HABIB UNIVERSITY

Data Structures & Algorithms

CS/CE 102/171 Spring 2023

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Hash Table Operations – Collision Handling Using Double Hashing – Pseudorandom Rehashing

Student 1: _____

For a hash table with size = 8, use Rotation method – rotate twice, and choose the first digit to get the slot index. Assume the order of random numbers generated as 3, 1, 3, 1, 3, 1, and continues until needed to resolve Collisions.

1. setitem(181728)

- Hash Function = Rotate twice & choose 1st digit
- 1st rotation = **8** 18172
- 2nd rotation = **2** 81817
- Slot Index = 2
- Empty slot, no collision so slot index = 2 gets key = 181728

0	
1	
2	**181728**
3	
4	
5	
6	
7	

2. setitem(1357)

- Hash Function = Rotate twice & choose 1st digit
- 1st rotation = **7** 135
- 2nd rotation = **5** 713
- Slot Index = 5
- Empty slot, no collision so slot index = 5 gets key = 1357

0	
1	
2	181728
3	
4	
5	**1357**
6	
7	

3. setitem(666666)

- Hash Function = Rotate twice & choose 1st digit
- 1st rotation = **6** 66666
- 2nd rotation = **6** 66666
- Slot Index = 6
- Empty slot, no collision so slot index = 6 gets key = 666666

0	
1	
2	181728
3	
4	
5	1357
6	**666666**
7	

4. setitem(30200203)

- Hash Function = Rotate twice & choose 1st digit
- 1st rotation = **3** 3020020
- 2nd rotation = **0** 3302002
- Slot Index = 0
- Empty slot, no collision so slot index = 0 gets key = 30200203

0	**30200203**
1	
2	181728
3	
4	
5	1357
6	666666
7	

5. setitem(12345)

- Hash Function = Rotate twice & choose 1st digit
- 1st rotation = **5** 1234
- 2nd rotation = **4** 5123
- Slot Index = 4
- Empty slot, no collision so slot index = 4 gets key = 12345

0	30200203
1	
2	181728
3	
4	**12345**
5	1357
6	666666
7	

6. getitem(1357)

- Hash Function = Rotate twice & choose 1st digit
- 1st rotation = **7** 135
- 2nd rotation = **5** 713
- Slot Index = 5
- Go to slot index 5 and check if key exists. It does, so it returns **True**
- Hash Table does not change

0	30200203
1	
2	181728
3	
4	12345
5	1357
6	666666
7	

7. setitem(46222329)

- Hash Function = Rotate twice & choose 1st digit
- 1st rotation = **9** 4622232
- 2nd rotation = **2** 9462223
- Slot Index = 2
- Already a key present in slot 2, so use pseudorandom rehashing to rehash the new address as:
- **$h_1(k) = [h_0(k) + \text{Random Generated Number}] \bmod N$**
- $h_1(46222329) = [h_0(46222329) + \text{Random Generated Number}] \bmod 8$
- $h_0(46222329) = 2$ (as calculated above)
- First Random number generated = 3
- $h_1(46222329) = [2 + 3] \bmod 8 = 5 \bmod 8 = 5$
- Slot index = 5
- Already a key present in slot 5, so use pseudorandom rehashing to rehash the new address as:
- **$h_2(k) = [h_1(k) + \text{Random Generated Number}] \bmod N$**
- $h_2(46222329) = [h_1(46222329) + \text{Random Generated Number}] \bmod 8$
- $h_1(46222329) = 5$ (as calculated above)
- Second Random number generated = 1
- $h_2(46222329) = [5 + 1] \bmod 8 = 6 \bmod 8 = 6$
- Slot index = 6
- Already a key present in slot 6, so use pseudorandom rehashing to rehash the new address as:
- **$h_3(k) = [h_2(k) + \text{Random Generated Number}] \bmod N$**
- $h_3(46222329) = [h_2(46222329) + \text{Random Generated Number}] \bmod 8$
- $h_2(46222329) = 6$ (as calculated above)
- Third Random number generated = 3
- $H_3(46222329) = [6 + 3] \bmod 8 = 9 \bmod 8 = 1$
- Slot index = 1
- Empty slot, no collision so slot index = 1 gets key = 46222329

0	30200203
1	**46222329**
2	181728
3	
4	12345
5	1357
6	666666
7	

8. setitem(48730)

- Hash Function = Rotate twice & choose 1st digit
- 1st rotation = **0** 4873
- 2nd rotation = **3** 0487
- Slot Index = 3
- Empty slot, no collision so slot index = 3 gets key = 48730

0	30200203
1	46222329
2	181728
3	**48730**
4	12345
5	1357
6	666666
7	

9. delitem(1357)

- Hash Function = Rotate twice & choose 1st digit
- 1st rotation = **7** 135
- 2nd rotation = **5** 713
- Slot Index = 5
- Go to slot index 5 and check if key exists. It does, so it deletes the given key from this slot index

0	30200203
1	46222329
2	181728
3	48730
4	12345
5	
6	666666
7	

10. setitem(944)

- Hash Function = Rotate twice & choose 1st digit
- 1st rotation = **4** 94
- 2nd rotation = **4** 49
- Slot Index = 4
- Already a key present in slot 4, so use pseudorandom rehashing to rehash the new address as:
- **$h_1(k) = [h_0(k) + \text{Random Generated Number}] \bmod N$**
- $h_1(944) = [h_0(944) + \text{Random Generated Number}] \bmod 8$
- $h_0(944) = 4$ (as calculated above)
- First Random number generated = 3
- $h_1(944) = [4 + 3] \bmod 8 = 7 \bmod 8 = 7$
- Slot index = 7
- Empty slot, no collision so slot index = 7 gets key = 944

0	30200203
1	46222329
2	181728
3	48730
4	12345
5	
6	666666
7	**944**

- getitem(449)
- Hash Function = Rotate twice & choose 1st digit
- 1st rotation = **9** 44
- 2nd rotation = **4** 94
- Slot Index = 4
- Go to slot index 4, and check if key exists. It doesn't, so use pseudorandom rehashing to rehash the new address as:
- **$h_1(k) = [h_0(k) + \text{Random Generated Number}] \bmod N$**
- $h_1(449) = [h_0(449) + \text{Random Generated Number}] \bmod 8$
- $h_0(449) = 4$ (as calculated above)
- First Random number generated = 3
- $h_1(449) = [4 + 3] \bmod 8 = 7 \bmod 8 = 7$
- Slot index = 7
- Go to slot index 7, and check if key exists. It doesn't, so use pseudorandom rehashing to rehash the new address as:
- **$h_2(k) = [h_1(k) + \text{Random Generated Number}] \bmod N$**
- This continues until the rehashing results back to slot index 4, by which time all the slots would have been checked and 449 would not have been found, so it gives an error that the key does not exist, and returns **False**
- Hash Table does not change

0	30200203
1	46222329
2	181728
3	48730
4	12345
5	
6	666666
7	944