Administrivia

- Reminder: Abelson lecture 4pm today, Chapman Auditorium. Other talks:
  - "Amorphous computing" in Dr. Myers's AI class tomorrow at 11:20am in HAS 340.
  - Cryptography at 3:30pm in HAS 228.

Slide 1

Minute Essay From Last Lecture

- Question: Given the recurrence relation:

$$\begin{aligned} P(1) &= 500 \\ P(n) &= P(n-1) * 1.1, \text{for } n > 1 \end{aligned}$$

What is a closed-form solution? (Okay to guess.)

- Answer?

Slide 2

Slide 3

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 1 * temp * temp; // extra "*", yes
        else
            return temp * temp * a;
    }
}
```

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

Slide 4

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
}
```

- 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 . . .

Analysis of Algorithms, Continued

Slide 5

- For a recurrence relation of the form

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

we can derive (in textbook) the following solution:

$$S(n) = c^{\log n} S(1) + \sum_{i=1}^{\log n} c^{\log n - i} g(2^i)$$

- Example — recurrence relation for exponentation algorithm:

$$M(1) = 0$$
$$M(n) = 2 + M(n/2), \text{for } n = 2^m, n > 1$$

- Example — practice #23 from textbook.

Minute Essay

Slide 6

- 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]);
    }
}
```

- Reminder: Homework 4 due today by 5pm.