

12.010 Homework #3

Due Thursday, October 27, 2005

Question (1): (25-points) Write, compile and run a C or C++ program which generates a table of Legendre polynomials and associated functions for degrees and orders from 0 to 4 (l and m on mathworld site) and for arguments (x) between -1 and 1 in steps of 0.25 (see <http://mathworld.wolfram.com/LegendrePolynomial.html> and HW 02 solution) Table should be no wider than 100 characters and should have headers explaining what the columns are. How would you change this program if 10 significant digits were required? Explain how you designed the program and give an example of the output. Fortran source code should also be supplied

Question (2): (25-points).

Write a program that reads your name in the form <first name> <middle name> <last name> and outputs the last name first and adds a comma after the name, the first name, and initial of your middle name with a period after the middle initial. If the names start with lower case letters, then these should be capitalized. The program should not be specific to the lengths of your name (ie., the program should work with anyone's name. As an example. An input of

thomas abram herring

would generate:

Herring, Thomas A.

Hints:

Look at the ASCII table and check the relationship between upper and lower case letters.

The C library functions toupper tolower can be used.

You can use either the C scanf and printf routines or the C++ cin and cout routines for I/O.

You should provide a C++ program I can run as your answer and an example of output from your program.

Question (3): (50-points) Write a C or C++ program that will compute the trajectory of a paper plane given an initial height and vector velocity (i.e., a speed and direction for the launch.) The program should run until the height of the plane is zero.

Lift and drag equations to be used are:

$$F_l = \frac{1}{2} C_l A \rho V^2 \quad F_d = -\frac{1}{2} C_d A \rho V^2$$

Where A is the wing area, and for a fixed wing, the lift is perpendicular the direction on motion and drag is opposite the direction of motion.

As a test of your code, compute the trajectory of a paper plane weighing 3 grams launched from a height of 2 meters at a speed of 3.5 meters/sec at angle of -10 degrees from level. Repeat the calculation with a 10.0 m/sec initial velocity. The wing area should be 0.017 square-meters. The lift and drag coefficients are 0.22 and 0.04 m². Air density of 1.225 kg/m³. Gravity is 9.8 m/sec². Use the force equations from the solution to homework 1.

Your answer to this question should include:

- (a) The algorithms used and the design of your program
- (b) The C or C++ program source code (I will compile and run your programs) in their own source files.
- (c) The results from the two test cases above.