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MTH213:NUMERICAL ANALYSIS I

If f(1) = -3, f(3) = 9, f(4) = 30 and f(6) = 132, find the Lagrange's interpolation polynomial of f(x).
P(x) = x3 – 3x2 = 5x – 6

Using Lagrange's interpolation formula, find the value of f when x = 1.4
from the following table.

x	1.2	1.7	1.8	2.0
f	3.3201	5.4739	6.0496	7.3891

f(x) = 4.05826

the formula for inverse interpolation is ____

$$P_n(\overline{y}) = \sum_{i=0}^{n} x_i \prod_{\substack{i=0 \\ i=j}}^{n} \frac{(y - y_j)}{(y_i - y_j)}$$

From the following table, find the Lagrange's interpolating polynomial
which agrees with the values of x at the given values of y. Hence find
the value of x when y = 2.

x	1	19	49	101
y	1	3	4	5

x = P(y) = y3 – y2 + 1

Find the value of x when y = 3 from the following table of values

x	4	7	10	12
y	-1	1	2	4

x(3) = P(3) = 12. 1333.

The general error term is ____

$$E_n(x) = f(x) - P_n(x) = \frac{f^{(n+1)}(\xi(x))}{(n+1)!}(x - x_0)(x - x_1).....(x - x_n)$$

The following table gives the values of f(x) = ex. If we fit an interpolating polynomial of degree four to the data, find the magnitude of the maximum possible error in the computed value of f(x) when x = 1.25

x	1.2	1.3	1.4	1.5	1.6
y	3.3201	3.6692	4.0552	4.4817	4.9530

0.00000135.

The langrage form is ___

$$P_n(x) = \sum_{i=0}^{n} f(x_i) L_i(x)$$

where

$$L_i(x) = \left[\prod_{\substack{j=0 \\ j \neq i}}^{n} (x - x_j)\right] / \left[\prod_{\substack{j=0 \\ j \neq i}}^{n} (x_i - x_j)\right]$$

If f(x) = x3, find the value of f[a, b, c].
f[a, b, c] = a + b + c.

Newton's form of interpolating polynomial is represented as_____

$$P_n(x) = \sum_{i=0}^{n} f[x_0, \ldots, x_i] \prod_{j=0}^{j-1} (x - x_j)$$

From the following table of values, find the Newton's form of interpolating polynomial approximating (x).

x	-1	0	3	6	7
f(x)	3	-6	39	822	1611

f(x) =P4(x) = x4 - 3x3 + 5x2 – 6

Find the approximate values of f(x) at x = 2 and x = 5

x	-1	0	3	6	7
f(x)	3	-6	39	822	1611

f(2) = 6 and f(5)= 369

Obtain the divided differences interpolation polynomial and the Lagrange's interpolating polynomial of f(x) from the following data and show that they are same.

x	0	2	3	4
f(x)	-4	6	26	64

Divided differences interpolation polynomial is P(x) = x3 + x – 4
Lagrange's interpolation polynomial is P(x) = x3 + x – 4.

Evaluate the difference 3[a2x2 + a1x + a0]
0

Evaluate the difference 3[a3x3 + a2x2 + a3x + a0].
a3.3 ! h2

The first order central difference of f at xk, denoted by dfk, is defined as___
df = f(x + h/2) – f(x – h/2) = fk+1/2 – fk-1/2.

The second order central difference is given by____
d2fk= fk+1 – 2fk + fk-1

From the following table, find the number of students who obtained less than 45 marks

Marks	30 - 40	40 - 50	50 – 60	60 - 70	70 - 80
No. of students	31	42	51	35	31

48

Stirling's formula for interpolation is given by___

$$P_n(x) = f(x_0) + \frac{s}{2}[df_{1/2} + df_{-1/2}] + \frac{s^2}{2!}d^2f_0$$

Using Stirling's formula, find the value of (1.32) from the following table of values

x	1.1	1.2	1.3	1.4	1.5
f(x)	1.3357	1.5095	1.6984	1.9043	2.1293

1.7382

Newton's backward difference formula is represented by ___

$$P_n(x) = P_n(x_n + sh) = \sum_{k=0}^{n} (-1)^k \binom{s}{k} \nabla^k f_n \quad \text{where } s = (x - x_0)/h$$

