$\langle 2,1\rangle \quad (0,0)$

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Exercise 1. Is the gradient of $f(x,y) = \sqrt{1+2x^2+y^2}$ orthogonal to it's level curve through $(1,1)$?

$$f_x(x,y) = \frac{(1+2x^2+y^2)^{-1/2}}{2}(4x) = \frac{2x}{\sqrt{1+2x^2+y^2}}$$

$$f_y(x,y) = \frac{(1+2x^2+y^2)^{-1/2}}{2}(2y) = \frac{y}{\sqrt{1+2x^2+y^2}}$$

$$\nabla f = \left\langle \frac{2x}{\sqrt{1+2x^2+y^2}}, \frac{y}{\sqrt{1+2x^2+y^2}} \right\rangle \quad (1,1) \quad N=\langle 2,1\rangle$$

$$\nabla f(1,1) = \left\langle \frac{2(1)}{\sqrt{1+2(1)+1}}, \frac{1}{\sqrt{1+2(1)+1}} \right\rangle = \left\langle \frac{2}{2}, \frac{1}{2} \right\rangle$$

$$\nabla f(1,1)\langle 1, 1/2\rangle \cdot \vec{u} = 0$$

$$1a + 1/2\, b = 0$$

$$\sqrt{a^2+(2a)^2} = 1 \quad \vec{u} = \left\langle \frac{1}{\sqrt{3}}, \frac{-2}{\sqrt{3}} \right\rangle \quad a = 1/2\, b$$

$3a^2$

$a\sqrt{2} = 1$

$a = 1/\sqrt{3}$

$$2 = \sqrt{1+2x^2+y^2} = 4 = 1+2x^2+y^2 \quad 3 = 2x^2+y^2$$

$$\frac{-4x}{2y} = \frac{2x}{y} = 1/1 = -2$$

$$\boxed{\vec{v} = \langle 1,-2\rangle}$$

So is orthogonal

Exercise 2. Find the equation of the plane tangent to the surface $F(x,y,z) = \frac{x^2}{9} + \frac{y^2}{25} + z^2 - 1 = 0$ at the point $P_0(0, 4, \frac{3}{5})$.

$F_y = \frac{2x}{9}$ at $P_0 = 0(x-0)$

$F_y = \frac{2y}{25}$ at $P_0 = 8/25(y-4)$

$F_z = 2z$ at $P_0 = 6/5(z - 3/5)$

The plane: $0(x-0) + 8/25(y-4) + 6/5(z - 3/5) = 0$

X,Y Z=0 X,Z Y=0 Y,Z X=0