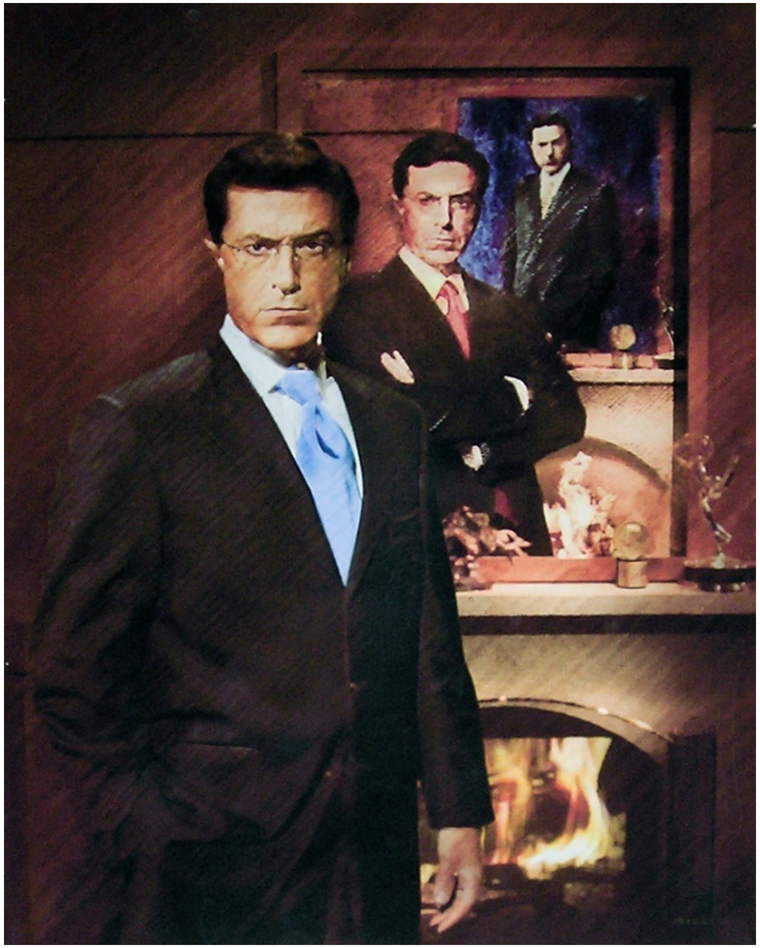


CSSE 220
Day 22

Sierpiński, Recursion and Efficiency, Mutual Recursion

Checkout *Recursion2* project from SVN

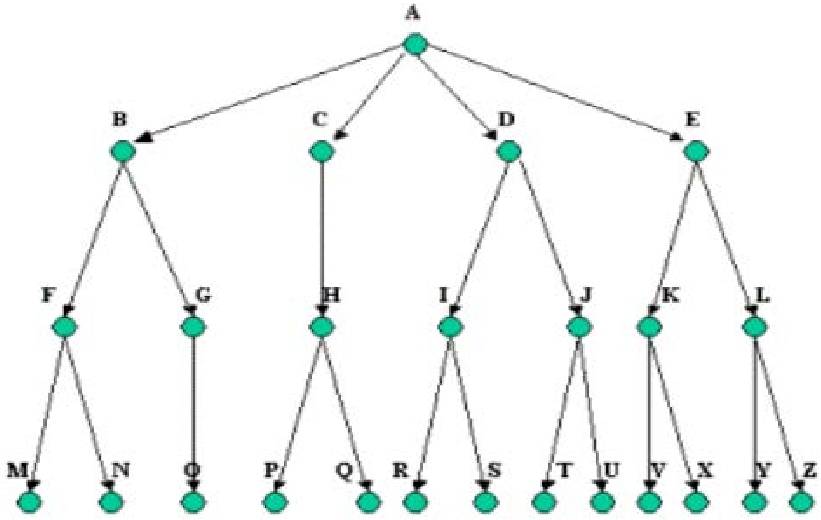

Bizarro
I have this recurring dream that I'm lying here telling you about a recurring dream about lying here telling you about a recur-ring dream about...
zzzZ
©DAN PIRARO
3-6-02
BIZARRO.COM

Recap: What are recursive methods?

- Any method that calls itself
  - On a simpler problem
  - So that it makes progress toward completion
  - **Indirect recursion:** May call another method which calls back to it.

When should recursive methods be used?

- When implementing a recursive definition
- When implementing methods on recursive data structures



- Where parts of the whole look like smaller versions of the whole

Q1

The pros and cons of recursive methods

- The pros
  - easy to implement,
  - easy to understand code,
  - easy to prove code correct

- The cons
  - Sometimes takes more space and time than equivalent iterative solution
  - Why?
    - because of function calls

Q2

Recap: Key Rules to Using Recursion

- Always have a **base case** that **doesn't recurse**

- Make sure recursive case always makes **progress**, by **solving a smaller problem**

- **You gotta believe**
  - Trust in the recursive solution
  - Just consider one step at a time


PAUL NOTH

Can one little Fib hurt?

