CS 225
Data Structures

March 25 – Hashing Analysis
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Running Times

The expected number of probes for find(key) under SUHA

**Linear Probing:**
- Successful: $\frac{1}{2}(1 + \frac{1}{1-\alpha})$
- Unsuccessful: $\frac{1}{2}(1 + \frac{1}{1-\alpha})^2$

**Double Hashing:**
- Successful: $\frac{1}{\alpha} \times \ln(1/(1-\alpha))$
- Unsuccessful: $1/(1-\alpha)$
ReHashing

What if the array fills?
Which collision resolution strategy is better?
- Big Records:

- Structure Speed:

What structure do hash tables replace?

What constraint exists on hashing that doesn’t exist with BSTs?

Why talk about BSTs at all?
Running Times

<table>
<thead>
<tr>
<th></th>
<th>Hash Table</th>
<th>AVL</th>
<th>Linked List</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Find</strong></td>
<td>SUHA:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Worst Case:</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Insert</strong></td>
<td>SUHA:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Worst Case:</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Storage Space</strong></td>
<td></td>
<td></td>
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</tbody>
</table>
std data structures

std::map
**std data structures**

**std::map**
- ::operator[]
- ::insert
- ::erase

- ::lower_bound(key) ➞ Iterator to first element ≤ key
- ::upper_bound(key) ➞ Iterator to first element > key
std data structures

std::unordered_map
  ::operator[]
  ::insert
  ::erase

  ::lower_bound(key) → Iterator to first element ≤ key
  ::upper_bound(key) → Iterator to first element > key
std data structures

std::unordered_map
  ::operator[]
  ::insert
  ::erase

  ::lower_bound(key) ➜ Iterator to first element ≤ key
  ::upper_bound(key) ➜ Iterator to first element > key

  ::load_factor()
  ::max_load_factor(ml) ➜ Sets the max load factor
CS 225 Final Exam

Exam Details:
CBTF Exam, 3 Hours Long
Format: 1 Theory Exam + 1 Programming Exam

When you finish your exam, you’re done with CS 225! :)

Signup Process:
CS 225 Exam will run Thurs, May 2 - Wed, May 8
(including both Saturday and Sunday)

You can sign up for your slot right now!