

For Wednesday

- Chapter 9, section 1
- Homework
 - Chapter 5, exercise 19

Research Paper

- Any questions?

Program 3

- Any questions?

External Dictionaries

- How would hashing differ for external dictionaries?

Extendible Hashing

- Usually applied to external dictionaries.
- What's the basic idea?

Equivalence Relations

- A relation is an equivalence relation if it is:
 - Reflexive
 - Symmetric
 - Transitive
- Examples?

Dynamic Equivalence

- Suppose we have a group of objects
- Suppose we also have an equivalence relation
- We have partial information about individual equivalence relations among the objects
- We want to set up a data structure that allows us to quickly determine whether a is equivalent to b given the information

Disjoint Sets

- Basic idea:
 - We have a set of N items which fall into equivalence classes.
 - We partition the set into N sets of one item each.
 - We have two operations: **union** and **find**
 - Union combines two sets, indicating that their members are equivalent
 - Find returns the label for the set an item belongs to, allowing us to determine equivalence

Assumptions

- Items are numbered 0 to $N-1$
- Can determine number immediately

Simple Approaches

- Use array of set names
 - How does find work?
 - How does union work?
 - Time?
- Keep a linked list of each set
- Add knowledge of number in each set

A Better Structure

- Still have an array to represent the sets.
- Represent each subset as a tree
- Value in the array in the parent link of the item
- Root nodes have a parent link of -1
- Name of the set is the index of the root node

Find

- Go to the correct index in the array
- Follow the parent links to the root

Union

- Make the root of one tree point to the root of the other

Better Unions

- By size
- By height

Path Compression

- Try to improve the height of our trees while changing time cost by a constant factor

Maze Generation