

Slide 1

Administrivia

- Reminder: Quiz 5 next Tuesday. Likeliest topic is something GUI-related.
- Reminder: Homework 6 design due today, code next Tuesday.
- I added a few more things to the sampler program from last time. On the Web ("sample programs" page).

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Recursion — Overview

- Basic approach:
 - Identify "base case" — something you can solve directly.
 - Figure out how to decompose non-base cases into "smaller" problems, and apply algorithm to smaller problems.
- How to think about "does it work?"
 - Does it work for base case(s)?
 - Assuming recursive calls work, does it work for other cases?
 - Does every recursive call get you at least one step closer to a base case?
- Implementation — conceptually (and usually in fact) involves a stack of calls-in-progress.
- Can be slower than iteration (though sometimes not), but can also be much easier to understand.

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Recursion — Simple Examples

- Factorial function.
- Function to compute Fibonacci numbers (very slow!).

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Recursion — Parsing an Arithmetic Expression

- “Fully parenthesized arithmetic expression” is one of two things:
 - A number n .
 - Something of the form

$$(e \text{ } op \text{ } f)$$

where e and f are expressions and op is one of the four arithmetic operators.

- How to evaluate one of these?
- Let's write code for that ...

Recursion — More Examples

- Quicksort — pick “pivot” element, split array into elements less than pivot and elements greater than pivot, and sort recursively. Why does this work?
- Mergesort — split array (or list) into two pieces of equal size, sort recursively, merge. Why does this work?
- Filling the area inside a border.

Slide 5

Minute Essay

- Consider the following recursive function.

```
public static int mystery(int m, int n) {  
    if (n == 0)  
        return m;  
    else  
        return 1 + mystery(m, n-1);  
}
```

- What does `mystery(5, 3)` return?
- Give a short description in general of what `mystery` accomplishes (not how it accomplishes it — e.g., we don't really care whether `Math.min(a, b)` uses `if` or something else, so long as it returns the smaller of `a` and `b`). Assume input `n` is non-negative, or also say what happens if `n` is negative.

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Minute Essay Answer

- `mystery(5, 3)` returns the value 8.
- In general, `mystery(m, n)` adds `m` and `n` — assuming `n` is non-negative. If `n` is negative, you get “infinite” recursion (the quotes are because usually the recursion stops, with a crash, when you run out of stack space).

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