LEC 10

CSE 122

Nested Collections

Questions during Class?

Raise hand or send here

sli.do #cse122

Talk to your neighbors:

Favorite warm weather drink?

Lemonade? Iced tea? Soda? Juice?

Music: 122 24sp Lecture Tunes

Instructors: Miya Natsuhara and Kasey Champion

TAs:

Ayush	Kyle	Colin	Chaafen
Poojitha	Jacob	Ronald	Smriti
Chloe	Atharva	Saivi	Ambika
Ailsa	Rucha	Shivani	Elizabeth
Jasmine	Megana	Kavya	Aishah
Lucas	Eesha	Steven	Minh
Logan	Zane	Ken	Katharine

Agenda

- Announcements
- Review/Finish: mostFrequentStart
- Recap: Nested Collections
- Practice: Search Engine

Announcements

- Programming Assignment 2 (P2) was released on Friday!
  - Seriously, start early! This assignment is much more involved…
  - Due **May 9th** by 11:59 PM
- Quiz 1 on **May 7th** in your registered Quiz Section
  - Topics: (Reference Semantics), Stacks and Queues, Sets, Maps
  - Practice Quiz 1 available, along with Extra Practice problems (by topic)
- Quiz 0 grades to be released later today!
- Tomorrow, Resubmission Cycle 3 (R3) form out, due May 7th by 11:59 PM
  - Available assignments: ***P0***, C1, P1
  - Reminder: to use a resubmission cycle you need to
    - (1) submit your work (big blue "Submit" button on Ed)
    - AND (2) fill out the resubmission form (linked from Ed + course calendar)

Announcements: Potential ASE Strike

- There is an open question about how a potential university-wide academic student employee (ASE) strike (which includes TAs) may affect the course, but it almost certainly would.

- A reduction in the size of our operating course staff may impact
  - TA office hour availability (IPL)
  - Grading timelines
  - Quantity and quality of grading feedback
  - Quiz section administration
  - Ed discussion board answers

Announcements: Potential ASE Strike

- The duration of a potential strike is unknown and the situation is still developing.

- Please stay in communication with the course staff via the course message board (or email for private matters) if you encounter unexpected circumstances during this time. We (at minimum, Kasey and Miya) will respond and do our best to work with and support you.

- On our end, we will do our best to communicate changes to course logistics with you. Please actively check your email and the Ed board.

Announcements: Potential ASE Strike

above all,

Please be kind.

We are all doing our best to provide a good learning environment for our students and to provide for ourselves.

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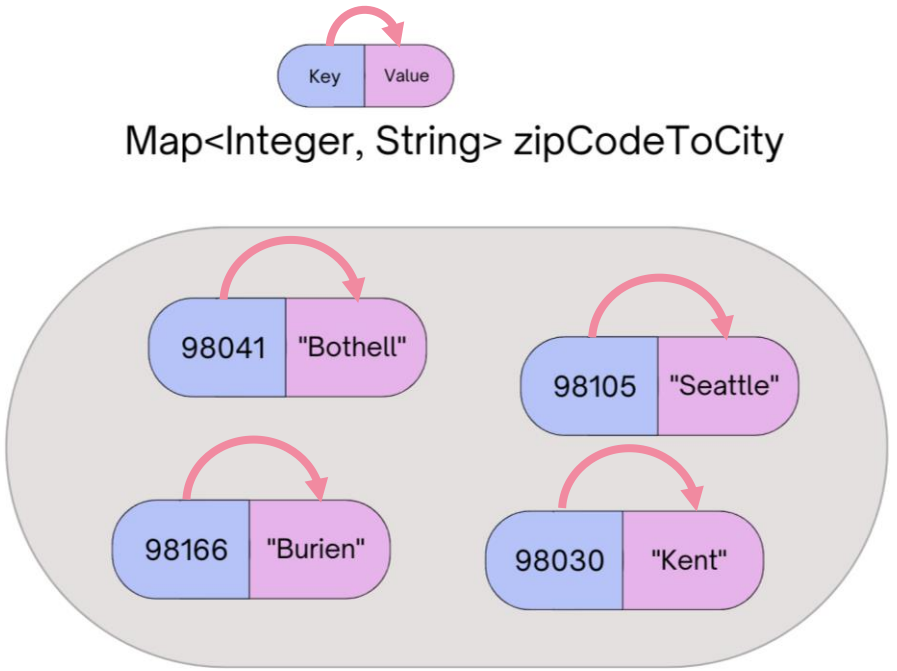
Map ADT

