CS 225

Data Structures

October 24 — Hashing Wade Fagen-Ulmschneider





CS 225

Data Structures

October 24 - Hashing

Wade Fagen-Ulmschneider



A Hash Table based Dictionary

Client Code:

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

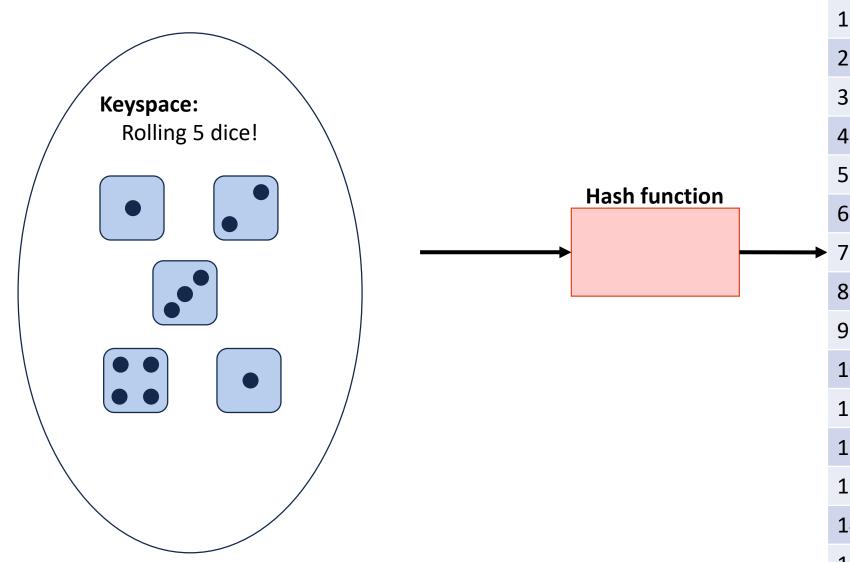
A **Hash Table** consists of three things:

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

A Perfect Hash Function

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

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

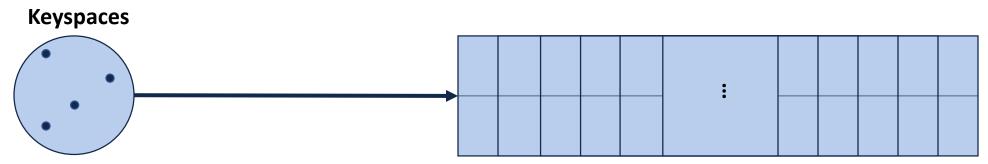
Characteristics of a good hash function:

1. Computation Time:

2. Deterministic:

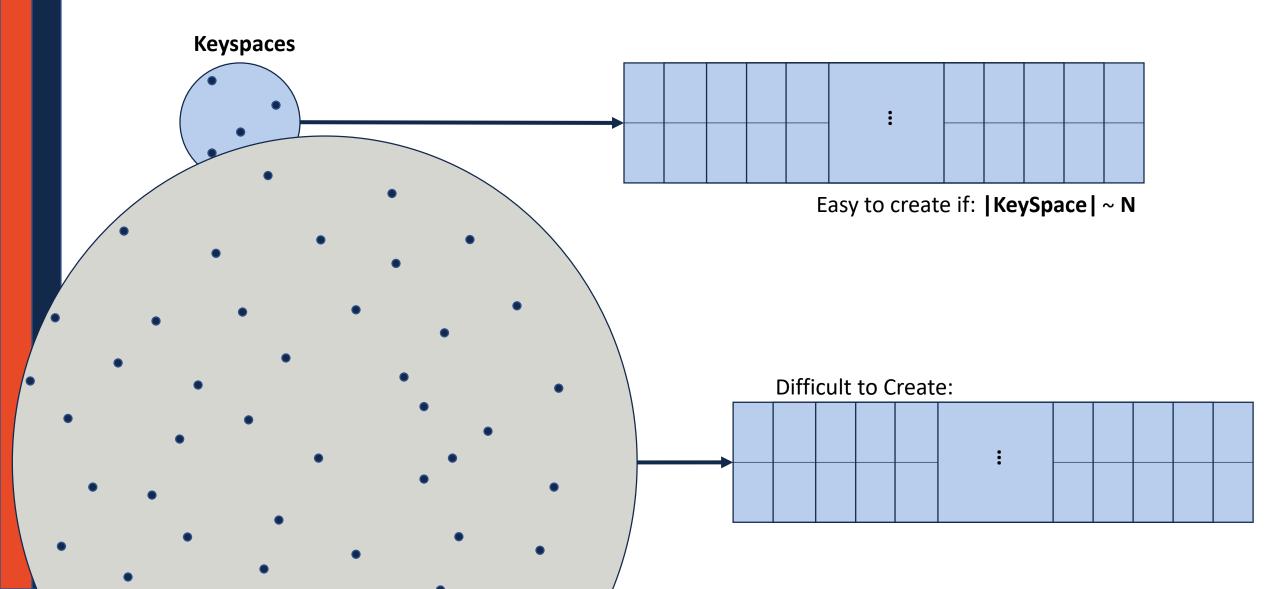
3. Satisfy the SUHA:

