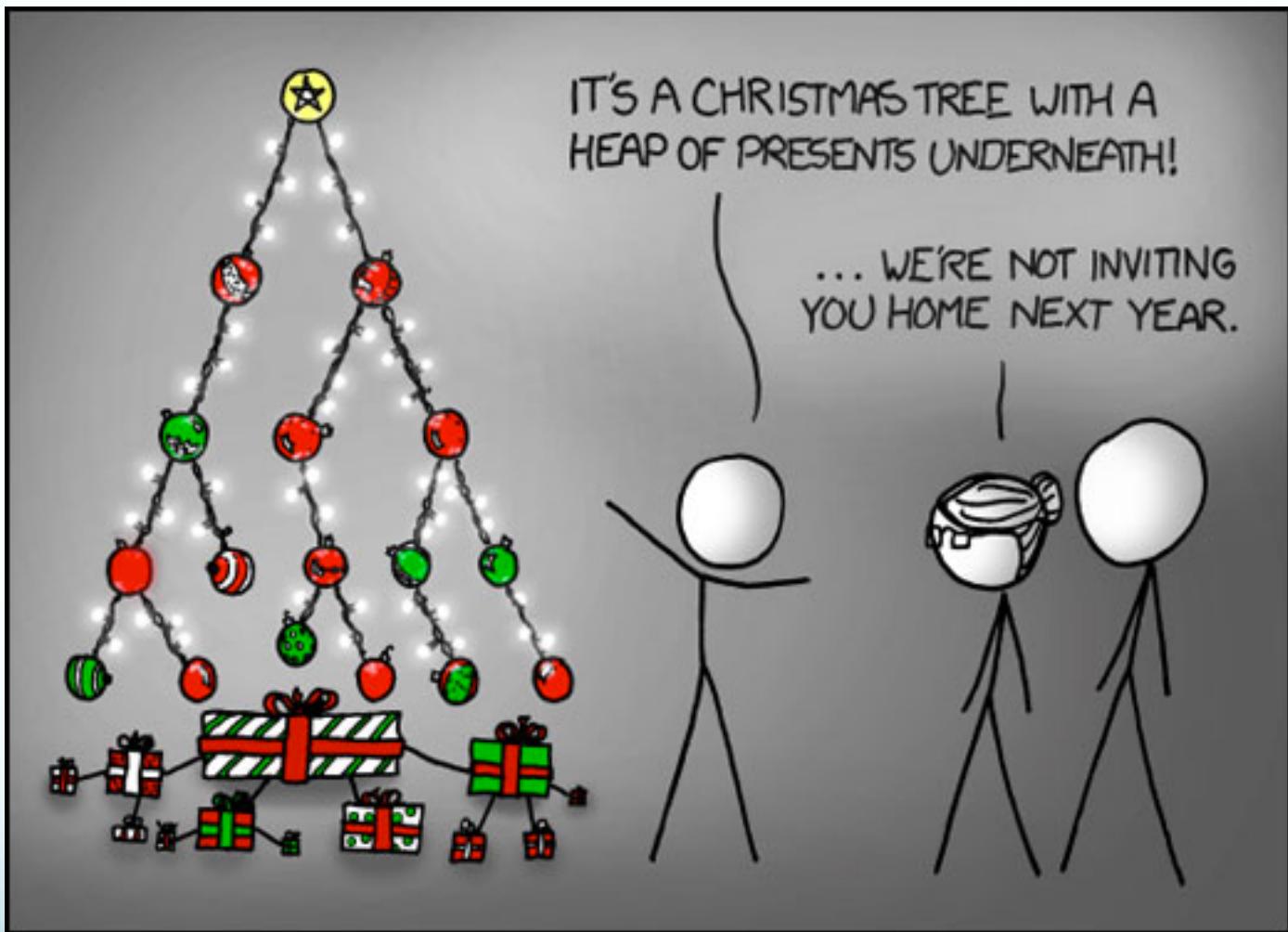


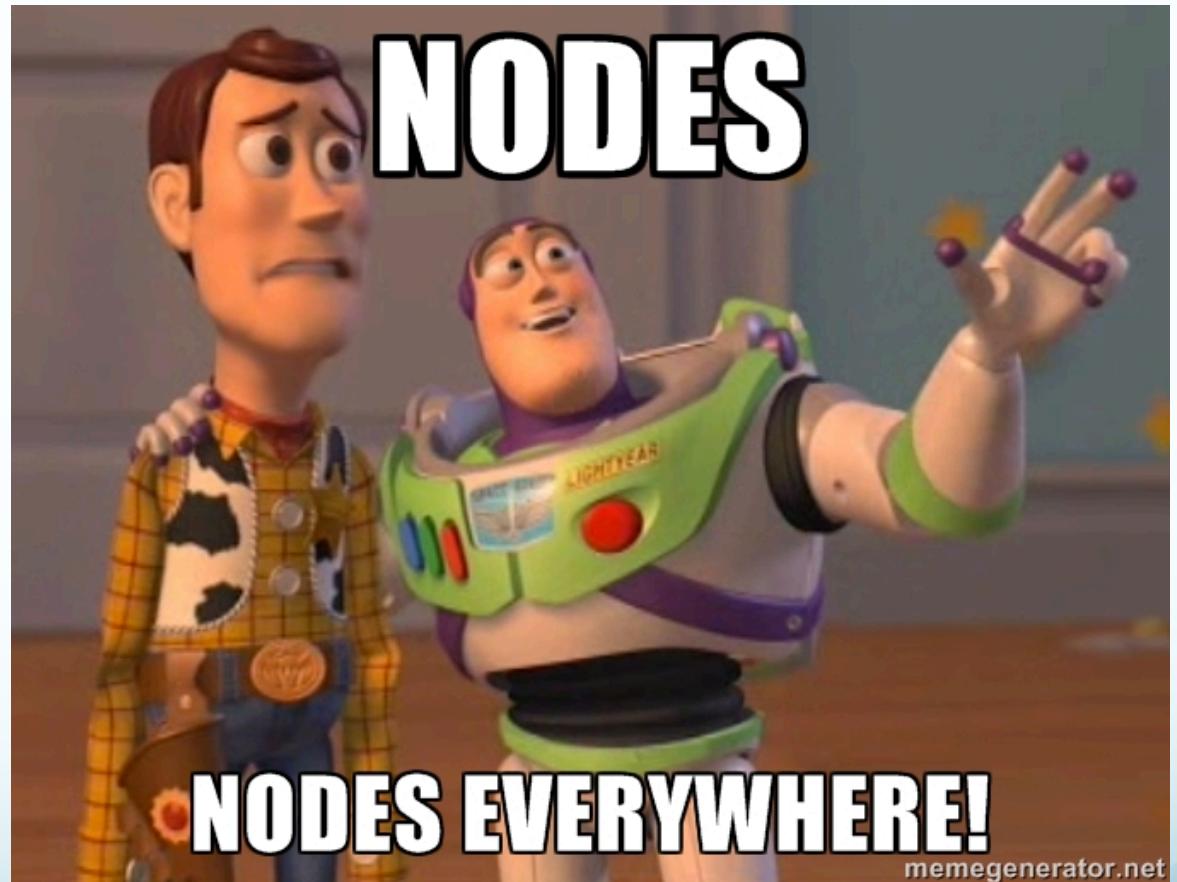
Data Structures

<http://lxr.free-electrons.com/source/include/linux/list.h>



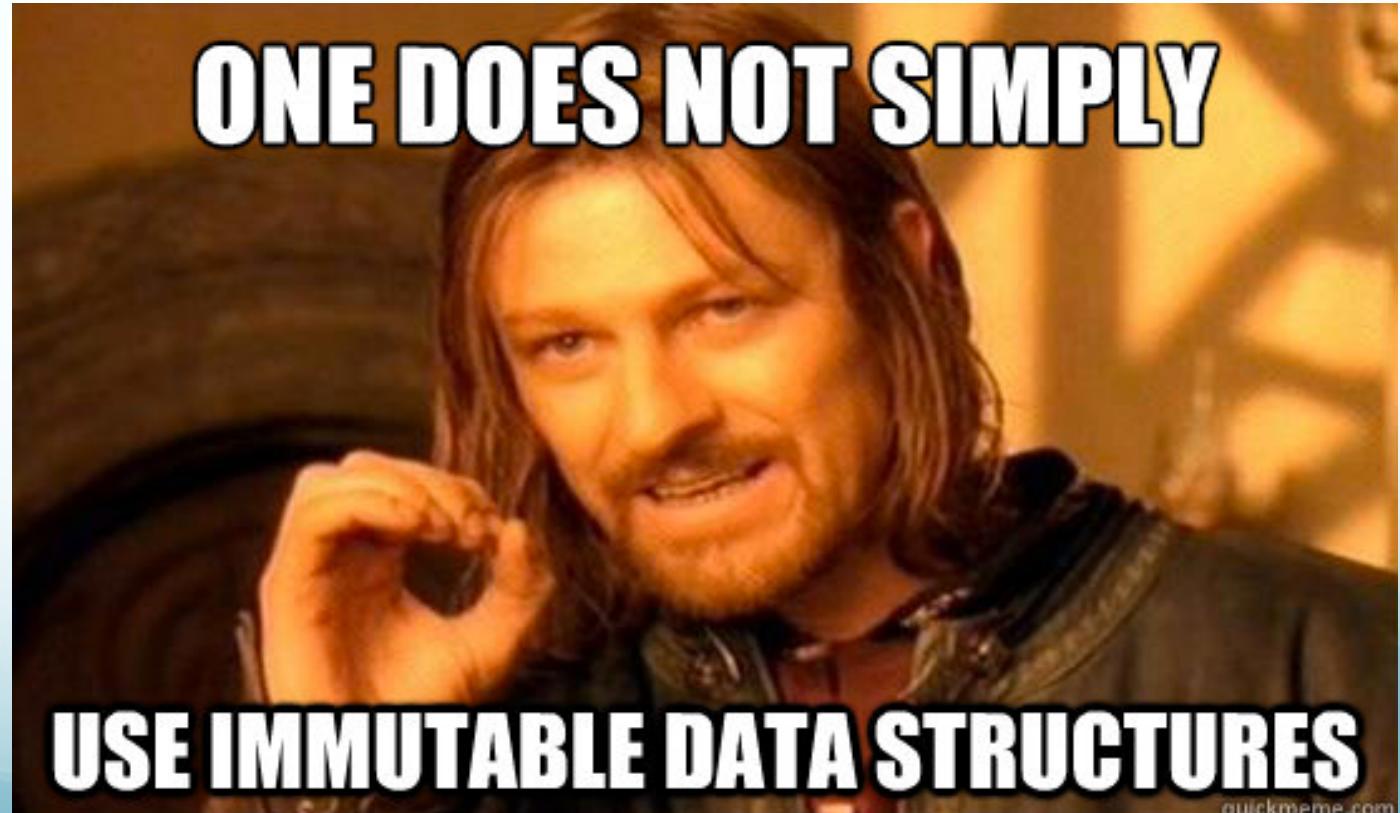
