Two-point Boundary Problem Project

Your work should be presented in the form of a typed report using clear and properly punctuated English. Where appropriate include full program listings and output.

1a. Find a standard subroutine for solving tridiagonal systems of equations. Use your mouse to connect to the National Institute of Standards and Technology web page at

`http://math.nist.gov/`

From this page select the following links in order:

1. Guide to Available Mathematical Software
2. What Problem it Solves
3. Taxonomy as a Decision Tree
4. D Linear Algebra
5. D2 Solution of Systems of Linear Equations
6. D2a Real Nonsymmetric Matrics
7. D2a2 Banded
8. D2a2a Tridiagonal

How many routines solve the system of linear equations $Ax = b$ where A is a tridiagonal matrix? Download one of them and print it out.

b. Consider the two-point linear boundary problem

$$\begin{cases} y'' + \cos(x)y' - (x^2+1)y = 2 \\ y(-2) = y(2) = -1. \end{cases}$$

Find conditions on the grid size h such that the corresponding central difference method is guaranteed to have a unique numerical solution.

c. Use the central difference method to solve the above boundary problem for grid sizes of $h = 4/n$ where $n = 4, 8, 16, 32, \ldots, 256$. Plot your solutions. Do they converge?

d. Repeat for the homogeneous equation

$$\begin{cases} y'' + \cos(x)y' - (x^2+1)y = 0 \\ y(-2) = y(2) = -1. \end{cases}$$

Do solutions to this equation have the weak min-max property?