General Purpose Hash Function

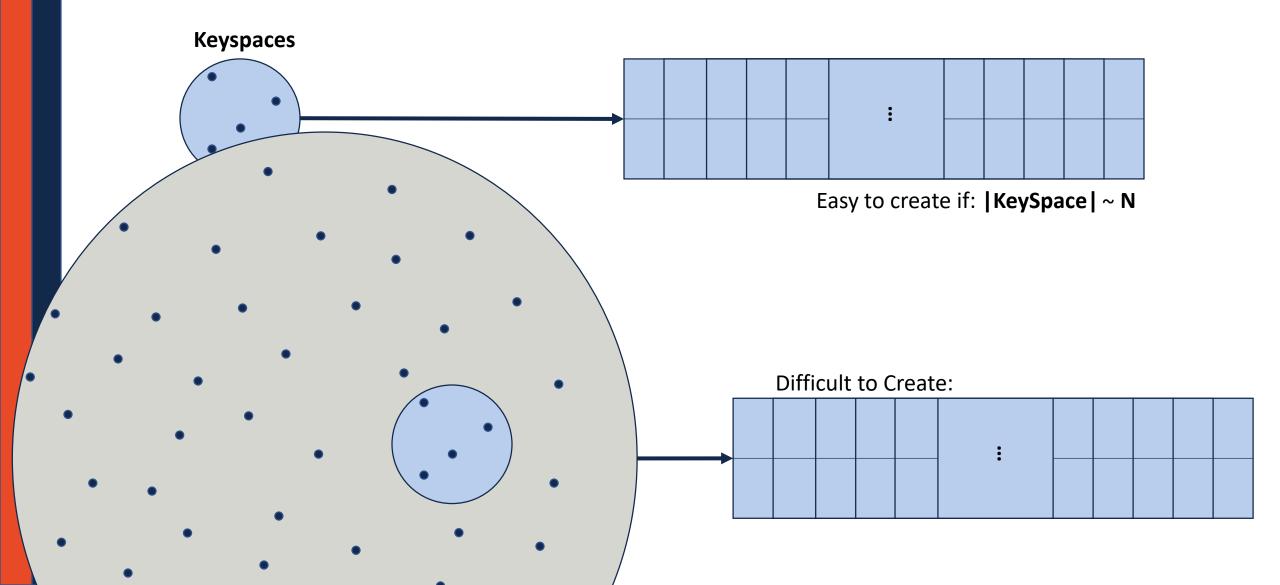


Easy to create if: | KeySpace | ~ N

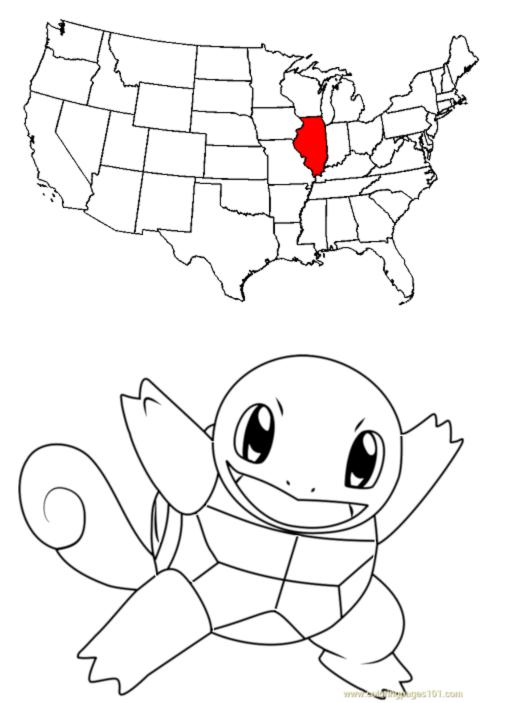
General Purpose Hash Function

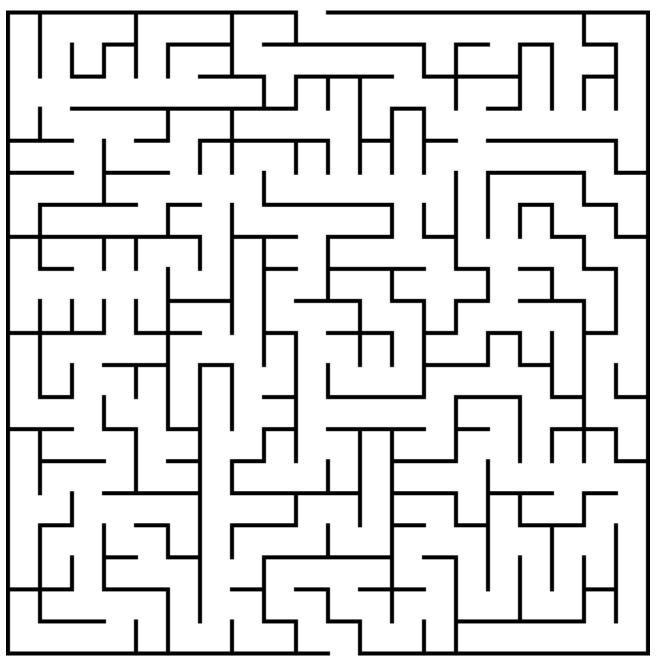


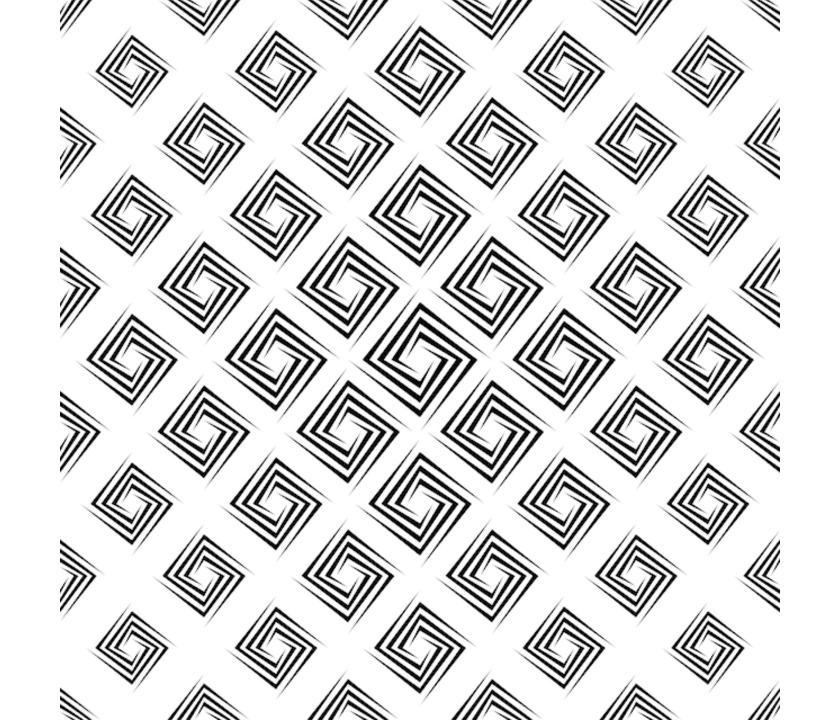
General Purpose Hash Function







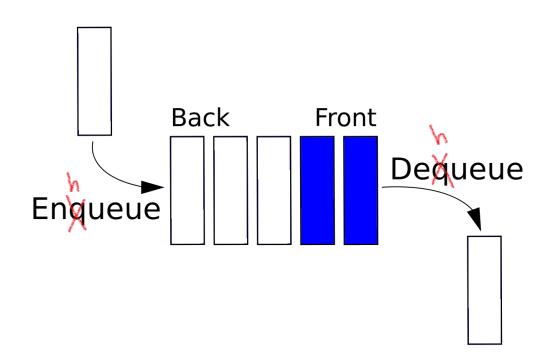






