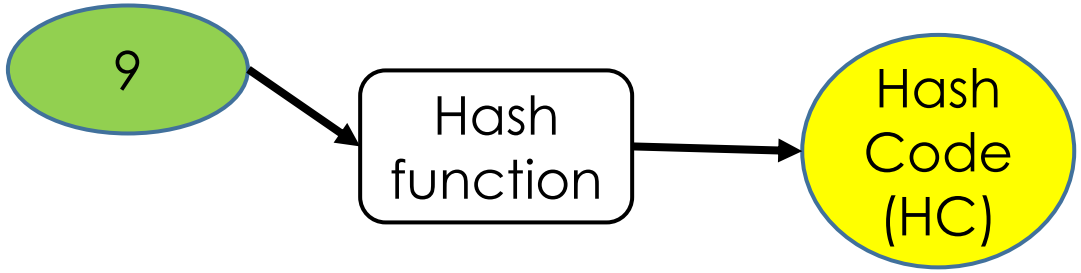
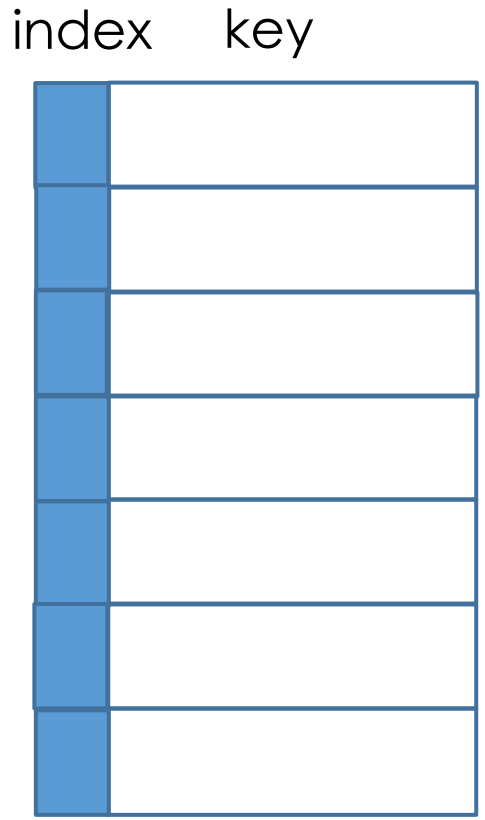
# Hash Tables: Collisions

# By the end of this video you will be able to…

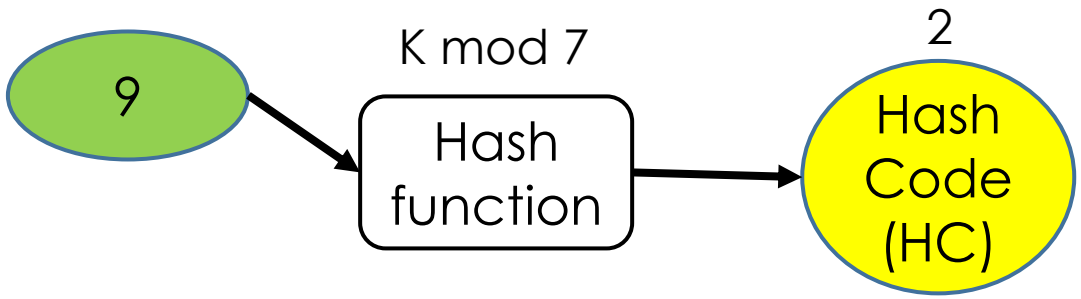
- Describe alternative methods for handling collisions in a Hash Table
- Identify other challenges associated with Hash Tables

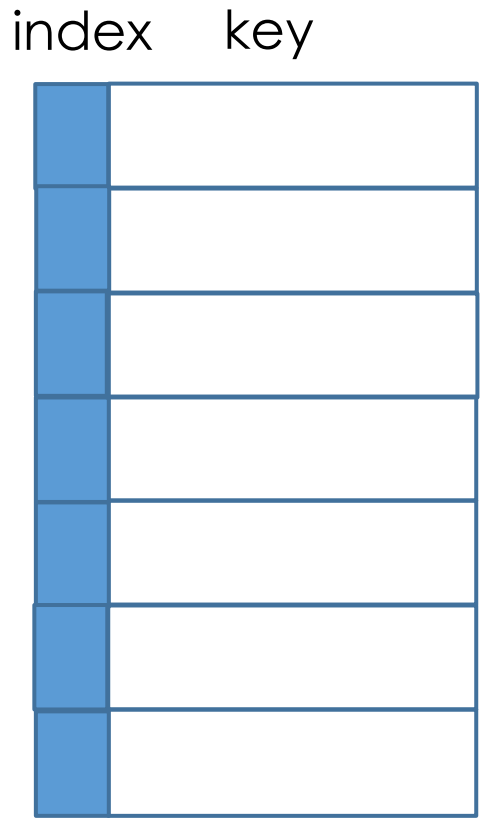
# Hash Table Insert



# Hash Table Insert



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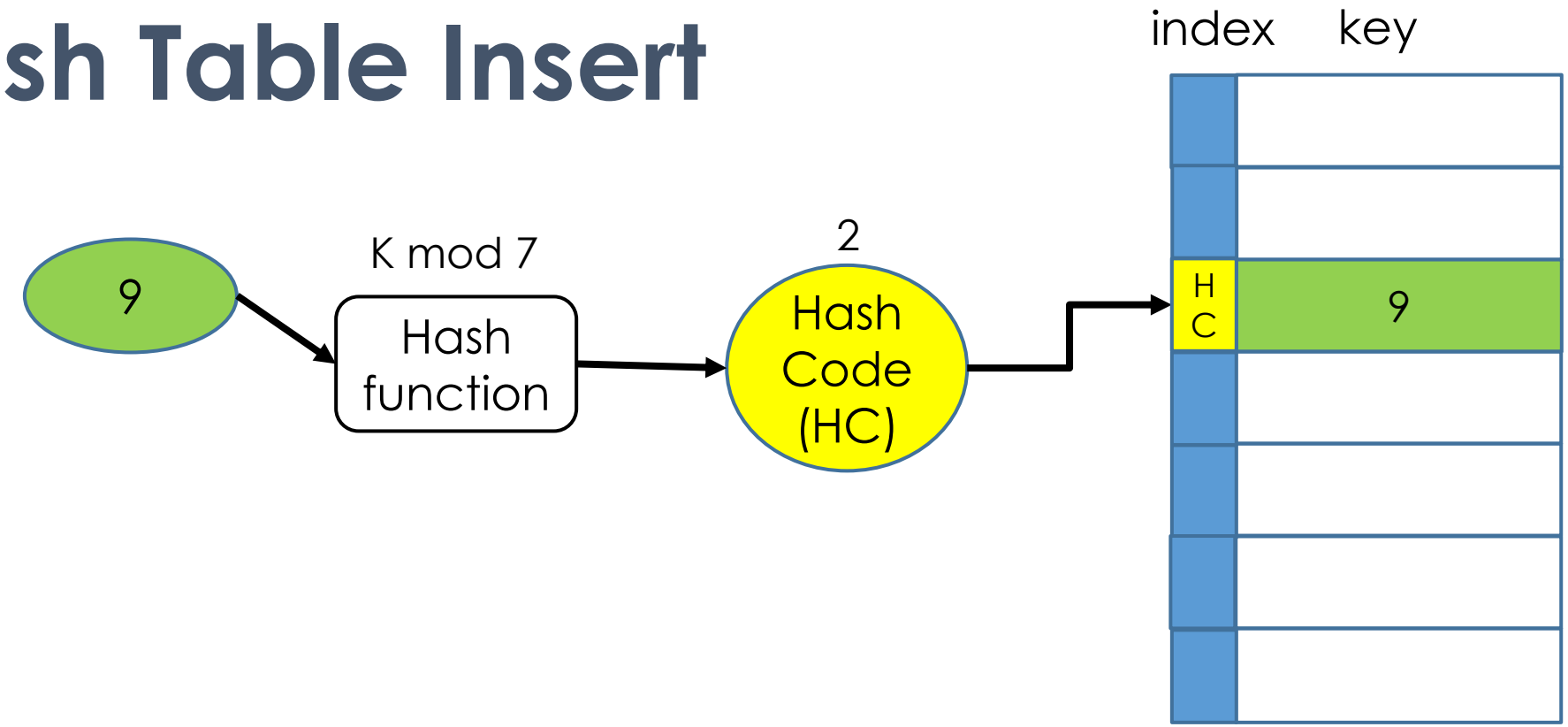
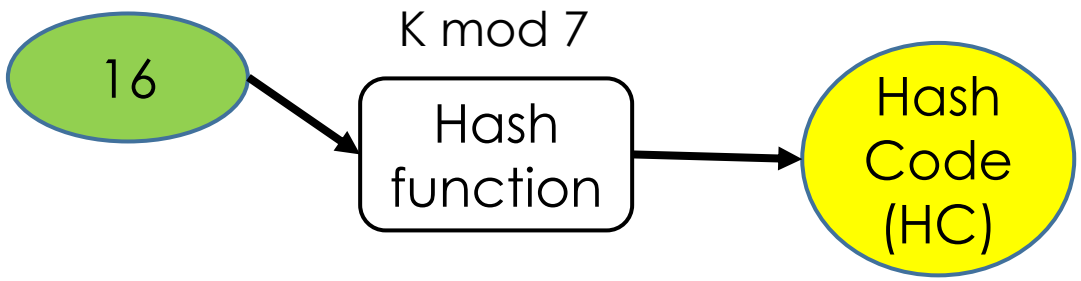
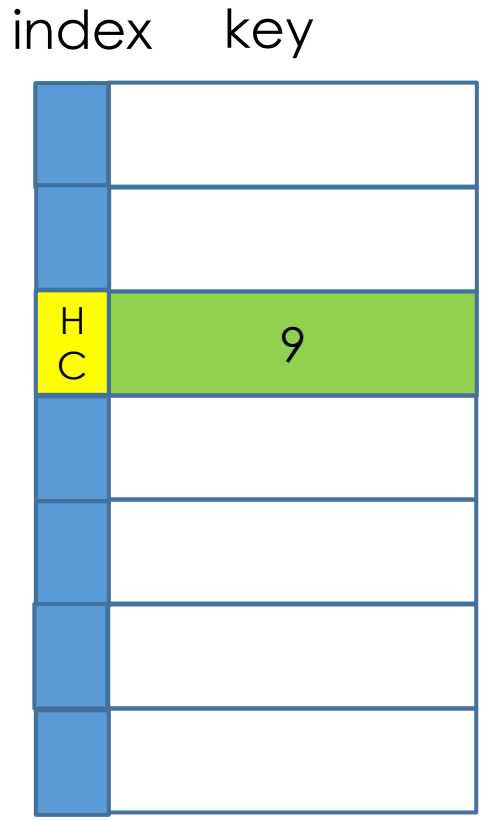
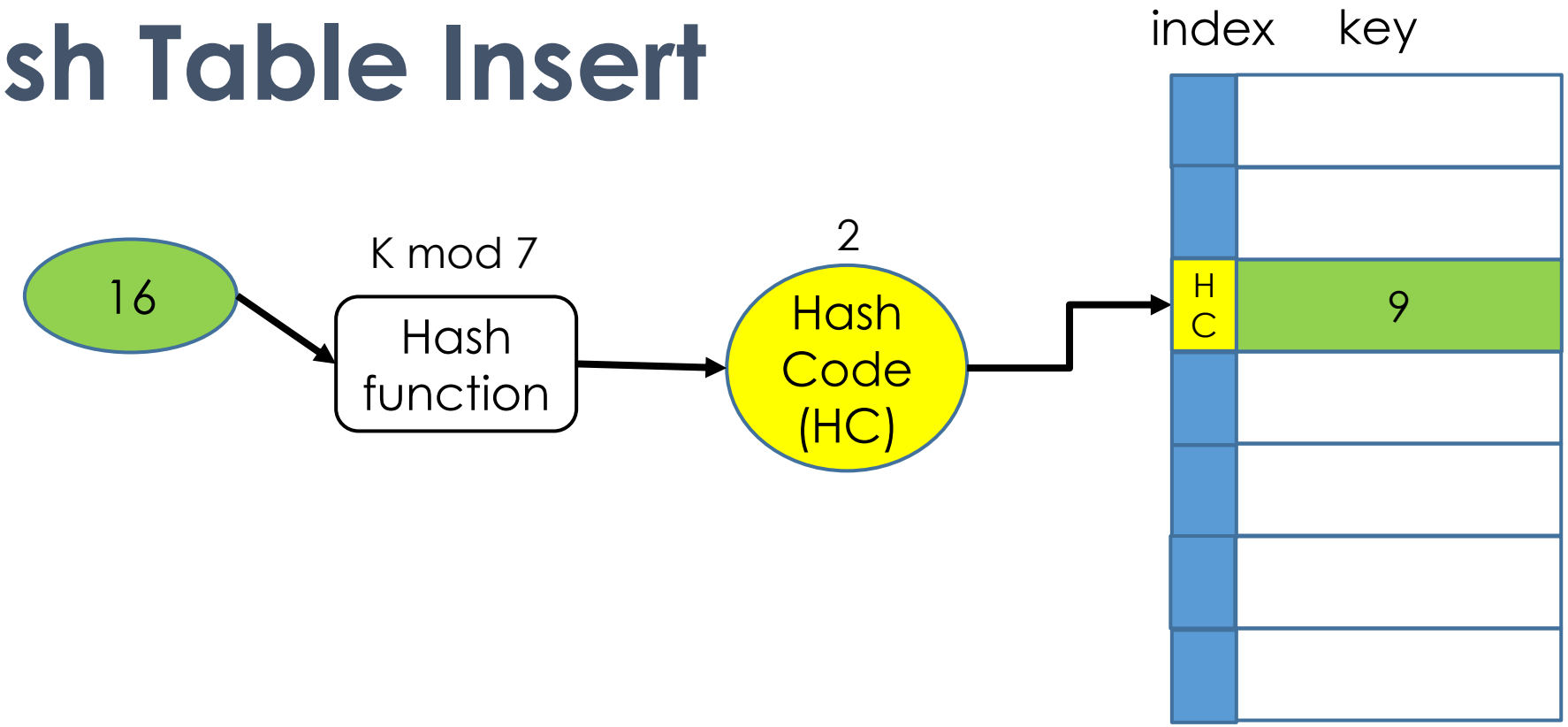