Data Structures Covered

- Arrays
- Linked List
- Queues
- Stacks
- Radix Tree
- Hash Maps



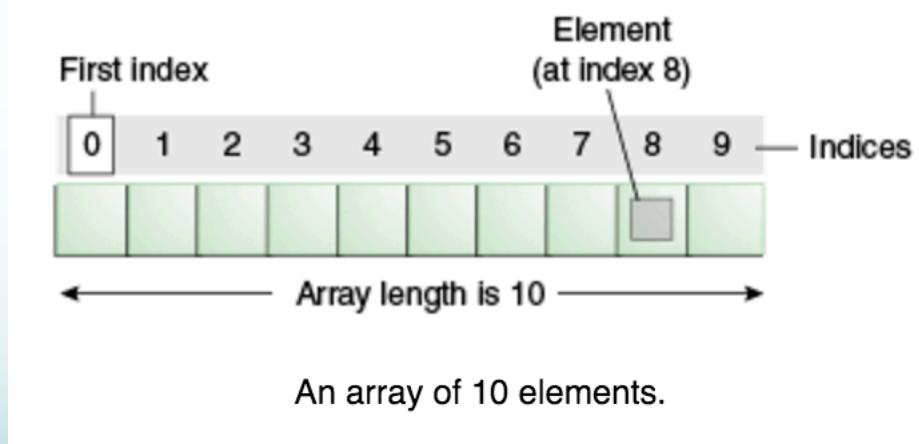
Why Data Structures?

- Storage
- Searching
