

Announcements

MP6 av, due 11/15, 11:59p. EC due 11/08, 11:59p.

Exam4 – 11/6-11/9. Review Fri, 7-9p, Siebel 1404.

client code

declares an object
of ADT dictionary

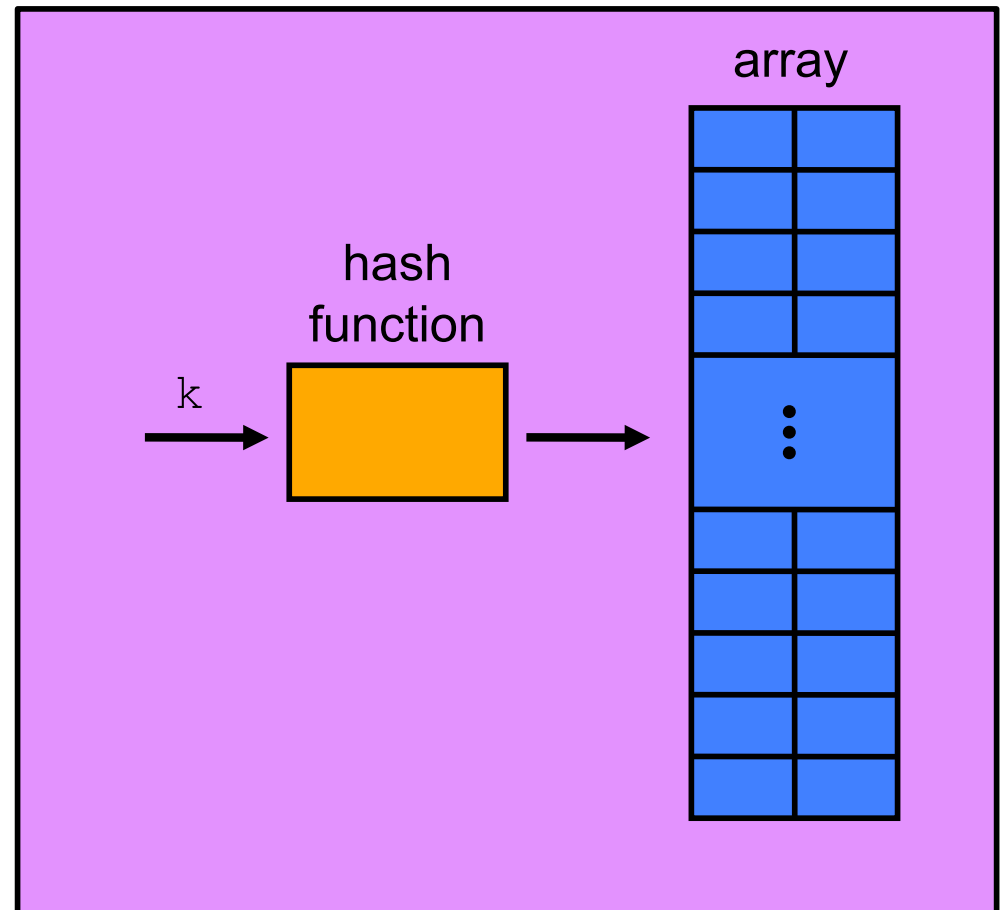
```
dict<ktype, vtype> d;
```

ex: insert is `d[k] = v;`

A Hash Table consists of:

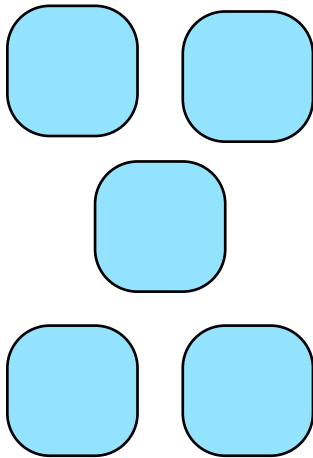
-
-
-

class `dict` (implemented with a hash table)



A perfect hash function?

Roll 5 dice:



Is this a good hash function?



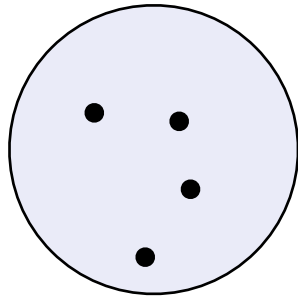
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	

Hash Functions:

- Consist of 2 parts:
 - A Hash: Function mapping a key to an integer i
 - A compression: function mapping i into the array cells 0 to $N-1$.
- Choosing a hash function is tricky...
 - Don't create your own (yet)
 - Smart people can produce poor hash functions (what's a bad hash function?)
 - Knuth's multiplicative hash in "the Art of Computer Programming"
- Characteristics:
 - Computed in _____ time.
 - Deterministic.
 - Satisfy the SUHA.

