24-311 NUMERICAL METHODS   Fall 03

Carnegie Mellon University

PROBLEM SET 3

Issued: 9/11/03 (Thr)
Due: 9/19/03 (Fri) 11:50am
                (Hand-in your paper in a box placed outside of Hamerschlag Hall B127.)
Weight: 3% of total

PS3-1   **Root finding with Mathcad**

A uniform beam is subject to linearly increasing distributed load. The equation for the resulting elastic curve is

$$y = \frac{w_0}{120EIL}\left(-x^5 + 2L^2x^3 - L^4x\right)$$

We are interested in determining the location of maximum deflection and the value of the maximum deflection. Use the following parameter values in your computation:

$$L = 450cm, \; E = 50,000kN/cm^2, \; I = 30,000cm^4, \; w_0 = 1.75kN/cm$$

Using Mathcad, (1) plot the elastic curve of the beam, (2) find the x coordinate value of the maximum deflection point, and (3) calculate the maximum deflection. Use the SI unit for the full credit.

In your hand-in directory on AFS, make a new directory called `ps3-1` (in lower case). Name your Mathcad file `ps3-1.mcd` and copy it to your hand-in AFS directory, `ps3-1.` Also, hand in the printout of the Mathcad file. (Include the title of this problem and your name, e.g., "Beam deflaction by Kenji Shimada," at the top of your Mathcad file.)
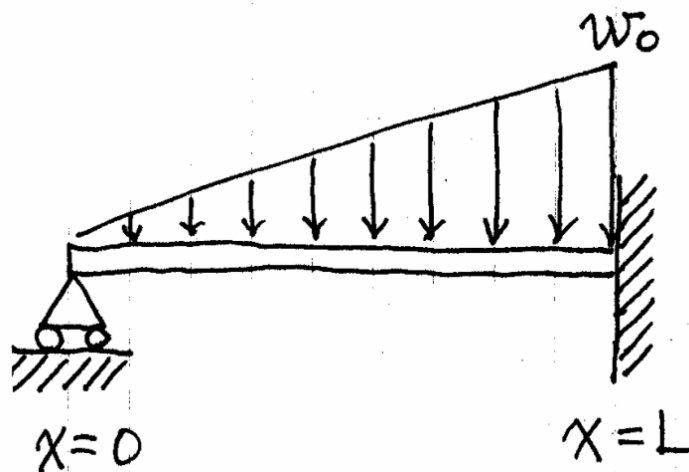

Figure 1: Beam deflection

PS3-2   C++/Java Programming – Newton-Raphson Method

Consider the same beam deflection problem in PS3-1, and write a computer program that finds the maximum deflection point x_0 using the Newton-Raphson method.

(1) Use an initial guess, $x_0 = 250$, and terminate the iteration when the absolute value of the approximate relative error $|\varepsilon_a|$ becomes smaller than $\varepsilon_s = 0.0001\%$.

To show that your program is properly implemented, the program has to generate as output a report file, `report.txt,` that shows in each line: (1) the number of iteration, (2) an estimated root in each iteration, (3) the approximate relative error in each iteration.

In your hand-in directory on AFS, make a new directory called `ps3-2` (in lower case). Hand in the following in your hand-in directory on AFS. <u>Do NOT copy object files</u>.

- Source code files (and header file if any)
- Executable file
- Output text from your program `report.txt`

Also hand in a printout of the following:
- Source code files (and header files if any)
- `report.txt`

(2) Try different initial values in your Newton-Raphson code, and find an initial value that leads to no convergence, or converges to a wrong root. Hand in a printout of `report.txt` for such an initial value. You do not need to submit anything to the AFS directory for this part of the problem.

PS3
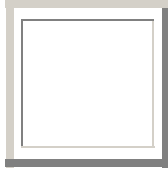
The first letter of
your LAST name

_____   _____
First Name   Last Name

PS3-1 (50 pts)	PS3-2 (50 pts)	PS3 (100 pts)

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