Recursion

Lecture 19 (8/9/2006)

Recursion

- Recursion is: the repeated application of a recursive procedure or definition.
- Self-referential instructions to do something or defining something
- Example:
  - GNU stands for “GNU is Not Unix” (which stands for “GNU is Not Unix is Not Unix,” which stands for........)
  - OAPKWOM stands for “Only Awesome People Know What OAPKWOM Means”

Recursive Algorithms

- How to Ace a Test:
  1. If you understand everything on the test, then take it and ace it.
  2. Otherwise, study one thing that you don’t understand until you understand it.
  3. Now, see “How to Ace a Test.”

Useless Fact of the Day

- We landed a man on the #@$#!% moon!
- Also, the computer on the Apollo Lunar Modules only had 74 kilobytes of fixed memory storage, and only 4 kilobytes of erasable storage -- in comparison, a modern computer has at least 80 gigabytes of hard drive space for long-term storage (80 million kilobytes), and 1 gigabyte of short-term memory (1 million kilobytes)
- Source: http://www.abc.net.au/science/moon/computer.htm
Recursive Algorithms

- Binary Search in a list $L$ of size $x$:
  1. If $x$ is 1, you're done! See if the thing in $L$ is what you're looking for.
  2. Find the midpoint of $L$
  3. If the midpoint is what you're looking for, you're done!
  4. Divide $L$ into two halves
  5. Do Binary Search in list $Z$ of size $x/2$

Game AI

- In many games, the only way to win is for the other player to lose
- There's is a recursive algorithm which exploits this principle
- Minimax Algorithm:
  - Pick the move that minimizes the maximum potential gain of your opponent...
  - ...and, to figure out the potential gain of your opponent, assume he's using the Minimax Algorithm!

Game Trees: Tic Tac Toe

- My Moves
- Your Moves

Game AI

- Minimax Issues:
  - Can we look at every possible path from start to end of the game tree?
  - Not in games like Chess (where there are $10^{120}$ possible games -- to look at all possibilities would take longer than the age of the universe, even with the fastest supercomputer)
Game AI

- Minimax Issues:
  - How far do we want to look ahead in the game tree?
  - How do we determine who's in a better position at the horizon of our look ahead?
  - Example: in Checkers, this might be a combination of who has more pieces, and some evaluation of whether or not the positions of the pieces are good
  - How can we avoid traps (sacrifices)?

Game AI

- Here are a couple of web sites with an example of the Minimax algorithm, and more information (Google searching can give you more information also):
  - http://www.ocf.berkeley.edu/~yosenl/extras/alphabeta/alphabeta.html