

§14.4 Tangent Lines & Planes

Recall any of the following could be used to describe a line in \mathbb{R}^2 :

$$y = mx + b \quad ax + by = c$$

$$y - y_1 = m(x - x_1).$$

Recall any of the following could be used to describe a plane in \mathbb{R}^3 :

$$\vec{n} \cdot (\langle x, y \rangle - \langle x_1, y_1 \rangle) \quad ax + by + cz = d$$

$$z - z_1 = m_x(x - x_1) + m_y(y - y_1).$$

Consider an example of my favorite type of differential calculus question:

1. Find the line tangent to the graph of $f(x) = 2x^2$ when $x=1$.

1. Find the plane tangent to the graph of $f(x, y) = 2x^2 + y^2$ when $x = 1$ and $y = 1$.

2. Find the local linearization of f when $x = 1$.

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3. Use the linearization of f at $(1, 2)$ to approximate $f(1.1)$.

3. Use the linearization of f at $(1, 1, 3)$ to approximate $f(1.1, 1.1)$.

4. How good is the approximation above? That is, what is the difference between your approximation above, and the actual value $f(1.1)$.

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§14.6 Directional Derivatives

1. Let $f(x, y) = x + e^y$.

(a) Find ∇f

(b) Find $D_{\vec{u}}f(1, 1)$ where $\vec{u} = \langle 1, -1 \rangle$.

(c) Find $D_{\vec{u}}f(1, 1)$ where $\vec{u} = \vec{i} + 2\vec{j}$.