Running Time Observations:

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

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

**ReHashing:**
What happens when the array fills?

...or a better question:

Algorithm:

**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?**

---

### Analysis of Dictionary-based Data Structures

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

**Data Structures in std library:**
- std::map
- std::unordered_map

**A Secret, Mystery Data Structure:**

**ADT:**
- insert
- remove
- isEmpty
Implementation of _______________

<table>
<thead>
<tr>
<th>insert</th>
<th>removeMin</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>O(n)</td>
<td>O(n)</td>
<td>Unsorted Array</td>
</tr>
<tr>
<td>O(1)</td>
<td>O(n)</td>
<td>Unsorted List</td>
</tr>
<tr>
<td>O(lg(n))</td>
<td>O(1)</td>
<td>Sorted Array</td>
</tr>
<tr>
<td>O(lg(n))</td>
<td>O(1)</td>
<td>Sorted List</td>
</tr>
</tbody>
</table>

Q1: What errors exist in this table? (Fix them!)

Q2: Which algorithm would we use?

A New Tree-like Structure:

A complete binary tree T is a min-heap if:

•

Implementing a (min)Heap as an Array

Operations:
leftChild(index) :=
rightChild(index) :=
pARENT(index) :=

Insert:

CS 225 – Things To Be Doing:

1. Theory Exam 3 starts next week (Thursday, April 9th)
2. MP5 EC+7 deadline is today – earn the extra credit!
3. lab_hash released Wednesday
4. Daily POTDs are ongoing!