

Slide 1

### Administrivia

- Review sheet for Exam 1 (a.k.a. midterm) available on Web, linked from schedule page. Lists topics, talks about exam format, etc. Ask me if something is not clear. Questions are likely to be similar to quiz questions (but harder) and homework problems (but easier/shorter). Open (text)book, open notes. "Notes" can include (your) graded work and (this year's) sample solutions. Solutions to quizzes online; solutions to homework to be distributed in hardcopy.
- Reminder: Homework 5 due Monday after break, not accepted later than Tuesday at noon. I advise starting on problems this week.
- I do plan to have class Friday, but it won't cover material that's critical to success on homework or exam.
- Answers to (non-opinion) minute essay questions now available in notes posted to Web.

Slide 2

### Analysis of Algorithms, Longer Example Continued

- Recall the more complicated version of the  $a^b$  algorithm:

```
double exp(double a, int b) {
    if (b == 1)
        return a;
    else {
        double temp = exp(a, b/2);
        if (b % 2 == 0)
            return temp * temp * 1; // extra "*", yes
        else
            return temp * temp * a;
    }
}
```

- How to figure out how many multiplications? Define and solve a recurrence relation.

### Analysis of Algorithms, Continued

- More complicated (but faster)  $a^b$  algorithm — example of “divide and conquer” algorithms. General form:

```
if (base case)
  solve
else {
  split into 2 subproblems
  solve subproblems
  merge subsolutions
}
```

Slide 3

- In general, recurrence relation for work involved has the form

$$S(n) = cS(n/2) + g(n), \text{ for } n = 2^m, n > 1$$

for which we can derive a formula — equation (6) on p. 152.

### Analysis of Algorithms, Continued

- Example — recurrence relation for exponentiation algorithm:

$$M(1) = 0$$

$$M(n) = 2 + M(n/2), \text{ for } n = 2^m, n > 1$$

Slide 4

- Example — practice #23 from textbook.

### Minute Essay

- How many comparisons are needed to sort an array of  $N$  elements using bubble sort?:

```
for (int i = 0; i < N-1; ++i) {  
    for (int j = 0; j < N-1-i; ++j) {  
        if (a[j+1] > a[j])  
            swap(a[j+1], a[j]);  
    }  
}
```

Slide 5

- If you're having trouble keeping up (and judging by some answers to minute essay questions, some students are) — is it lack of time, or something else we/I can help with?

### Minute Essay Answer

- $N-1 + N-2 + N-3 + \dots + 0$ , i.e.,  $(N-1) * N / 2$ . (One comparison per trip through the inner loop, and the number of inner-loop trips for each trip through the outer loop depends on the value of  $i$ .)

Slide 6