Numerical methods for solving linear algebraic systems may be divided into two types,namely____
direct and iterative

The horizontal lines of a matrix are called -___
Rows

The vertical lines of a matrix are called -___
Columns

A matrix with m rows and n columns is called an___
m´ n matrix

If the matrix has the same number of rows and columns, we say it's a ____
square matrix

If a matrix has only one column it is called a _____
column matrix or column vector

If a matrix has only one row it is called a ___
row matrix or row vector

A matrix A = (aij) in which aij = 0 (i, j = 1, 2 ....., n) is called a___
null matrix

A matrix A in which all the non-diagonal elements vanish is called ___
diagonal matrix

The identity matrix I is a diagonal matrix in which all the diagonal elements are equal to ____
One

A square matrix is lower triangular if_____
all the elements above the main diagonal vanish

The matrix obtained by interchanging the rows and columns of A is called the ___
transpose of A

If $A = \begin{bmatrix} 1 & 2 & 6 \\ 5 & 4 & 1 \\ 7 & 3 & 2 \end{bmatrix}$ calculated det (A).

-79

The transpose of the cofactor matrix Ac of A is called ___
the adjoint of Aand is written as adj(A).

A system of linear Eqns is said to be _____if it has at least one solution.
Consistent

A system of linear Eqns is said to be _____ If no solution exists
Inconsistent

A non-homogeneous system of n linear equations in n known has a _____if and only if the coefficient matrix A is nonsingular
unique solution

Solve the system of equations

$$3x_1 + x_2 + 2x_3 = 3$$
$$2x_1 - 3x_2 - x_3 = -3$$
$$x_1 - 2x_2 - x_3 = 4$$

x1=1, x2=2 and x3=-1

The diagonal elements which are used as divisors are called____
Pivots

_____method is another direct method for solving large systems (n > 4).
Gauss elimination

In _____method if at any stage of the elimination any of the pivots vanishes or become small in magnitude, elimination procedure cannot be continued further. In such cases pivoting is used to obtain the solution vector x
Gauss elimination

_____is another problem associated with the problem of finding solutions of a linear system
Matrix inversion

the transpose of the matrix of the cofactors of elements of A is called the
adjoint matrix

inverse of a matrix is represented as ____

$$A^{-1} = \frac{1}{\det(A)} \operatorname{adj}(A)$$

Find A-1 for the matrix

$$A = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 3 & 0 \\ 4 & 5 & 6 \end{bmatrix}$$

A-1= $\begin{bmatrix} 1 & 0 & 0 \\ 2/3 & 1/3 & 0 \\ 1/9 & -5/18 & 1/6 \end{bmatrix}$

Find A-1 for the matrix

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 4 & 5 \\ 0 & 0 & 6 \end{bmatrix}$$

$$A^{-1} = \frac{1}{24} \begin{vmatrix} 24 & -12 & -2 \\ 0 & 6 & -5 \\ 0 & 0 & 4 \end{vmatrix} = \begin{vmatrix} 1 & -1/2 & -1/12 \\ 0 & 1/4 & -5/24 \\ 0 & 0 & 1/6 \end{vmatrix}$$

Find the inverse of the matrix

$$A = \begin{bmatrix} 3 & 1 & 2 \\ 2 & -3 & -1 \\ 1 & -2 & 1 \end{bmatrix}$$

$$A^{-1} = \begin{bmatrix} 1/4 & 1/4 & -1/4 \\ 3/20 & -1/20 & -7/20 \\ 1/20 & -7/20 & 11/20 \end{bmatrix}$$

