



CS 225

Data Structures

October 24 – Hashing

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A Hash Table based Dictionary

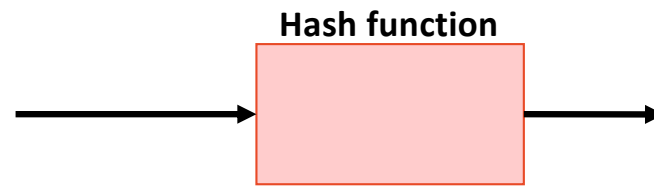
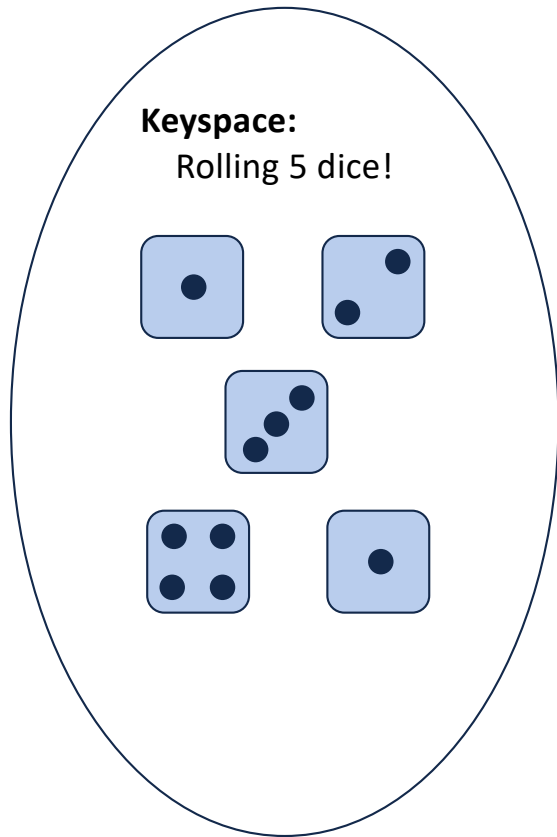
Client Code:

```
1 Dictionary<KeyType, ValueType> d;  
2 d[k] = v;
```

A **Hash Table** consists of three things:

1. A hash function, $f(k)$
2. An array
3. Something to handle chaos when it occurs!

A Perfect Hash Function



Key	Value
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	



Hash Function

Our **hash function** consists of two parts:

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

Choosing a good hash function is tricky...

- Don't create your own (yet*)
- Very smart people have created very bad hash functions

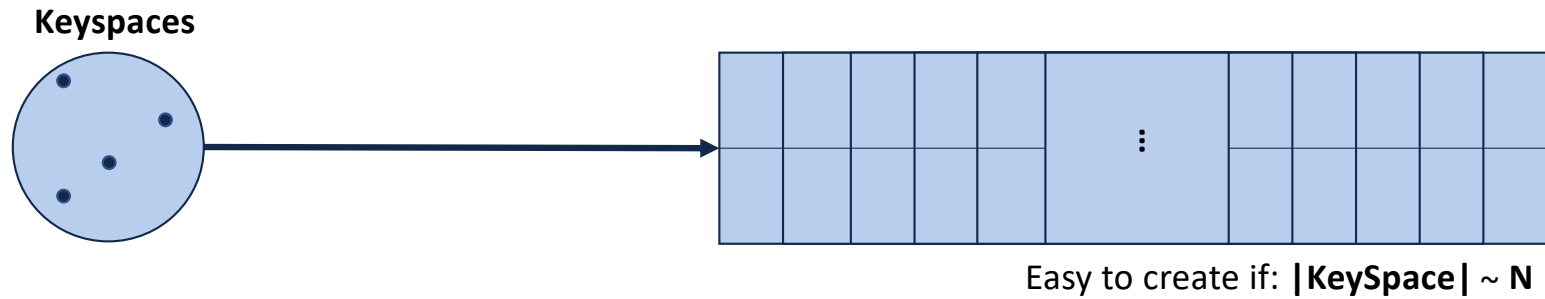


Hash Function

Characteristics of a good hash function:

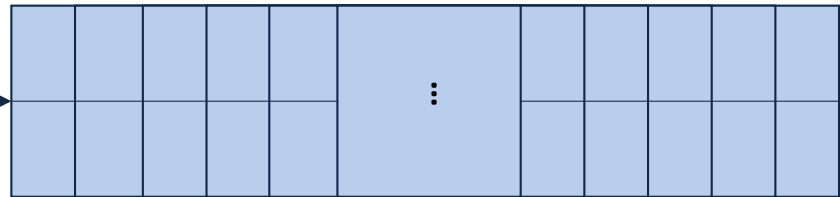
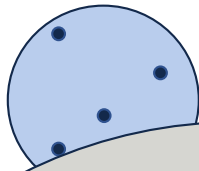
1. Computation Time:
2. Deterministic:
3. Satisfy the SUHA:

General Purpose Hash Function

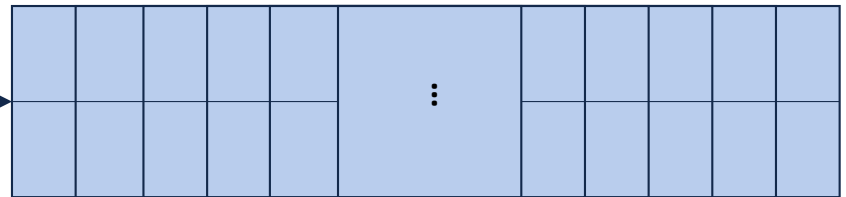
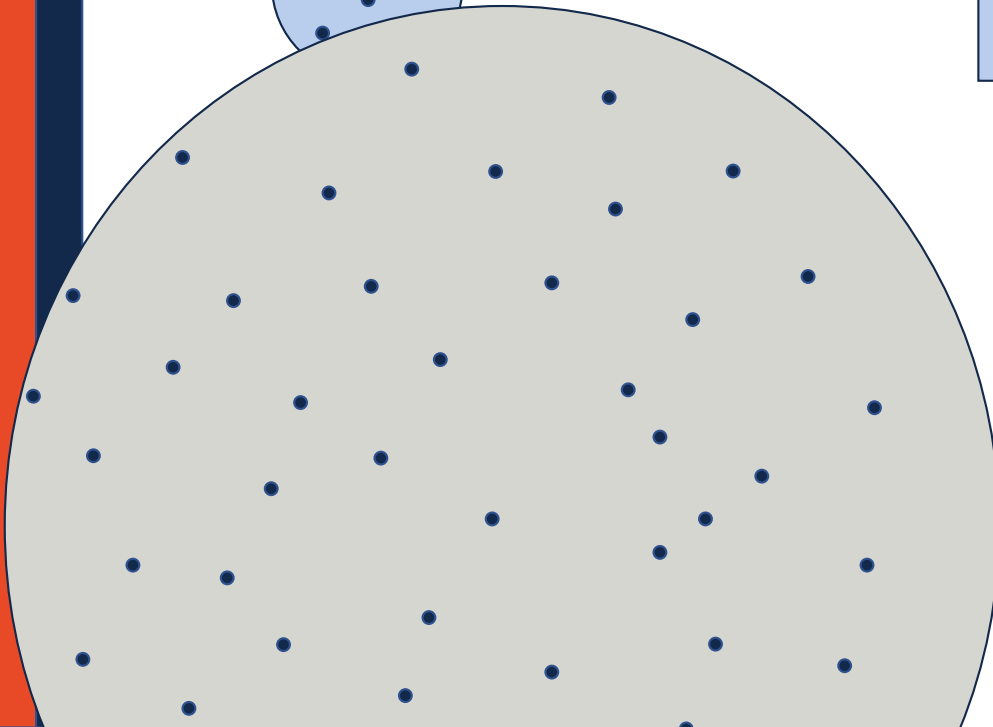