- Sorting



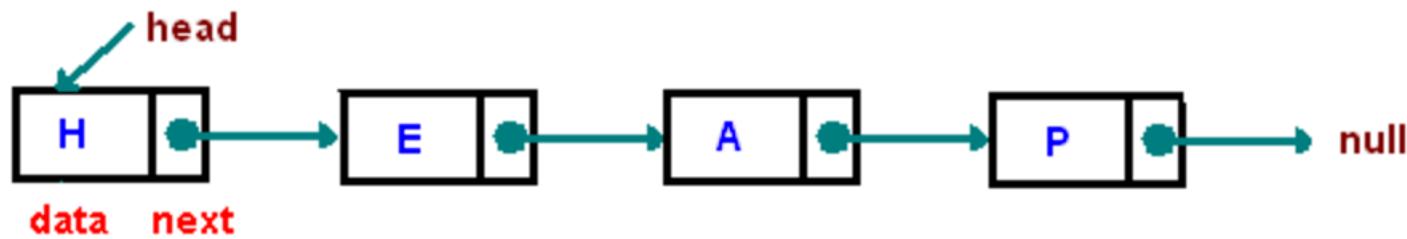
Arrays

An array is a container object that holds a fixed number of values of a single type. The length of an array is established when the array is created. After creation, its length is fixed.



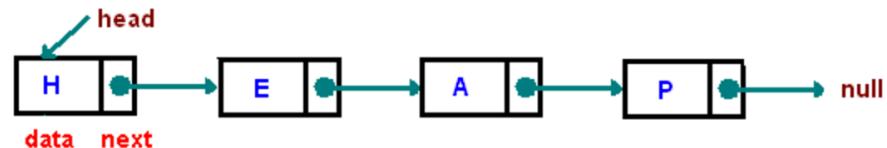
Linked List

A linked list is a linear data structure where each element is a separate object.