General Purpose Hash Functions

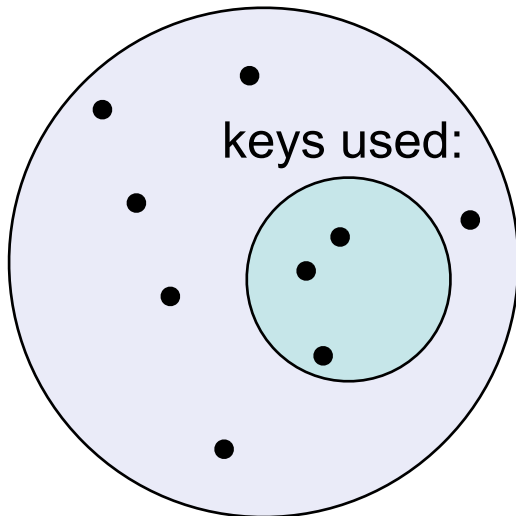
KeySpace



0	1		...				N-1

Easy, if
 $|\text{KeySpace}| \sim N$

KeySpace



0	1		...				N-1

Hashing Strings (an example)

Given: 8 character strings are easy to hash

The idea: Select 8 random positions from long strings and hash that substring.

A bunch of strings:

Lookyhere, Huck, being rich ain't going
No! Oh, good-licks; are you in real dead
Just as dead earnest as I'm sitting here
nto the gang if you ain't respectable, y
Can't let me in, Tom? Didn't you let me
Yes, but that's different. A robber is m
irate is -- as a general thing. In most
Now, Tom, hain't you always ben friendly
ut, would you, Tom? You wouldn't do that
Huck, I wouldn't want to, and I DON'T wa
ay? Why, they'd say, 'Mph! Tom Sawyer's
t!' They'd mean you, Huck. You wouldn't
uck was silent for some time, engaged in
Well, I'll go back to the widder for a m
can come to stand it, if you'll let me
All right, Huck, it's a whiz! Come along
Will you, Tom -- now will you? That's go
he roughest things, I'll smoke private a
hrough or bust. When you going to start
Oh, right off. We'll get the boys togeth

Hashing Strings (an example)

Given: 8 character strings are easy to hash

The idea: Select 8 random positions from long strings and hash that substring.

A bunch of strings:

```
http://en.wikipedia.org/wiki/Le%C5%9Bna_Grobla
http://en.wikipedia.org/wiki/Blow_the_Man_Down
http://en.wikipedia.org/wiki/Swen_K%C3%B6nig
http://en.wikipedia.org/wiki/2/7th_Cavalry_Commando_Regiment_(Australia)
http://en.wikipedia.org/wiki/Salman_Ebrahim_Mohamed_Ali_Al_Khalifa
http://en.wikipedia.org/wiki/Alice_High_School
http://en.wikipedia.org/wiki/Beautiful,_Dirty,_Rich
http://en.wikipedia.org/wiki/RFA_Sir_Bedivere_(L3004)
http://en.wikipedia.org/wiki/Birthright_(band)
http://en.wikipedia.org/wiki/Jacky_Vimond
http://en.wikipedia.org/wiki/Vachon
http://en.wikipedia.org/wiki/McCarthy_%26_Stone
http://en.wikipedia.org/wiki/Salisbury,_New_Hampshire
http://en.wikipedia.org/wiki/A_Line_of_Deathless_Kings
http://en.wikipedia.org/wiki/Newfoundland_Irish
http://en.wikipedia.org/wiki/Beatrice_Politi
http://en.wikipedia.org/wiki/Bona_Sijabat
http://en.wikipedia.org/wiki/Sour_sanding
http://en.wikipedia.org/wiki/Dr_Manmohan_Singh_Scholarship
http://en.wikipedia.org/wiki/Religion_in_Jordan
```

Collision handling - Separate Chaining: (an example of open hashing)

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

$|S| = n$ $h(k) = k \% 7$

0	
1	
2	
3	
4	
5	
6	

	Worst case	Under SUHA
Insert		
Remove/find		

Collision Handling - Probe based hashing: (example of closed hashing)

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

$|S| = n$ $h(k) = k \% 7$

0	
1	
2	
3	
4	
5	
6	

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...