

# CMSC 441

## Homework 2

### Reading Assignment:

- Listen to Igor Stravinsky's Firebird
- Read Chapters 1 through 3 of text and Chapters 0 to 2 Of Algorithms by DPV

### Homework:

- 1) There are four people who want to cross a rickety bridge; they all begin on the same side. You have 17 minutes to get them across to the other side. It's night, and they have one flashlight. A maximum of two people can cross the bridge at one time. Any party that crosses, either one or two people, must have a flashlight with them. The flashlight must be walked back and forth; it cannot be thrown. Person 1 takes 1 minute to cross the bridge, person 2 takes 2 minutes, person 3 takes 5 minutes, and person 4 takes 10 minutes. A pair must walk together at the rate of the slower person's pace.
- 2) Place a single grain of wheat on the first square of a chessboard, two on the second, four on the third, eight on the fourth, sixteen on the fifth, and so on, until all 64 squares had been filled. If it takes just 1 second to count each grain, how long would it take to count all the grain on the chessboard?
- 3) For each of the following functions, indicate the class  $\Theta(g(n))$  the function belongs to. (Use the simplest  $g(n)$  possible in your answers.) Justify your assertions.
  - a)  $(n^2 + 1)^{10}$
  - b)  $\sqrt{10n^2 + 7n + 3}$
  - c)  $2n \lg^2(n+2) + (n+2)^2 \lg\left(\frac{n}{2}\right)$
  - d)  $2^{n+1} + 3^{n-1}$
  - e)  $\lceil \log_2(n^{100}) \rceil$
- 4) Compute the following sums
  - a)  $\sum_{i=1}^n \sum_{j=1}^n ij$
  - b)  $\sum_{i=1}^n \frac{1}{i(i+1)}$

5) Consider the following algorithm:

```
Algorithm Enigma ( A[0..n-1,0..n-1] )  
  //Input: A matrix A[0..n-1,0..n-1] of real numbers  
  for i  $\leftarrow$  0 to n-2 do  
    for j  $\leftarrow$  i+1 to n-1 do  
      if A[i,j]  $\neq$  A[j,i] return "false"  
  return "true"
```

- a) What does the algorithm compute?
- b) What is the basic (i.e., dominant) operation
- c) What is the time complexity of this algorithm expressed in asymptotic notation?
- d) Can you improve the algorithm?