# Hash Table Insert



# Hash Table Insert



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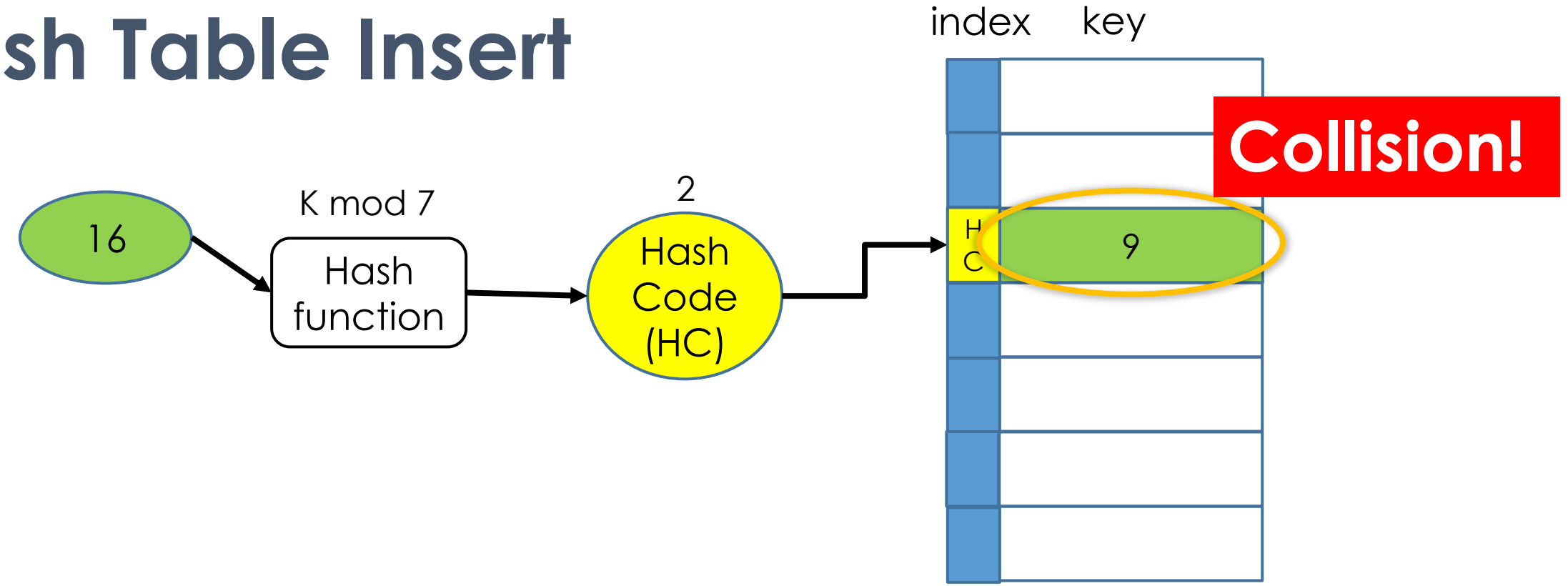

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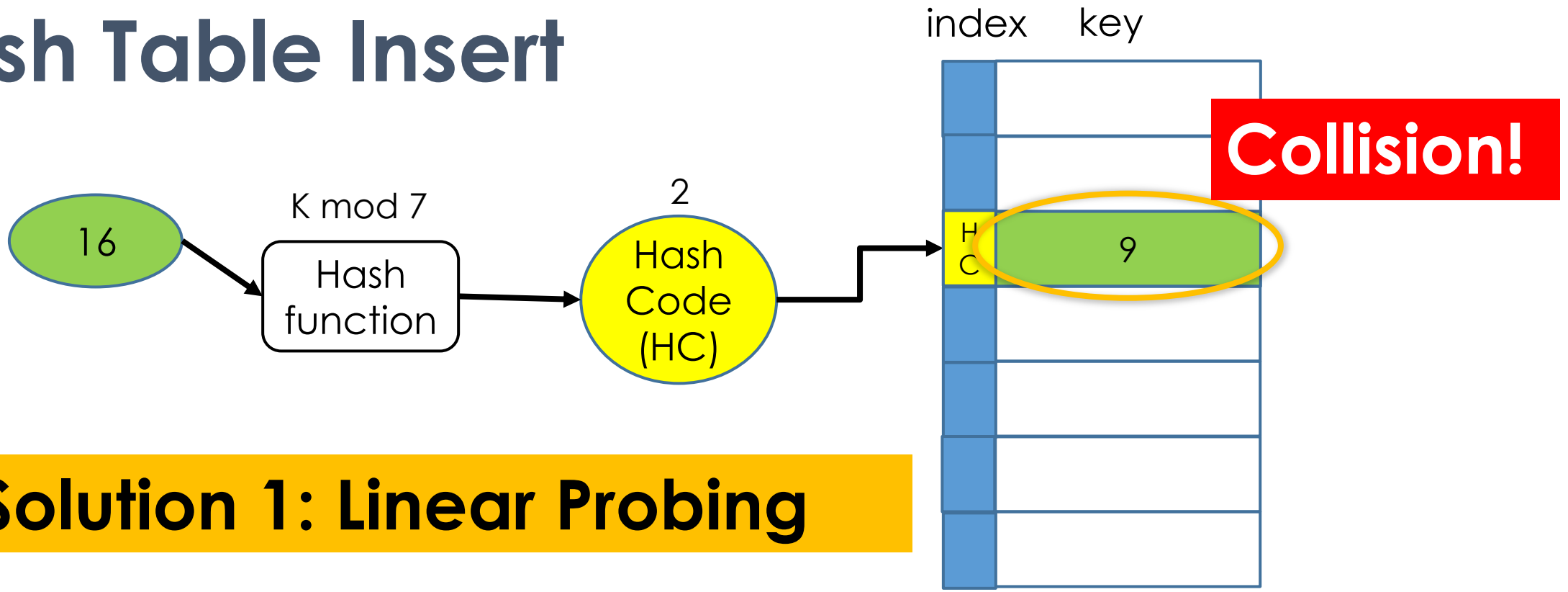
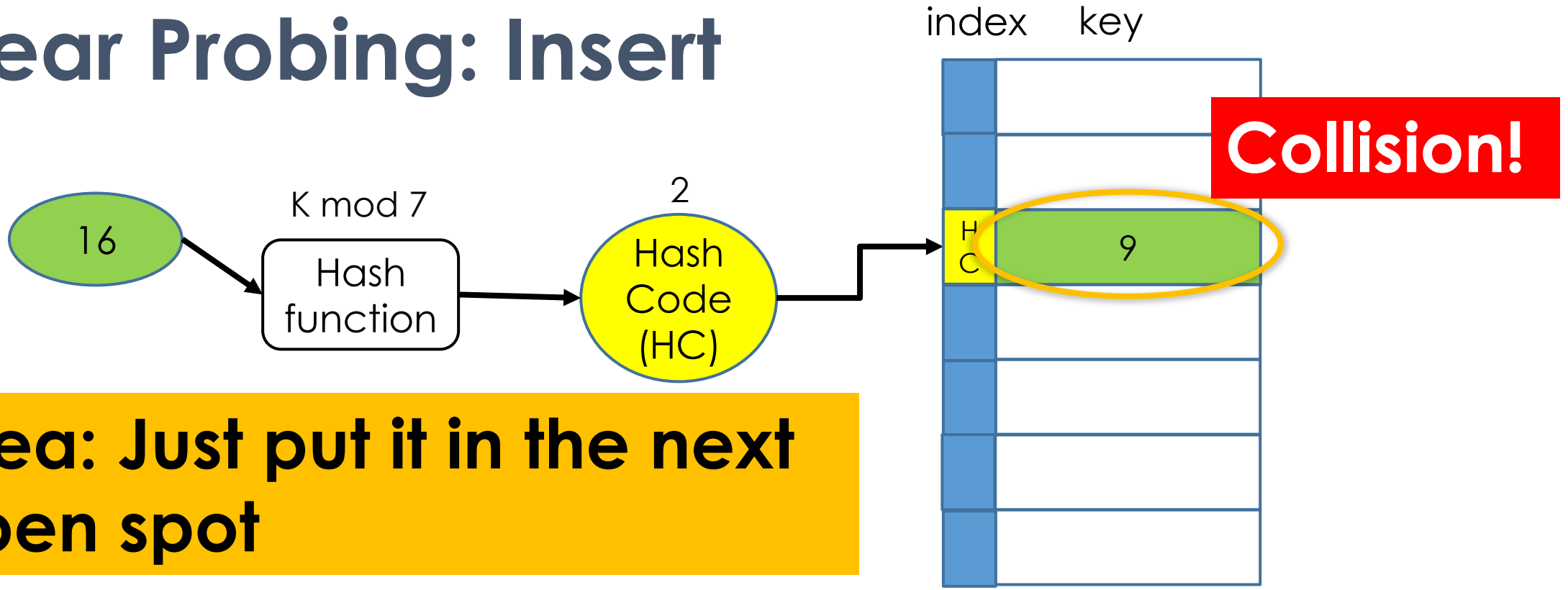


