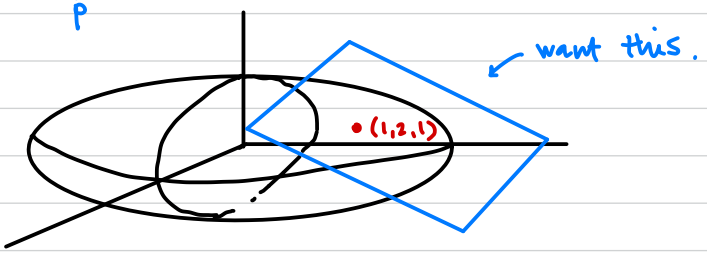
Ex Tangent plane to ellipsoid.

$F(x,y,z)$

$$3x^2 + y^2 + 4z^2 = 11$$

✓ on surface.

at $(1,2,1)$? $\bar{p}$



$\bar{n} = \nabla F(\bar{p})$

$\nabla F(x,y,z) = (6x, 2y, 8z)$

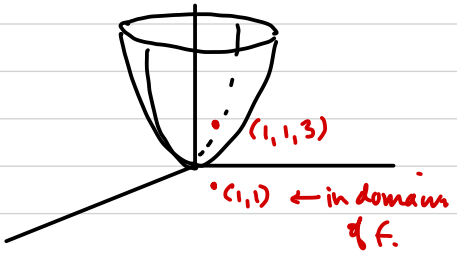
$\nabla F(1,2,1) = (6,4,8)$

Plane: $(6,4,8) \cdot (x-1, y-2, z-1) = 0$

$6x + 4y + 8z = 22.$

Ex Tangent plane to graph of $f(x,y) = x^2 + 2y^2$ at $(1,1,3)$?

$$z = x^2 + 2y^2$$



Think of this as a level surface:

$$F(x,y,z) = x^2 + 2y^2 - z = 0 \quad (= k)$$

$$\nabla F(x,y,z) = (2x, 4y, -1) \quad (f_x, f_y)$$

F_x F_y F_z

$$\nabla F(1,1,3) = (2, 4, -1)$$

plane: $(2,4,-1)\cdot(x-1, y-1, z-3) = 0$

$$2x + 4y - z = 3$$