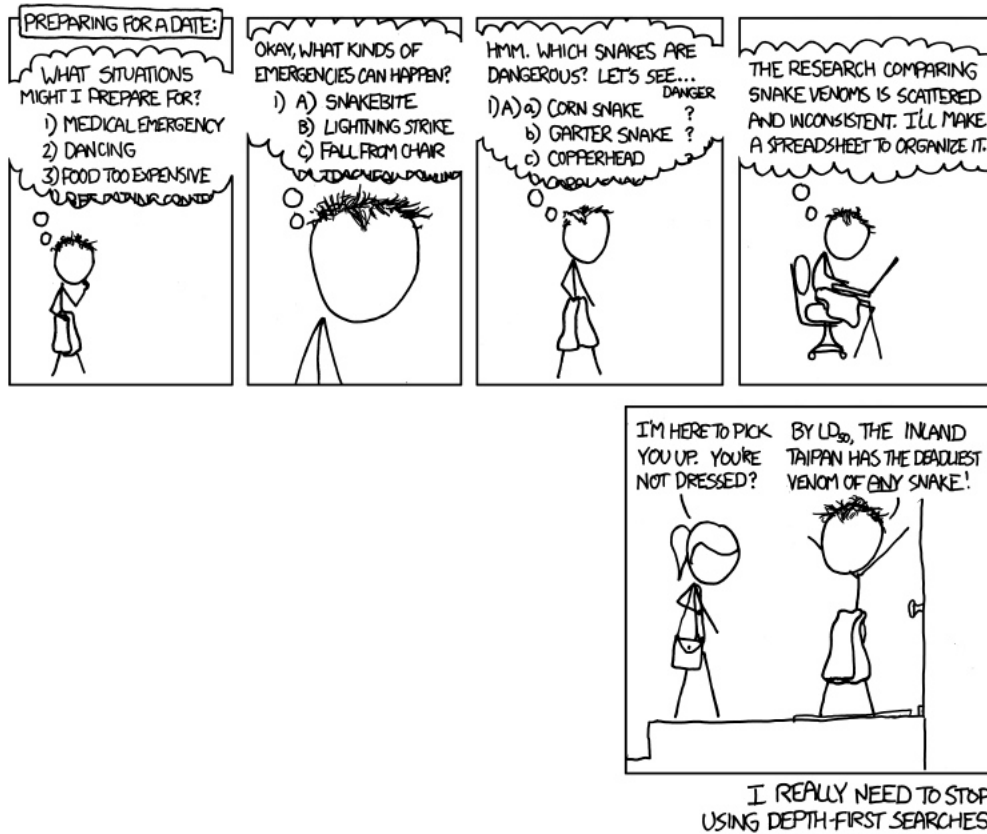# CS302 - Assignment 15
Due: Thursday, April 19 at the beginning of class
Hand-in method: paper

http://xkcd.com/761/

Notes:

- Many of the algorithms below can be accomplished by either modifying the graph and applying a known algorithm or slightly modifying a known algorithm. Try thinking of these *first* as they will save you a lot of work, and writing :)

- You will be graded on efficiency!

- If not specified in the problem, you may assume whatever graph representation makes your algorithm more efficient (adjacency list or adjacency matrix). State which one you are using.

1. **[5 points] Induction on Graphs**

   Use induction to prove that any connected, undirected graph $G = (V, E)$ satisfies $|E| \geq |V| - 1$.

2. **[5 points]** Write pseudocode for an algorithm which, given an undirected graph G and a particular edge e in it, determines whether G has a cycle containing e. What is the runtime of this algorithm?

3. **[8 points]** Often there are multiple shortest paths between nodes of a graph. Write pseudocode for an algorithm that given an undirected, unweighted graph G and nodes $u, v \in V$, output the number of distinct shortest paths from u to v. What is the running time?