

MAE-185
Midterm
2006

Short Answers: UNIX commands

Provide a brief explanation that describe what each of the following UNIX commands does: (1 pt each)

- less work
- more fun
- pwd
- wc -l
- !p

Linear Systems

Given the system

$$-12x + y - z = -20; \quad -2x - 4y + 2z = 10; \quad x + 2y + 2z = 25$$

1. Write the system of equations in matrix form (3 pts)
2. Solve the system $Ax = b$ using Cramer's Rule. You must show all steps of the computation. (5 pts)
3. Solve the system $Ax = b$ using Gaussian elimination method employing partial pivoting. You must show all steps of the computation. (5 pts)

Taylor Series

Provide the first 3 terms of the Taylor series expansion for each of the following. (3 pts each)

- $f(x + \delta x)$
- $f(x - \delta x)$
- $f'(x + \delta x)$
- $\sin(x)$

Non-linear Systems

Determine the lowest positive root of $f(x) = 7 \sin(x) \exp(-x) - 1$.

- Using the Newton-Raphson method (three iterations $x_i = 0.3$). (9 pts)
- Using the secant method (three iterations with $x_{i-1} = 0.5$ and $x_i = 0.4$). (9 pts)

Algorithm Implementation

Implement Euler's method to solve a first-order ODE in FORTRAN. (7 pts)

Take Home Project

Reuse the code that you developed for homework 2 in order to solve the following problem. You are allowed to work on it 1.5 hours only.

In aerodynamics, one of the most important early applications is Blasius's equation

$$2f''' + ff'' = 0$$

which gives the incompressible velocity profile for a flat plate. The independent variable is usually denote η . Two initial conditions for this problem are $f(0) = f'(0) = 0$. It is also known that $f''(0) = 0.322$.

Your FORTRAN code should print a table of η versus $f'(\eta)$. Caution: As f' approaches a constant f'' gets small and it can underflow. This signals success rather than failure. However, an abort underflow is an ugly way for a program to terminate.

"You need chaos in your soul to give birth to a dancing star."

Friedrich Nietzsche