

For Wednesday

- Read Weiss, chapter 9, section 4
- Homework:
 - Chapter 8, exercises 1-2

Program 3

- Any questions?

Research Paper

- Any questions?

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

Graphs

- A **graph** is a collection of **vertices** (singular **vertex**) and **edges**
- Vertices are sometimes called **nodes**
- Vertices are usually named, edges are identified by the vertices they connect: **AB** is an edge connecting vertex **A** to vertex **B**

Graphs (cont)

- We will denote the number of vertices in a graph by V and the number of edges by E
- A **path** from vertex A to vertex B is a listing of the vertices touched as we traverse edges from A to B .
- If there is a path from every node to every other node in a graph, the graph is **connected**.

More Graphs

- A **cycle** is a path which begins and ends at the same vertex.
- A **simple path** is a path with no cycles in it.
- A graph with no cycles is called a **tree**.
- A **spanning tree** of a graph is a tree subgraph that contains all the vertices in the original graph.

Even More Graphs

- A graph with fewer than $V-1$ edges cannot be connected.
- A graph with V or more edges must contain a cycle.
- **Complete** graphs have all possible edges present.
- **Dense** graphs have most possible edges present.
- **Sparse** graphs have few of the possible edges present.

Types of Graphs

- Graphs with edges that can go either way are **undirected**.
- Graphs with edges that have particular direction are **directed**.
- Graphs may also have weights associated with their edges. Those are **weighted** graphs.
- Weighted graphs may be either directed or undirected.

Graph Representation

- Adjacency matrix
 - Graph is represented using an 2-d array
 - Indices of array represent nodes in the graph
 - Cells of the matrix represent edges
- Adjacency lists

Graph Applications

- ???

Graph Applications

- Parallel computing
- Scheduling
- Games
- Problem solving
- Mapquest
- Networks (of wires, pipes, etc.)
- Knowledge representation

Topological Sorting

Shortest Path Problem

- Single source
- Two points
- All shortest paths

Unweighted Graphs

- Breadth-first search

Weighted Graphs

- Dijkstra's algorithm
- A **greedy** algorithm
- A form of best-first search

Negative Weights Problem