Homework 4

Monday, October 31, 2022 2:41 PM

Problem 1

0	
1	
2	12
3	13
4	2
5	3
6	23
7	5
8	18
9	15

Insert 12 : 12 mod 10 = 2 → Index 2 - open
Insert 18 : 18 mod 10 = 8 → Index 8 - Open
Insert 13 : 13 mod 10 = 3 → Index 3 - Open
Insert 2 : 2 mod 10 = 2 → Index 2 - Closed, implement index 4 open
Insert 3 : 3 mod 10 = 3 → Index 3 - Closed, implement index 5 open
Insert 23 : 23 mod 10 = 3 → Index 3 - Closed, implement index 6 open
Insert 5 : 5 mod 10 = 5 → Index 5 - Closed, implement index 7 open
Insert 15 : 15 mod 10 = 5 → Index 5 - Closed, implement index 9 open

Problem 2

$h_1(x) = x \bmod 5$
$h_2(x) = x \bmod 10$

Function $(h_1(x) + i * h_2(x)) \% 11$

0	70
1	71
2	72
3	28
4	32
5	35
6	74
7	36
8	56
9	37
10	

Add(70) $h_1(70) = 70 \bmod 5 = 0$ - Index 0 open
Add(71) $h_1(71) = 71 \bmod 5 = 1$ - Index 1 open
Add(72) $h_1(72) = 72 \bmod 5 = 2$ - Index 2 open
Add(32) $h_1(32) = 32 \bmod 5 = 2$ - Index 2 closed
→ Function: $(h_1(32) + 1 * h_2(32)) \% 11$
$(2 + 2) \% 11$
$= 4$ - Index 4 open
Add(28) $h_1(28) = 28 \bmod 5 = 3$ - Index 3 open
Add(35) $h_1(35) = 35 \bmod 5 = 0$ - Index 0 closed
→ Function: $(h_1(35) + 1 * h_2(35)) \% 11$
$= (0 + 1 * 5) \% 11$
$= 5 \% 11 = 5$ - Index 5 open

Add(36) $h_1(36) = 36 \bmod 5 = 1$ - Index 1 closed
→ Function: $(h_1(36) + 1 * h_2(36)) \% 11$
$(1 + 1 * 6) \% 11$
$7 \% 11 = 7$ - Index 7 open

Add(37) $h_1(37) = 37 \bmod 5 = 2$ - Index 2 closed
→ Function: $(h_1(37) + 1 * h_2(37)) \% 11$
$(2 + 1 * 7) \% 11$
$9 \% 11 = 9$ - Index 9 Closed

Add(56) $h_1(56) = 56 \bmod 5 = 1$ - Index 1 closed
→ Function: $(h_1(56) + 1 * h_2(56)) \% 11$
$(1 + 1 * 6) \% 11$
$7 \% 11 = 7$ - Index 7 closed

$(h_1(56) + 2 * h_2(56)) \% 11$
$1 + 2 * 6 \% 11$
$13 \% 11 = 2$ - Index 2 closed

$(h_1(56) + 3 * h_2(56)) \% 11$
$1 + 3 * 6 \% 11$
$19 \% 11 = 8$ - Index 8 open

Add(74) $h_1(74) = 74 \bmod 5 = 4$ - Index 4 closed
Function $(h_1(74) + 1 * h_2(74)) \% 11$
$(4 + 1 * 4) \% 11$
$8 \% 11 = 8$ - Index 8 closed

Function $(h_1(74) + 2 * h_2(74)) \% 11$
$(4 + 2 * 4) \% 11$
$12 \% 11 = 1$ - Index 1 closed

Function $(h_1(74) + 3 * h_2(74)) \% 11$
$(4 + 3 * 4) \% 11 = 5$ - Index 5 closed

Function $(h_1(74) + 4 * h_2(74)) \% 11$
$(4 + 4 * 4) \% 11 = 9$ - Index 9 closed

Function $(h_1(74) + 5 * h_2(74)) \% 11$
$(4 + 5 * 4) \% 11 = 2$ - Index 2 closed

Function $(h_1(74) + 6 * h_2(74)) \% 11$
$(4 + 6 * 4) \% 11 = 6$ - Index 6 open

b. Delete (72). From $h_1(72) \rightarrow$ index = 2. Go to table, index 2 contain 72 → delete
Now index 2 is opened

Delete (56). From $h_1(56) \rightarrow$ index 1. Go to table, index 1 not 56
→ To funtion $(h_1(56) + i * h_2(56)) \% 11$, $i = 1 \rightarrow$ index 7 (not 56), go to
$i = 2 \rightarrow$ index 2 (not 56) → go to $i = 3 \rightarrow$ index 8 (is 56) → delete. Now index 8 open

c. Since every key shares at least 1 common factor with number of buckets m will be hashed to a bucket that is multiple of this factor, therefore, the prime number of buckets (m) reduced the number of common factor between number of buckets & keys.

Problem 3.

- Create a hash Table
- Add all keys of T set into hash Table. Since all keys of T needed to add is O(n), each key can take O(1) time to insert to hash Table. ⇒ To add T set: $O(n) \times O(1) = O(n)$
- For each key is S set, search in hash Table takes O(1). Searching all keys in S takes O(m). If key can be found in T, continue next search. If there's 1 key cannot be found, return false. Else, if all keys in S found in T, return true (S is subset of T)
⇒ $O(m) \times O(1) = O(m)$

- Because S is subset of T ⇒ $m \leq n$ ⇒ $O(m) \leq O(n)$
⇒ Algorithms to indicate if S is subset of T O(n)