- Data structure to map keys to values
  - Keys can be any* type; Keys must be unique
  - Values can be any type
- Example: Mapping ticker to stock price in P0
- Operations
  - `put(key, value)`: Associate key to value
    - Overwrites duplicate keys
  - `get(key)`: Get value for key
  - `remove(key)`: Remove key/value pair



Same as Python's `dict`

mostFrequentStart

Write a method called mostFrequentStart that takes a Set of words and does the following steps:

- Organizes words into “word families” based on which letter they start with
- Selects the largest “word family” as defined as the family with the most words in it
- Returns the starting letter of the largest word family (and if time, should update the Set of words to only have words from the selected family).

mostFrequentStart

For example, if the `Set` words stored the values

```
["hello", "goodbye", "library", "literary", "little", "repel"]
```

The word families produced would be

```
'h' -> 1 word ("hello")
'g' -> 1 word ("goodbye")
'l' -> 3 words ("library", "literary", "little")
'r' -> 1 word ("repel")
```

Since 'l' has the largest word family, we return 3 and modify the `Set` to only contain `Strings` starting with 'l'.

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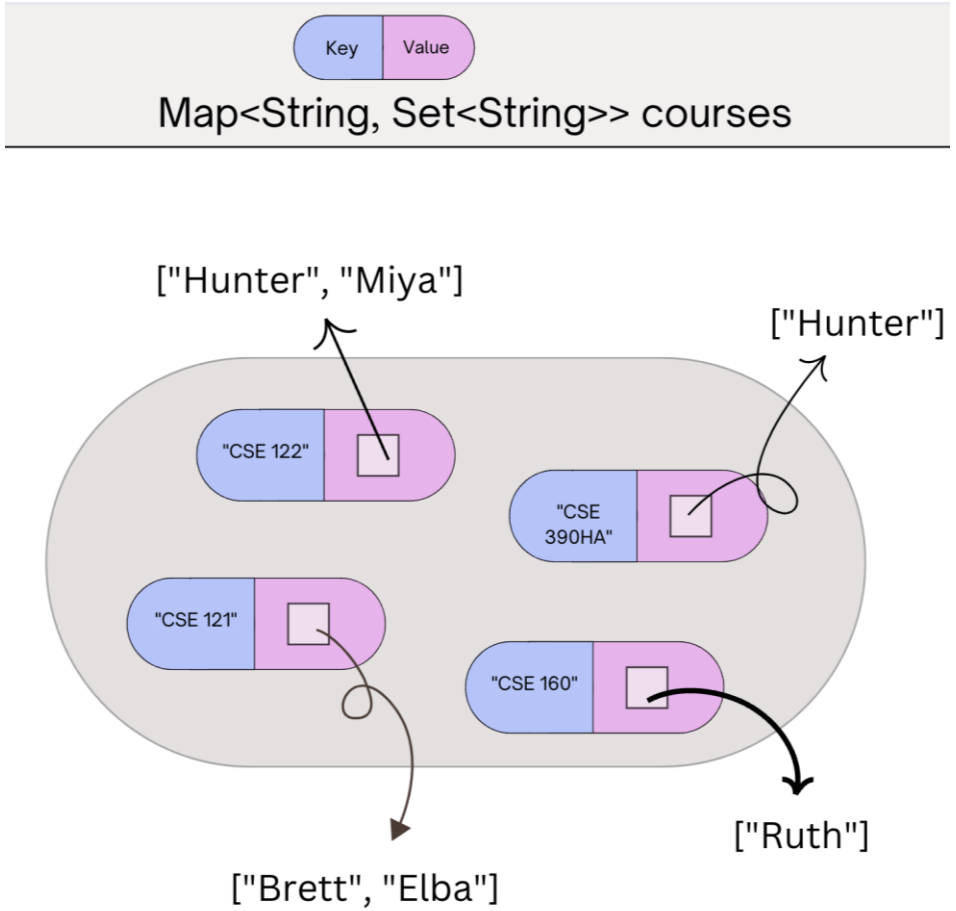
Nested Collections