Find the inverse of the matrix

$$A = \begin{bmatrix} 2 & 0 & 0 & 0 \\ 1 & 1/2 & 0 & 0 \\ 1 & 0 & -3 & 0 \\ 1 & -7/2 & -17 & 55/3 \end{bmatrix}$$

$$A^{-1} = \begin{bmatrix} 1/2 & 0 & 0 & 0 \\ -1 & 2 & 0 & 0 \\ 1/3 & 0 & -1/3 & 0 \\ 1/11 & 21/55 & -17/55 & 3/55 \end{bmatrix}$$

Find the inverse of the matrix

$$A = \begin{bmatrix} 1 & 3/2 & 2 & 1/2 \\ 0 & 1 & -4 & 1 \\ 0 & 0 & 1 & 2/3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$A^{-1} = \begin{bmatrix} 1 & -3/2 & -8 & 19/3 \\ 0 & 1 & 4 & -11/3 \\ 0 & 0 & 1 & -2/3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Find the inverse of the matrix

$$A = \begin{bmatrix} 3 & 1 & 2 \\ 2 & -3 & -1 \\ 1 & -2 & 1 \end{bmatrix}$$

$$L^{-1} = \begin{bmatrix} 1/3 & 0 & 0 \\ 2/11 & -3/11 & 0 \\ 1/20 & -7/20 & 11/20 \end{bmatrix}$$

_____provide the exact solution in a finite number of steps provided exact arithmetic is used and there is no round-off error

Direct methods

___ start with an initial approximation and by applying a suitably chosen algorithm, lead to successively better approximations

Iterative methods

For a square matrix A of order n, and a number l the value of l for which the vector equation Ax = l x has non-trivial solution x ¹ 0, is called an ___

eigenvalue or characteristic value of the matrix A

The largest eigenvalue in magnitude of A is called ___

the spectral radius of A ad is denoted by p(A).

The roots of this polynomial l 1, l 2, ..., l n are the
eigenvalues of A

Jacobi iteration method or the method of simultaneous displacements. Is represented by___
H = -D-1(L + U); c = D-1b

If the matrix A in Eqn. (1) is strictly diagonally dominant then the Jacobi and Gauss-Seidel methods converge,___
Gauss-Seidel method converges faster than the Jacobi method.

_____is used to solve the system of equations given in no. 4
Gauss-Seidel method

When an equation have a non zero solution,it is called___
eigenvalues of A

Corresponding to these eigenvalues, the nonzero solutions i.e the vectors x is called____
eigenvectors of A

The problem of finding the eigenvalues and the eigenvectors of a square matrix A is known as the ____
eigenvalue problem

A matrix A is singular if and only if it has a ____
zero eigenvalue

Find the eigenvalue of the matrix

$$A =; \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$$

the eigenvalues of A are l 1 = 1, l 2 = 2, l 3 = 3.

Find the eigenvalue of the matrix

$$A = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 3 & 0 \\ 4 & 5 & 6 \end{bmatrix}$$

the eigenvalues of A are l 1 = 1, l 2 = 3, l 3 = 6

Find the eigenvalue of the matrix

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 4 & 5 \\ 0 & 0 & 6 \end{bmatrix}$$

Eigenvalues of A are l 1 = 1, l 2 = 4, l 3 = 6.

The eigenvalues of a diagonal, lower triangular or an upper triangular matrix are the ___
diagonal elements themselves

Find the eigenvalues and the corresponding eigenvectors of the matrix
$\begin{bmatrix} 2 & 2 \\ 1 & 3 \end{bmatrix}$;

The matrix A has two distinct real eigenvalues l 1 = 1, l 2 = 4.
[-2 1]T and [1 1]T are the eigenvectors