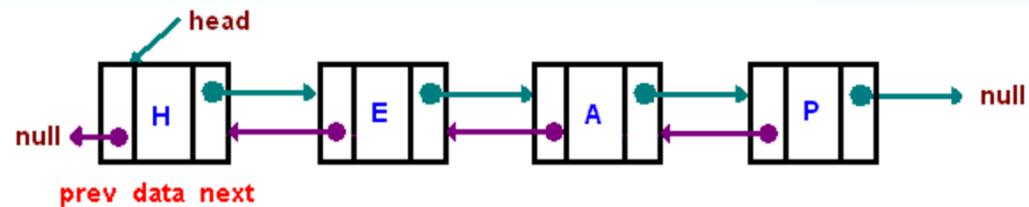


Types of Linked Lists

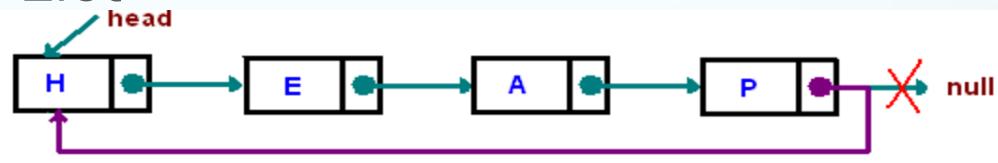
- Singly linked list



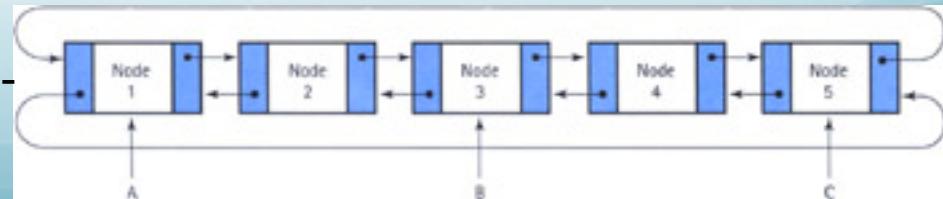
- Doubly linked list



- Singly Circular Linked List



- Doubly Circular Linked List



<https://www.cs.cmu.edu/~adamchik/15-121/lectures/Linked%20Lists/linked%20lists.html>

Lists and Arrays

Lists and Arrays are two of the most fundamental data structures in Computer Science used to implement many other abstract structures such as stacks, queues, and trees.

No Meme 😞

Arrays vs. Linked List Big O

Average Time Complexity

	Arrays	Linked List
Access	$O(1)$	$O(n)$
Search	$O(n)$	$O(n)$
Insertion	$O(n)$	$O(1)$
Deletion	$O(n)$	$O(1)$

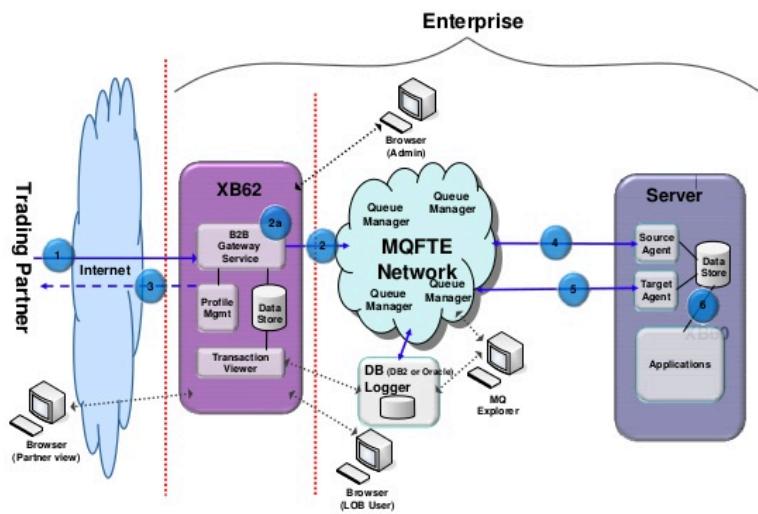
Queues

A queue is a particular kind of abstract data type or collection in which the entities in the collection are kept in order and the principal operations on the collection are the addition of entities to the rear terminal position, known as enqueue, and removal of entities from the front on the terminal position known as dequeue.

