As you arrive:

A graph is *strongly connected* if there exists a path from vertex *a* to vertex *b* for all combinations of *a* and *b*.

Given a directed, unweighted graph *G*, pseudocode a method that returns true if *G* is strongly connected, and false otherwise.

`http://goo.gl/AqOQz`

This is not a zero.

"Vertex" is another word for "node".

Today: Graph Search

(and course evaluations)

Today: Graph Search

The *fifteen puzzle* (in the goal state)

This is a classic search problem. I was introduced to it by Jim Marshall.

http://www.archimedes-lab.org/game_slide15/slide15_puzzle.html

Today: Graph Search

Today: Graph Search

16! / 2 = 10,461,394,944,000 possible states

Snarf FifteenPuzzle

http://goo.gl/Zy35P

Expansion Ordering

or: Where do I look next?

DFS

"Go all the way to the end, then back up."

Expansion Ordering

or: Where do I look next?

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"Go all the way to the end, then back up."

BFS

"Search in increasing order of the number of moves you have to make."

Expansion Ordering

or: Where do I look next?

DFS

"Go all the way to the end, then back up."

BFS

"Search in increasing order of the number of moves you have to make."

Complete the BFS method in FifteenPuzzleSolver.

`http://goo.gl/9a3bH`

And submit it to fifteenpuzzle (sometime today)

Be *absolutely sure* that everybody's NetIDs are on it.

Expansion Ordering

Expansion Ordering

or: Where do I look next?

DFS

"Go all the way to the end, then back up."

BFS

"Search in increasing order of the number of moves you have to make."

Informed

Use a *heuristic function* to help you choose next states to explore.

Heuristic Functions

- Function of your state.
- Counts *moves until the goal state*.
- *Admissible* heuristics are *optimistic*.

That is, if the shortest path from *x* to the goal is *C* steps long, then $h(x) \leq C$.

Fifteen-puzzle heuristics

Heuristic Functions

- Function of your state.
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That is, if the shortest path from *x* to the goal is *C* steps long, then $h(x) \leq C$.

Let $g(x)$ denote the path cost (in steps) from the start state to *x*. Expand your nodes in increasing order of $g(x) + h(x)$.

(Accurate) measurement of how expensive it was to get here.

(Approximate, optimistic) measurement of how far we have to go.

A* search

For a given heuristic, A will provably expand fewer nodes than any other search algorithm.*

Note the difference:

Dijkstra's Algorithm

Shortest path on
weighted-edge graphs.

A*

Shortest path *measured*
in number of edges.

Course Evaluations

These are a *really big deal*. Tabitha and I take them very seriously. The department takes them very seriously. The deans take them very seriously. People are offered jobs (or not!) based on these.

Also, believe me, we will read *every single one* in great detail, and the next offering of the course will be different, and better, because of what you say.