 \% 13 \rightarrow (10 + (2 \text{ collisions})) \% 13 = 12$

**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	$49 \% 13 = 10 \rightarrow (10 + (2 \text{ collisions})^2) \% 13 = 1$
2	15	$15 \% 13 = 2$
3	54	$54 \% 13 = 2 \rightarrow (2 + (1 \text{ collision})^2) \% 13 = 3$
4	27	$27 \% 13 = 1 \rightarrow (1 + (4 \text{ collisions})^2) \% 13 = 4$
5	135	$135 \% 13 = 5$
6	174	$174 \% 13 = 5 \rightarrow (5 + (1 \text{ collision})^2) \% 13 = 6$
7		
8		
9		
10	10	$10 \% 13 = 10$
11	114	$114 \% 13 = 10 \rightarrow (10 + (1 \text{ collision})^2) \% 13 = 11$
12	24	$24 \% 13 = 11 \rightarrow (11 + (1 \text{ collisions})^2) \% 13 = 12$

**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	$13 \% 13 = \mathbf{0}$
1	27	$27 \% 13 = \mathbf{1}$
2	15	$15 \% 13 = \mathbf{2}$
3	49	$49 \% 13 = 10 \rightarrow q = 49 / 13 = 3 \rightarrow$ $(10 + 3) \% 13 = 0 \rightarrow (0 + 3) \% 13 = \mathbf{3}$
4		
5	135	$135 \% 13 = 5$
6	54	$54 \% 13 = 2 \rightarrow q = 54 / 13 = 4 \rightarrow$ $(2 + 4) \% 13 = \mathbf{6}$
7		
8	114	$114 \% 13 = 10 \rightarrow q = 114 / 13 = 8 \rightarrow$ $(10 + 8) \% 13 = 5 \rightarrow (5 + 8) \% 13 = 0 \rightarrow$ $(0 + 8) \% 13 = \mathbf{8}$
9		
10	10	$10 \% 13 = \mathbf{10}$
11	174	$174 \% 13 = 5 \rightarrow q = 174 / 13 = 13 \rightarrow$ $q \% 13 = 0 \rightarrow \text{offset} = 19 \rightarrow$ $(5 + 19) \% 13 = \mathbf{11}$
12	24	$24 \% 13 = 11 \rightarrow q = 24 / 13 = 1 \rightarrow$ $(11 + 1) \% 13 = \mathbf{12}$