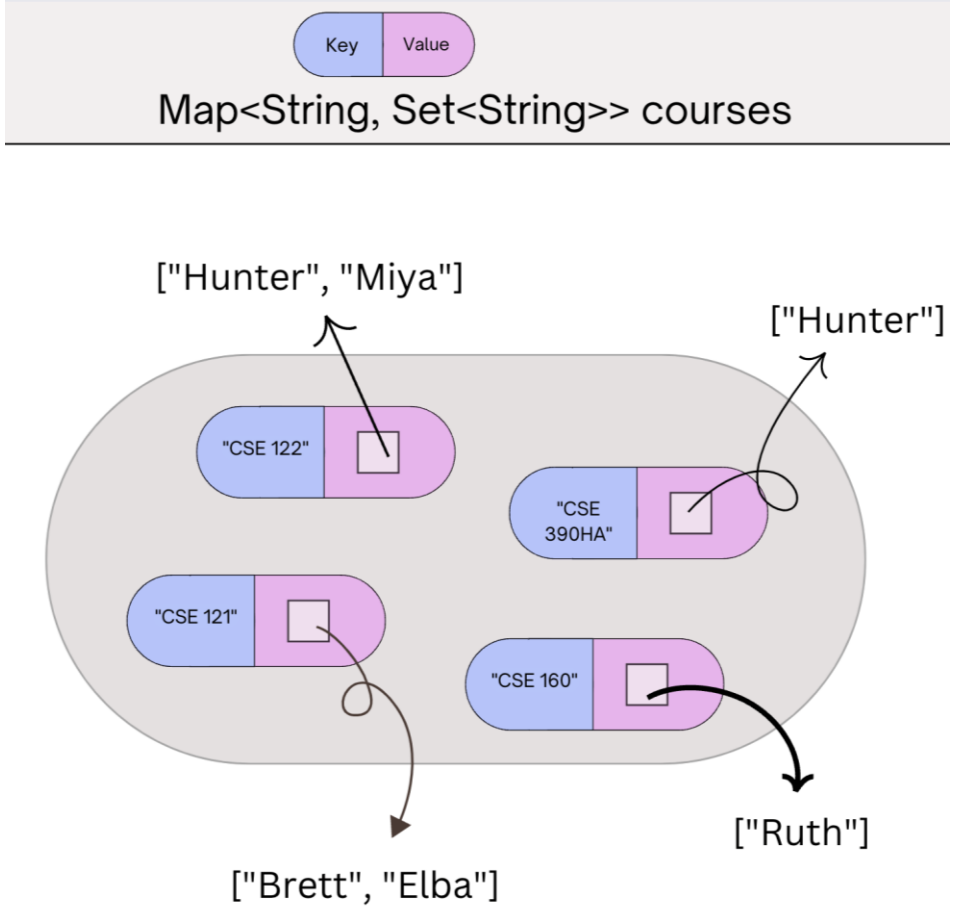
- The values inside a Map can be any type, including data structures
- Common examples:
  - Mapping: Section ➔ Set of students in that section
  - Mapping: Recipe ➔ Set of ingredients in that recipe
    - Or even Map<String, Map<String, Double>> for units!



