

## 18.310 Exam #2: Take Home Part

### Problem 1. 25 points

Write a spreadsheet that, for an input number  $N$  of up to 2,000,000, will find a prime (if one exists) in the numbers between  $N$  and  $N + 100$ . As usual, inputs and outputs should be clearly marked. It should

- (1) apply a sieve to eliminate numbers with small prime factors,
- (2) apply the probabilistic primality test that uses Fermat's theorem to the remaining numbers to eliminate all but a few candidates.

You should then

- (3) also build a spreadsheet which will let you input one of these candidates, and which applies a probabilistic test that screens out Carmichael numbers. (If you want, you can have the spreadsheet input it automatically.)

### Problem 2. 25 points

- (1) Set up a spreadsheet that calculates the exact probability of finding the best candidate, given that there are  $N$  candidates, you see candidates one at a time, and you must accept or reject each one before seeing the next. The spreadsheet should work for  $N$  up to 50.
- (2) Set up a spreadsheet that calculates the expected value of the optimal strategy in the following situation: you see candidates one at a time, and you must accept or reject each one before seeing the next. You win money only if you choose the best candidate, and if you have looked at  $k$  candidates, your reward is  $k$  dollars. Again, the spreadsheet should work for  $N$  up to 50.
- (3) Suppose now that you are rewarded only if you find one of the top two candidates. You are awarded \$2000 for finding the best, and \$1000 for finding the second best. Set up a spreadsheet which finds the strategy maximizing your expected reward.