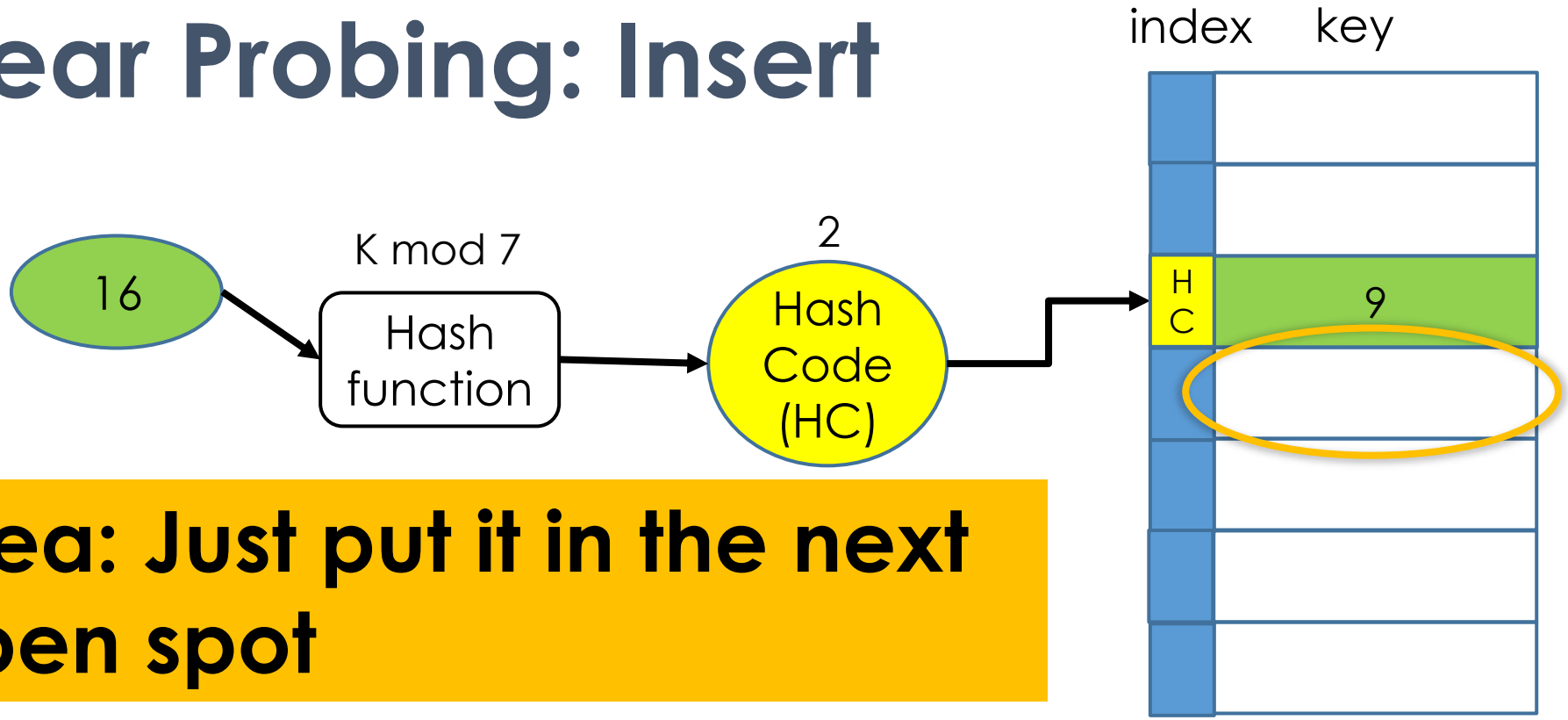

**Solution 1: Linear Probing**

# Linear Probing: Insert



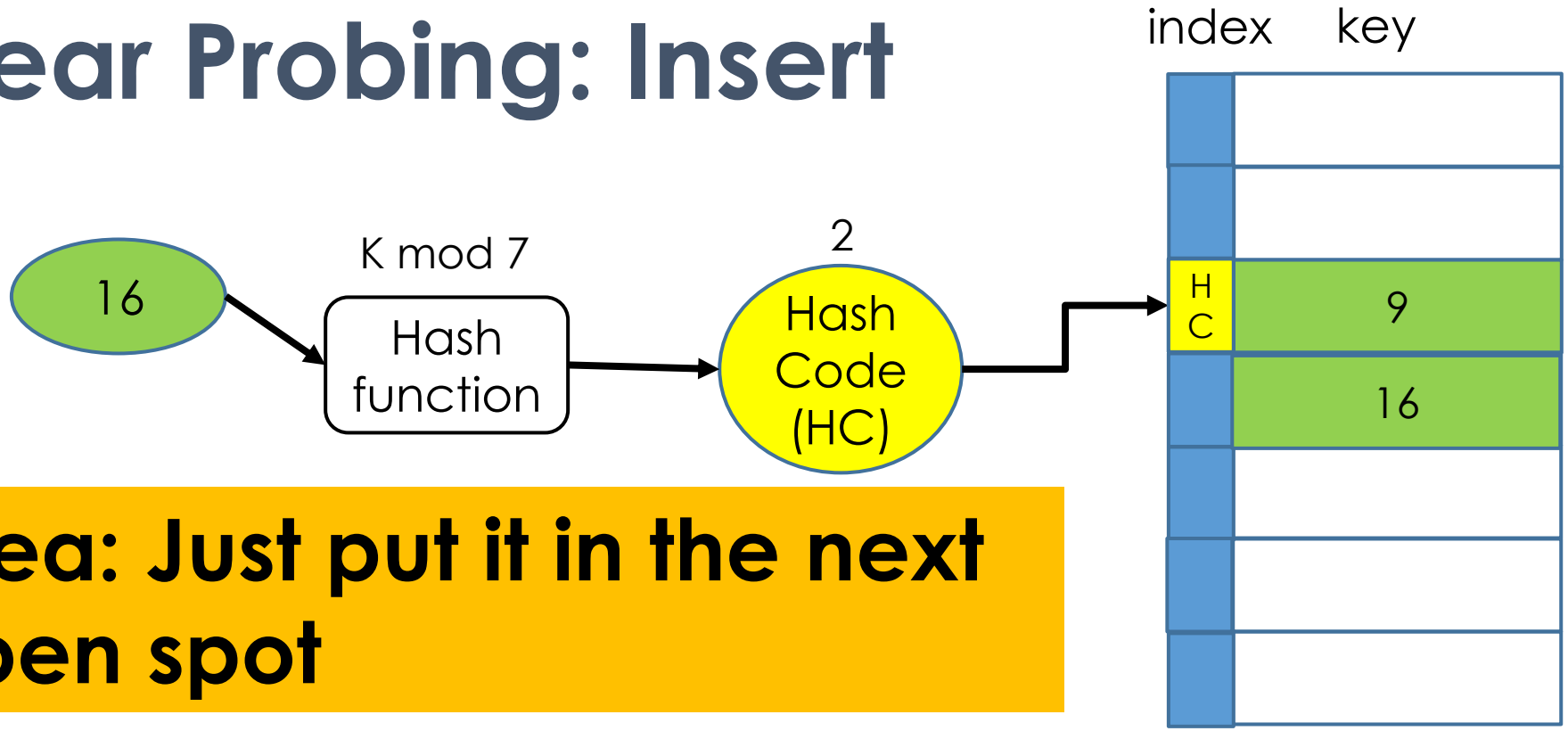

**Idea: Just put it in the next open spot**

# Linear Probing: Insert



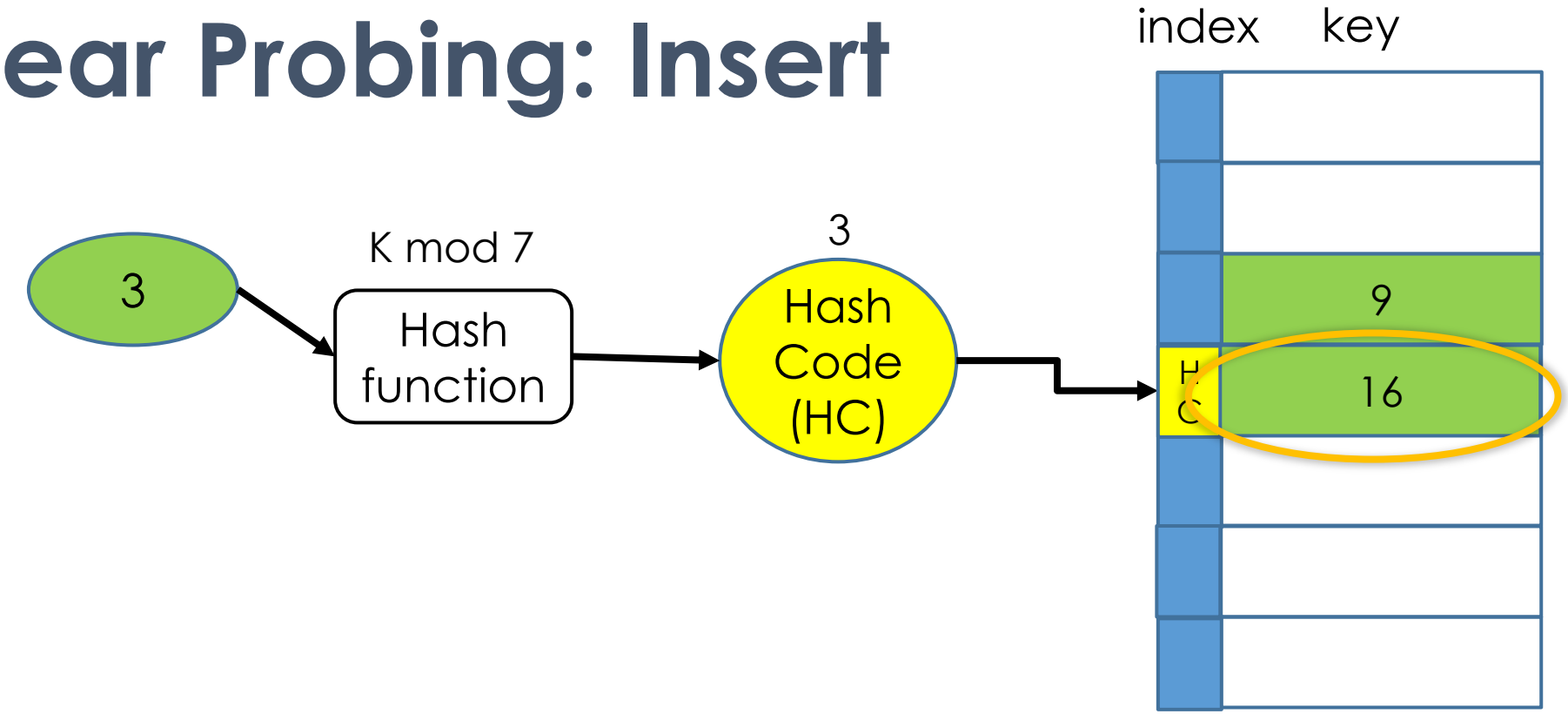

**Idea: Just put it in the next open spot**

# Linear Probing: Insert

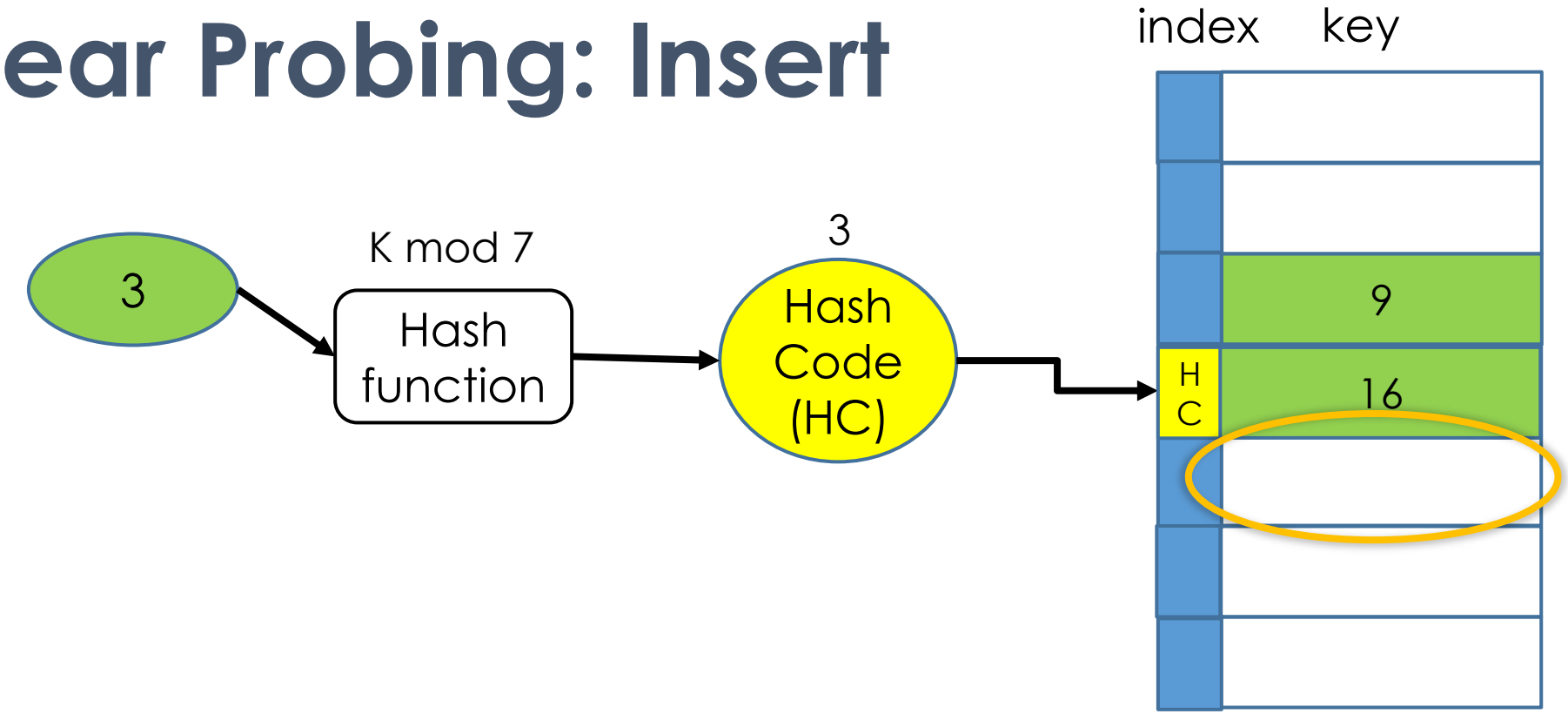



**Idea: Just put it in the next open spot**

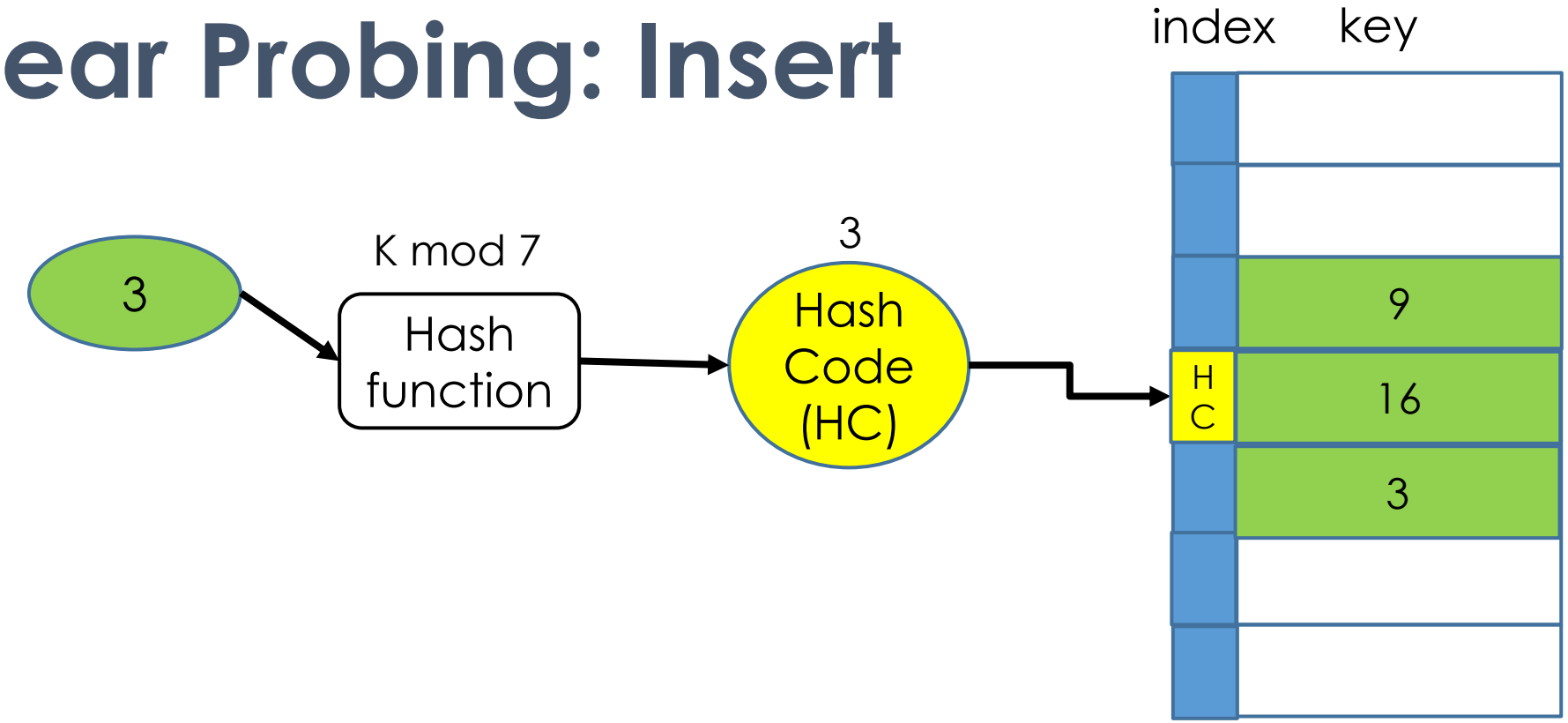
