

Integration U.V:

$$\int u v dx = u \int v dx - \int \left[v du \left(\frac{du}{dx} \right) \right] dx$$

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Series Convergence and Divergence

A series is the sum of terms in a sequence:
 $S = a_1 + a_2 + a_3 + \dots$

- A convergent series approaches a fixed value.
- A divergent series grows infinitely or does not settle at one value.

Simple Examples

Convergent Series

Example:
 $S = \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \dots$

Each term gets smaller, and the sum gets closer to 1 (but never exceeds it). So, it converges.

Divergent Series

Example:
 $S = 1 + 2 + 3 + 4 + 5 + \dots$

The sum keeps growing and never settles. So, it diverges.

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Integration by Parts

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Integration

For integrals of the form $\int \frac{1}{a+bx+cx^2} dx$, write,

For integrals of the form $\int \frac{1}{a+bx+sinx} dx$, write,

Application of derivatives and anti-derivatives

Decrease of points of local maximum or minimum

- Evaluate $f'(x)$ i.e. $\frac{dy}{dx}$
- Evaluate critical points i.e. value of x for which $f'(x) = 0$ and let it be a etc.
- If $f''(a) > 0$, then $f(x)$ is minimum at $x=a$ and $x=a$ is the point of minimum.

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Topics for Calculus

- 1. Limits, Series and basic derivatives
- 2. Minima Maxima
- 3. Multivariate
- 4. Integral and Numerical Optimization
- 5. Matrix Calculus

2D Curl =

$$\frac{\partial Q}{\partial x} - \frac{\partial P}{\partial y}$$

2D Divergence =

$$\frac{\partial P}{\partial x} + \frac{\partial Q}{\partial y}$$

Line & Surface Integrals

- Line Integral:**
$$\int_C \vec{F} \cdot d\vec{r}$$
- Surface Integral:**
$$\iint_S \vec{F} \cdot d\vec{S}$$
- Green's Theorem (2D):**
 - Converts: Line integral → Double integral (area)
- Stokes' Theorem (3D Rotational Flow):**
 - Converts: Line integral → Surface integral
- Divergence Theorem (Flux Out of a Surface):**
 - Converts: Surface integral → Volume integral

Given [A]_{3x3} → Eigen value?

$\lambda^3 - (\text{Trace of } A)\lambda^2 + (\text{Sum of principle diagonal minors})\lambda - |A| = 0$

$\text{Ex: } A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$

$\lambda^3 - (18)\lambda^2 + (5+20+20)\lambda - 0 = 0$

$\lambda(\lambda^2 - 18\lambda + 45) = 0$

$\lambda = 0, 3, 15$

Increasing/Decreasing, Max & Min Stuff

$y = 2x^2 - 8x + 6$

$y' = 4x - 8 = 0 \Rightarrow x = 2$

$y'' = 4 > 0$ (local min)

$y = 2(x-2)^2 - 10 + 6 = 2(x-2)^2 - 4$

$y = 2x^2 + 3x^2 - 12x + 8$

$y' = 6x + 6 + (-12) = 6(x-2) = 0 \Rightarrow x = 2$

$y'' = 6 > 0$ (local min)

$y = 2(x-2)^2 - 4$

absolute maxima and minima

Rank of matrix

If simple elements haru cha vani find garna lai turn matrix to echelon form ani tespachi aaucha

If number haru complex cha calculate garna time lagcha vani

use calc to find determinant of 3
 if d.3 = 0, d.3 not equal = vaye rank is 3
 find d.2, if d.2 = 0 find every d.2 inside matrix, rank 2