

## 12.010 Homework #1

Due Thursday September 29, 2011

**Question (1): (10-points)** Express the following numbers in base 2, 8, 10, and 16 as appropriate (subscript denotes the base of the input number). (See notes on web page and power point)

$65261_{10}$

$15_{16}$

$5655_8$

$6013_8$

**Question (2): (10-points)** How long will it take on a 56K modem to transfer a 56 Mbytes file? How long on 45 Mbps T1 Ethernet line? Calculation should be accurate to 3-significant digits.

**Question (3): (10-points)** In a computer with 1 Gbytes of memory, what is the maximum size matrix that can be stored with 8-bytes per number in (a) full storage i.e.,  $N \times N$ , (b) lower triangular form. What are the values if the numbers are stored in 4-byte numbers (assume all of the memory can be used for storage)? **The numbers here should be exact, not approximations.**

**Question (4): (10-points)** In class we gave the precision and range for IEEE 4-byte floating point numbers. What is the precision and range for IEEE 8-byte floating-point numbers? (IEEE 8-byte floating point uses 11 bits for the exponent and 53 bits for the mantissa (don't forget about the sign bits). (see Notes on web page and power point)

**Question (5): (10-points)** Develop an algorithm to sum the squares of integers between two values  $n$  and  $m$  i.e.  $\sum_{i=n}^m i^2$ . The solution is not computer code but rather the method to be used written out in English sentences.

**Question (6): (50-points)** Design an algorithm to predict how long it will take a bicyclist to travel a specified course given the characteristics of the bicycle and rider and the amount of power the bicyclist can output as a function of time. This problem will lead to later questions where you will write a program to simulate the motion of the bicyclist. In this question you are not writing computer code: You are finding the equations you will need to use and thinking about how to implement those equations into an algorithm to solve this problem.

You will write (in English) a description of

(1) Equations of motions of the bicycle. Concentrate here on basic energy and force equations. (Final problems will be 2-D motion i.e., no corners)

(2) Converting forces and accelerations: Given the forces acting on the bicycle, how do you calculate the motion of the bicycle and the power requirements.

- (3) Input and outputs for the program. What types of information will the program need for input and what might it output?
- (4) List a set of methods that you will use to validate that your program outputs the correct values and how you will judge "correct".
- (5) Given the nature of this problem, describe what you think will be the issues that you will need to consider carefully when programming this problem.

(Your answer should address each of the items above. Your answer should be equations and written description.)

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