Updating Nested Collections

The "value" inside the Map is a reference to the data structure!

- Think carefully about number of references to a particular object




```
courses.put("CSE 123", new HashSet<String>());
courses.get("CSE 123").add("Nathan");

Set<String> cse123 = courses.get("CSE 123");
cse123.add("Joe");
```

Practice : Think

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Suppose map had the following items. What would its items be after running this code?

```
map: {"KeyA"=[1, 2], "KeyB"=[3], "KeyC"=[4, 5, 6]}
```

```
Set<Integer> nums = map.get("KeyA");
nums.add(7);
map.put("KeyB", nums);
map.get("KeyA").add(8);
map.get("KeyB").add(9);
```

A. {"KeyA"=[1, 2], "KeyB"=[1, 2, 7], "KeyC"=[4, 5, 6]}

B. {"KeyA"=[1, 2, 8], "KeyB"=[1, 2, 7, 9], "KeyC"=[4, 5, 6]}

C. {"KeyA"=[1, 2, 7, 8], "KeyB"=[1, 2, 7, 9], "KeyC"=[4, 5, 6]}

D. {"KeyA"=[1, 2, 7, 8, 9], "KeyB"=[1, 2, 7, 8, 9], "KeyC"=[4, 5, 6]}

Practice : Pair

sli.do #cse122

Suppose map had the following items. What would its items be after running this code?

```
map: {"KeyA"=[1, 2], "KeyB"=[3], "KeyC"=[4, 5, 6]}
```

```
Set<Integer> nums = map.get("KeyA");
nums.add(7);
map.put("KeyB", nums);
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```

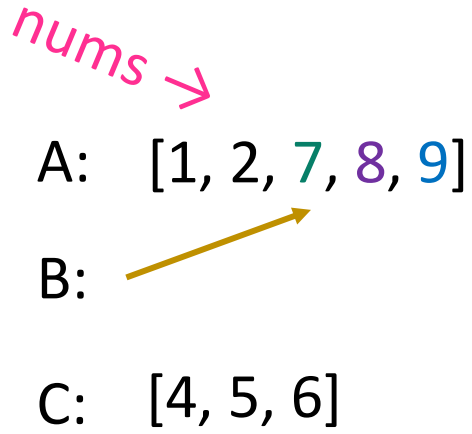

A. `{"KeyA"=[1, 2], "KeyB"=[1, 2, 7], "KeyC"=[4, 5, 6]}`
