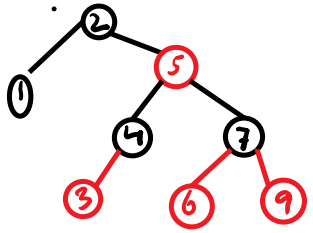


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# CS 201 Data Structure II (L2 / L5)

# Hash Tables

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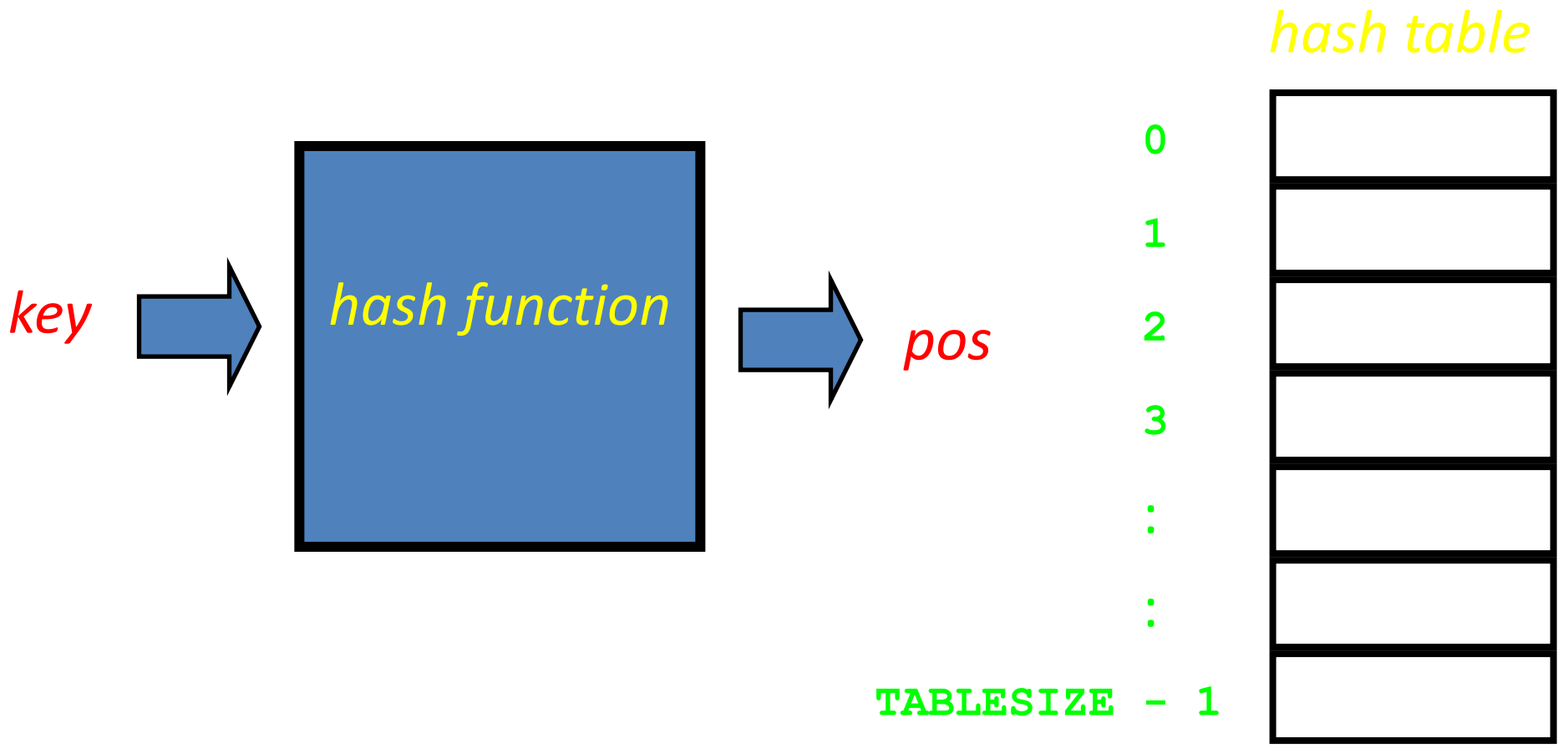
# Map ADT (Abstract Data Type)