# Linear Probing: Insert



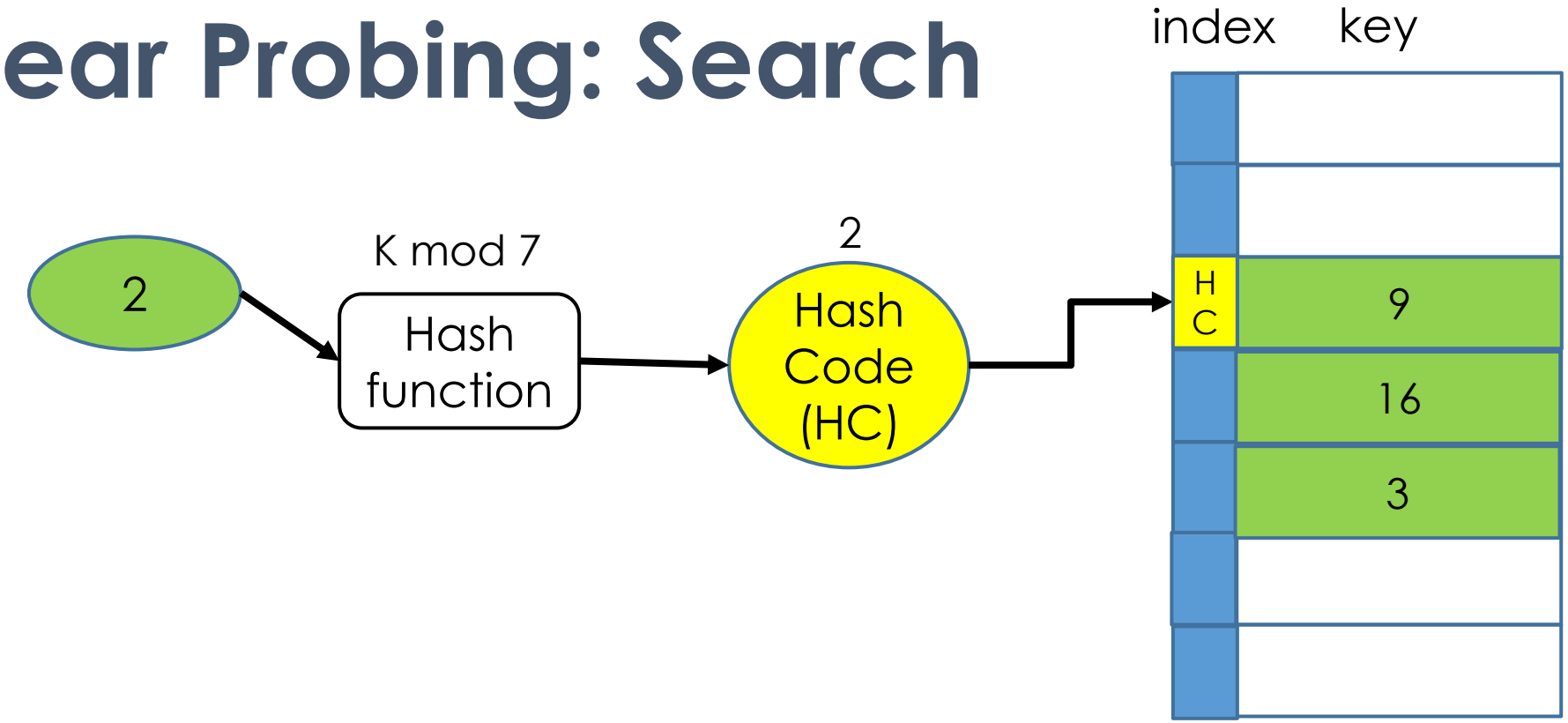
# Linear Probing: Insert



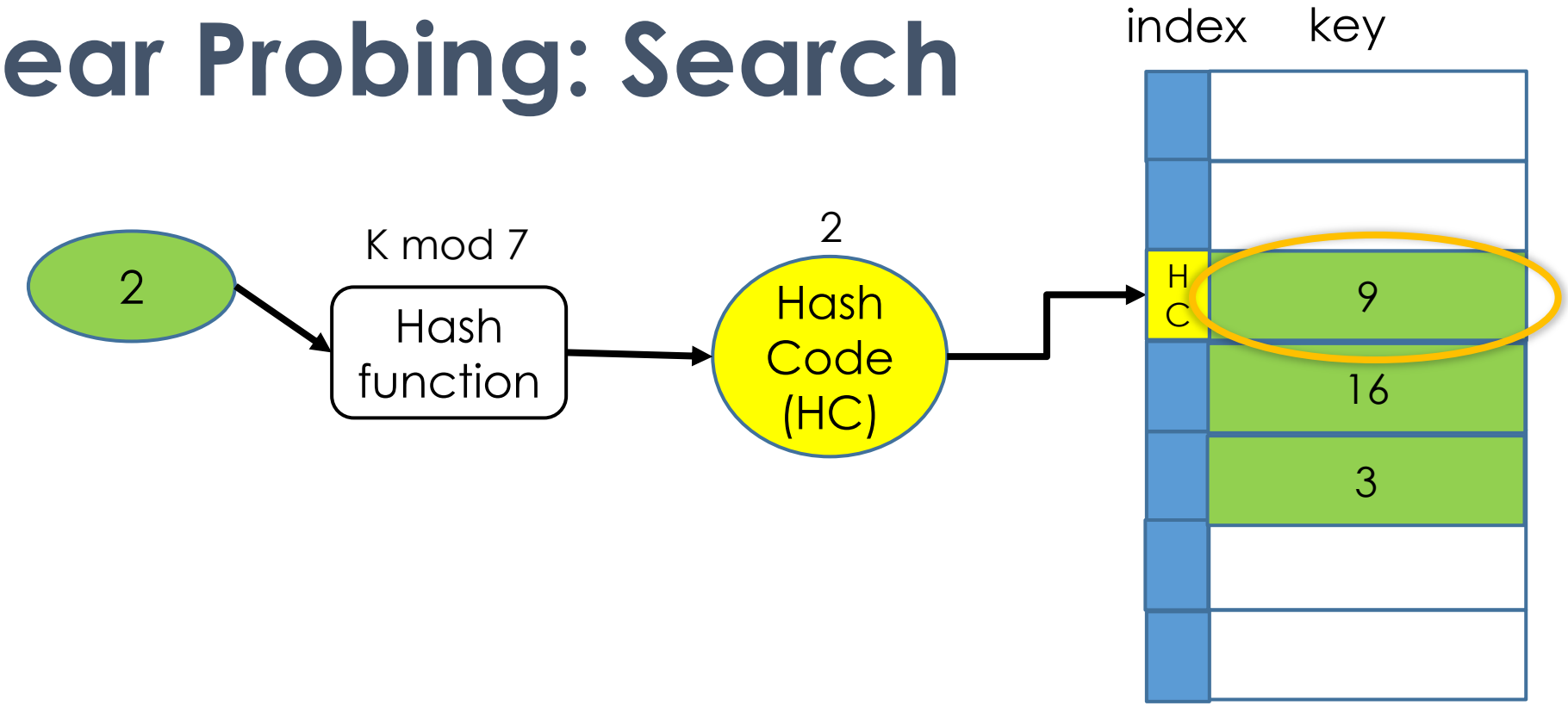
# Linear Probing: Insert



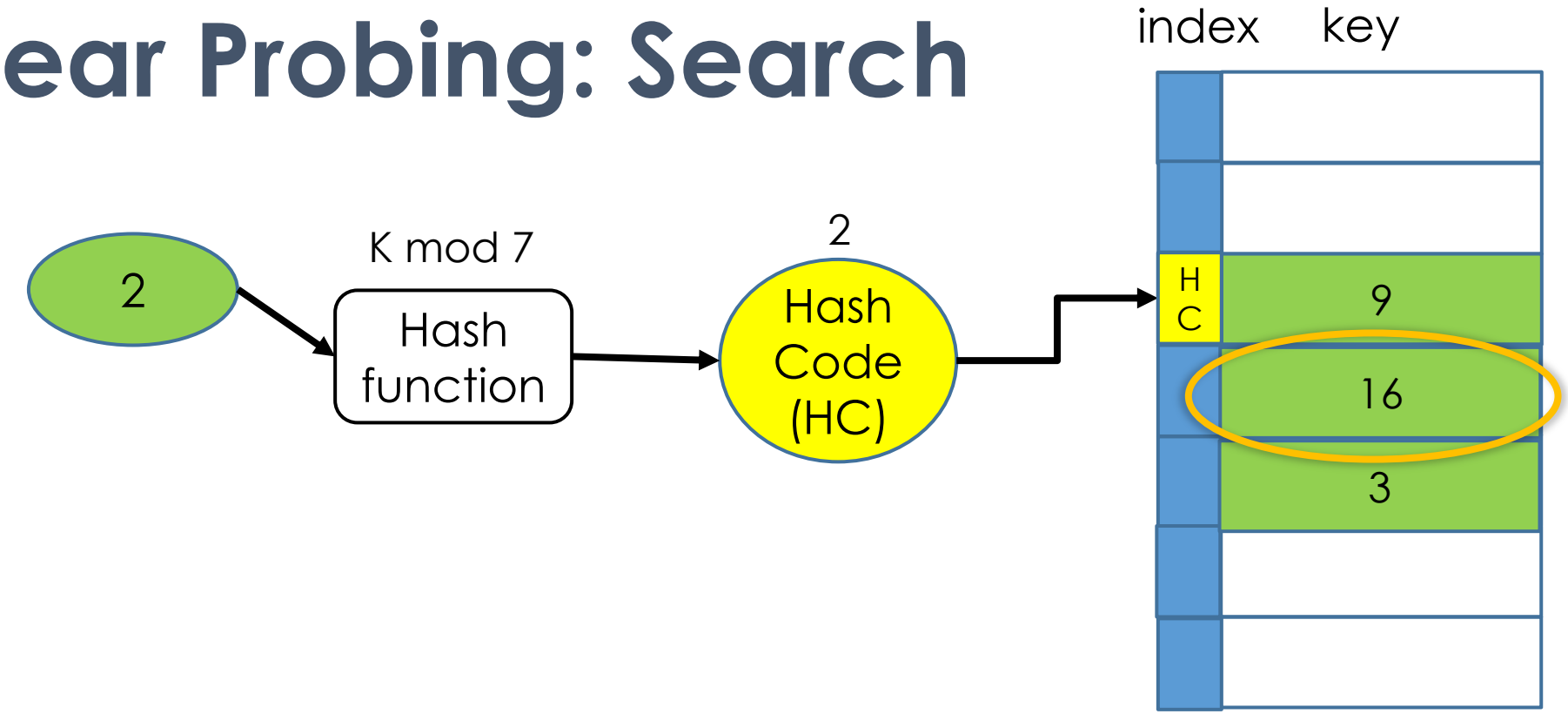
# Linear Probing: Search



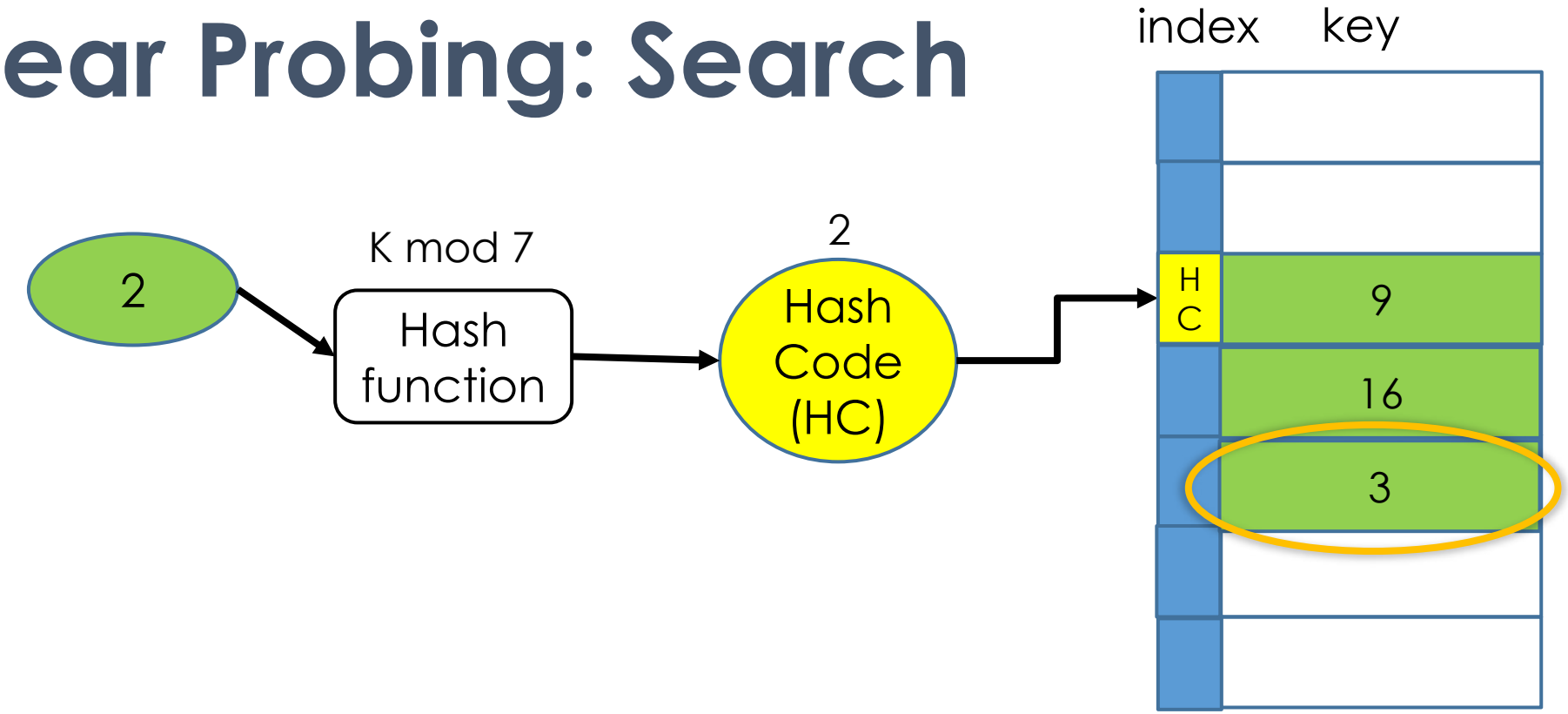
# Linear Probing: Search



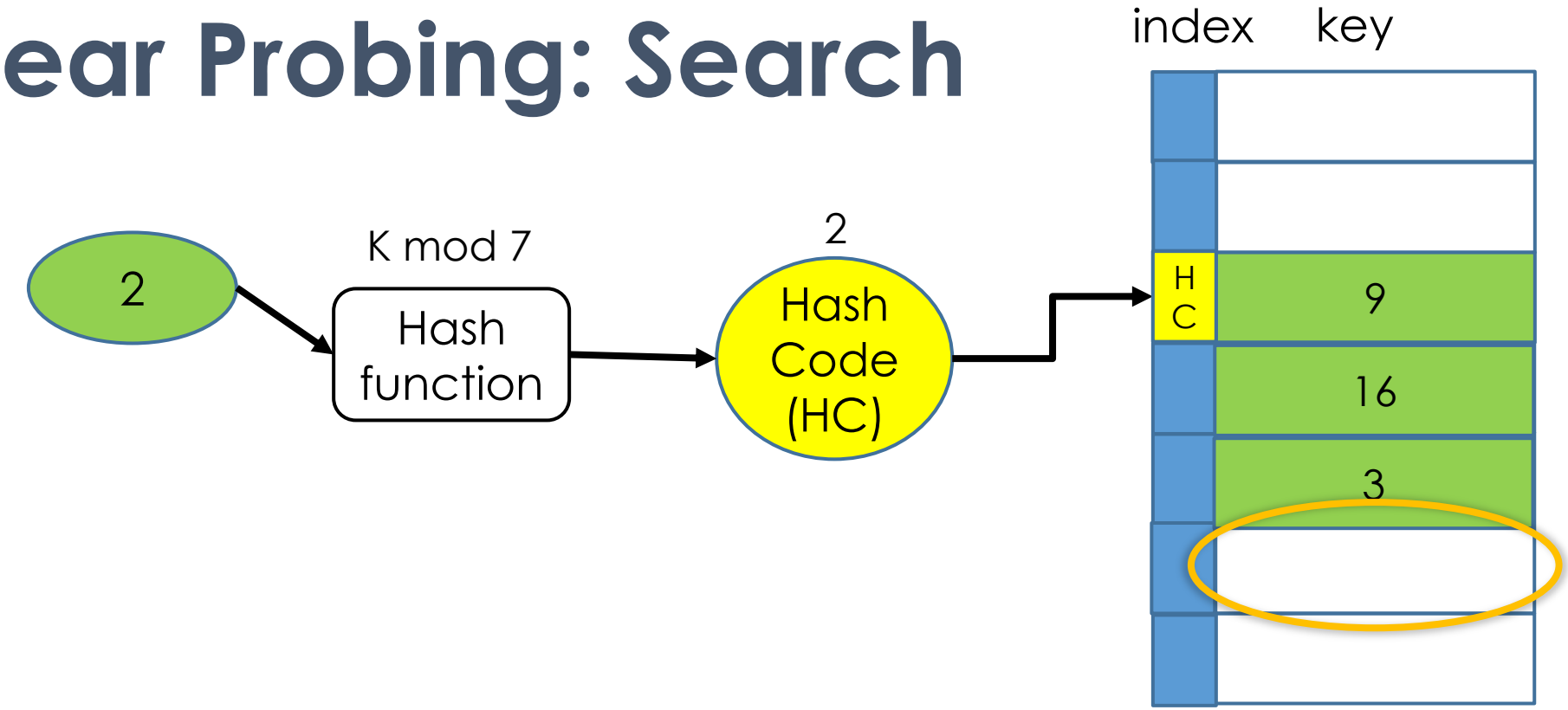