B. `{"KeyA"=[1, 2, 8], "KeyB"=[1, 2, 7, 9], "KeyC"=[4, 5, 6]}`
C. `{"KeyA"=[1, 2, 7, 8], "KeyB"=[1, 2, 7, 9], "KeyC"=[4, 5, 6]}`
D. `{"KeyA"=[1, 2, 7, 8, 9], "KeyB"=[1, 2, 7, 8, 9], "KeyC"=[4, 5, 6]}`

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- **Practice: Search Engine**

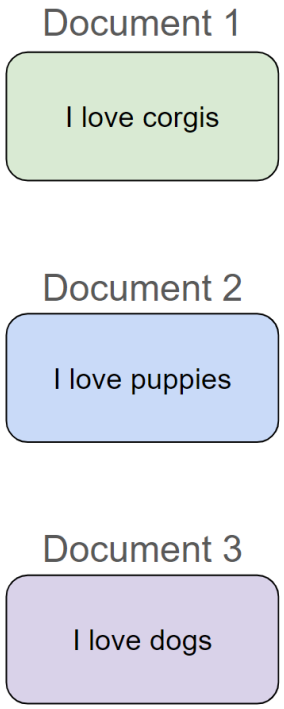
Background: Search Engines

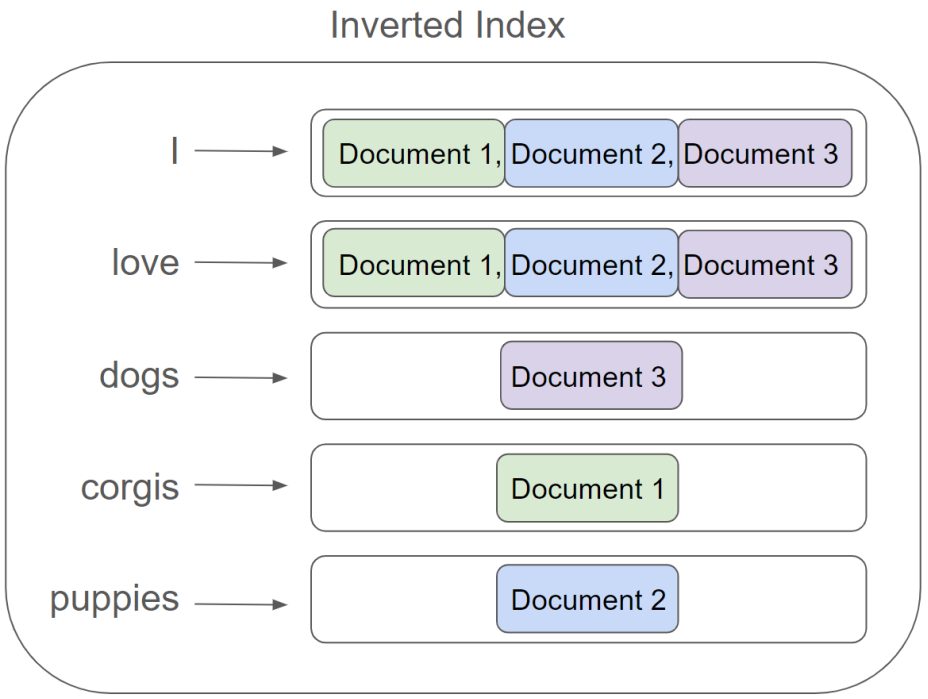
- A **search engine** receives a **query** and returns a set of relevant **documents.** Examples: Google.com, Mac Finder, more.
  - Queries often can have more
- A search engine involves two main components
  - An **index** to efficiently find the set of documents for a query
    - Will focus on “single word queries” for today’s example
  - A **ranking algorithm** to order the documents from most to least relevant
    - Not the focus of this example

- Goal: Precompute a data structure that helps find the relevant documents for a given query

Inverted Index

- An **inverted index** is a Mapping from possible query words to the set of documents that contain that word
  - Answers the question: "What documents contain the word 'corgis'?"





Ranking Results

- There is no one right way to define which documents are “most relevant” There are approximations, but make decisions about what relevance means
