Assignment 7

R-2.19 Draw the 11-item hash table resulting from hashing the keys 12, 44, 13, 88, 23, 94, 11, 39, 20, 16, and 5, using the hash function *h(i)* = (2*i* + 5) mod 11 and assuming collisions are handled by chaining.

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

hash(key) = (2key+5) mod 11

key = 12, 44, 13, 88, 23, 94, 11, 39, 20, 16, 5

H = 7, 5, 9, 5, 7, 6, 5, 6, 1, 4, 4

5=2, 88=2, 11=3, 39=2, 23=2

Average = 18/11 = 1.6363

R-2.20 What is the result of the previous exercise, assuming collisions are handled by linear probing?

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

hash(key) = (2key+5) mod 11

key = 12, 44, 13, 88, 23, 94, 11, 39, 20, 16, 5

H = 7, 5, 9, 6, 8, 10, 0, 1, 2, 4, 3

12=1, 44=1, 13=1, 88=2, 23=2, 94=5, 11=7, 39=7, 20=2, 16=1, 5=11

Average = 40/11 = 3.6363

R-2.21 Show the result of Exercise R-2.19, assuming collisions are handled by quadratic probing, up to the point where the method fails because no empty slot is found.

Quadratic probing formula is **A[(i+j2) mod N] = A[(i+52) mod 11]**

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

Quadratic probing is **A[(i+j2) mod N]** doesn’t be 0.

R-2.22 What is the result of Exercise R-2.19 assuming collisions are handled by double hashing using a secondary hash function *h’(k)* = 7 – (*k* mod 7) ?

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

A screenshot of a computer program

Description automatically generated with low confidence

Give the pseudo-code description for performing a removal from a hash table that uses linear probing to resolve collisions. Why is it necessary to use a special marker to represent deleted elements?

|  |
| --- |
| removeLinearProbing(key):  index = hash\_function(key)  **while** table[index] **is** **not** **None**:  **if** table[index] == key:  table[index] = DELETED  num\_elements -= 1  **return**  index = (index + 1) % size  **raise** NO\_KEY\_FOUND |