# Linear Probing: Search



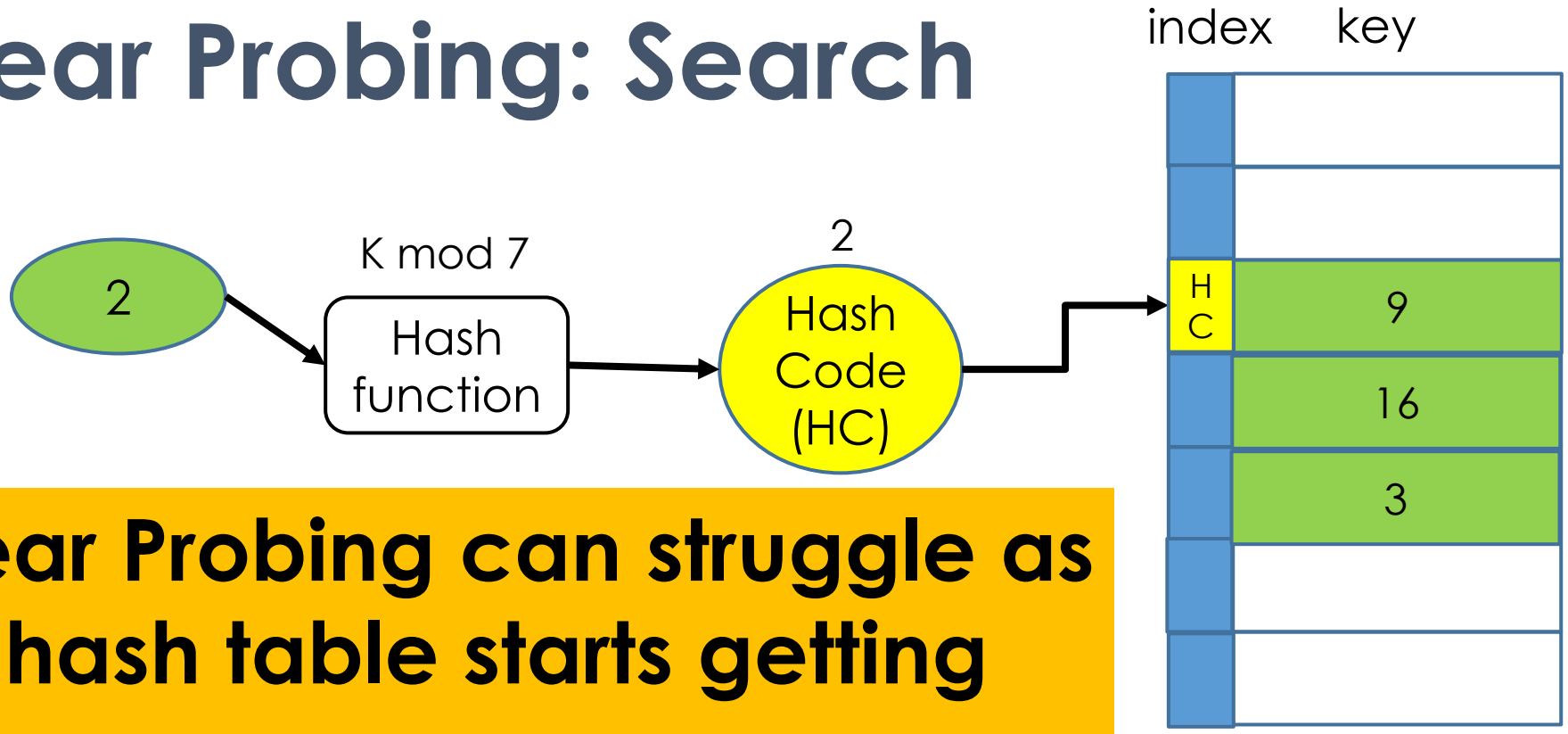
# Linear Probing: Search



# Linear Probing: Search

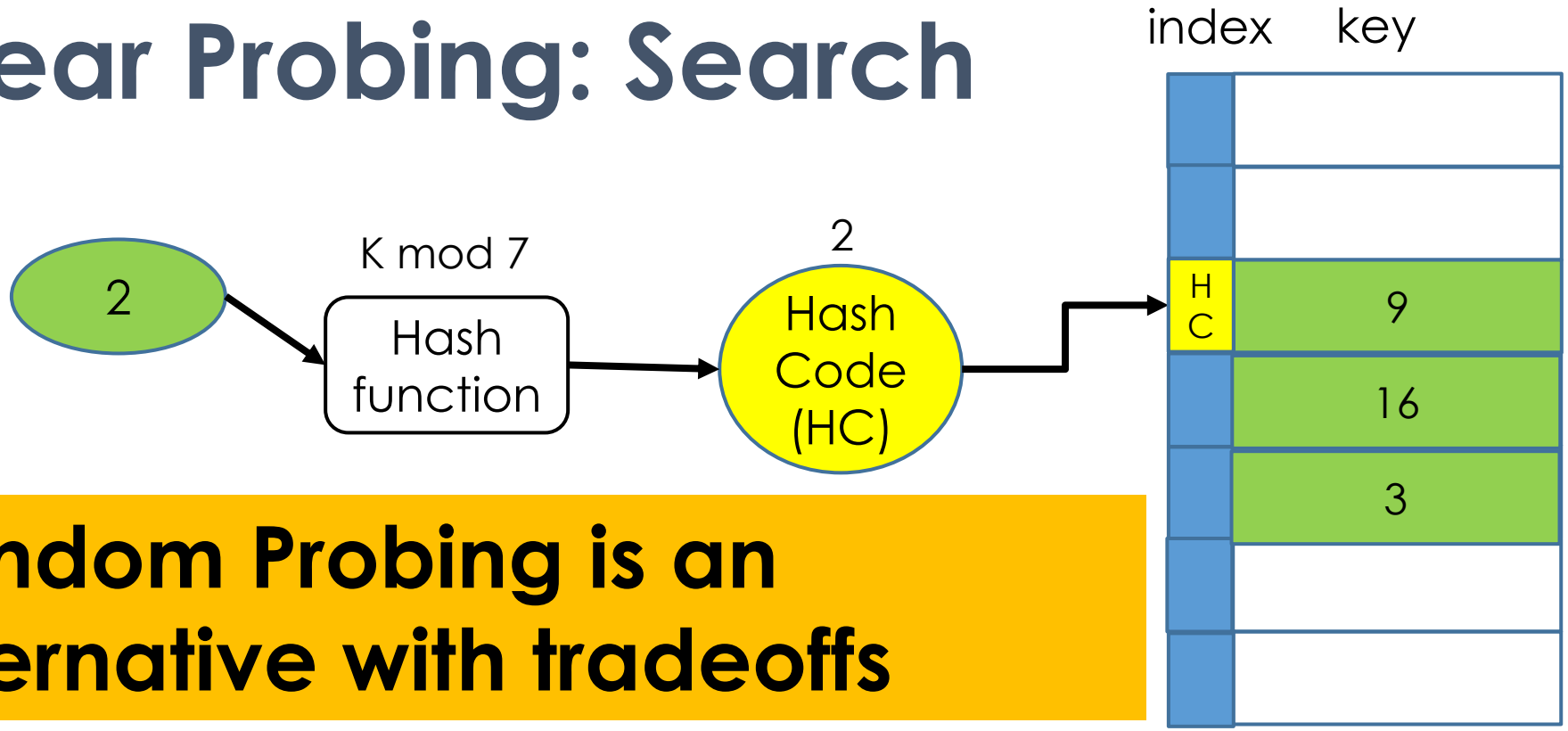


# Linear Probing: Search



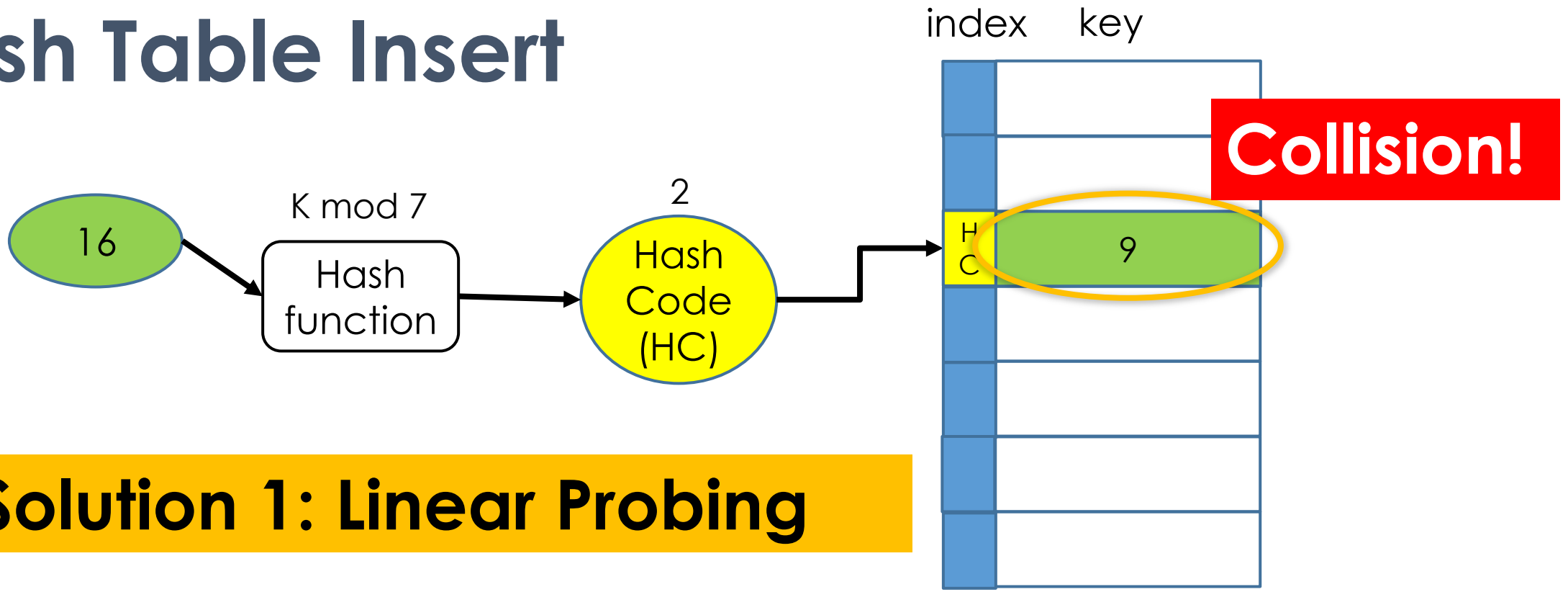

**Linear Probing can struggle as the hash table starts getting full**

# Linear Probing: Search



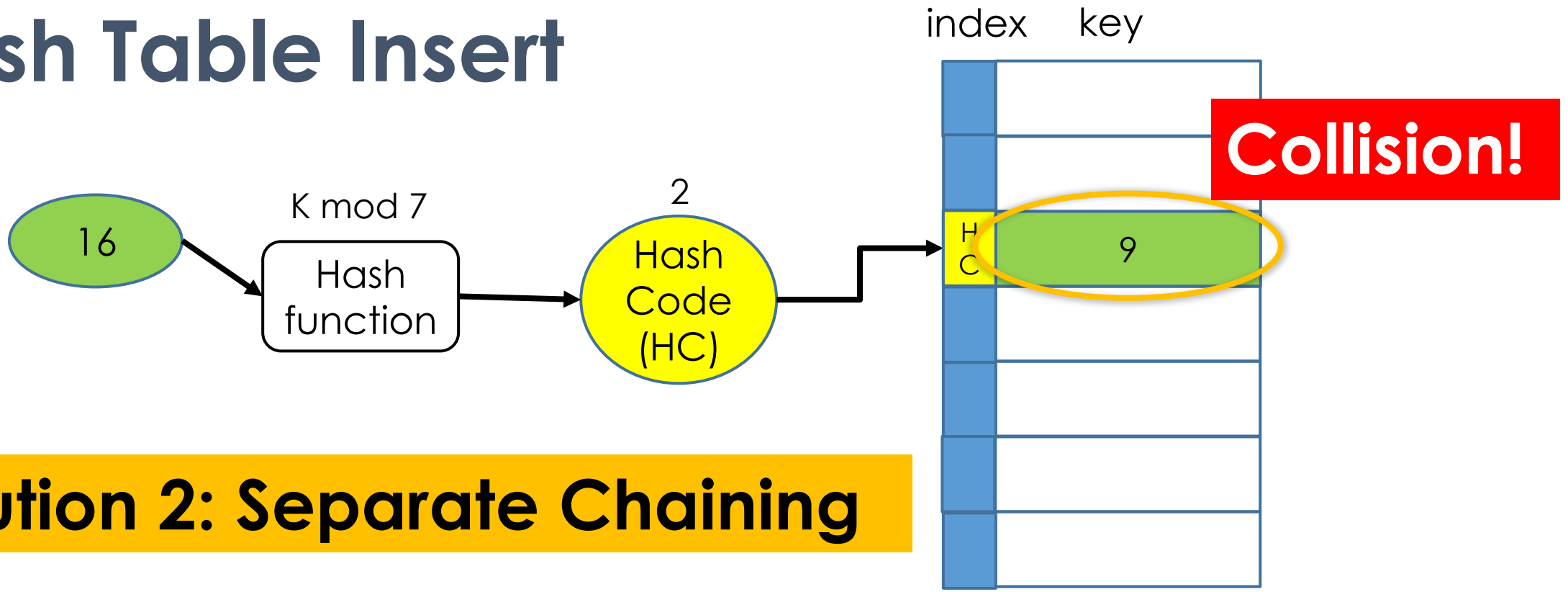

**Random Probing is an alternative with tradeoffs**

# Hash Table Insert



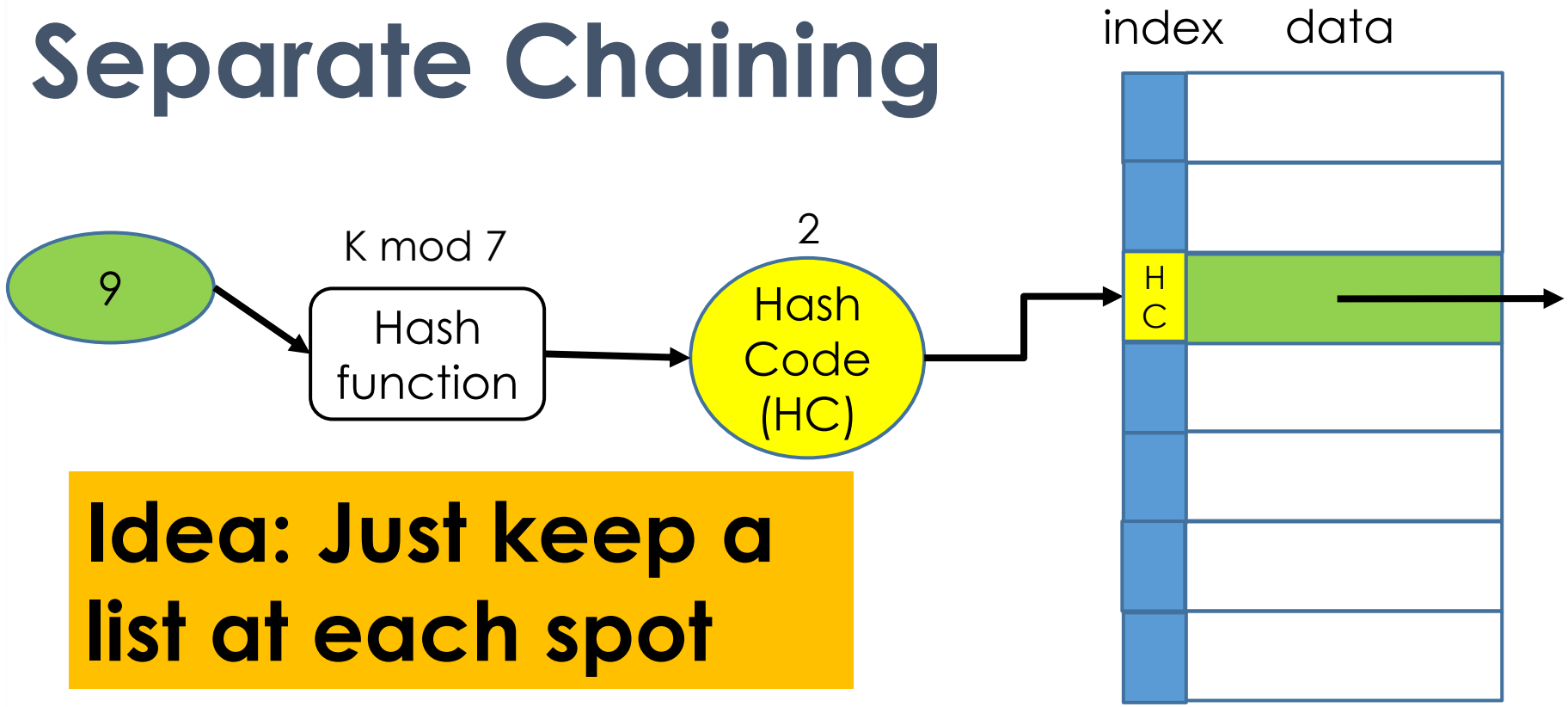

