Assignment 1

Due Date

2016/05/18, PM 11:59 ◦ No LATE Submission will be accepted.

Problems

Prob1.

Prepare two functions “NumToSngBin.m” and “SngBinToNum.m” for floating point number conversion.

- “NumToSngBin” converts a given number to the binary representation corresponding to the single precision floating point number using truncation/round-down mode. The output of the function should be a 1x32 array containing only 0 and 1 corresponding to IEEE754 standard. The left-most bit of each section is the most significant bit.

- “SngBinToNum” converts a 1x32 binary array of a single precision floating point number back to its decimal representation.

- MainScript/MainFunction: Write a script “F74xxxxxx_Prob1.m” and choose three numbers to demonstrate how the two functions work. The output of the script displays following information in the Matlab command window.

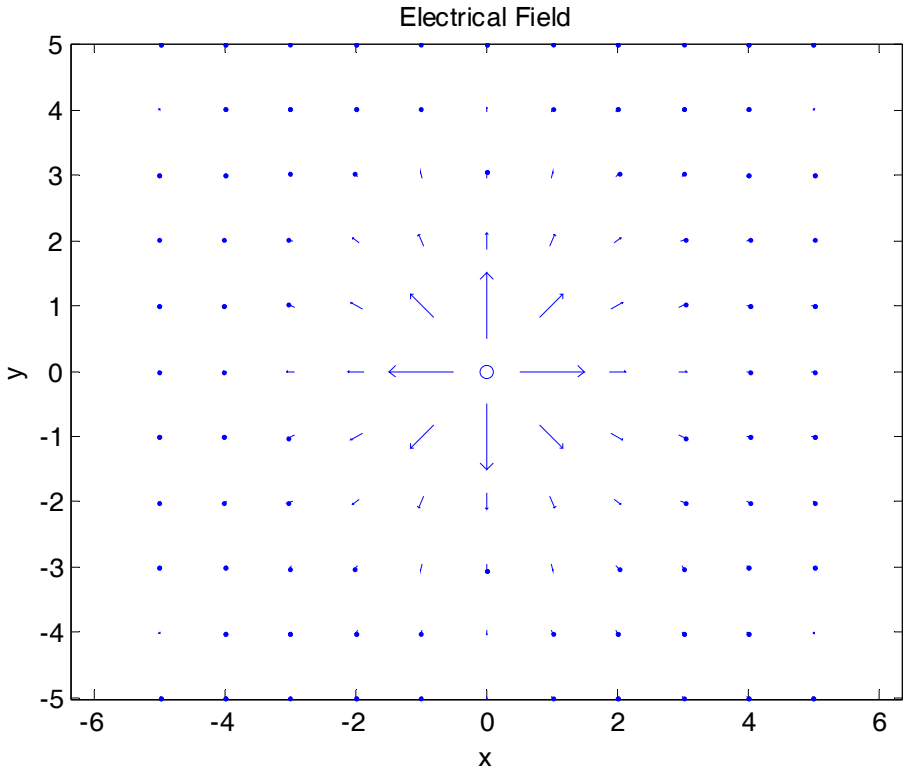
The binary representation of A.B is [0 110…0 0….0];
The decimal representation of [0 110…0 0….0] is A.B;
The binary representation of C.D is [0111001….01];
The decimal representation of [0111001….01] is C.D;
The binary representation of -E.F is [1111000….01];
The decimal representation of [1111000….01] is -E.F;

Prob2.

Prepare a function, “PlotArrow.m” .to plot an arrow on a 2D figure

- PlotArrow.m The input of the function should be TWO VARIABLES, a and b, to instruct the function drawing an arrow from the 2D positional vector a to b. For the drawing function, only “line” or “plot” are allowed to be used for this task.
- MainScript/MainFunction: Write a script “F74xxxxxx_Prob2.m” to demonstrate a figure specified as follows:

Suppose that a unit charge Q = 1C is placed at the origin (0,0,0). Plot the ELECTRIC FIELD for grid points (格子點) on the x-y plane (z=0) using the “PlotArrow” function you just accomplished. The direction of the arrow should point to the direction of the field at the designated grid point. And the length of the arrow should reflect the magnitude of the field. You are allowed to compose other functions necessary and store them as separate m-files to facilitate your composing of the main script.



