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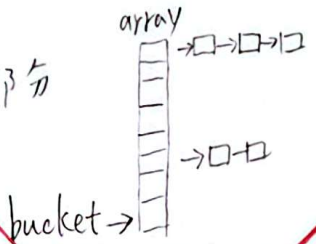
Part A: Hash Table Definitions (Conceptual Understanding)

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

A1: 經過 hash function 有 2 個以上的 key 得到相同的結果

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

A2: hash table 中 array 的部分



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

A3: α = 資料總數量 ÷ 儲存的空間大小
α 值越大，發生 collision 的可能越大

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

A4: 1. mod m，其中的 m 不是質數
2. 存於空間過小
造成得出的結果有集中的現象

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

A5: key 經過各種運算後，得出的結果一樣有集中的現象

Q6. Briefly explain the difference between:

- **Open addressing**
- **Separate chaining**

A6: Open addressing 是連續的空間像是 array，會浪費較多空間
Separate chaining 是用 Linked List，非連續空間，較少空間浪費

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: $h_1(k)$

27 → 7

37 → 7

47 → 7

$h_1(k)$

57 → 7

67 → 7

Q8. (Identify collision pattern)

From your results in Q1:

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

A8: 所有的 key 經過 $h_1(k)$ 都得到 7

因為 $h_1(k)$ 中是 key mod 10，同等於取 key 的個位數.

Q9. (Compute using Hash Function 2)

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

A9:

1234 → 12+34 → 46 → 46 mod 11 → 2

9217 → 92+17 → 109 → 109 mod 11 → 10

4519 → 45+19 → 64 → 64 mod 11 → 9

9902 → 99+2 → 101 → 101 mod 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: $h_1(k)$ 出現更多 collisions，$h_2(k)$ 將 key 分佈的更平均

$h_1(k)$ 只看個位數字，$h_2(k)$ 將 key 分成兩段再相加取 mod 11.

mod 質數比 mod 非質數可以得到較少 collision.