A queue is First-In-First-Out (FIFO) data structure

Common Uses of Queues

MQ FTE Integration Pattern – Inbound File to Message



62

Print Jobs for All Printers - KJobViewer

Job ID	Owner	Name	State	Size (KB)	Page(s)	Priority	Bil
2813	kde4	help:/kdeprint/theo...	Held	501	0	70	
2895	kde4	AcroyS4aT6	Held	100	0	50	
2889	kde4	ex.cpp	Held	110	0	70	
2688	kde4	(stdin)	Queued	38	0	70	
2683	kde4	KPrinter	Held	2	0	40	
2664	kde4	KPrinter	Held	1	0	70	
2224	kdetest	one.pcl	Held	1	0	60	
2901	kde4	test.cpp	Held	18	0	57	
2881	kde4	file:/	Held	83	0	41	
2882	kde4	i105.ppd	Held	2023	0	51	
2878	kde4	<STDIN>	Held	659	0	51	

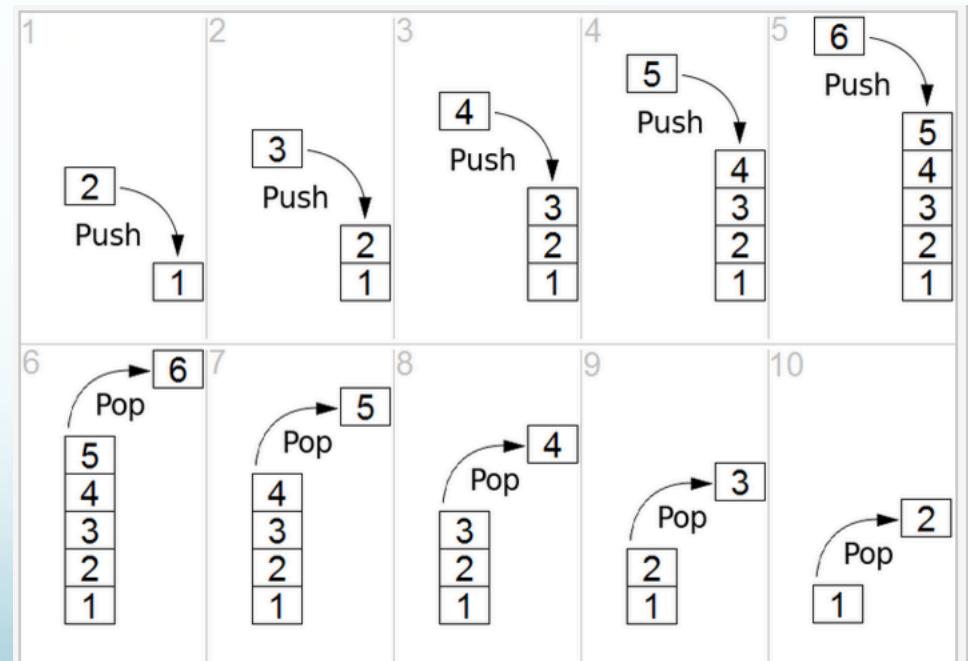
Stack

A stack is an abstract data type that serves as a collection of elements, with two principal operations push, which adds an element to the collection, and pop, which removes the last element that was added.

A stack is a

Last-In-First-Out (LIFO)