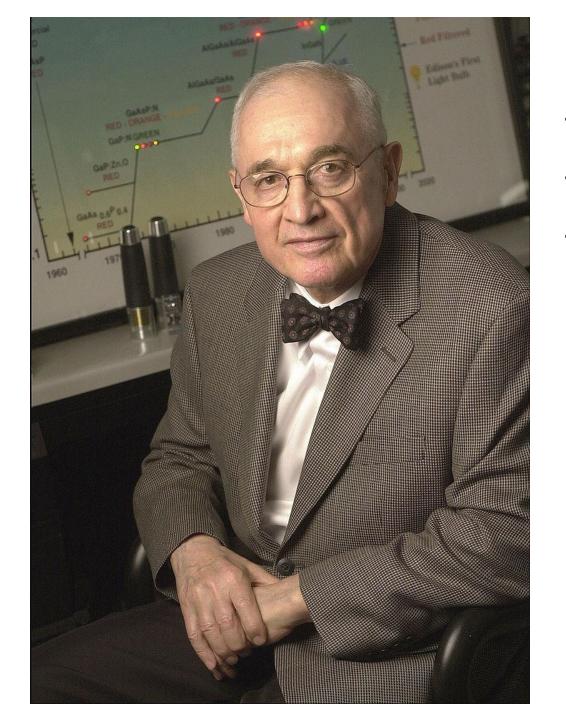


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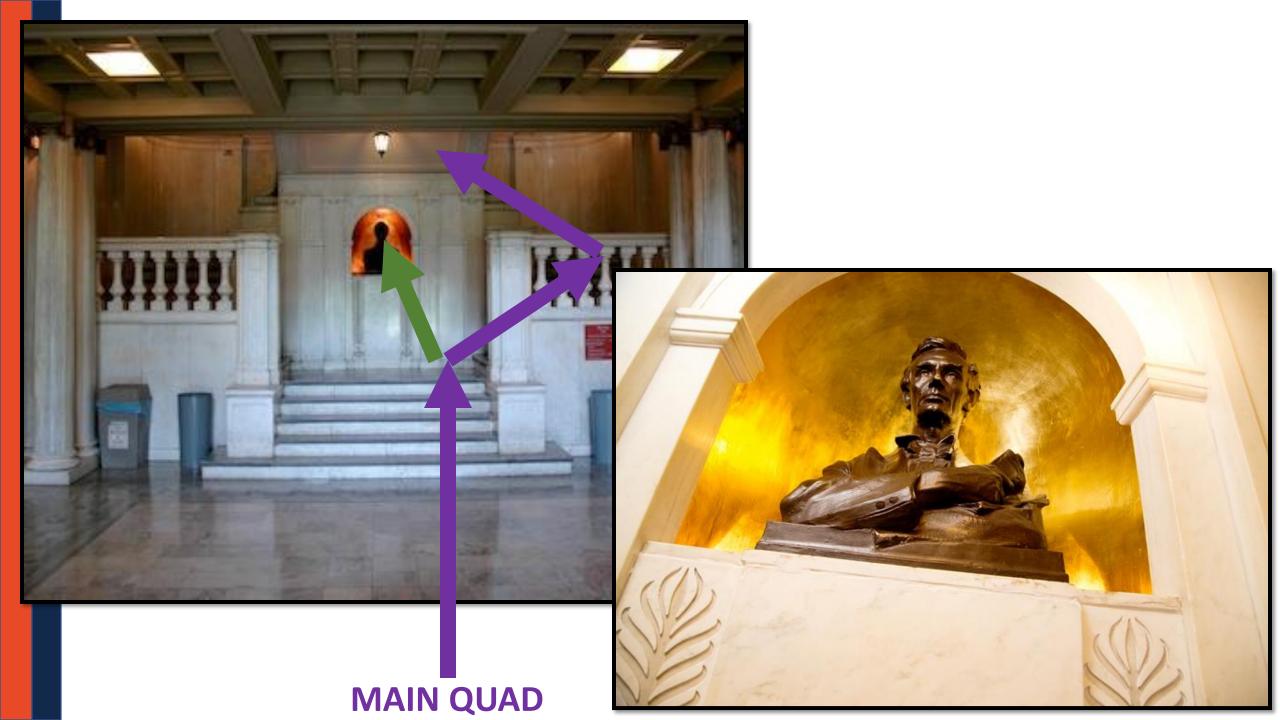


Nick Holonyak

- Invented the visible-light LED
- Professor of ECE at UIUC
- Celebrating his 90th birthday!







A CS 225 Field Trip (Section AL1, 11am ONLY)

This Friday (Oct. 26), CS 225-AL1 (11:00am) will meet in Lincoln Hall Theater instead of ECEB.

CS 225-AL2 (2:00pm) will meet in ECEB as normally scheduled. (However, feel free to come to AL1!)

MP5





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 #unofficiallllinimascot (**)

idesigner3 @meg733 정말 우리 다람이 닮 았다

frantastic2021 @elise_marie28 !!!!

