Announcements

- Homework 2 out. Due 10/14 (correction)
- Midterm review 10/16, exam 10/21
- Submission procedure and deadline
Review

- Functions
- Variable Scope - when variables are valid
- Recursion - when a function calls itself
Today

- Go over HW1
- Recursion (continued)
Homework 1

http://www.cs.columbia.edu/~bert/courses/1003/homework1_soln.txt
Functions Illustrated

User

O.S.

Computer Hardware

main()

myFunction()

otherFunction()
Recursion Examples

Painting by M.C. Escher
http://aixa.ugr.es/escher/640x480/Manos_dibujando.jpg
Silly Recursion Examples

- GNU (of gcc) stands for GNU is Not Unix

- The C Programming Language index:
  recursion 86, 139, 141, 182, 202, 269
  is listed on page 269

- This sentence is not true.

- Every rule has exceptions.
Recursion Examples

- Fibonacci Sequence: 1, 1, 2, 3, 5, 8, 13, 21, 34 ...
  
  - Base case: \( \text{fib}(0) = 0, \text{fib}(1) = 1 \)
  
  - \( \text{fib}(n) = \text{fib}(n-2) + \text{fib}(n-1) \)
    
    - \( \text{fib}(2) = \text{fib}(0) + \text{fib}(1) = 1 \)
    
    - \( \text{fib}(3) = \text{fib}(1) + \text{fib}(2) = 2 \)
Fibonacci Illustrated

Fibonacci

Main
Towers of Hanoi
In English, target function:
Move stack of N discs from peg A to peg B

Base case: When N = 1, just move the disc

What about N=2?

Move disc 1 from A to C,
Move disc 2 from A to B,
Move disc 1 from C to B
Towers of Hanoi

- N = 3?
- General rule: Move N discs from A to B
  1) Move stack of (N-1) discs from A to C
  2) Move Nth disc from A to B
  3) Move stack of (N-1) discs from C to B
Recursion Summary

- Simple, elegant algorithms with often complex results
- Always possible to use loops instead, but recursion can significantly simplify the algorithm
- Sometimes recursion can be less efficient; tradeoff between simplicity and efficiency
Reading

- Practical C Programming Ch. 9
- The C Programming Language, Ch. 4