- Idea 1: Documents that have more hits of the query should come first
  - Pro: Simple
  - Con: Favors longer documents (query: “the dogs” will favor long documents with lots of “the”s)
- Idea 2: Weight query terms based on their “uniqueness”. Often use some sort of score for “Term Frequency – Inverse Document Frequency (TF-IDF)
  - Pro: Doesn’t put much weight on common words like “the”
  - Cons: Complex, many choices in how to compute that yield pretty different rankings
- Idea 3: Much more! Most companies keep their ranking algorithms very very secret ☺

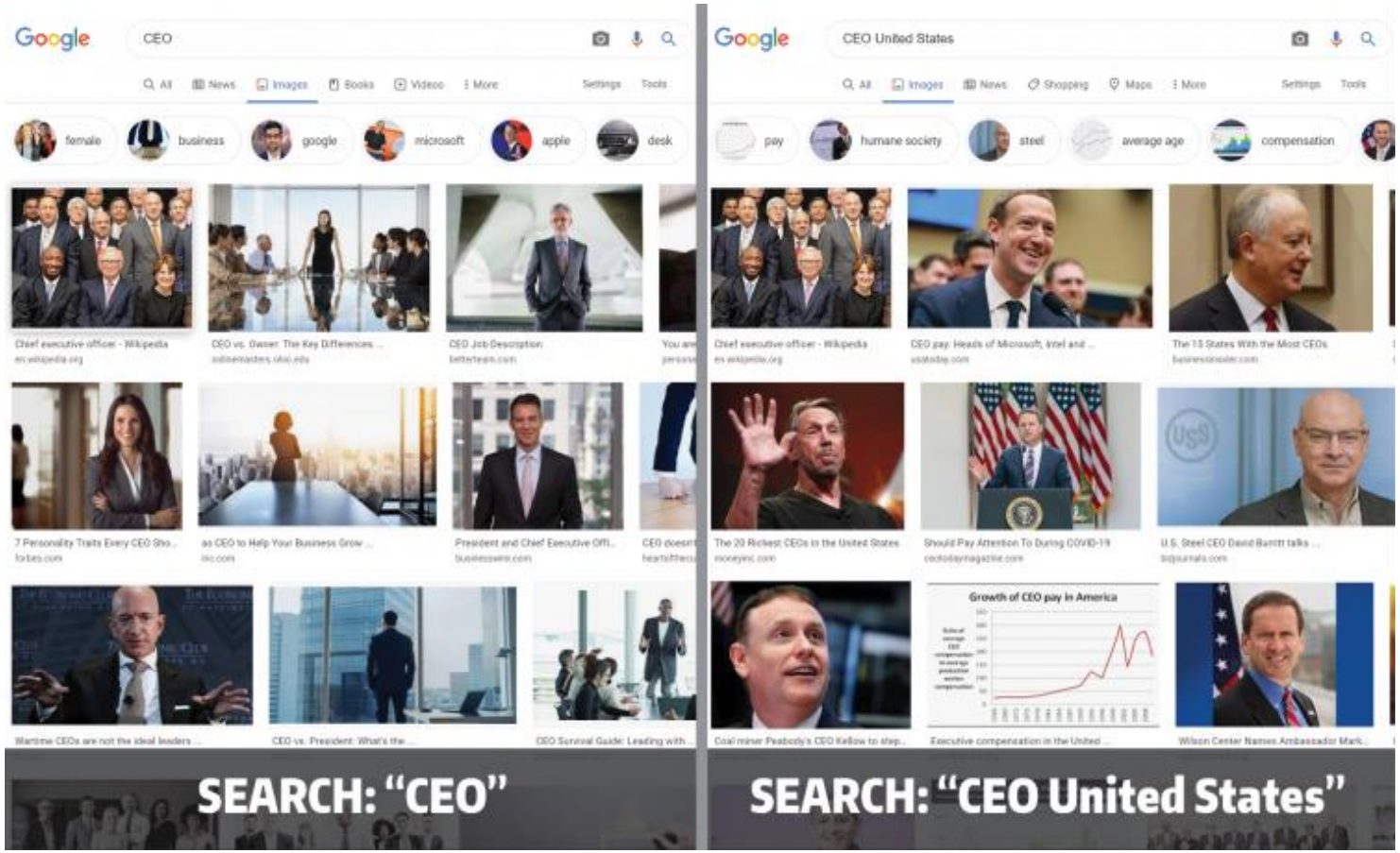
Data Bias

- Image results for searching the term “CEO” on Google (2015)
  - Notice anything about the results?

https://www.washington.edu/news/2015/04/09/whos-a-ceo-google-image-results-can-shift-gender-biases/

Data Bias

- Fix: Image results for searching “CEO” and “CEO United States” (2022)



https://www.washington.edu/news/2022/02/16/googles-ceo-image-search-gender-bias-hasnt-really-been-fixed

Data Bias

- Google's autocomplete recommendations used to actually look like this
  - Fix: Don't display autocomplete results for phrases like "why are [group] ____"

<u>Are these changes fixing the right thing?</u>

Btw, this is a great book that you should check out if you're interested ->