____process involved in the Gauss elimination method
the solution vector

The eigenvalues of a diagonal matrix are …….
the diagonal elements themselves

A system of linear equations is said to be …….. if not all its right hand side is zero
Nonhomogeneous

\[\Delta^2 f_k= …….\]
All the options

Find the inverse of the matrix \[\begin{pmatrix} 1 & 2& 3\\0 & 4 & 5\\0 & 0 & 6\end{pmatrix}\]
\[\begin{pmatrix}__
1 & -1/2 & \frac{-1}{12}\\0 & \frac{1}{4} & \frac{-5}{24}\\0 & 0 & \frac{1} {6}\end{pmatrix}\]

\[The \;interpolating \;polynomial \;of \;degree \leq n\; with\; the\; nodes \;x_{0},x_{1}, … ,x_{n}\] can be written as__
\[P_{n}(x) = \sum_{k\to 0}^{n} \frac{ f (x_{k}) } { (x -x_{k}) w'(x_{k}) }\]

Solve the system of equations: \[a + b + c = 1\] \[4a +3b - c = 6\] \[3a + 5b + 3c = 4\]
a = 1 ; b = 1/2 ; c = -
½

The Lagrange's interpolating polynomial P(x) is given
by ……..
\[P(x)=L_0(x)f_0 + L_1(x)f_1 + L_2(x)f_2 + L_3(x)f_3\]

……. Theorem states that 'If f is a continuous function defined on [a, b] and differentiable on]a, b[; and If f(a) = f(b), then there exists a number \[x_{0}\in]a, b[\;such\; that \;f '(x_{0}) = 0\]
Rolle's

The inverse of a matrix A is given by___
\[A^{-1} = \frac{1} {det(A)} adj(A)\]

One of the following is true__
\[\triangle ^3 f_4 = f_4 - f_3\]

If the inverse of matrix B exists, then it is …….
Unique

The inverse of the matrix \[\begin{pmatrix} 1 & 2 & 3\\0 & 4 & 5\\0 & 0 & 6\end{pmatrix}\; is\; …….. \]
\[\begin{pmatrix} 1 & \frac{-1}{2} & \frac{-1} {12}\\0 & \frac{1}{4} & \frac{-5}{24}\\0 & 0 & \frac{1} {6}\end{pmatrix}\]

The backward differences of order three \ [\triangledown ^3\; of\; f(x)\] is denoted by …….
\[\triangledown^3
f_k = f_k - 3f_(k- 2) - 3f_(k-2) - f_(k-3)\]

One of the following is not true Two matrices A and B can be__
multiplied only if the number of columns of A equals the number of rows of B.

The following statements are true except
The divided difference is dependent of the order of its arguments

The following statements are true except
\[For\; the\; central\; difference\; formulas,\; the \;origin\; x_0\;,\; should\; not \;be\; chosen \;near\; the\; point\; being\; approximated.\]

One of these is not a method of solving system of linear equations
Solution method D

Iterative methods of the solutions of systems of equations are ……..
Infinite

The process of determining the value of f(x) for a value of x lying outside the interval [a, b] is called___
Extrapolation

A matrix A is__ if and only if it has a zero eigenvalue
Singular

Determinant is a number associated with____ matrices.
Square

A matrix A = (aij) in which aij = 0 (i, j = 1, 2 ....., n) is Called_____
NULL

The transpose of the cofactor matrix of a square matrix A is called the_____A
Adjoint

A system of linear equations is said to be_____ f it has at least one solution.
Homogeneous

A matrix in which all the non-diagonal elements
vanish is known as_____ diagonal
A matrix having the same number of rows and columns is called-___ matrix
square

Given that the Lagrange's interpolating polynomial
P(x) is given by P(x) = L0(x)f0 + L1(x)f1 + L2(x)f2 + L3(x)f3 Hence, If f(1) = -3, f(3) = 9, f(4) = 30 and f(6) = 132,therefore Lagrange fundamental polynomial L0(x) will be ____
7

____ is the determinant of the system of equations
4x1 + x2 + x3 = 4
x1 + 4x2– 2x3 = 4
−x1 + 2x2– 4x3 = 2
36

If AB = BA = I , then A is the_____-OF B
Inverse

Given that f(3) = 168, f(7) = 120, f(3) =72 and f(10) = 63,the approximate value for f(6) is_____
147