meg733 @idesigner3 나이가 있어보이네

merdive_m12 📵 🀌 💢



allison_nichols4 @emily_tyndorf why am i

not surprised that Rosy made the Illinois nage







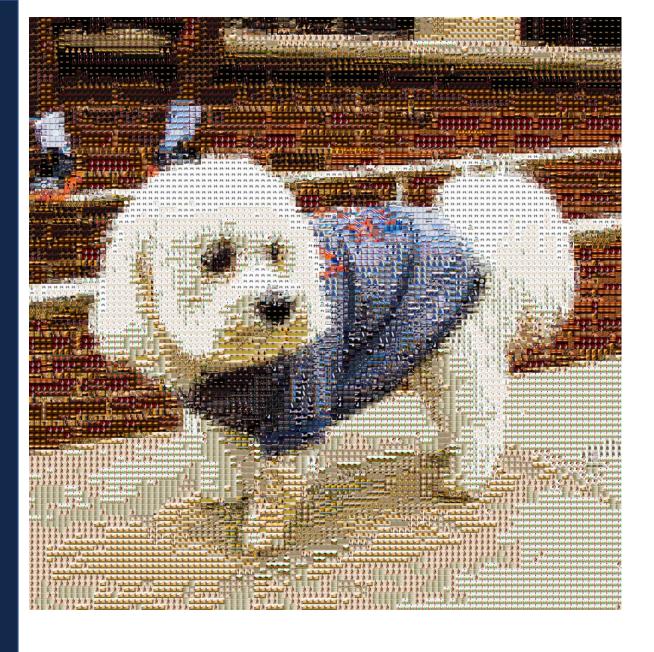


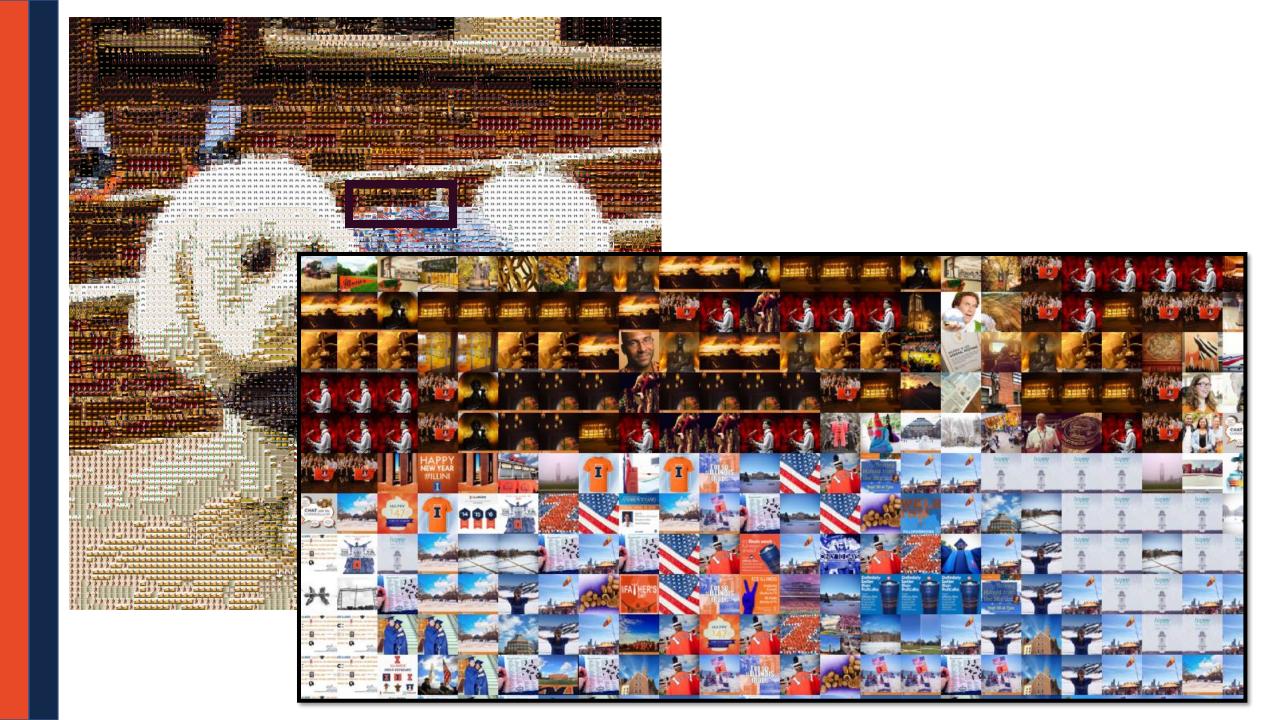
1,691 likes

OCTOBER 11

Log in to like or comment.

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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 s he had peeped into the book her sister w as reading, but it had no pictures or co nversations in it, 'and what is the use of a book, ' thought Alice 'without pictu res or conversations?' So she was consi dering in her own mind (as well as she c ould, for the hot day made her feel very sleepy and stupid), whether the pleasur e of making a daisy-chain would be worth the trouble of getting up and picking t he 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 it self, '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:

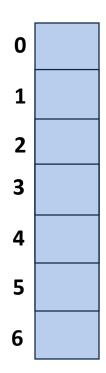
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Hash Function

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

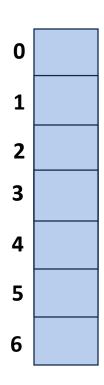
Other hash functions exists with different properties (eg: cryptographic hash functions)

Collision Handling: Separate Chaining



	Worst Case	SUHA
Insert		
Remove/Find		

Collision Handling: Probe-based Hashing



```
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 ...
```