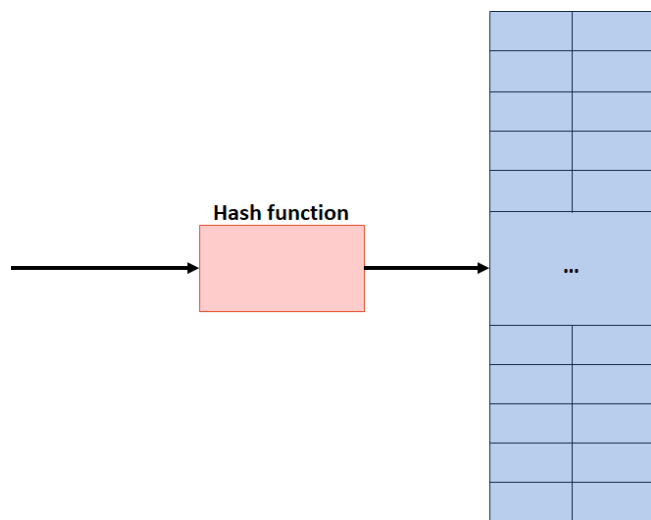**#26: Hashing**
October 25, 2017

Goals for Understanding Hashing:

1. We will define a **keyspace**, a (mathematical) description of the keys for a set of data.

2. We will define a function used to map the **keyspace** into a small set of integers.
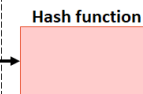
Hash function

...

Dictionary ADT in Client Code
1	Dictionary<KeyType, ValueType> d;
2	d[k] = v;

A hash table consists of three things:

1.

2.

3.

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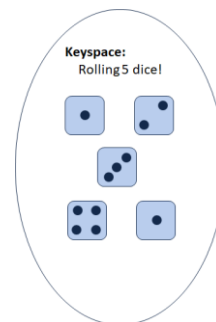
(Angrave, CS 241)
(Beckman, CS 421)
(Cunningham, CS 210)
(Davis, CS 101)
(Evans, CS 126)
(Fagen-Ulmschneider, CS 225)
(Gunter, CS 422)
(Herman, CS 233)

Hash function

Key	Value

...characteristics of this function?

A Second Hash Function

Keyspace:
Rolling 5 dice!

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

...characteristics of this function?

All hash functions will consist of two parts:

- A **hash**:

- A **compression**:
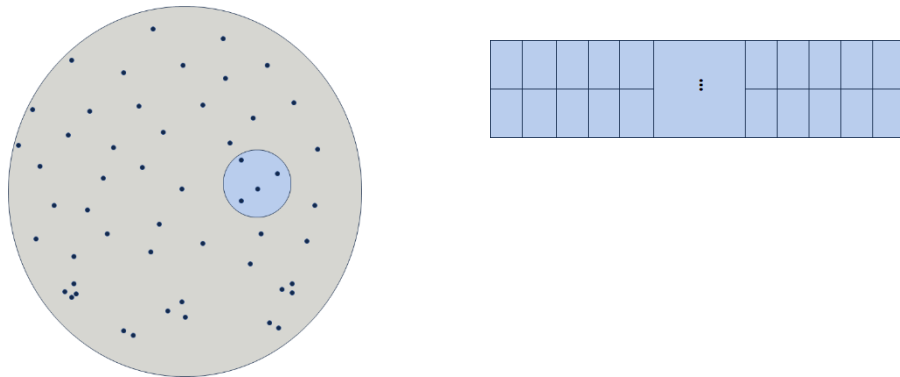
Characteristics of a good hash function:
1. Computation Time:

2. Deterministic:

3. SUHA:

Towards a general-purpose hashing function:
It is <u>easy to create</u> a general-purpose 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:

Ex: Hashing a string of 8 characters is considered easy, 40 is not.

My 40-character strategy:

Alice in Wonderland, Page 1
1   Alice was beginning to get very tired of
2   sitting by her sister on the bank, and
3   of having nothing to do: once or twice s
4   he had peeped into the book her sister w
5   as reading, but it had no pictures or co
6   nversations in it, 'and what is the use
7   of a book,' thought Alice 'without pictu
8   res or conversations?' So she was consi
9   dering in her own mind (as well as she c
10   ould, for the hot day made her feel very
11   sleepy and stupid), whether the pleasur
12   e of making a daisy-chain would be worth
13   the trouble of getting up and picking t
14   he daisies, when suddenly a White Rabbit
15   with pink eyes ran close by her. There
16   was nothing so very remarkable in that;
17   nor did Alice think it so very much out
18   of the way to hear the Rabbit say to it
19   self, 'Oh dear! Oh dear! I shall be late
20   !' (when she thought it over afterwards,
21   it occurred to her that she ought to ha

...characteristics of this function?

Reflections on Hashing
In CS 225, we are starting the study of general-purpose hash functions. There are many other types of hashes for specific uses:
- **Common**: 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?

CS 225 – Things To Be Doing:
1. Exam #8 (programming, MP4-like and AVL) starts Monday
2. MP5 is available now; extra credit +7 deadline is Monday, Oct. 30
3. lab_btree due on Sunday (Oct. 29)
4. Daily POTDs