Course: Data Structures (CSE CS203A, 114-1)

Quiz III: Hash Table

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Student ID: 1130824 Student Name: 何若宇

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Part A: Hash Table Definitions (Conceptual Understanding)

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

A1: key 經由 hash function 轉成 index

有相同 index ⇒ collision

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

A2: array 結構，存放 index

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

A3: $\alpha = \frac{element}{table\ size}$ α↑ ⇒ 填充程度↑ ⇒ 時間複雜度較大

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

A4: 連續聚集的，會造成探查長度↑，會聚集越來越多。 ↓ linear probing

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

A5: 不同 key，相同 h(k) ex: 平方 probing

經由一樣程序會得出相同結果

定義不同，primary clustering ⇒ 會聚集在一起

secondary clustering ⇒ 得出的結果會一樣

Q6. Briefly explain the difference between:

- Open addressing
- Separate chaining

A6: open addressing：尋找空的 slot，ex: linear probing

append/array 來處理

separate chaining：用 linked list 處理 collision

array + linked list

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: 27 mod 10 = 7
37 mod 10 = 7
47 mod 10 = 7
57 mod 10 = 7
67 mod 10 = 7

Q8. (Identify collision pattern)

From your results in Q1:

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

A8: $h_1(k)$ 都 = 7. 會 collision
皆是7
經由 hash function 將 key 轉成 index. ⇒ 有相同 index ⇒ collision

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: h1
h2
h1 more collisions ⇒ 皆=7, mod 質數易 collision
非
h2 more evenly ⇒ mod 質數不容易 collision ⇒ 較平均分佈