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Theory I, Sheet 4

- The solutions should be submitted in English.
- JUST FOR FUN exercises are not mandatory.
- Your solutions should be delivered to the lockbox in building 051 floor 00, or right before the start of the tutorial (May 21, 4:00 p.m.).
- You are allowed to discuss your solutions with each other. Nevertheless, you are required to write down the answers in your own words.

Exercise 4.1 - Hashing: chaining

Insert the keys $8, 12, 15, 16, 19, 38, 27, 5, 21, 49, 65, 42$ into a hash table with collisions resolved by chaining. Let the table have 15 slots and let the hash function be $h(k) = k \mod 15$. Show the resulting table.

Exercise 4.2 - Hashing: open addressing

Consider an empty hash table of size 15. Insert the following keys

$$8, 12, 15, 16, 19, 38, 27, 5, 21, 49, 65, 42$$

using $h(k) = k \mod 15$ and:

1. Linear probing.
2. Quadratic probing.
3. Double hashing with $h'(k) = 1 + (k \mod 13)$.

Give the resulting tables.

Exercise 4.3 - Universal Hashing

JUST FOR FUN. Let $U = \{0, \ldots, N-1\}$, where N is 49 and m is 35. Let $a_i = 42 \cdot i$ and $b_i = 28 \cdot i$. Now consider the following class of hash functions.

$$\mathcal{H} = \{h_i(k) = ((a_i \cdot k + b_i) \mod N) \mod m\} \text{ for } i \in \{1, \ldots, N(N-1)\}$$

Is $\mathcal{H}$ universal? Prove your answer.