CS 180 - Hash Tables 2

Announcements

- Midterm 2 back today
- Average: 36.9
- Std Dev: 15
- Max: 55
- Min: 19

- Program 5 - due Tuesday
- Next homework out this weekend
- Quiz 1 due when we get back from break
- Flight + + arrival time

- Leader number of name

- Examples:
  - Log key
  - Insert
  - Delete
  - Type

A structure which supports the following:

Dictionaries:
String: Polynomial Hashing

- Depends on type:
  - Integer keys to numeric keys
  - Non-numeric letters for converting

Some int
- Temp
- Temp 1

Long: add first 32 bits of 2nd 32 bits
Char: Cast to an int
Compressing number down to something between 0 and N-1.

Ideas?

Modular arithmetic

\[ h(x) \mod N \]

int

\[ x \mod n \]
\[ S \mod 11 = 5 \]
\[ 16 \mod 11 = 5 \]
\[ 26 \mod 11 = 4 \]
\[ 37 \mod 11 = 0 \]
\[ 21 \mod 11 = 10 \]
\[ 12 \mod 11 = 1 \]

Map is \( h(k) = 5 \mod 11 \)

Example

\[ 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 \]
Go for a number

Why?

a prime number.

This works because if size of table is

Some comments:
The MAD (multiply add + divide) method is a bit better:

\[ h(x) = |ax + b| \mod N \]

where \(a, b\) are not equal
- relatively prime
  \[ \gcd(a, b) = 1 \]
- \(21, 16\)  
- \(3, 7, 21\)
- \(1, 2, 4, 8, 16\)
- less than \(N\)
Essentially, "demonstrates as random"

\[
\Pr\left[|h(x)| \leq \frac{N}{2}\right] = \frac{1}{2^n},
\]

for all $x \in \mathcal{F}$.  

Goal: Simple Uniform Hashing Assumption.
Key space is larger than our

Can we ever totally avoid collisions?

No
vector
trees
- more than one thing?
Do we have data structures to share
how can we handle collisions?
insert 2

For a complete breadth first traversal, we can start from the root and visit all nodes at a given level before moving to the next level.

For example, in a search tree where each node has two children, a breadth-first search would follow a path all the way to the left before moving to the next level.
balanced (ex AVL)