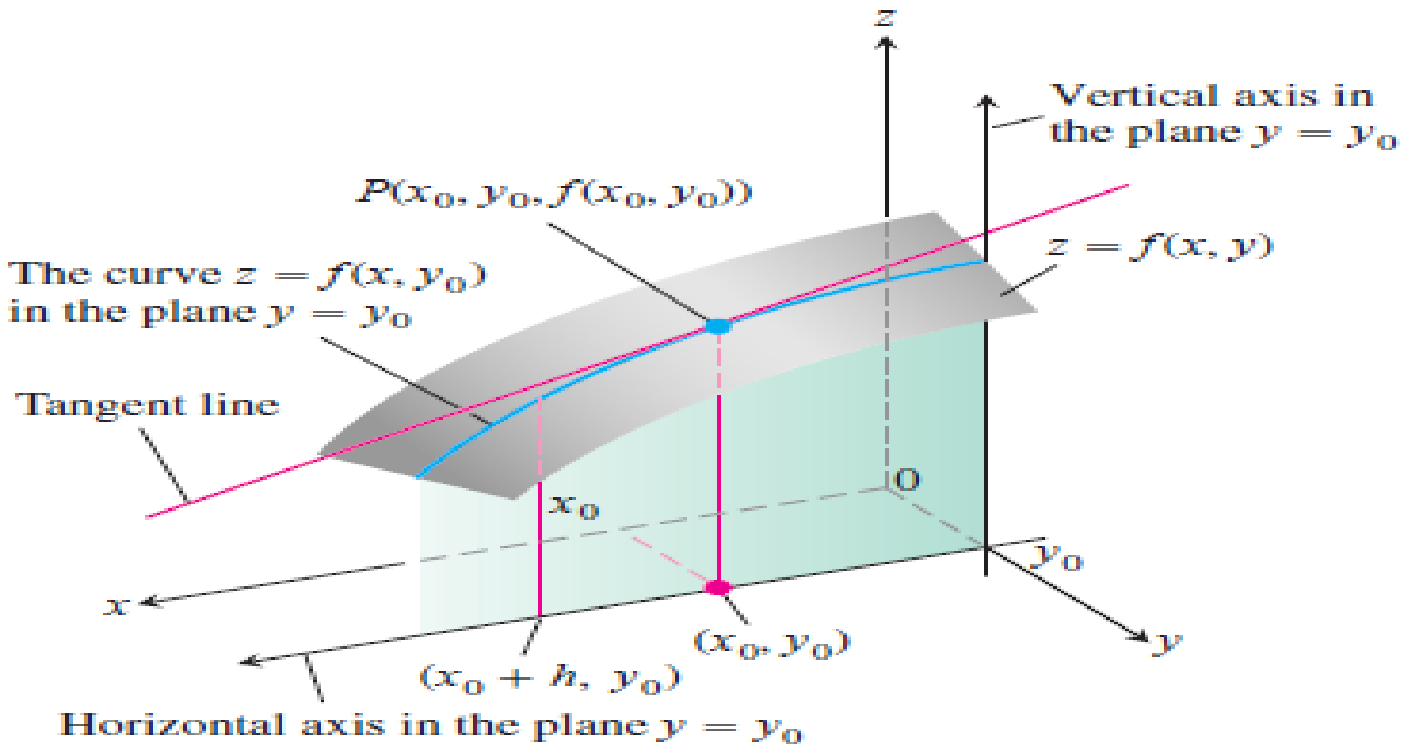
Partial Derivatives



The intersection of the plane $y = y_0$ with the surface $z = f(x, y)$, viewed from above the first quadrant of the xy-plane.

3. Partial Derivatives

Aim

- To write MATLAB codes to find Partial derivative of a given function $f(x,y)$ at a given point (x_1,y_1) and also visualize it

Mathematical form

If f' is a function of two variables, its partial derivatives are the functions f_x and f_y defined by

$$F_x(x,y) = \lim_{h\to 0}[f(x+h,y) - f(x,y)]/h$$

$$F_y(x,y) = \lim_{h\to 0}[f(x,y+h) - f(x,y)]/h$$

MATLAB Syntax Used:

diff(f,x)	Differentiate the function with respect to x symbolically
R = subs(S, old, new)	Replaces old value with new value in the symbolic expression S.
line(X,Y,Z)	Creates a line object in the current axes with default values x = [0 1] and y = [0 1]. You can specify the color, width, line style, and marker type, as well as other characteristics.
Y = ones(n)	Returns an n-by-n matrix of 1s. An error message appears if n is not a scalar.

```
clc
clear all
syms x y
z = input('Enter the two dimensional function f(x,y): ');
x1 = input('enter the x value at which the derivative has to be evaluated: ');
y1 = input('enter the y value at which the derivative has to be evaluated: ');
z1 = subs(subs(z,x,x1),y,y1)
ezsurf(z,[x1-2 x1+2])
hold on
```

```
option=input('Enter 1 for partial derivative w.r.t x or 2 for partial derivative w.r.t y:')
if(option==1)
f1 = diff(z,x)
slopex = subs(subs(f1,x,x1),y,y1)
range_z = input('Enter the range of z as a row vector: ');
[x2,z2]=meshgrid(x1-2:0.25:x1+2,range_z)
y2=y1*ones(size(x2))
surf(x2,y2,z2)
t=linspace(-1,1)
x3=x1+t
y3=y1*ones(size(t))
z3=z1+slopex*t
line(x3,y3,z3,'color','black','linewidth',2)
```

```
else
f1 = diff(z,y)
slopey = subs(subs(f1,x,x1),y,y1)
range_z = input('Enter the range of z as a row vector: ');
[y2,z2]=meshgrid(y1-2:.25:y1+2,range_z)
x2=x1*ones(size(y2))
surf(x2,y2,z2)
t=linspace(-1,1)
y3=y1+t
x3=x1*ones(size(t))
z3=z1+slopey*t
line(x3,y3,z3,'color','green','linewidth',2)
end
```

Example 1:

Find the partial derivative of $F(x,y)=4-x^2-2y^2$ with respect to x at the point $(1,1)$ and visualize it.

Practice Problems:

1) Find the partial derivatives of $F(x,y)=\sin\left(x/(1+y)\right)$ with respect to x at the point (1, 2).
2) Find the partial derivatives of $F(x,y)=x^3+y^3+6xy-1$ with respect to y at the point (1, 1).