

# Scientific Computing Final Exam

1. State ONE advantage and ONE disadvantage of a method over another
2. Using Newton–Cotes quadrature to compute the integral

$$\int_0^1 \cos(10^4 \pi x) f(x) dx$$

requires  $n \gg 10^4$ , where  $n$  is the number of subintervals. Explain why this is the case, and suggest an alternative numerical integration method that can compute the integral accurately with only 2 points.

3. Derive practical method to estimate the error of a general composite quadrature rule, don't just state the error formula of a certain quadrature rule.
4. Write down Gauss–Seidel method for solving linear system, derived from the PDE:

$$-\Delta u = f$$

5. Least Square computation (vectors)
6. For matrix

$$A = \begin{pmatrix} 1 & a & a \\ a & 1 & a \\ a & a & 1 \end{pmatrix},$$

determine all values of  $a$  such that  $A$  is p.d. but the Jacobi method for solving the linear system  $Ax = 0$  does not converge.