Linear Probing

0	41
1	30
2	39
3	64
4	72
5	74
6	55
7	68

$h(k) = (5k + 3) \bmod 8$

insert 41: $(5(41) + 3) \% 8 = 0$

$0 \% 8 = 0$

insert 30: $(5(30) + 3) \% 8 = 1$

$1 \% 8 = 1$

insert 74: $(5(74) + 3) \% 8 = 5$

$5 \% 8$

insert 55: $(5(55) + 3) \% 8 = 6$

$6 \% 8 = 6$

insert 68: $(5(68) + 3) \% 8 = 7$

$7 \% 8 = 7$

insert 39: $(5(39) + 3) \% 8 = 6$

$6 \% 8 = 6$

insert 64: $(5(64) + 3) \% 8 = 3$

$3 \% 8 = 3$

$(6 + 1) \% 8 = 7$

$(6 + 2) \% 8 = 0$

$(6 + 3) \% 8 = 1$

$(6 + 4) \% 8 = 2$

insert 72: $(5(72) + 3) \% 8 = 3$

$3 \% 8 = 3$

$3 + 1 \% 8 = 4$

Quadratic Probing $h(k) = 3k+1$

0	24
1	16
2	19
3	14
4	13
5	29
6	27
7	26

insert 19: $(3(19)+1) \% 8 = 2$

$29 \% 8 = 2$

insert 24: $(3(24)+1) \% 8 = 0$

$\% 8 = 0$

insert 16: $(3(16)+1) \% 8 = 1$

$14 \% 8 = 1$

insert 26: $(3(26)+1) \% 8 = 7$

$79 \% 8 = 7$

insert 14: $(3(14)+1) \% 8 = 3$

$34 \% 8 = 3$

insert 24: $(3(24)+1) \% 8 = 1$

$14 \% 8 = 1$ full

$1 + (1)^2 = 2 \% 8 = 2$ full

$1 + (2)^2 = 5 \% 8 = 5$

insert 13: $(3(13)+1) \% 8 = 0$

$0 \% 8 = 0$ full

$0 + (1)^2 \% 8 = 1$ full

$0 + (2)^2 \% 8 = 4$

insert 27: $(3(27)+1) \% 8 = 2$

$7 \% 8 = 2$ full

$2 + (1)^2 \% 8 = 3$ full

$2 + (2)^2 \% 8 = 6$

Double hashing

$h_1 = (3k) \bmod 8$ $\quad h_2 = ((5k+3) \bmod 7) + 1$

0	40
1	
2	30
3	
4	36
5	
6	14
7	

insert 30: $3(30) \bmod 8 = 2$

$2 + 0(h_2) \% 8 = 2$

insert 14: $3(14) \% 8 = 2$

$2 + 0(h_2) \% 8 = 2$

$2 + 1[4] \% 8 = 6$

$h_2 = [5(14)+3] \% 7 + 1 = 4$

insert 40:

$h_1 = 3(40) \% 8 = 0$

$0 + 0(h_2) \% 5 = 0$

insert 36:

$3(36) \% 8 = 4$

$4 + 0(h_2) \% 8 = 4$

insert 56: $h_1 = 3(56) \% 8 = 0$

$h_2 = [5(56)+3] \bmod 7 + 1$

$= 4$

$0 + 1(4) \% 8 = 4$ full

$0 + 2(4) \% 8 = 0$ full

$0 + 3(4) \% 8 = 4$ full

$0 + 4(4) \% 8 = 0$ full

$0 + 5(4) \% 8 = 4$ full

$0 + 6(4) \% 8 = 0$ full

double size ← ∴ infinite loop

m = 16

0	40
1	75
2	80
3	44
4	36
5	50
6	14
7	
8	56
9	
10	
11	
12	
13	
14	
15	

insert 80: $h_1 = 2$

2%

$2 + 0(h_2)$ % 16 = 2

insert 14: $h_1 = 2$

$h_2 = 9$ $2 + 0(h_2)$ % 16 = 2 full

$2 + 1(9)$ % 16 = 6

insert 40: $h_1 = 0$

$0 + 0(h_2)$ % 16 = 0

insert 36: $h_1 = 4$

$4 + 0(h_2)$ % 16 = 4

insert 56: $h_1 = 0$

$h_2 = 4$

$0 + 1(4)$ % 16 = 4 full

$0 + 2(4)$ % 16 = 8

insert 75:

$h_1 = 3(75)$ % 8 = 1

$h_2 =$

$1 + 0(h_2)$ % 16 = 1

insert 44:

$h_1 = 3(44) \bmod 8 = 3$

$3 + 0(h_2) \bmod 16 = 3$

insert 50: 150 % 16 = 6

$6 + 0(h_2)$ % 16 = 6 full

$h_2 = 5(50) + 3$ % 7 + 1 = 2

$3 + 1(2) = 5$

Cuckoo Hashing

table 1	
0	23
1	
2	12
3	10
4	22
5	
6	46

table 2	
0	24
1	
2	
3	17
4	
5	85
6	

insert 10:

$h_1 = 3(10) + 1 \ \% 7 = 3$

$h_2 = \left[\lfloor 5(10)/2 \rfloor + 3 \right] \% 7 = 0$

insert 22:

$h_1 = 3(22) + 1 \ \% 7 = 4$

$h_2 = \left[\lfloor 5(22)/2 \rfloor + 3 \right] \% 7 = 2$

insert 24:

$h_1 = 3(24) + 1 \ \% 7 = 3$ full

$h_2 = \left[\lfloor 5(24)/2 \rfloor + 3 \right] \% 7 = 0$

insert 17:

$3(17) + 1 \ \% 7 = 3$ full

$\left[\lfloor 5(17)/2 \rfloor + 3 \right] \% 7 = 3$

insert 85:

$3(85) + 1 \bmod 7 = 4$ full

$\lfloor 5(85)/2 \rfloor + 3 \bmod 7 = 5$

insert 23:

$h_1 = 3(23) + 1 \bmod 7 = 0$

insert 12:

$h_1 = 3(12) + 1 \bmod 7 = 2$

insert 46:

$h_1 = 3(46) + 1 \bmod 7 = 6$