

- I want to take the BASIC EXAM
 I want to take the ADVANCED EXAM

Exam rules:

- Basic exam: the maximum grade is 24/30.
- Advanced exam: the maximum grade is 30/30 cum laude.

Total time is 1 hour. Students who get a positive grade in the written part (i.e., at least 18/30) *might* choose to take an oral exam. For students who choose the basic written exam, the maximum grade obtainable can never exceed 24/30.

BASIC EXAM

1. Starting from $x^{(0)} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$, compute 2 iterations of the Jacobi method to compute an approximate solution of the system $Ax = b$, where

$$A = \begin{bmatrix} 4 & 2 & 0 \\ 0 & 2 & 1 \\ 1 & -1 & 4 \end{bmatrix} \quad b = \begin{bmatrix} 0 \\ 2 \\ 0 \end{bmatrix}$$

2. Write the pseudocode of the Newton method. With initial guess $x_0 = 1$ apply one Newton iteration to find an approximate solution of the equation

$$(2x + 2)(x + 3) = 0$$

ADVANCED EXAM

3. Write the pseudo-code of the composite midpoint quadrature rule, then use the composite midpoint quadrature rule to compute an approximation of

$$\int_{-1}^2 (t^2 + 2t) dt$$

by splitting the integration interval $[-1, 2]$ into three subintervals. Report the intermediate computations.

4. Write the pseudocode of the Gaussian Elimination Method, without pivoting, and give an estimate of its computational cost. Give an example when the method does not work, that is, pivoting is necessary