Data structure



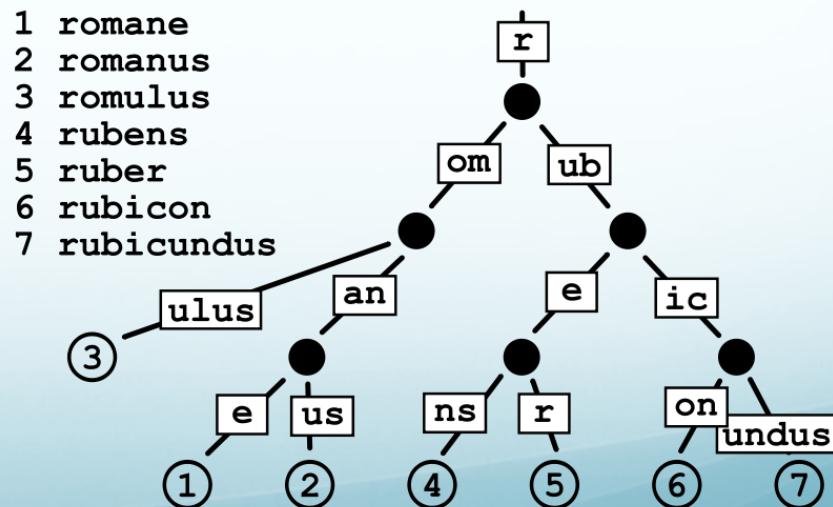
Queues vs. Stacks Big O

Average Time Complexity

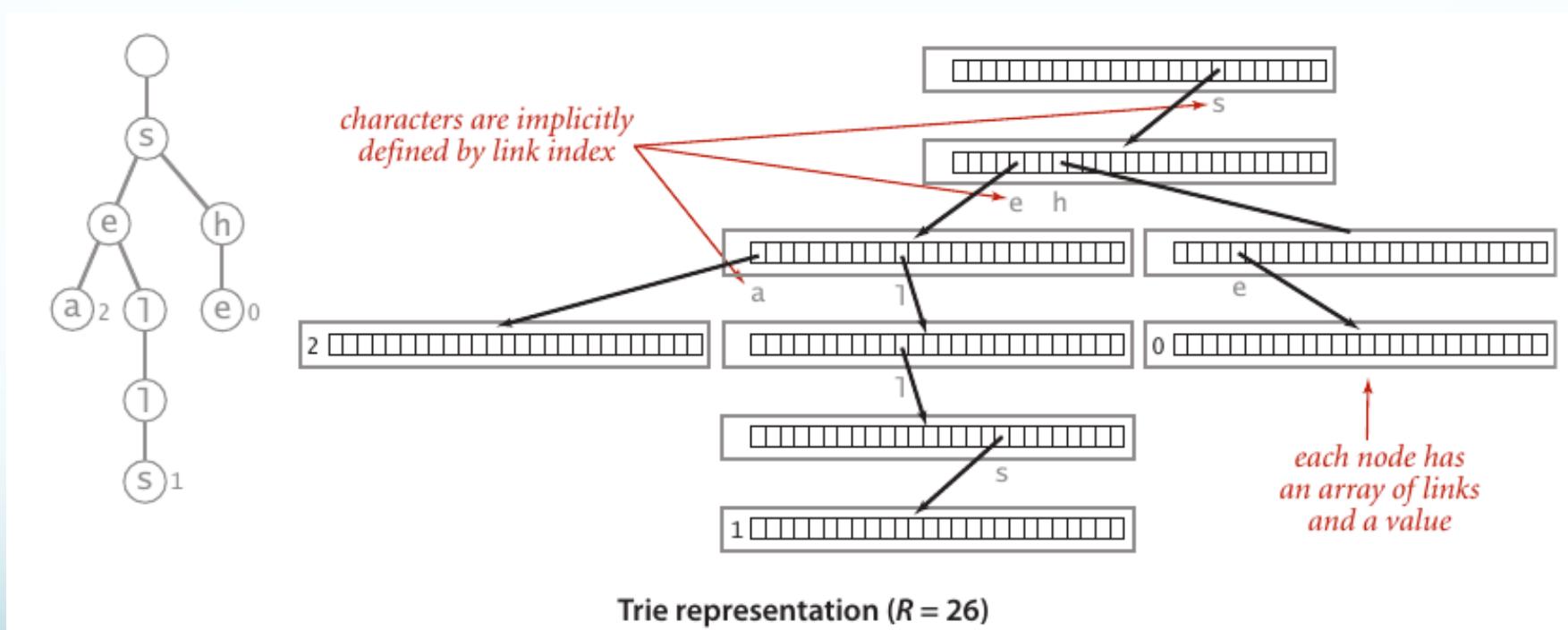
	Queue	Stack
Access	$O(n)$	$O(n)$
Search	$O(n)$	$O(n)$
Insertion	$O(1)$	$O(1)$
Deletion	$O(1)$	$O(1)$

Radix Trees

A radix tree is a data structure that represents a space-optimized trie (pronounced tree) in which each node that is the only child is merged with its parent. The result is that the number of children of every internal node is at least the radix r of the radix trie, where r is a positive integer and a power of x of 2 having $x \geq 1$.