If the Lagrange's interpolation polynomial of f(x) is given as x3 − x2 + 3x + 8 , then f (2) = 1 is____
8

If any matrix A is transformed into another matrix B by a series of elementary row operations, then A and B are_____-MATRICES
equivalent

One of these is not a__
is obtained using the factorisation method

Every non-singular matrix A can be written as__
the product of a lower riangular matrix and an upper triangular matrix if all principal minors of A are non-singular

The diagonal elements used as divisors are called___
Pivots

Using the Gauss Eliminating method, the elementary row operations include the following except
adding (or subtracting) any row by a non-zero constant

Find the product of \[\begin{bmatrix}2&3&-1\end{bmatrix}\] and
\[\begin{bmatrix}1\\4\\2\end{bmatrix}\]
12

The transpose of matrix \[\begin{bmatrix}1&0&-7\\0&-2&3\\4&5&6\end{bmatrix}\]
\begin{bmatrix}1&0&4\\0&-2&5\\-7&3&6\end{bmatrix}\]

the inverse matrix of \[\begin{bmatrix}2&3\\5&6\end{bmatrix}\] [\begin{bmatrix}-2&1\\\frac{5}{3}&-\frac{2}{3}\end{bmatrix}\]

The determinant of \[\begin{bmatrix}2&3\\5&6\\1&-7\end{bmatrix}\]
cannot be determined

The Lagrange form of interpolating polynomial can be determined for__
both equally and unequally spaced nodes

The interpolating polynomial for a given data is ____.
UNIQUE

Any problem involving inverse interpolation can always be solved
if f(x) is continuous and strictly increasing or decreasing

_____.. Theorem states that 'If f is a continuous function defined on [a, b] and differentiable on]a, b[; and If f(a) = f(b), then there exists a number \[x_{0}\; in;]a, b[\;such\; that \;f '(x_{0}) = 0\]
Rolle's

\[If\; z_1, z_2___, z_k\] are distinct zeros of the polynomial P(x), then____
[P(x) = (x ?? z_1) (x ? z_2)?.(x ?? z_k)R(x)\] for some polynomial R(x)

This best describes the fundamental theorem of algebra___
If P(x) is a polynomial of degree \[n \geq1\] that is \[P(x) = a_nx_n + a_{n-1]x_{n-1} + a_1x + a_0,, a_n\] real or complex numbers and \[a_n \neq 0,\] then P(x) has at least one zero, that is, there exists a real or complex number \[\gamma\] such that \[p(\gamma)= 0\]

a polynomial P(x) of degree n which agrees with the values of f(x) at the given (n + 1) distinct points is known _____
nodes

The technique of determining an approximate value of f(x) for a non-tabular value of x which lies in the interval [a, b] is known as _____
Interpolation

the eigenvalues of a diagonal matrix are _____
the diagonal elements themselves

The inverse of a matrix A is given by___
[A^{-1} = \frac{1}{det(A)} adj(A)\]

One of the following is not true__
A square matrix is said to be lower triangular if all the elements below the main diagonal vanish

Iterative methods of the solutions of systems of equations are
Infinite

Solve the system of equations: x + y + z = 1; 4x +3y - z = 6; 3x + 5y + 3z = 4

x = 1 ; y = 0.5 ; z = -0.5

A system of linear equations is said to be _____ if it has at least one solution
Consistent

A system of linear equations is said to _____.. if all its right hand side is zero
Homogeneous

A system of linear equations is said to _____.. if no solution exists
non-homogeneous

The following statements are true except
The divided difference is independent of the order of its arguments

The zeroeth divided difference of the function f, with respect to \[x_{i} \; denoted\; by\; f[x_{i}]\] can be written as
\[f[x_{i}] = f(x_{i})\]

The interpolating polynomial of degree \[\leq n\;with\; the\; nodes\; x_0, x_1,., x_n\] can be written as
\[f[x_{i}] = f(x_{i})\]

