Partial Differentiation

Differentiating a multiraciable function w. x.t one variable while treating other variables as constants.

Gradients:

Vector that contains all the first partial derivatives of fine.) If point in direction of steepest ascent of function

Notation: for 
$$f(x,y)$$
  $\nabla f = \left(\frac{\partial f}{\partial n}, \frac{\partial f}{\partial y}\right)$   
row rector of gradient  
rector of partials

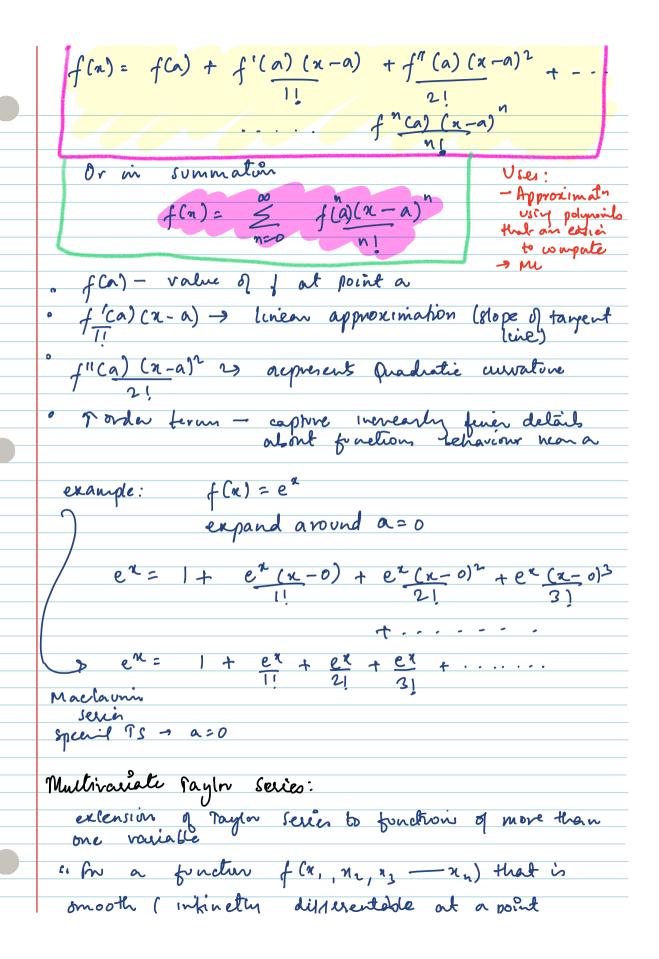
Example: 
$$f(x,y) = x^2 + y^2$$

of =  $\left(\frac{\partial f}{\partial x}, \frac{\partial f}{\partial y}\right) = \left(\frac{\partial x}{\partial x}, \frac{2y}{2y}\right)$ 

may ( of) = rate of increase T may Takent

example: 
$$F(n,y) = \begin{pmatrix} a^{n}y \\ e^{n}\cos y \end{pmatrix}$$
  $J(x,y) = \begin{pmatrix} 2xy & n^{n}y \\ e^{n}\cos y & -e^{n}\sin y \end{pmatrix}$ 

Kigh Order Derivatives: Derivative of Partial derivation. 2 nd order derivatives and higher Example: f(x,y) = n2y + 3ny2 · Pure Second ID  $\frac{\partial^2 f}{\partial n} = \frac{\partial}{\partial n} \left( \frac{\partial}{\partial n} (n^2 y + 3ny^2) \right)$  $= \frac{\partial}{\partial n} \left( 2n y + 3y^2 \right)$ curvature & surfaces > Ophinization to · Mixed Second ID & hidy/classify  $\frac{\partial^2 f}{\partial n} = \frac{\partial}{\partial y} \left( \frac{\partial}{\partial n} \left( n^2 y + 2n y^2 \right) \right)$  $\frac{\partial \mathcal{L}}{\partial n \partial y} = 2 n + 6 y$ Paylor Analysis. Infinite selles representation of mooth function as a sum of terms calculated from practions derivatives at a sigle point expressing it in polynomial series " f(x) → infuitely déferentiable at point a Paylor series of of around a is:



a = (a,, az, az an) the MTS expands as:  $f(a) \approx f(a) + \frac{2}{2} \frac{\partial f}{\partial x} (a) (n; -a;) + \frac{2}{2} \frac{2}{2} \frac{\partial f}{\partial x} (a)$ (z;-a;) (z;-a;) near a Pangent plane appx" for forebrin example: Washuck Paylor Series through second order for f(n,y)= n2y + y2 at (x,y)= (1,3) f(1,3) = 3+ 9=12 on | = 6

on | 1,3

of | = 1+6=7 2 n2 + 2y  $f(x,y) = 12 + 6(x-1) + f(y-3) + \frac{1}{2!} (6(x-1)^{2} + 6(x-1)^{2} +$ 

for a produce f(1,1) = 22+ ky + y2 , expand it around (0,0) f(0,0) = 0 Dy = net 2y 5,0 = [  $f(n) = 0 + o(x - 0) + (y - 0)^{0} + 1 (2(x - 0)^{2} + 2(y)^{2}$ 21 + 2y2 + 1xy > n2+ g2 + 4 4 Other way Marik K(a,y)= 2nd order taylor Series: General formula

for example;

$$f(x,y) = 0 + 1 (m y) (2 1) {m \choose 2}$$