**Solution 1: Linear Probing**

# Hash Table Insert



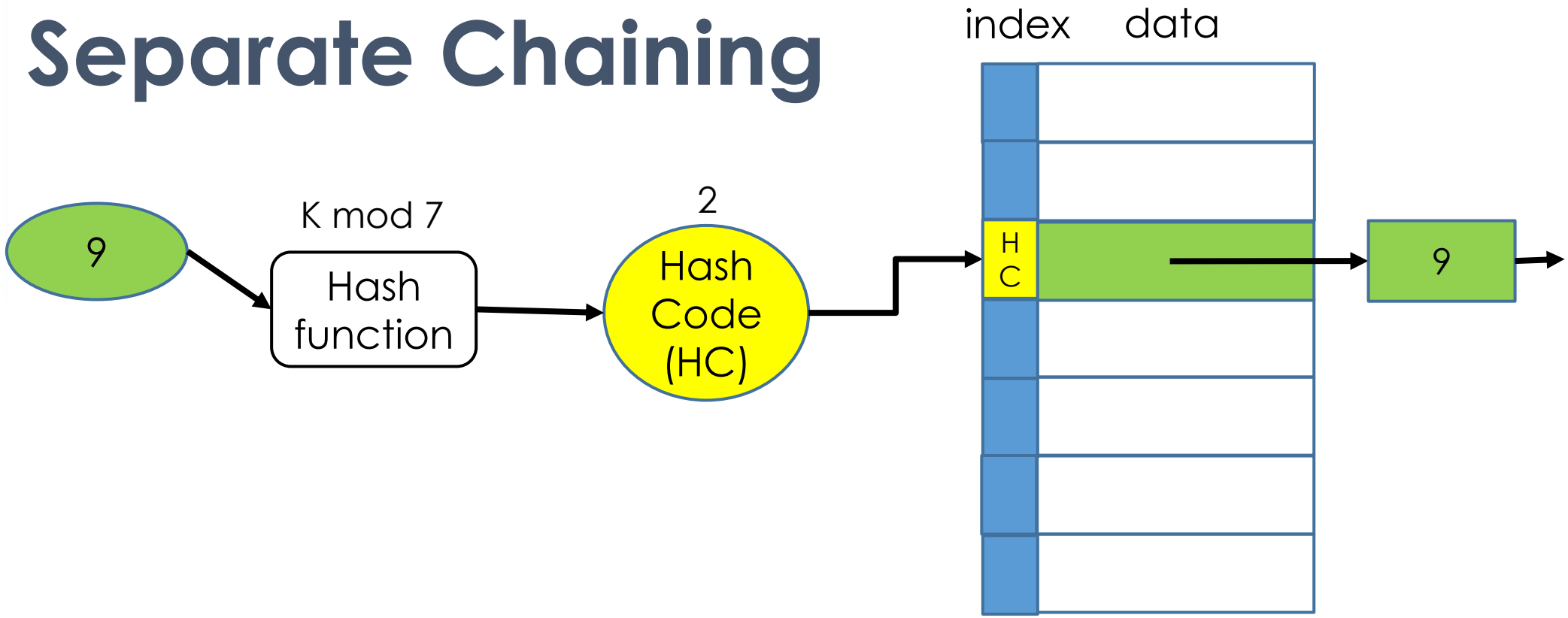

## Solution 2: Separate Chaining

# Separate Chaining

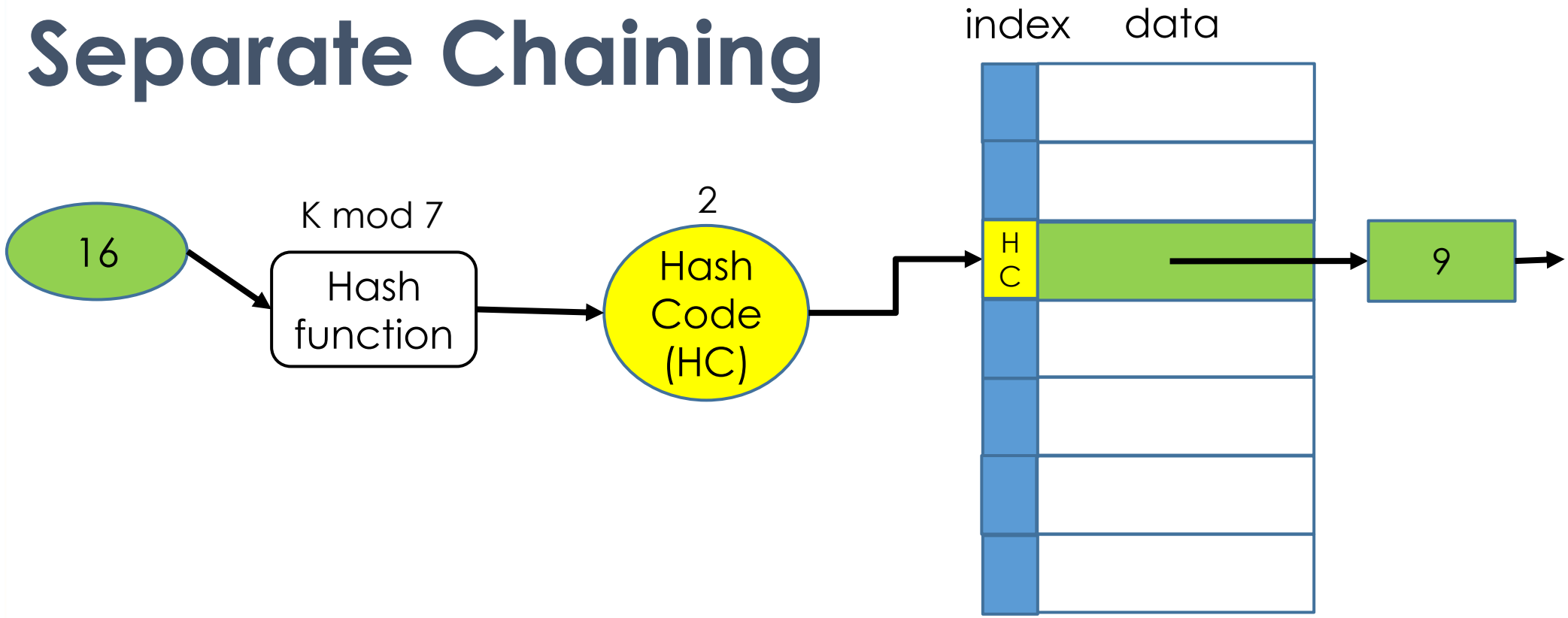



**Idea: Just keep a list at each spot**

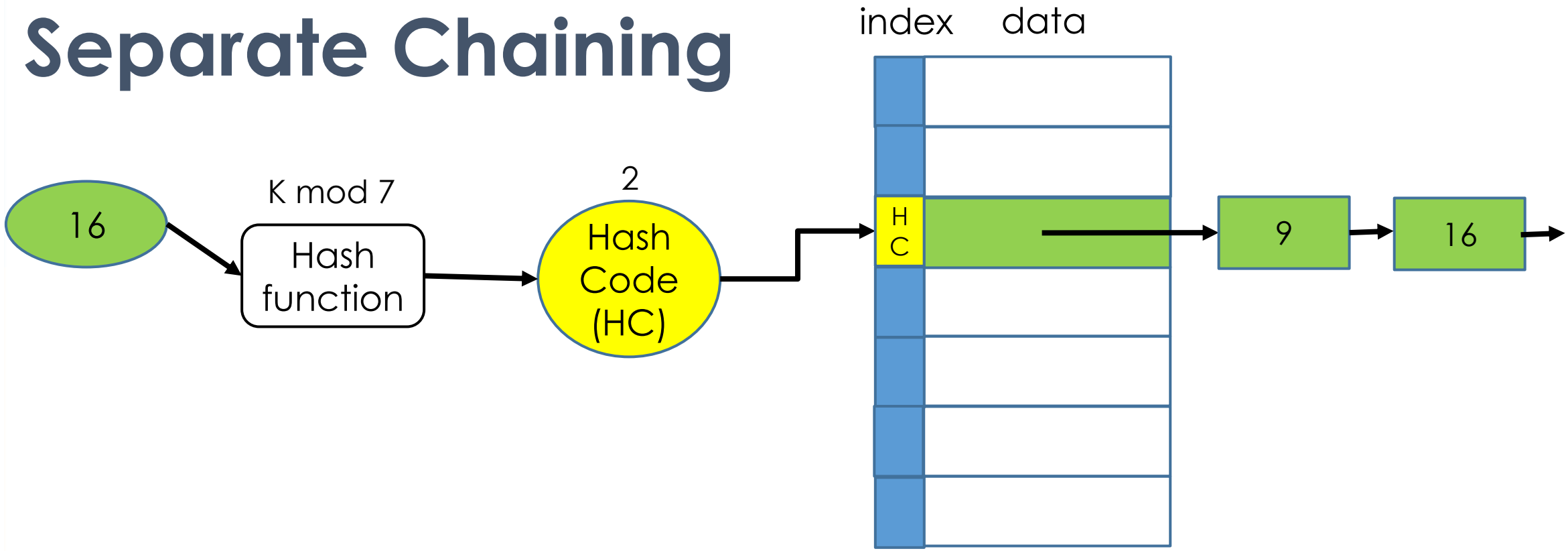
# Separate Chaining



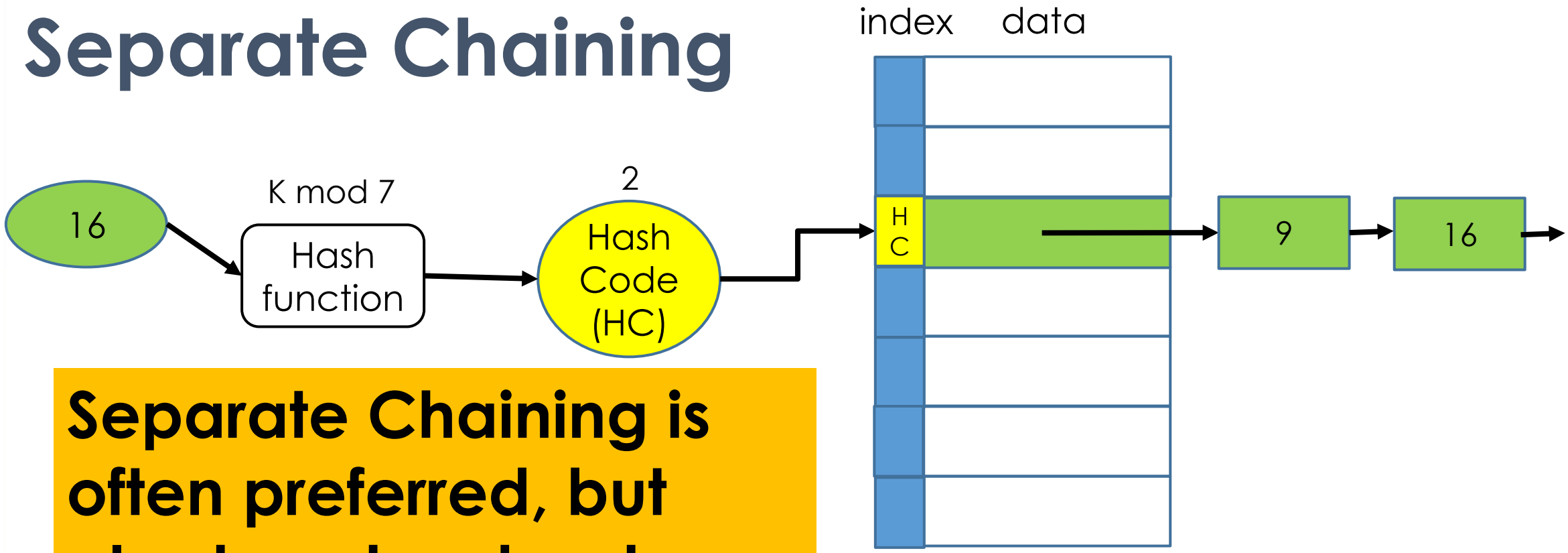
