HASHTABLES

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CS 140 – Spring 2023

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Admin

Assignment 6 due Friday

No LCs

Mentor hours for the rest of this week:

- Wednesday, 7-9:30pm: Claire and David
- Friday, 1-3pm: Jan

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Running time of insert and search for open addressing

Average case?

We have to make at least one probe

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Running time of insert and search for open addressing

Average case?

What is the probability that the first probe will **not** be successful (assume uniform hashing function)?

α

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Running time of insert and search for open addressing

Average case?

What is the probability that the first **two** probed slots will **not** be successful?

why '~'?

$\sim\alpha^2$

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Running time of insert and search for open addressing

Average case?

What is the probability that the first **two** probed slots will **not** be successful

Technically, second probe is: $\frac{n-1}{m-1}$

$\sim\alpha^2$

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Running time of insert and search for open addressing

Average case?

What is the probability that the first **three** probed slots will **not** be successful?

$\sim\alpha^3$

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Running time of insert and search for open addressing

Average case: expected number of probes

sum of the probability of making 1 probe, 2 probes, 3 probes, …

$$E[probes] = 1 + \alpha + \alpha^2 + \alpha^3 + \ldots$$
$$= \sum_{i=0}^{m} \alpha^i$$
$$< \sum_{i=0}^{\infty} \alpha^i$$
$$= \frac{1}{1-\alpha}$$

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Average number of probes

$$E[probes] = \frac{1}{1-\alpha}$$

α	Average number of searches
0.1	$1/(1-.1) = 1.11$
0.25	$1/(1-.25) = 1.33$
0.5	$1/(1-.5) = 2$
0.75	$1/(1-.75) = 4$
0.9	$1/(1-.9) = 10$
0.95	$1/(1-.95) = 20$
0.99	$1/(1-.99) = 100$

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How big should a hashtable be?

A good rule of thumb is the hashtable should be around half full

What happens when the hashtable gets full?

Copy: Create a new table and copy the values over

- results in one expensive insert
- simple to implement

Amortized copy: When a certain ratio is hit, grow the table, but copy the entries over a few at a time with every insert

- no single insert is expensive and can guarantee per insert performance
- more complicated to implement

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Checkpoint 1

Induction on trees

$$T(n) = T(\sqrt{n}) + c$$

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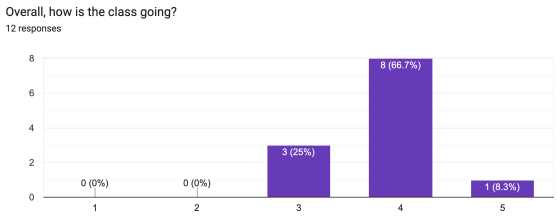
Course feedback



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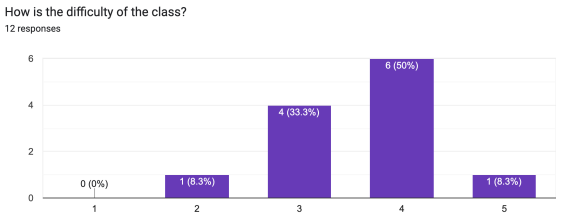
Course feedback



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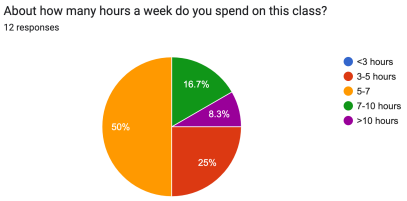
Course feedback



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Course feedback

I love proving things and looking at the Math behind the concepts from CS62.

the group assignments

Honestly I just really like the little comics at the start of every homework

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Course feedback

lectures are wayyy too fast, barely enough time to process things so it feels pointless to take notes; current course content is comprehensive and makes sense but it feels disorganized, like different content stitched together sort of so…

Having more examples, or going through the slides a bit slower

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Course feedback

The homeworks are a lot of work and the mentors are super helpful but someone's even they don't have the solutions and that wastes hours of our time. I think homeworks can have more straight forward problems that show we understand things rather than problems that we always have to scavenge the internet and bug mentors for understandings.

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Course feedback

During Class, could we have some more exercises along with the lecture contents?

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Class overview

Math/Algorithm Tools
- math basics
- big-O (omega and theta)
- recurrences
- amortized analysis
- proofs by induction

Algorithm techniques
- divide and conquer
- greedy
- dynamic programming

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Class overview

Revisiting data structures
- ArrayList: amortized analysis
- hashtables: big-O analysis
- Redblack trees
- binomial heaps
- disjoint sets

Graphs/Graph Algorithms:
- More details: Dijkstra's, Bellman-Ford, Prim's, Kruskal's
- Topological sort for DAGs
- Floyd-Warshall, Johnsn's (all pairs shortest paths)
- Network flow

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Class overview

NP completeness

Linear programming

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https://leetcode.com/problems/largest-number/

179. Largest Number

Medium 6.6K 542

Companies

Given a list of non-negative integers `nums`, arrange them such that they form the largest number and return it.

Since the result may be very large, so you need to return a string instead of an integer.

Example 1:

```
Input: nums = [10,2]
Output: "210"
```

Example 2:

```
Input: nums = [3,30,34,5,9]
Output: "9534330"
```

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https://leetcode.com/problems/group-anagrams/

Given an array of strings `strs`, group **the anagrams** together. You can return the answer in **any order**.

An **Anagram** is a word or phrase formed by rearranging the letters of a different word or phrase, typically using all the original letters exactly once.

Example 1:

```
Input: strs = ["eat","tea","tan","ate","nat","bat"]
Output: [["bat"],["nat","tan"],["ate","eat","tea"]]
```

Example 2:

```
Input: strs = [""]
Output: [[""]]
```

Example 3:

```
Input: strs = ["a"]
Output: [["a"]]
```

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