Week 4

Data Structures

Week 4

Discuss and ask questions about Week 4.

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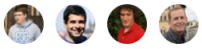
Hash Tables



In this module you will learn about very powerful and widely used technique called hashing. Its applications include implementation of programming languages, file systems, pattern search, distributed key-value storage and many more. You will learn how to implement data structures to store and modify sets of objects and mappings from one type of objects to another one. You will see that naive implementations either consume huge amount of memory or are slow, and then you will learn to implement hash tables that use linear memory and work in O(1) on average! In the end, you will learn how hash functions are used in modern disrtibuted systems and how they are used to optimize storage of services like Dropbox, Google Drive and Yandex Disk!

Less

Learning Objectives

- List applications of hashing
- Apply direct addressing to retrieve names by phone numbers
- Develop a hash table based on chaining scheme
- Apply hashing to find patterns in text
- Describe how Dropbox, Google Drive and Yandex Disk save space
- Describe the principles on which distributed hash tables are built

Less

Coursera Lab Sandbox BETA

- Easily launch Coursera's preconfigured environment for C++, Java, and Python 3 programming
- Get access to all dependencies (libraries and packages) for VSCode—no local software installation required
- Practice C++, Java, and Python 3 programming, run test cases, and work on assignments from your browser

Open Lab Sandbox

Introduction, Direct Addressing and Chaining

Video: Applications of Hashing 2 min — Resume

Video: Analysing Service Access Logs 7 min

Video: Direct Addressing 7 min

Video: List-based Mapping 8 min

Video: Hash Functions 3 min

Video: Chaining Scheme 6 min

Video: Chaining Implementation and Analysis 5 min

Video: Hash Tables 6 min

Reading: Slides and External References 10 min

Hash Functions

- **Video:** Phone Book Problem 4 min
- **Video:** Phone Book Problem - Continued 6 min
- **Video:** Universal Family 9 min
- **Video:** Hashing Integers 9 min
- **Video:** Proof: Upper Bound for Chain Length (Optional) 8 min
- **Video:** Proof: Universal Family for Integers (Optional) 11 min
- **Video:** Hashing Strings 9 min
- **Video:** Hashing Strings - Cardinality Fix 7 min
- **Reading:** Slides and External References 10 min
- **Quiz:** Hash Tables and Hash Functions 4 questions Due Aug 23, 1:59 AM CDT

Searching Patterns

- **Video:** Search Pattern in Text 7 min
- **Video:** Rabin-Karp's Algorithm 9 min
- **Video:** Optimization: Precomputation 9 min
- **Video:** Optimization: Implementation and Analysis 5 min
- **Reading:** Slides and External References 10 min

Distributed Hash Tables (Optional)

- **Video:** Instant Uploads and Storage Optimization in Dropbox 10 min
- **Video:** Distributed Hash Tables 12 min
- **Reading:** Slides and External References 10 min

Programming Assignment 3

- **Practice Quiz:** Hashing 3 questions
- **Programming Assignment:** Programming Assignment 3: Hash Tables 2h Due Aug 23, 1:59 AM CDT