Prob3. Try to find both the smallest positive root and the biggest negative root of the following equations. The accuracy of the answer should at least up to 8 significant digits.

(a) $4x^2 - e^x - e^{-x} = 0$

(b) $\frac{1}{2} + \frac{1}{4}x - xsin(x) - \frac{1}{2}\cos(2x) = 0$

(c) $e^{3x} - 27x^6 + 27x^4e^x - 9x^2e^{2x} = 0$

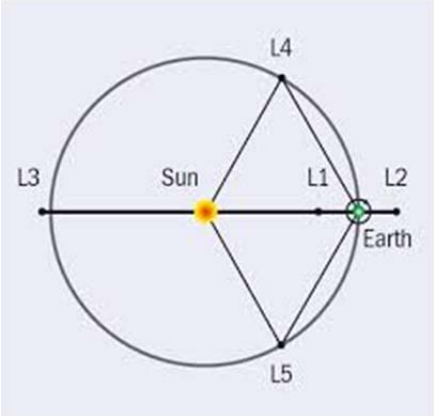
- MainScript/MainFunction: Write a script "F74xxxxxx_Prob3.m" to print out following message on the command window

  The smallest positive root of Prob.3(a) is xxxxxxxxx
  The largest negative root of Prob.3(a) is xxxxxxxxx
  The smallest positive root of Prob.3(b) is xxxxxxxxx
  The largest negative root of Prob.3(b) is xxxxxxxxx
  The smallest positive root of Prob.3(c) is xxxxxxxxx
  The largest negative root of Prob.3(c) is xxxxxxxxx

Prob4.

As shown in the figure, the Lagrange points are the five positions in an orbital configuration where a small object (m) affected only by gravity with two larger objects (such as a satellite with respect to the Sun (M_s) and Earth(M_e)). The combined gravitational force from the two larger masses acting on the small object at the Lagrange point provides precisely the centripetal force for the small object required to maintain a stable position relative to the two larger objects. That is the angular velocity of an object at any of the Lagrange Point possesses identical angular velocity of the Earth with respect to the sun and hence it would maintain the same position with respect to the sun as seen from the earth. Without the earth's gravitational influence, a satellite at the distance of any of the Lagrange Points, would have to move at a different angular velocity than that of the earth. Now try to follow the instructions/questions below to find the Lagrange points.

Note: You are allowed to assume that $M_s \gg M_e \gg m$. Thus all the centers of the orbits lie right on the center of the Sun to simplify the analysis.



(a) Write down the equations to find the three points L1, L2 and L3 in terms of $M_s, M_e, R_{M_s m}$ and $R_{M_s M_e}$.

(b) Find distance ratios (x = $R_{M_s m}/R_{M_s M_e}$) of the Lagrange points L1, L2 and L3 for up to 6 significant digits using your program that solves single variable equations with $M_S = 1.98892 \times 10^{30}$kg and $M_e = 5.97219 \times 10^{24}$ kg.

- MainScript/MainFunction: Write a script “F74xxxxxx_Prob4.m” to print out following message on the command window. (Be aware of the precision/significant digits of the numbers)

  The distance ratio of L1: xxxxx

  The distance ratio of L2: xxxxx

  The distance ratio of L3: xxxxx

Contents to submit

1. All the m-files you compose for the assignment.
2. All the m-files should include proper COMMENTS.
   (No comment, no score)
3. A word document or a PDF includes Your Name, Your Student ID Number, Introduction to your program, such as What your program can do, How do you finish this homework, and the test result that convinced you that your program is correct.

Notice

1. DO NOT PLAGIARIZE. You are encouraged to ask and to discuss the homework content with your fellow classmates, the TAs and the instructor. But identical core program wording is NEVER ACCEPTABLE.
2. Upload all the files without archiving. Do not upload files that don't work well. Any missing file or function that leads to fail of the execution will be regarded as a program that never works.