

12.010 Homework #1

Due Thursday September 30, 2010

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)

1313_{10}

1313_{16}

1313_8

1313_4

Question (2): (10-points) In a 32-bit computer, what is the maximum memory size that is possible, and what size matrix can be stored in this amount of memory in full and lower triangular form if values are 64-bit real numbers?

Question (3): (10-points) In class we gave the precision and range for IEEE 4-byte floating point numbers (~6 significant digits with $10^{\pm 38}$ range). IEEE 8-byte floating point uses 11-bit exponents and 53-bit mantissa and has precision of ~16 significant digits and $10^{\pm 308}$ range. How many significant digits and range of values does IEEE-16 floating-point number have? (15-bit exponent and 113 bit mantissa). See Notes on in pdf and power point notes.

Question (4): (10-points) Develop an algorithm to sum $(1+j)x^j$ between two values n and m where x is any number i.e. $\sum_{j=n}^m (1+j)x^j$. The solution is not computer code but rather the method to be used written out in English sentences.

Question (5): (50-points) Start considering developing a program to solve the Lorentz strange attractor problem. The problem was originally studied by Ed Lorentz at MIT and lead to early development of chaos theory and what is called the butterfly effect. This question will be the core of the remaining homeworks and you will need to implement the algorithms you describe here. 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.

To answer this question:

- (1) Describe briefly what the Lorentz strange attractor problem is.
- (2) Write the differential equations that describe this problem (you do not need to derive these equations)
- (3) Outline (in English sentences) how you would solve these equations including input and output that will be needed. (You will see many images of the solution to this problem and so you need to think about how to generate the input to those images).
- (4) List a set of methods you would use to validate the solution to the problem.

(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. The more completely you think about how to solve this problem, the easier the coding of the solution in the next homework will be.

Answers should be emailed to tah@mit.edu as PDF, Word or text files.