



CS 225

Data Structures

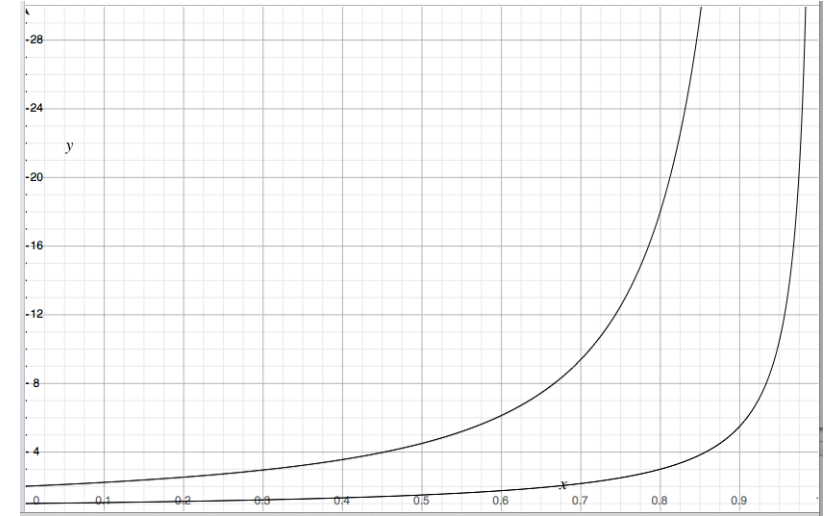
Nov. 1 – Hashing 3

Running Times

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

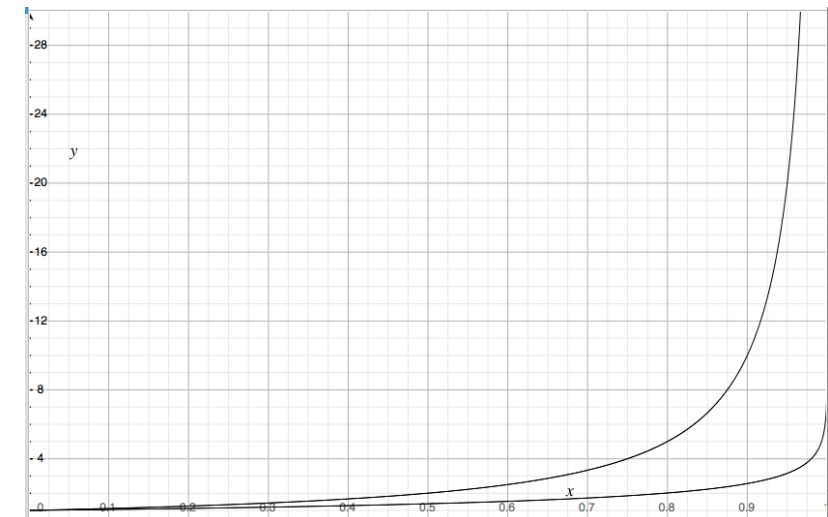
Linear Probing:

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



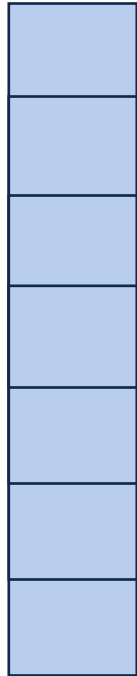
Double Hashing:

- Successful: $1/\alpha * \ln(1/(1-\alpha))$
- Unsuccessful: $1/(1-\alpha)$



ReHashing

What if the array fills?



Running Times

	Hash Table	AVL	Linked List
Find	Amortized: Worst Case:		
Insert	Amortized: Worst Case:		
Storage Space			

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?

std data structures

std::map

std data structures

std::map

`::operator[]`

`::insert`

`::erase`

`::lower_bound(key)` → Iterator to first element \leq 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 \leq 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 \leq key~~

~~::upper_bound(key) → Iterator to first element $>$ key~~

::load_factor()

::max_load_factor(ml) → Sets the max load factor

CS 225's Final Exam

Exam Details:

CBTF Exam, 3 Hours Long

Theory (MCQ) and Programming Questions

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

Signup Process:

CS 225 Exam will run **Thursday, Dec. 14 - Monday, Dec. 18**

(including both Saturday and Sunday)

You can sign up for your slot starting **tomorrow at 9:00am.**

Secret, Mystery Data Structure

ADT:

