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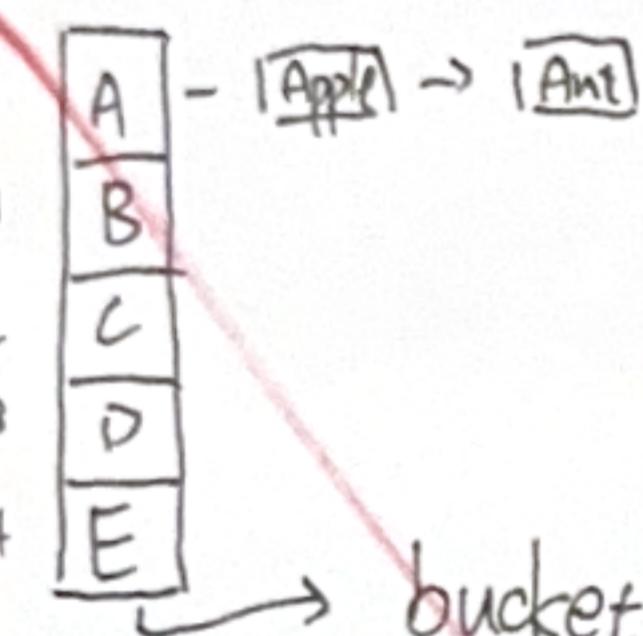
~~+10~~ Part A. Hash Table Definitions (Conceptual Understanding)

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

A1: 兩個或兩個以上的 value 只用一個 key

+5

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

A2: Q3. Define "load factor ( $\alpha$ )" and explain why it affects performance.A3:  $\alpha = n/m$  $n$  = 元素數量 $m$  = hashing function 數量 $\alpha$  越大，效能就愈差

X

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

A4:

primary clustering 是指經過 collision 後，會有一串主要的 Linked List 在儲存

Division probing

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

A5: secondary clustering 是次要的，比 primary clustering 更分散，效能會更好。  
能更好的分配空間

Q6. Briefly explain the difference between:

- Open addressing
- Separate chaining

A6:

Open addressing

用更多的 hashing function

Separate chaining

用 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.

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

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:

$$\begin{aligned} A7: h_1(27) &= 27 \bmod 10 = 7 \\ h_1(37) &= 37 \bmod 10 = 7 \\ h_1(47) &= 47 \bmod 10 = 7 \end{aligned}$$

$$\begin{aligned} h_1(k) &= k \bmod 10 \\ h_1(57) &= 57 \bmod 10 = 7 \\ h_1(67) &= 67 \bmod 10 = 7 \end{aligned}$$

Q8. (Identify collision pattern)

From your results in Q7:

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

A8: collision, 因為每個 value 都指向同一個 key

Q9. (Compute using Hash Function 2)

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

$$\begin{aligned} A9: h_2(1234) &= 12 + 34 \rightarrow 46 \rightarrow 46 \bmod 11 = 2 \\ h_2(9217) &= 92 + 17 \rightarrow 109 \rightarrow 109 \bmod 11 = 10 \\ h_2(4519) &= 45 + 19 \rightarrow 64 \rightarrow 64 \bmod 11 = 9 \\ h_2(9902) &= 99 + 02 \rightarrow 101 \rightarrow 101 \bmod 11 = 2 \quad \text{occupy} \end{aligned}$$

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:  $h_1$  produced more collisions  
 $h_2$  能更好的使用 key, 比較不容易形成 primary clustering, 效能會更好