# Separate Chaining



# Separate Chaining



# Separate Chaining




**Separate Chaining is often preferred, but also has drawbacks**

# Challenge 1: Resizing

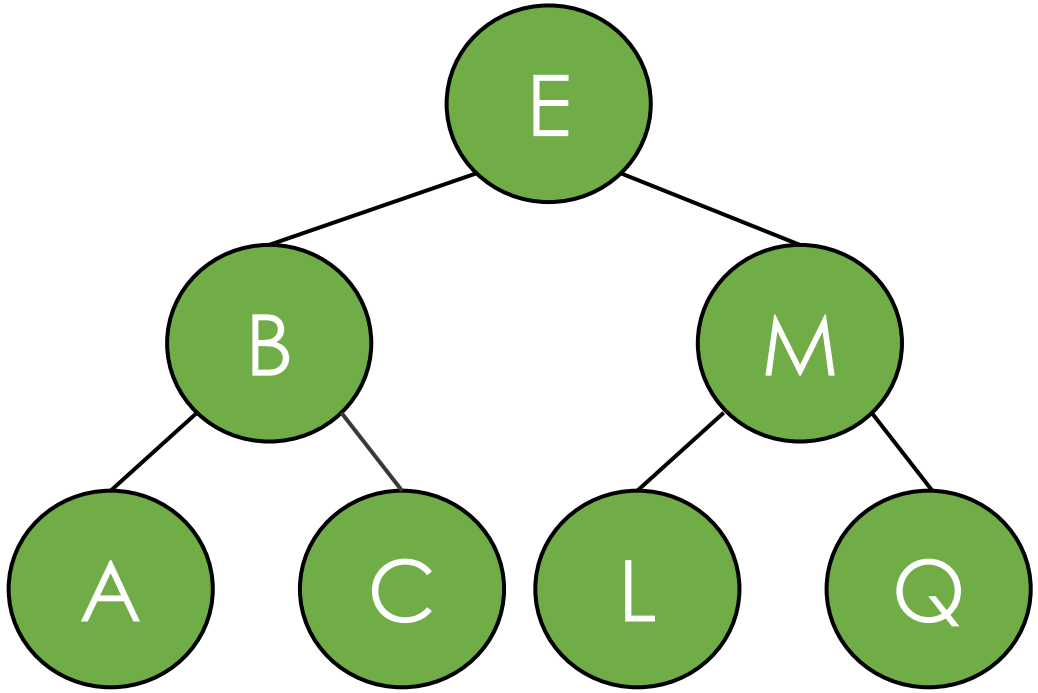
**When a hash table gets too full, the best thing to do is resize it.**

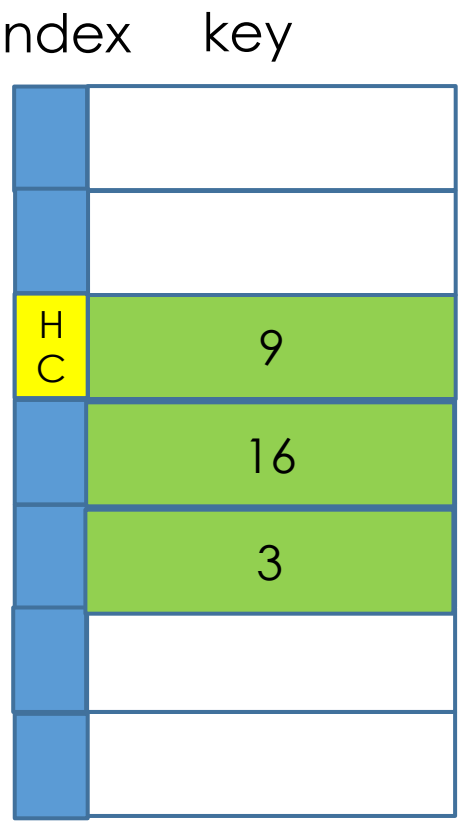
# Challenge 1: Resizing

## When a hash table gets too full, the best thing to do is resize it.

**Requires you create a new table, new hash function, and reinsert everything!**

# Challenge 2: Ordering data



# Hash Table Implications

Average: O(1) lookup, insert, and remove

Resizing costs
No data ordering

http://docs.oracle.com/javase/7/docs/api/java/util/HashSet.html

# Summary

- We've looked at solving collisions with:
  - Linear Probing
  - Separate Chaining
- Seen additional Hash Table challenges
- Next, we'll look at using Hash Tables in Java