NUMERICAL ANALYSIS
FINAL EXAM

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ABSTRACT. The solution to each problem consists of two files: a C or C++ program (.C or .CPP extension), and output from that program (.TXT extension). You may use and modify the programs found at `www.saumag.edu/pbailey`.

Submit solutions by email to `plbailey@saumag.edu` dated on or before Tuesday, December 9, 2003.

Problem 1. Start with the program `Matrix.cpp`. Recall that the determinant of an upper diagonal matrix is the product along the diagonal. Add a function to compute the determinant of a matrix by first applying the function `RowEch`. Find and print the determinant and the inverse of the matrix

$$A = \begin{bmatrix} 3 & 4 & 2 & 7 \\ 2 & 3 & 3 & 2 \\ 5 & 7 & 3 & 9 \\ 2 & 3 & 2 & 3 \end{bmatrix}.$$

Problem 2. Start with the program `Integ.cpp`. Let $f(x) = \frac{2}{1+x^2}$. For $n \in \{1, 2, 4, 8, 16, 32\}$, estimate $\int_{-1}^{1} f(x)\,dx$ using the midpoint rule, the trapezoidal rule, and Simpsons rule. Display the results in a grid for easy comparison.

Problem 3. Start with the program `Spline.cpp`. Consider the following table of points, derived from the function $f(x) = \frac{2}{1+x^2}$.

i	0	1	2	3	4	5	6
x	-3	-2	-1	0	1	2	3
y	$\frac{1}{5}$	$\frac{2}{5}$	1	2	1	$\frac{2}{5}$	$\frac{1}{5}$

Let $p(x)$ be the Lagranage interpolation polynomial, $s_1(x)$ the degree one spline, and $s_2(x)$ the degree two spline corresponding to this table. Compute $f(x)$, $p(x)$, $s_1(x)$, and $s_2(x)$ for the values $a + kh$ for $a = -4$, $h = 0.4$, and $k = 0, 1, \ldots, 20$. Print these functions. Display the results in a grid for easy comparison.

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