Course: Data Structures (CSE CS203A, 114-1)
Quiz III: Hash Table
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Part A: Hash Table Definitions (Conceptual Understanding)

Q1. Define "collision" in the context of hash tables.

A1: keys after calculate by hash function has same hash value.
It means we need to decide to put those keys where.

Q2. What is a "bucket" in a hash table?

A2: The space that store value.

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Q3. Define "load factor (α)" and explain why it affects performance.

A3: load factor(α) shows how strong a hash table's collision has.
If a table has lot of collision, it doesn't has a good rate using.

Q4. What is "primary clustering," and which probing method suffers from it?

A4: Linear probing may lead to this. It means many keys has the same value after h(key), but their place in bucket(h(key)+i), i=0,1...n. All keys has same h(key) are stored side by side.

Q5. What is "secondary clustering," and how is it different from primary clustering?

A5: All keys has same h(key) (h() means hash function) are stored by a regular space. for example. key1 is stored at bucket(i), key2 is stored at bucket(i+n), keys at bucket(i+
Secondary clustering is more serberate than primary one but may leads to some keys can not get their own space.

Q6. Briefly explain the difference between:

- Open addressing → array only
- Separate chaining → array + linked list

A6: Open addressing:
- need more computing to determine where key is put.
- if collision happend, need a way to find another space to put key
- good space using rate

Separate chaining
- just add the node after h(key)
- don't need to worried about collision.
- May have lots of array spaces don't be

Part B: Hash Function Calculation (Collision & Pattern Observation)

Show your steps clearly.

Hash Function 1 — Division Method

$$h_1(k) = k \bmod 10$$

Hash Function 2 — Folding Method

Split key into two-digit chunks and sum the chunks.

$$h_2(k) = (sum\ of\ 2-digit\ groups) \bmod 11$$

Example:

Key = 8429 → groups: 84 + 29 → 113 → 113 mod 11 = 3

Q7. (Compute using Hash Function 1)

Given keys: 27, 37, 47, 57, 67

Compute their hash values using:

$$h_1(k) = k \bmod 10$$

A7: $h_1(27) = 7$ $h_1(57) = 7$

$h_1(37) = 7$ $h_1(67) = 7$

$h_1(47) = 7$

Q8. (Identify collision pattern)

From your results in Q7:

- What pattern do you observe?
- Explain why these keys collide.

A8: All keys has same hash values after $h_1()$.

because they have same digit. first-

Q9. (Compute using Hash Function 2)

Compute $h_2(k)$ for: 1234, 9217, 4519, 9902

A9:

$h_2(1234) = 12+34 \Rightarrow 46 \bmod 11 = 2$

$h_2(9217) = 92+17 \Rightarrow 109 \bmod 11 = 10$

$h_2(4519) = 45+19 \Rightarrow 64 \bmod 11 = 9$

$h_3(9902) = 99+02 \Rightarrow 101 \bmod 11 = 2$

Q10. (Compare distribution)

- Which hash function (h_1 or h_2) produced more collisions for the input set?
- Which seems to spread keys more evenly?
- Provide 1–2 sentences of explanation.

A10: h_1 use mod10, will lead the hash value only has 0 ~ 9.

h_1 has more collisions because

h_2 may spread keys more evenly because it has more calculate and also, mod11 will let to determine hash value

hash value between 0 ~ 10, more than h_1.