insert

remove

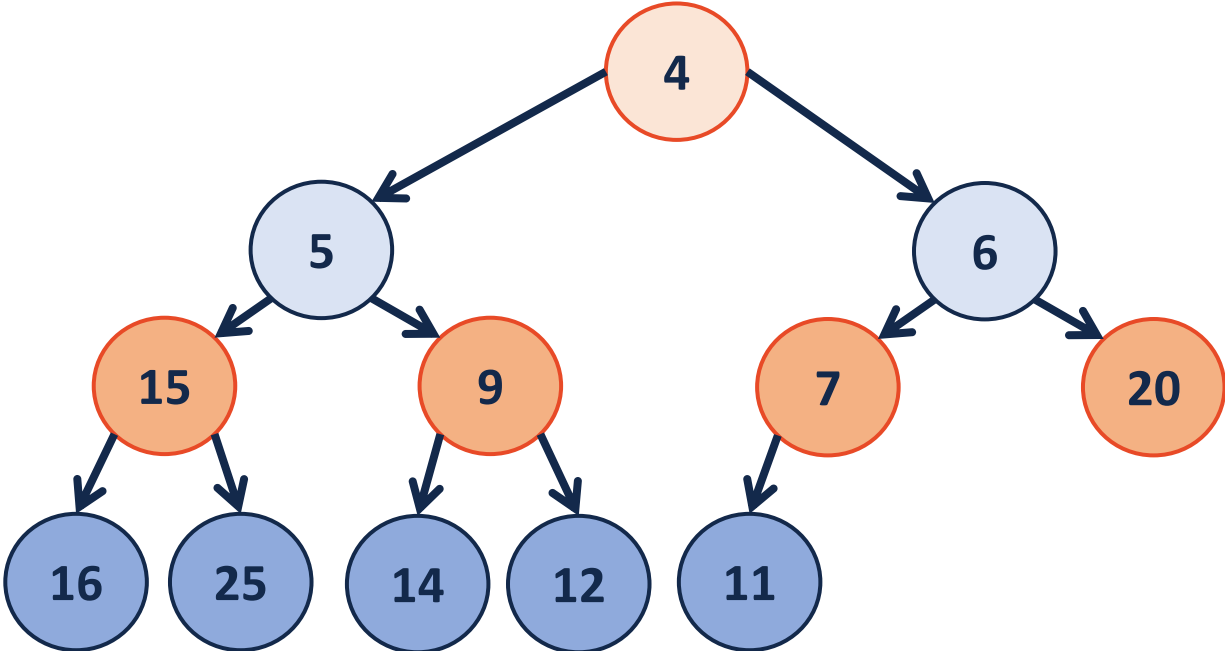
isEmpty

Priority Queue Implementation

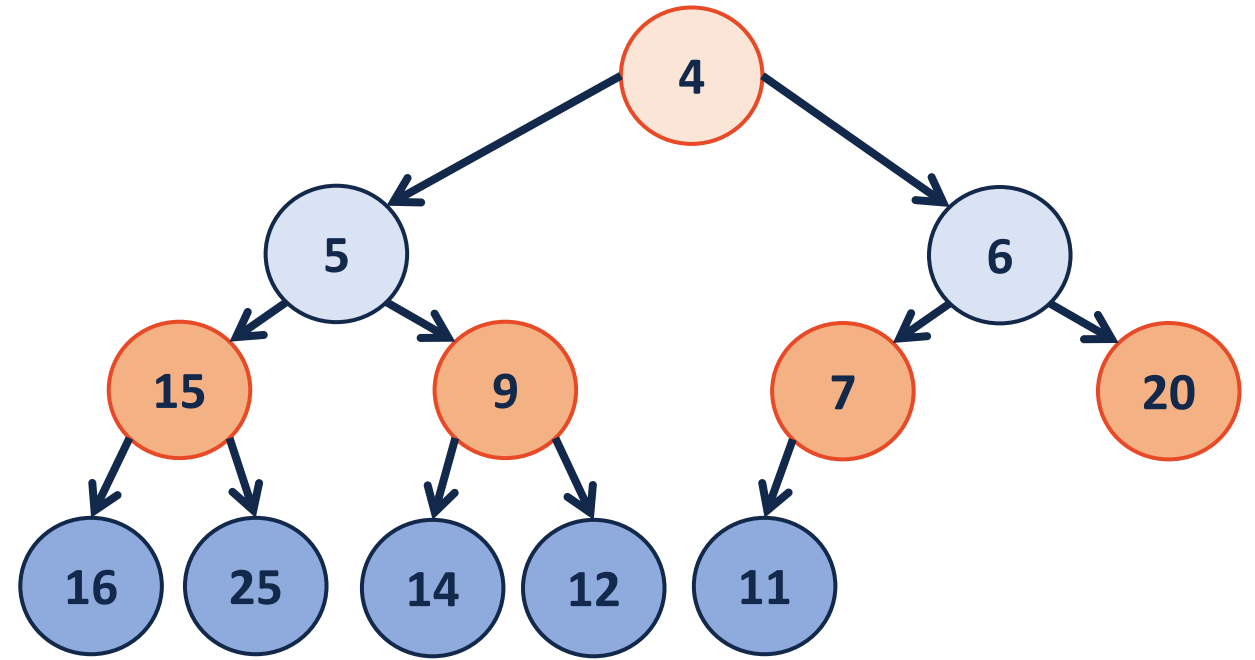
insert	removeMin
$O(n)$	$O(n)$
$O(1)$	$O(n)$
$O(\lg(n))$	$O(1)$
$O(\lg(n))$	$O(1)$



A New Tree Structure



(min)Heap



4	5	6	15	9	7	20	16	25	14	12	11			
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CS 225 – Things To Be Doing

Register for CS 225's Final Exam!

Exam 8 (programming exam, MP4-like and AVL) is live!

More Info: <https://courses.engr.illinois.edu/cs225/fa2017/exams/>

MP5: kd-trees

Due Monday, Nov. 6 at 11:59pm

Lab: lab_hash released today

Due Sunday, Nov. 5 at 11:59pm

POTD

Every Monday-Friday – *Worth +1 Extra Credit /problem (up to +40 total)*