- Why does recursive Fibonacci take so long?!?
- Can we fix it?

```
private static long fib(int n) {
    // TODO: Convert this to use memoization.
    long f;
    if (n <= 2) {
        f = 1;
    } else {
        long fNMOne = fib(n - 1);
        long fNMTwo = fib(n - 2);
        f = fNMOne + fNMTwo;
    }
    return f;
}
```

Q3

Memoization

- Save every solution we find to sub-problems

- Before recursively computing a solution:
  - Look it up
  - If found, use it
  - Otherwise do the recursive computation

Q4

Classic Time-Space Trade Off

- A deep discovery of computer science
- In a wide variety of problems we can tune the solution by varying the amount of storage space used and the amount of computation performed
- Studied by “Complexity Theorists”
- Used everyday by software engineers

Mutual Recursion

- 2 or more methods call each other repeatedly
  - E.g., Hofstadter Female and Male Sequences

$$F(n) = \begin{cases} 1 & \text{if } n = 0 \\ n - M(F(n-1)) & \text{if } n > 0 \end{cases}$$

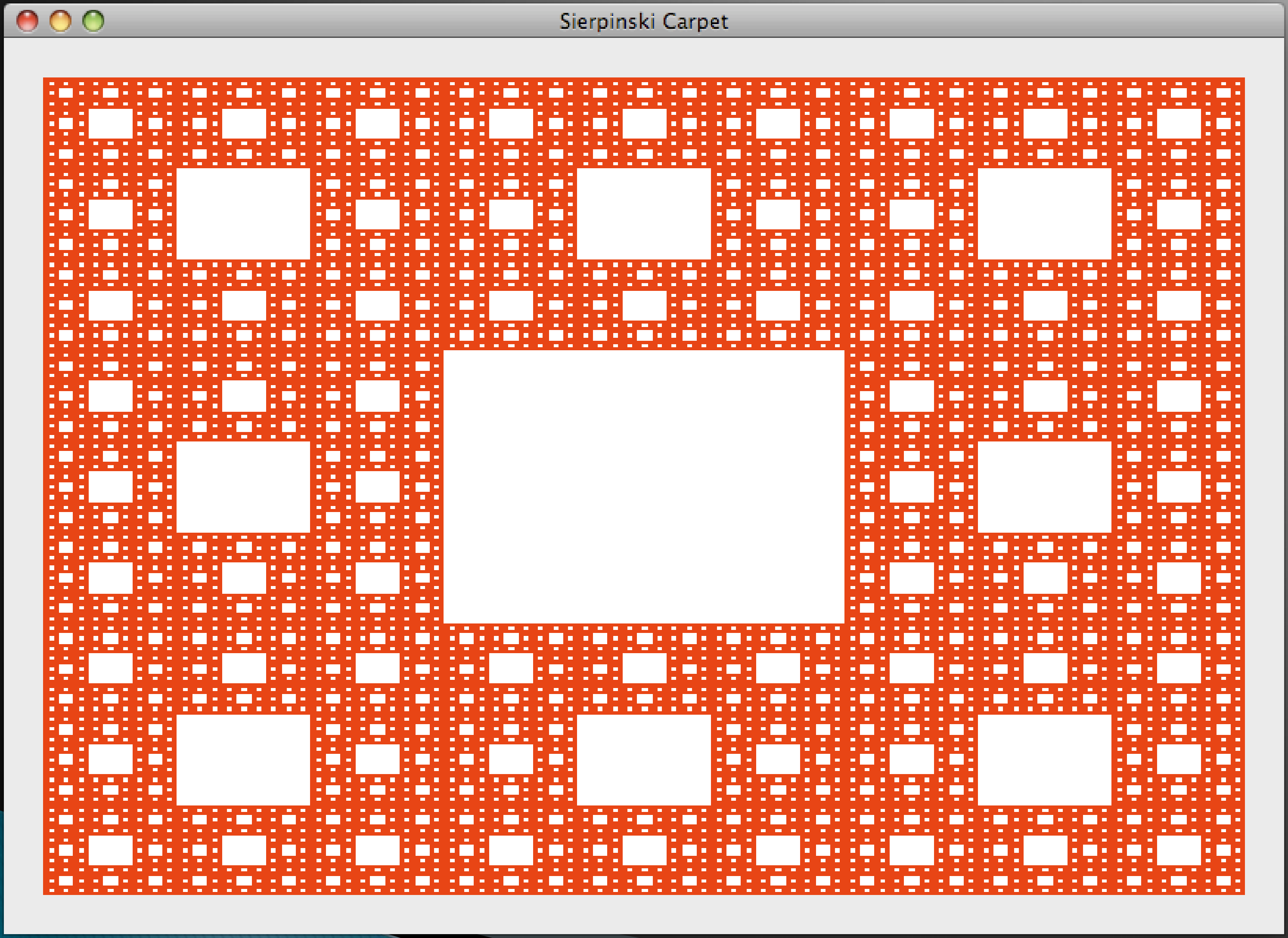
$$M(n) = \begin{cases} 0 & \text{if } n = 0 \\ n - F(M(n-1)) & \text{if } n > 0 \end{cases}$$

  - In how many positions do the sequences differ among the first 50 positions? first 500? first 5,000? first 5,000,000?

http://en.wikipedia.org/wiki/Hofstadter_sequence

Q5

Homework: Sierpinski Carpet



Q6–7