- A Map stores “key” “value” pairs (k,v) called entries
- Each key should be unique
- There is a mapping from k to v
- k can be a primitive data type or an object
- It can be same as a part of the value
- E.g. phone book, yellow pages, dictionary

# Hash Function



# Example Hash function


- f(s) = char at f[0] % SIZE

- What would hash function return when size is 7
  - a =
  - asap =
  - bros =
  - pehlwan =
  - due =
  - logic =

# Collision

- When two keys are mapped to the same position.
- Very likely.
- Can be resolved by:
  - Linear Probing
  - Chaining

# Linear Probing

- Linear search in the array from the position where collision occurred.

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Used | Used | Empty | Empty | Empty | Empty | Empty | Used | Used | Deleted |
| k4 | k5 | | | | | | k2 | k1 | |

examples are discussed on board during the class.

# Chaining

- Us

§5.1 Hash Tables

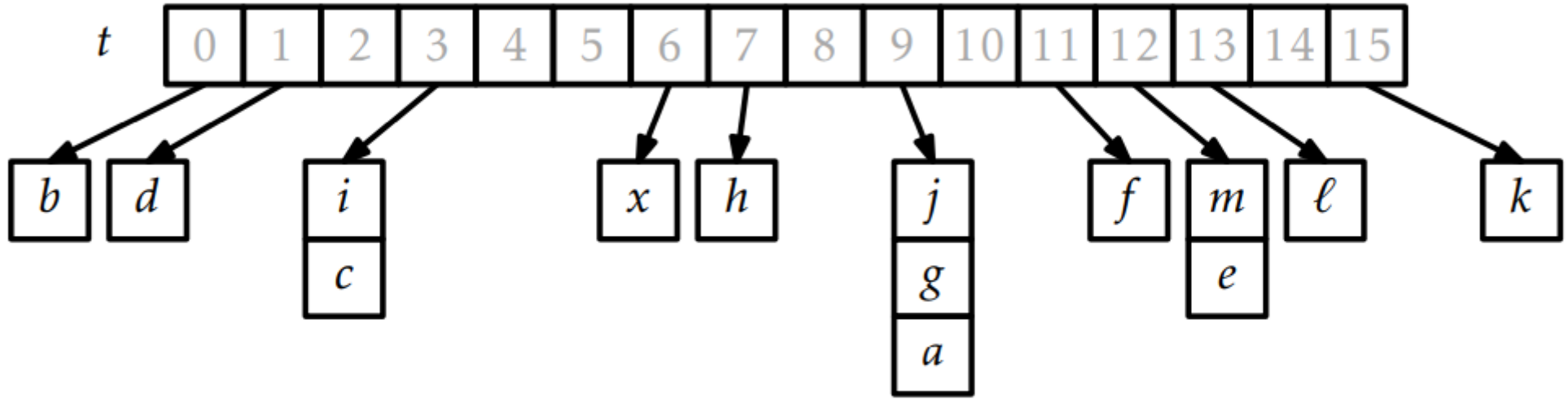



Figure 5.1: An example of a ChainedHashTable with $n = 14$ and length$(t) = 16$. In this example hash$(x) = 6$

Image: Open Data Structures

examples are discussed on board during the class.

# Chained Hash table

- Let’s have a hash-function f(x) such that:

  f(x) = number of characters in x

–Insert the following keys in a chained-hash table of size 10.

  - table, chair, flower, cat, try, kite

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

Image: Data Structures and Algorithms

# Linear Probing

- Let's have a hash-function f(x) such that:

  f(x) = number of characters in x

–Insert the following keys in a hash table of size 10 using linear probing:

  - table, chair, flower, cat, try, kite

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

# Resources

- Section 5.1 and 5.2 of the textbook Open Data Structures
- Visualization:

  https://www.cs.usfca.edu/~galles/visualization/OpenHash.html