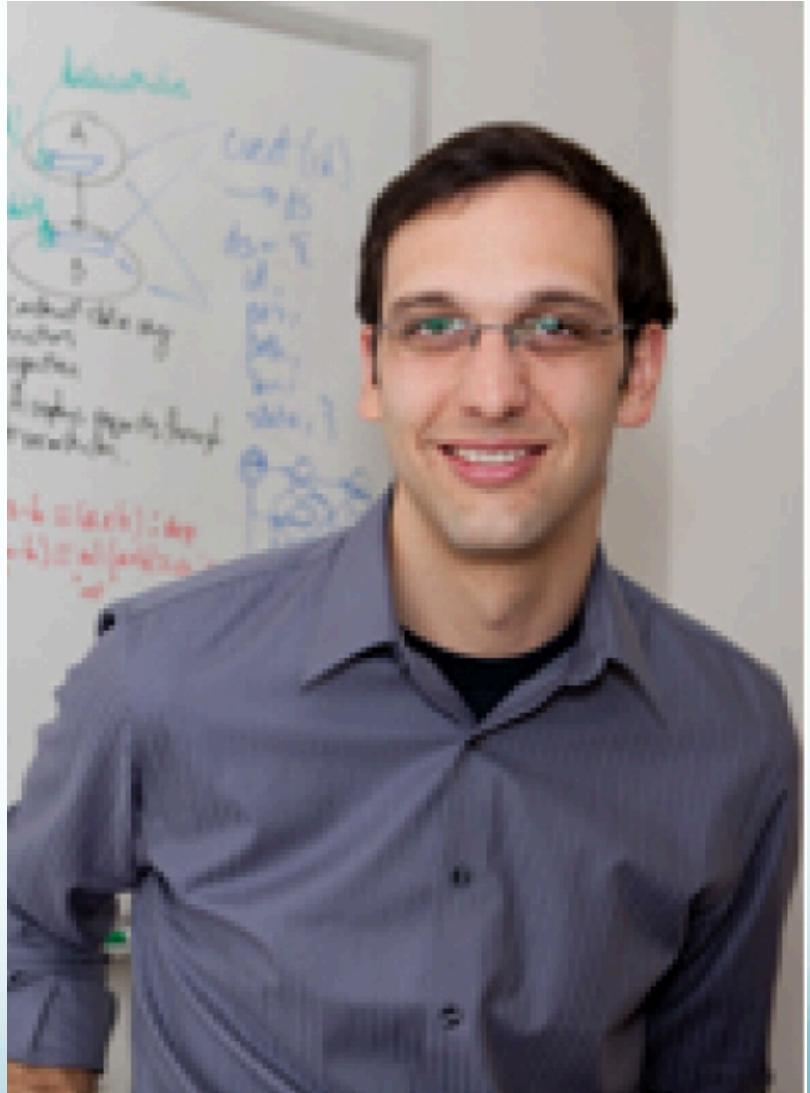


Where Are Radix Tries Used?



Composite OS

<http://composite.seas.gwu.edu>



Hash Maps

I want hash browns instead.



Hash Maps

A hash map or hash table is a data structure used to implement an associative array, a structure that can map keys to values. A hash table uses a hash function to compute an index into an array of buckets or slots, from which the desired value can be found.

Ideally the hash function will assign each key to a unique bucket, but it is possible that two keys will generate an identical hash causing both keys to point to the same bucket.

Hash Table Big O

	Average Case	Worst Case
Search	$O(1)$	$O(n)$
Insertion	$O(1)$	$O(n)$
Deletion	$O(1)$	$O(n)$