**B1**. Two desirable properties of hash function are:

- Very fast to compute

- Minimize duplication of output values(Collisions)

**B2**. Hash function h(i) = (2i + 5) % 11;

Keys: 12, 44, 13, 88, 23, 94, 11, 39, 20, 16, 5;

h(12) = (2\*12+5) mod 11 = 29 mod 11 = 7

h(44) = (2\*44+5) mod 11 = 93 mod 11 = 5

h(13) = (2\*13+5) mod 11 = 31 mod 11 = 9

h(88) = (2\*88+5) mod 11 = 181 mod 11 = 5

h(23) = (2\*23+5) mod 11 = 51 mod 11 = 7

h(94) = (2\*94+5) mod 11 = 193 mod 11 = 6

h(11) = (2\*11+5) mod 11 = 27 mod 11 = 5

h(39) = (2\*39+5) mod 11 = 83 mod 11 = 6

h(20) = (2\*20+5) mod 11 = 45 mod 11 = 1

h(16) = (2\*16+5) mod 11 = 37 mod 11 = 4

h(5) = (2\*5+5) mod 11 = 15 mod 11 = 4

a) Separate chaining:

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| ***1*** | 20 |  |  |
| ***2*** |  |  |  |
| ***3*** |  |  |  |
| ***4*** | 16 | 5 |  |
| ***5*** | 44 | 88 | 11 |
| ***6*** | 94 | 39 |  |
| ***7*** | 12 | 23 |  |
| ***8*** |  |  |  |
| ***9*** | 13 |  |  |
| ***10*** |  |  |  |

b) Linear probing:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 11 | 39 | 20 | 5 | 16 | 44 | 88 | 12 | 23 | 13 | 94 |
| ***0*** | ***1*** | ***2*** | ***3*** | ***4*** | ***5*** | ***6*** | ***7*** | ***8*** | ***9*** | ***10*** |

**B3**. Hash function h(i) = (i + 3) mod 17

Keys: 1, 3, 18, 8, 23, 35, 11, 36, 20, 16;

h(1) = (1+3) mod 17 = 4 mod 17 = 4

h(3) = (3+3) mod 17 = 6 mod 17 = 6

h(18) = (18+3) mod 17 = 21 mod 17 = 4

h(8) = (8+3) mod 17 = 11 mod 17 = 11

h(23) = (23+3) mod 17 = 26 mod 17 = 9

h(35) = (35+3) mod 17 = 38 mod 17 = 4

h(11) = (11+3) mod 17 = 14 mod 17 = 14

h(36) = (36+3) mod 17 = 39 mod 17 = 5

h(20) = (20+3) mod 17 = 23 mod 17 = 6

h(16) = (16+3) mod 17 = 19 mod 17 = 2

a) Separate chaining:

|  |  |  |  |
| --- | --- | --- | --- |
| ***0*** |  |  |  |
| ***1*** |  |  |  |
| ***2*** | 16 |  |  |
| ***3*** |  |  |  |
| ***4*** | 1 | 18 | 35 |
| ***5*** | 36 |  |  |
| ***6*** | 3 | 20 |  |
| ***7*** |  |  |  |
| ***8*** |  |  |  |
| ***9*** | 23 |  |  |
| ***10*** |  |  |  |
| ***11*** | 8 |  |  |
| ***12*** |  |  |  |
| ***13*** |  |  |  |
| ***14*** | 11 |  |  |
| ***15*** |  |  |  |
| ***16*** |  |  |  |

b) Linear probing:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 16 |  | 1 | 18 | 3 | 35 | 36 | 23 | 20 | 8 |  |  | 11 |  |  |
| ***0*** | ***1*** | ***2*** | ***3*** | ***4*** | ***5*** | ***6*** | ***7*** | ***8*** | ***9*** | ***10*** | ***11*** | ***12*** | ***13*** | ***14*** | ***15*** | ***16*** |