Problem #2 3-25-18

PID: 5160328

Given: $h(k) = k \bmod \text{TableSize}$, where TableSize = 11.

Insert $\{10, 22, 31, 4, 15, 28, 17, 88, 59\}$

(a) Linear probing

Probing function: $h_i(k) = (h(k) + i) \bmod \text{TableSize}$, for $i = 1, 2, 3, \ldots$

Resulting Table:

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

$h(10) = 10 \% 11 = 10$
$h(22) = 22 \% 11 = 0$
$h(31) = 31 \% 11 = 9$
$h(4) = 4 \% 11 = 4$
$h(15) = 15 \% 11 = 4$ (collision)
$h_1(15) = (4 + 1) \% 11 = 5$
$h(28) = 28 \% 11 = 6$
$h(17) = 17 \% 11 = 6$ (collision)
$h_1(17) = (6 + 1) \% 11 = 7$
$h(88) = 88 \% 11 = 0$ (collision)
$h_1(88) = (0 + 1) \% 11 = 1$
$h(59) = 59 \% 11 = 4$ (collision)
$h_1(59) = (4 + 1) \% 11 = 5$ (collision)
$h_2(59) = (4 + 2) \% 11 = 6$ (collision)
$h_3(59) = (4 + 3) \% 11 = 7$ (collision)
$h_4(59) = (4 + 4) \% 11 = 8$

(b) Quadratic Probing

Probing Function:

$h_i(k) = (h(k) + 3i^2 + i) \bmod \text{TableSize}$ for $i = 1, 2, 3, \ldots$

Resulting Table:

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

$h(10) = 10 \% 11 = 10$
$h(22) = 22 \% 11 = 0$
$h(31) = 31 \% 11 = 9$
$h(4) = 4 \% 11 = 4$
$h(15) = 15 \% 11 = 4$ (collision)
$h_1(15) = (4 + (3)(1)^2 + (1)) \% 11 = 8 \% 11 = 8$
$h(28) = 28 \% 11 = 6$
$h(17) = 17 \% 11 = 6$ (collision)
$h_1(17) = (6 + (3)(1)^2 + (1)) \% 11 = 10 \% 11 = 10$ (collision)
$h_2(17) = (6 + (3)(2)^2 + (2)) \% 11 = 20 \% 11 = 9$ (collision)
$h_3(17) = (6 + (3)(3)^2 + (3)) \% 11 = 36 \% 11 = 3$
$h(88) = 88 \% 11 = 0$ (collision)
$h_1(88) = (0 + (3)(1)^2 + (1)) \% 11 = 4 \% 11 = 4$ (collision)
$h_2(88) = (0 + (3)(2)^2 + (2)) \% 11 = 14 \% 11 = 3$ (collision)
$h_3(88) = (0 + (3)(3)^2 + (3)) \% 11 = 30 \% 11 = 8$ (collision)
$h_4(88) = (0 + (3)(4)^2 + (4)) \% 11 = 52 \% 11 = 8$ (collision)
$h_5(88) = (0 + (3)(5)^2 + 5) \% 11 = 80 \% 11 = 3$ (collision)
$h_6(88) = (0 + (3)(6)^2 + 6) \% 11 = 114 \% 11 = 4$ (collision)
$h_7(88) = (0 + (3)(7)^2 + 7) \% 11 = 154 \% 11 = 0$ (collision)
$h_8(88) = (0 + (3)(8)^2 + 8) \% 11 = 200 \% 11 = 2$ ✓
$h(59) = 59 \% 11 = 4$ (collision)
$h_1(59) = (4 + (3)(1)^2 + 1) \% 11 = 8$ (collision)
$h_2(59) = (4 + (3)(2)^2 + 2) \% 11 = 18 \% 11 = 7$ ✓

(c) Double Hashing

Given: $U(k) = k$ and $V(k) = 1 + (k \bmod (\text{TableSize} - 1))$

Probing function: $h_i(k) = [U(k) + i * V(k)] \bmod \text{TableSize}$

Resulting Table:

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

$h(10) = 10 \% 11 = 10$
$h(22) = 22 \% 11 = 0$
$h(31) = 31 \% 11 = 9$
$h(4) = 4 \% 11 = 4$
$h(15) = 15 \% 11 = 4$ (collision)
↳ $V(15) = 1 + (15 \% 10) = 6$
$h_1(15) = [15 + (1)(6)] \% 11 = 21 \% 11 = 10$ (collision)
$h_2(15) = [15 + (2)(6)] \% 11 = 27 \% 11 = 5$
$h(28) = 28 \% 11 = 6$
$h(17) = 17 \% 11 = 6$ (collision)
↳ $V(17) = 1 + (17 \% 10) = 8$
$h_1(17) = [17 + (1)(8)] \% 11 = 25 \% 11 = 3$
$h(88) = 88 \% 11 = 0$ (collision)
↳ $V(88) = 1 + (88 \% 10) = 9$
$h_1(88) = [88 + (1)(9)] \% 11 = 9$ (collision)
$h_2(88) = [88 + (2)(9)] \% 11 = 106 \% 11 = 7$
$h(59) = 59 \% 11 = 4$ (collision)
↳ $V(59) = 1 + (59 \% 10) = 10$
$h_1(59) = [59 + (1)(10)] \% 11 = 3$ (collision)
$h_2(59) = [59 + (2)(10)] \% 11 = 2$