General Purpose Hash Function

Keyspaces

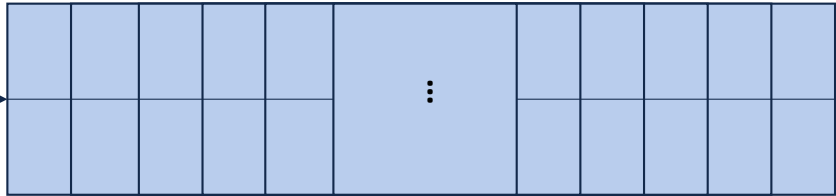
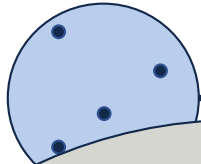


Easy to create if: $|\text{KeySpace}| \sim N$

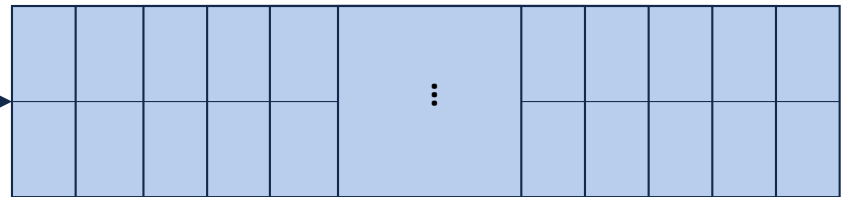
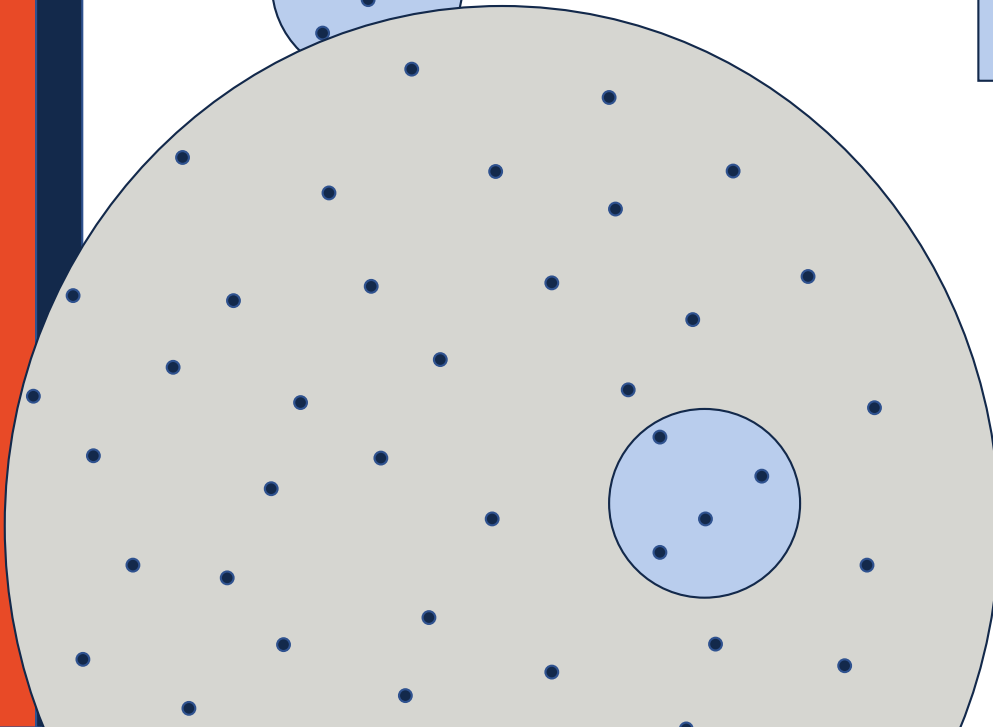


General Purpose Hash Function

Keyspaces



Easy to create if: $|\text{KeySpace}| \sim N$



Difficult to Create:



MP5



illinois1867 • Follow

illinois1867 Serious #ILLINOIShomecoming question... how do you say "I-L-L" in dog language?

thejordanbarry Omg @emily_tyndorf your puppy is so famous

tessafurlong @emily_tyndorf WHAT IS HAPPENING

tyndorfanne Rosy will be hosting a "meet and greet" for all that are interested 🤗
#unofficialllinimascot ❤️

idesigner3 @meg733 정말 우리 다람이 님 았다

frantastic2021 @elise_marie28 !!!!