When the number of rows is equal to the number of columns in a matrix, it is called _____. matrix
Square

Iterative methods of the solutions of systems of equations are _____
Infinite

One of these is a method of solving system of linear equations:
Inverse method

If all the elements above the main diagonal of a square matrix vanish, the matrix is known as
lower triangular

One of these describes the LagrangeÐ´ÑƒÂ»s interpolating polynomial P(x)
\[P(x) = L_{0}(x)f_{0} + L_{1}(x)f_{1} + L_{2}(x)f_{2} + L_{3}(x)f_{3}\]

The technique of determining an approximate value of f(x) for a non-tabular value of x which lies in the internal [a, b] is referred to as___
Interpolation

A matrix in which all the non-diagonal elements vanish is called Ð´Ñƒ_..... matrix.
Diagonal

When the number of rows is equal to the number of columns in a matrix, it is called _____. matrix
square

Stirling's formula for interpolation is given by
\[P_n (x) = f (x_0) + \frac{s}{2}[df_\frac{1}{2} + d_\frac{-1}{2}] + 2\frac{s^2}{2!}d^{2}f_0\]

The zeroeth divided difference of the function f, with respect to \[x_{i} \; denoted\; by\; f[x_{i}]\] can be written as_____
\[f[x_{i}] = f(x_{i})\]

A system of linear equations is said to be _____... if not all its right hand side is zero
non-homogeneous

A system of linear equations is said to be _____ if no solution exists
Inconsistent

\[If\; z_1, z_2, Ð´Ñƒ_, z_k\] are distinct zeros of the polynomial P(x), then _____
\[P(x) = (x Ð´ÑƒÑ z_1) (x Ð´ÑƒÑ z_2)Ð´Ñƒ_.(x Ð´ÑƒÑ z_k)R(x)\] for some polynomial R(x)

One of the following describes Taylor's Theorem
\[f(x)=f(x_{0})+\frac{x-x_0}{1!}f'(x_0)+\frac{x-x_0}^2{2!}f^(2)(x_0)+Ð´Ñƒ_+\frac{x x_0}^n{n!}f^(n)(x_0)+\frac{x-x_0}^(n+1){(n+1)!}f^(n+1)(x_0)

All but one are not true of divided difference
The divided difference \[f[x_1, x_2, Ð´Ñƒ_., x_k]\] is invariant under all permutations of the arguments \[x_1, x_2, Ð´Ñƒ_., x_k\]

_____ Theorem states that 'If f is a continuous function defined on [a, b] and differentiable on]a, b[; and If f(a) = f(b), then there exists a number \[x_{0}\; in;]a, b[\;such\; that \;f '(x_{0}) = 0\]
Rolle's

Any problem involving inverse interpolation can always be solved__
if f(x) is continuous and strictly increasing or decreasing

The interpolating polynomial for a given data is Ð´Ñƒ_Ð´Ñƒ_.
Unique

The Lagrange form of interpolating polynomial can be determined for
both equally and unequally spaced nodes

Find an approximate value of $\sqrt[3]{26}$

2.963

The rth Taylor polynomial at x0 is given by____

$$P_r(x) = f(x_0) + (x - x_0)\, f'(x_0) + \ldots + \frac{f^{(n)}(x_0)}{r!}(x - x_0)^r.$$

Find the fourth Taylor polynomial of f(x) = In x about x0=1.

$$\text{Therefore, } P_4(x) = (x - 1) - \frac{(x-1)^2}{2} + \frac{(x-1)^3}{3} - \frac{(x-1)^4}{4}$$

Expand f(x) = x4 – 5x3 + 5x2 + x + 2 in powers of (x – 2).
-7(x – 2) – (x – 2)2 + 3(x – 2)3 + (x – 2)4

Maclaurin series is expressed as _____

$$e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \ldots + \frac{x^n}{n!} + \frac{x^{n+1}}{(n+1)!}e^c \ldots$$