CS 225

#35: Hashing

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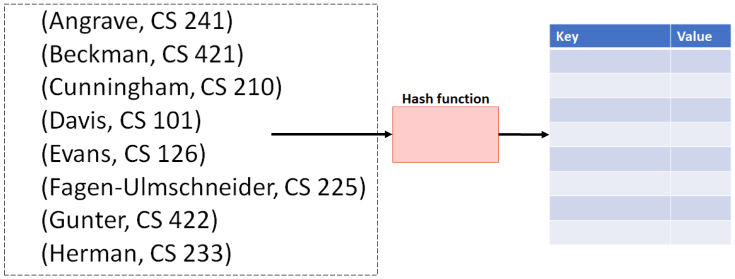
Every hash table contains three pieces:

1. A **hash function**. The hash function transforms a key from the keyspace into an integer.
2. **A data storage structure**. (Usually an array)
3. A method of handling **hash collisions**.

A Perfect Hash Function



(Angrave, CS 241)
(Beckman, CS 421)
(Cunningham, CS 210)
(Davis, CS 101)
(Evans, CS 126)
(Fagen-Ulmschneider, CS 225)
(Gunter, CS 422)
(Herman, CS 233)

...characteristics of this function?

A hash function must be:

- **Deterministic**:
- **Efficient**:
- **Defined for a given size:**

In CS 225, we think hash functions as two separate parts:

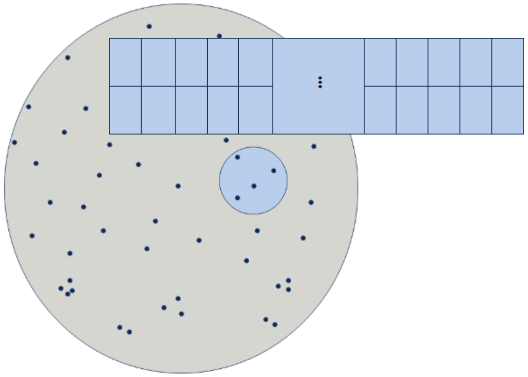
- A **hash**:
- A **compression**:

Towards a general-purpose hashing function:

It is easy to create a perfect hashing function when the keyspace is proportional to the table size:

- **Ex:** Professors at CS@Illinois
- **Ex:** Anything you can reason about every possible value

It is difficult to create a general-purpose hashing function when the keyspace is large:



For example, given a fixed collection of books what is a viable hash function that will yield no collisions?

... will those hash functions work for all *possible* books?

What is an example of bad input data on this hash function?

Reflections on Hashing

We are starting the study of general-purpose hash functions. There are many other types of hashes for specific uses (ex: cryptographic hash functions).

Even if we build a good hash function, it is not perfect. What happens when the function isn't always a bijection?

Dealing with hashing depends on which type of storage structure you are using.

Open Hashing:

Closed Hashing:

Draw the following hash table using ***separate chaining.***

Key	Value	Hash
Bob	B+	2
Anna	A-	4
Alice	A+	4
Betty	B	2
Brett	A-	2
Greg	A	0
Sue	B	7
Ali	B+	4
Laura	A	7
Lily	B+	7

Simple Uniform Hashing Assumption (SUHA)

SUHA assumes that our hash function is uniform and independent for all keys in the keyspace (universe).

The expected length of a chain under SUHA:

This value is also known as our 'load factor'.

Running time of Separate Chaining:

	Worst Case	SUHA
Insert		
Remove/Find		