Question

Consider the ODE IVP

$$\frac{dy}{dt} = y + t\log(y), \quad y(0) = 1.$$

With step size 0.1, the forward Euler approximation of $y(0.1)$ equals

Correct Answer
- 1.1
- 1
- 0.9
- 0.2

Question

To numerically solve the second order ODE

$$5\frac{d^2y}{dx^2} + x\frac{dy}{dx} + \sin(x)y = 0$$

with appropriate initial conditions, we need to re-write it as a first order vector ODE

Correct Answer
- $\frac{d}{dx}\begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \begin{bmatrix} y_2 \\ -\frac{(y_2 x + y_1 \sin(x))}{5} \end{bmatrix}.$
- $\frac{d}{dx}\begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \begin{bmatrix} y_2 \\ \frac{y_2 x + y_1 \sin(x)}{5} \end{bmatrix}.$
- $\frac{d}{dx}\begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \begin{bmatrix} y_2 \\ -\frac{(y_1 x + y_2 \sin(x))}{5} \end{bmatrix}.$

Question

The $n \times n$ matrix $\begin{bmatrix} \frac{1}{n} & \frac{1}{n} & \cdots & \frac{1}{n} \\ \frac{1}{n} & \frac{1}{n} & \cdots & \frac{1}{n} \\ \vdots & \vdots & \vdots & \vdots \\ \frac{1}{n} & \frac{1}{n} & \cdots & \frac{1}{n} \end{bmatrix}$ has spectral radius

Correct Answer
- 1
- $\frac{1}{n}$
- n

Question

The power iteration applied to the 2×2 diagonalizable matrix $\begin{bmatrix} -b & a \\ -c & b \end{bmatrix}$ is guaranteed to converge

- for any values of a, b, c

Correct Answer
- when $b^2 > ac$
- when $b^2 < ac$
- when $b^2 = ac$

Question

When applying the inverse power iteration for computing the smallest magnitude eigenvalue, we can

Correct Answer
- use the LU decomposition to avoid explicit computation of matrix inverse.
- never apply LU decomposition.
- never guarantee convergence.

Question

Given a diagonalizable $n \times n$ matrix, the power iteration can be used to compute the dominant eigenvalue λ_1 where $|\lambda_1| > |\lambda_2| \geq |\lambda_3| \geq \ldots \geq |\lambda_n|$.

The above inequality implies that λ_1

Correct Answer
- must be a real eigenvalue.
- must be a complex eigenvalue.
- maybe real or complex depending on the matrix.

Question

The backward Euler method for solving ODE IVP is

Correct Answer
- an implicit method.
- an explicit method.

Question

Suppose we compute the dominant eigenvector $v^{(1)}$ for a diagonalizable matrix A using the power iteration.

What is the most efficient way to compute the dominant eigenvector of the transposed matrix $A^\top$?

- It has to be computed by applying the power iteration all over again to the transposed matrix.

Correct Answer
- It is the same as $v^{(1)}$ and therefore, we don't need to compute anything else.
- It is a known nonlinear function of $v^{(1)}$ and therefore, can be computed by writing some additional code.

Question

Consider an adjacency matrix $A = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 0 & 0 \\ 1 & 0 & 1 \end{bmatrix}$.

The corresponding column-stochastic matrix S is given by

Correct Answer
- $S = \begin{bmatrix} \frac{1}{3} & \frac{1}{3} & \frac{1}{2} \\ \frac{1}{3} & \frac{1}{3} & 0 \\ \frac{1}{3} & \frac{1}{3} & \frac{1}{2} \end{bmatrix}$
- $S = \begin{bmatrix} \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} & 0 \\ \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \end{bmatrix}$
- $S = \begin{bmatrix} \frac{1}{3} & 0 & \frac{1}{2} \\ \frac{1}{3} & 0 & 0 \\ \frac{1}{3} & 0 & \frac{1}{2} \end{bmatrix}$
- $S = \begin{bmatrix} \frac{1}{3} & 0 & \frac{1}{3} \\ \frac{1}{3} & 0 & 0 \\ \frac{1}{3} & 0 & \frac{1}{3} \end{bmatrix}$

Question

MATLAB ode45 is

Correct Answer
- is a variable step-size solver.
- is a fixed step-size solver.