meg733 @idesigner3 나이가 있어보이네

merdive_m12 🤔 🍊 🌟

allison_nichols4 @emily_tyndorf why am i not surprised that Rosy made the Illinois name 🤔

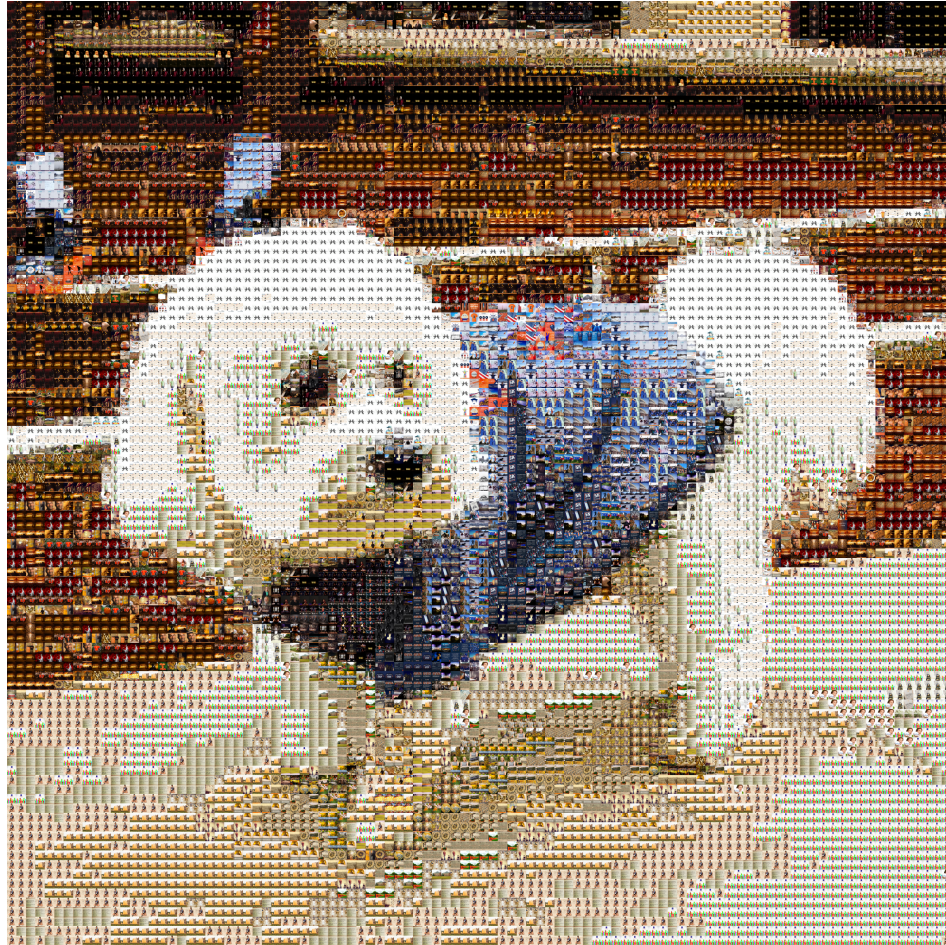


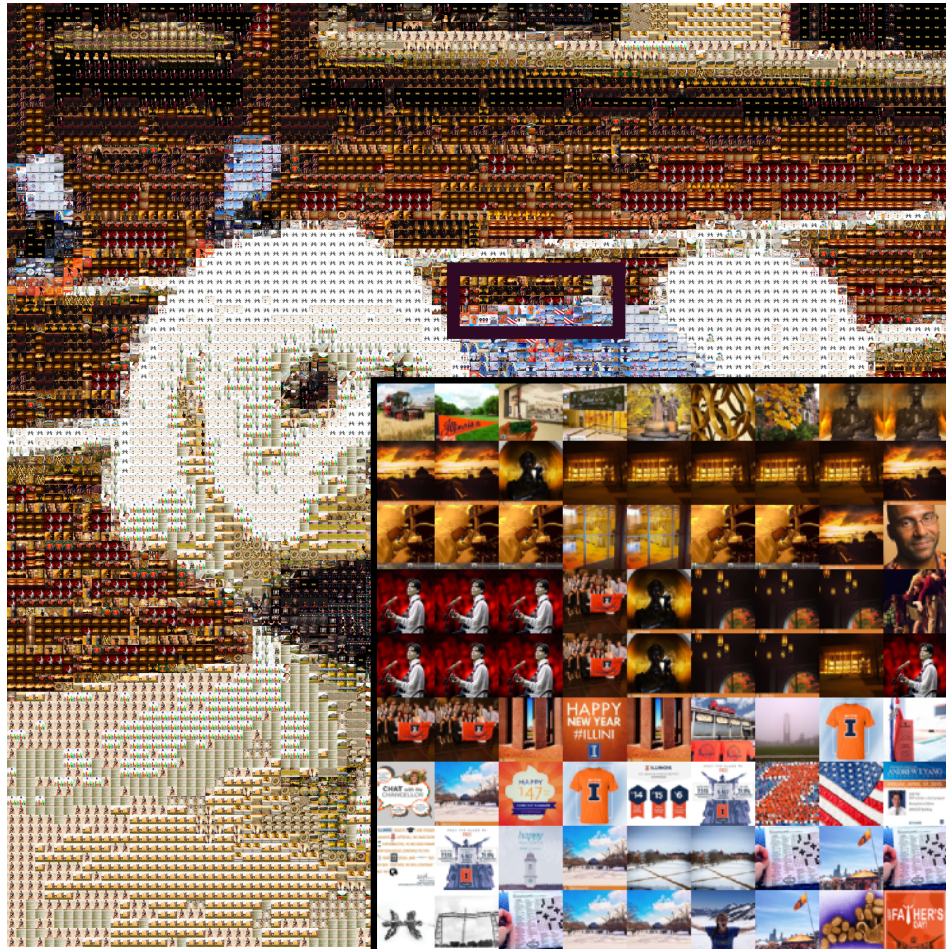
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Hash Function

Given: Easy to create a hash function of strings of length 8.



Idea: Map 40 character things to length 8:

Alice was beginning to get very tired of sitting by her sister on the bank, and of having nothing to do: once or twice she had peeped into the book her sister was reading, but it had no pictures or conversations in it, 'and what is the use of a book,' thought Alice 'without pictures or conversations?' So she was considering in her own mind (as well as she could, for the hot day made her feel very sleepy and stupid), whether the pleasure of making a daisy-chain would be worth the trouble of getting up and picking the daisies, when suddenly a White Rabbit with pink eyes ran close by her. There was nothing so very remarkable in that; nor did Alice think it so very much out of the way to hear the Rabbit say to itself, 'Oh dear! Oh dear! I shall be late!' (when she thought it over afterwards, it occurred to her that she ought to ha



Idea: Map 40 character things to length 8:

`https://en.wikipedia.org/wiki/Main_Page`
`https://en.wikipedia.org/wiki/Battle_of_`
`https://en.wikipedia.org/wiki/Vector_Gen`
`https://en.wikipedia.org/wiki/2017_Austr`
`https://en.wikipedia.org/wiki/19th_Natio`
`https://en.wikipedia.org/wiki/Japanese_g`



Hash Function

In CS 225, we focus on **general purpose** hash functions.

Other hash functions exist with different properties
(eg: cryptographic hash functions)

(Example of open hashing)

Collision Handling: Separate Chaining

$S = \{ 16, 8, 4, 13, 29, 11, 22 \}$

$|S| = n$

$h(k) = k \% 7$

$|\text{Array}| = N$



	Worst Case	SUHA
Insert		
Remove/Find		

(Example of closed hashing)

Collision Handling: Probe-based Hashing

$S = \{ 16, 8, 4, 13, 29, 11, 22 \}$ $|S| = n$

$h(k) = k \% 7$

$|\text{Array}| = N$



Try $h(k) = (k + 0) \% 7$, if full...

Try $h(k) = (k + 1) \% 7$, if full...

Try $h(k) = (k + 2) \% 7$, if full...

Try ...