Question

Runge phenomenon refers to

Correct Answer

- large oscillation in high degree polynomial interpolation.
- lack of convergence in solving a nonlinear equation.
- a coding error.

Question

The matrix $\begin{pmatrix} 1 & -0.1 & 0.01 \\ 1 & 0.3 & 0.09 \\ 1 & 0.2 & 0.04 \end{pmatrix}$

- is NOT a Vandermonde matrix

Correct Answer

- is a Vandermonde matrix with **infinity norm** condition number $\geq \frac{100}{9}$
- is a Vandermonde matrix with **infinity norm** condition number less than 10

Question

For $a+b=p+q$, the function

$$S(x)=\begin{cases} ax+b & \text{when } x\in[0,1] \\ px+q & \text{when } x\in[1,2] \end{cases}$$

is

Correct Answer

- a linear spline.
- a quadratic spline.
- NOT a spline.

Question

Is the following function $S\left(x\right)$ a quadratic spline?

$$S\left(x\right)=\begin{cases} x^2+1, & x\in[0,2] \\ \frac{1}{2}x^2+x+1, & x\in[2,4] \\ x^2-2x+5, & x\in[4,6] \end{cases}$$

- Yes, it is a quadratic spline.

Correct Answer

- No, but it is a continuous function.
- No, it is not even a continuous function.

Question

Determine the real numbers a, b, c, such that the following function $S(x)$ is a cubic spline.

$$S(x)=\begin{cases} 4+ax+2x^2-\frac{1}{6}x^3, & 0\leq x\leq 1, \\ 1-\frac{4}{3}(x-1)+b(x-1)^2-\frac{1}{6}(x-1)^3, & 1\leq x\leq 2, \\ 1+c(x-2)+(x-2)^2-\frac{1}{6}(x-2)^3, & 2\leq x\leq 3. \end{cases}$$

- Such real numbers a, b, c do NOT exist

Correct Answer

- $a=-\frac{29}{6}, b=\frac{3}{2}, c=\frac{7}{6}$
- $a=-\frac{29}{6}, b=\frac{3}{2}, c=-\frac{7}{6}$

Question

To perform **linear** spline interpolation over 100 datapoints, we need to solve for

Correct Answer

- 198 unknowns.
- 199 unknowns.
- 200 unknowns.

Question

Given $m\times n$ matrix$A$ and $m\times 1$ vector b, where $m>n$.

Solving the linear system $Ax=b$ for x involves

- solving for more unknowns with less equations.

Correct Answer

- solving for less unknowns with more equations.
- solving for number of unknowns same as the number of equations.

Question

The tall linear system $\begin{bmatrix} 2 & 5 \\ -1 & 1 \\ 0 & \alpha \end{bmatrix}\begin{pmatrix} x_1 \\ x_2 \end{pmatrix}=\begin{pmatrix} 1 \\ 0 \\ 3 \end{pmatrix}$

Correct Answer

- has no solution for $\alpha\neq 21$
- has a unique solution for $\alpha\neq 21$
- has infinitely many solutions for $\alpha\neq 21$

Question

Solving the **least squares problem** involves minimizing the squared 2 norm of an error vector. This minimum value

Correct Answer

- must be a nonnegative scalar.
- must be equal to zero.
- may be a negative scalar.

Question

For the tall linear system $\begin{bmatrix} 2 & 0 \\ -1 & 1 \\ 0 & 2 \end{bmatrix}x=\begin{pmatrix} 1 \\ 0 \\ -1 \end{pmatrix}$, the **normal equation** is

Correct Answer

- $\begin{bmatrix} 5 & -1 \\ -1 & 5 \end{bmatrix}\widehat{x}=\begin{pmatrix} 2 \\ -2 \end{pmatrix}$
- $\begin{bmatrix} 5 & -1 & 1 \\ -1 & 2 & 5 \\ 3 & -2 & 4 \end{bmatrix}\widehat{x}=\begin{pmatrix} 2 \\ -2 \\ 1 \end{pmatrix}$
- $\begin{bmatrix} 5 & -1 \\ -1 & 5 \end{bmatrix}\widehat{x}=\begin{pmatrix} 1 \\ -1 \end{pmatrix}$