AMS326 (Numerical Analysis) 2025

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Exam 2: 03/25/2025 3:30-4:50 pm

Notes:

1. *You earn 100 Points (to be normalized to 13 credits for the eventual letter grading) for doing any one of the two problems correctly. If both are tried, the best solution will be credited.*
2. *You need to compose a self-contained report for each problem, as you did for HW sets.*
3. *You may use any language, e.g., Python, C, C++, Fortran, Java, MATLAB, etc.*
4. *You may use any external resources including programs as long as you quote the sources.*
5. *You may use any computer systems as long as you can e-submit your solutions.*

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Problem T2.1 (100 Points) We know by some "magical" calculation

$$I = \int_{-1}^{1} e^{(x^5)} dx \approx 2.0949681713212$$

The integrand looks like

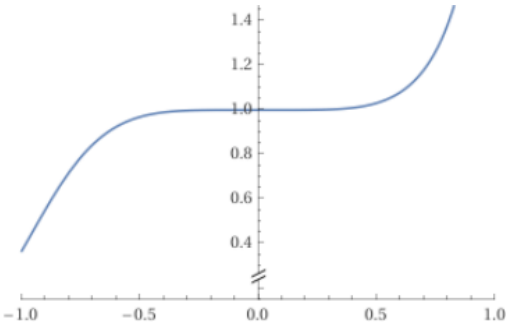

Figure 1. The integrand for this problem.

For this test, you write programs with the following methods with associated given parameters to compute the integral. You need sufficient details in implementing these algorithms.

Method	Number of Mesh Points	Your Integral	Your Error	Credits to Give
Midpoint	$N = 100$			20
Simpson 1/3	$N = 101$			20
Simpson 3/8	$N = 101$			20
Gaussian Quadrature	$N = 5$			20
Monte Carlo	$N = 1000$			20

Problem T2.2 (100 points) Please write program(s) to carry out the following tasks:

(1) (10 points) To generate matrices $A^{n\times n}$ and $B^{n\times n}$ with elements $a_{ij}, b_{ij}\sim U(-2,2)$ where $n = 2^{10}$.
(2) To compute $A \times B$ and estimate the number of floating-point operations by
    (a) the naïve method (30 points).
    (b) Strassen algorithm of 2 levels (60 points).

Note: Direct calls of MATLAB or some AI tools get you no credits, although borrowing them to verify your results is encouraged.