

$$1. \quad \blacksquare f(x, y) = \frac{x}{x^2+y^2}$$

$$\blacksquare P = (1, 2)$$

$$\blacksquare v = (3, 5)$$

$$u = \frac{v}{\|v\|} = \left(\frac{3}{\sqrt{34}}, \frac{5}{\sqrt{34}} \right)$$

$$\nabla f(x, y) = (f_x, f_y)$$

$$f_x = \frac{x^2+y^2-2x^2}{(x^2+y^2)^2} = \frac{y^2-x^2}{(x^2+y^2)^2}$$

$$f_y = \frac{\partial(x \cdot \frac{1}{x^2+y^2})}{\partial y} =$$

$$x \cdot \frac{-2y}{(x^2+y^2)^2} =$$

$$\frac{-2xy}{(x^2+y^2)^2}$$

$$Df_u(1, 2) = \nabla f(1, 2) \cdot u$$

$$\nabla f(1, 2) = \left(\frac{1}{25}, \frac{-4}{25} \right)$$

$$Df_u(1, 2) = \left(\frac{1}{25}, \frac{-4}{25} \right) \cdot \left(\frac{3}{\sqrt{34}}, \frac{5}{\sqrt{34}} \right) =$$

$$\frac{1}{25} \cdot \frac{3}{\sqrt{34}} + \frac{-4}{25} \cdot \frac{5}{\sqrt{34}}$$

$$2. \quad \blacksquare f(x, y, z) = xe^y + ye^z + ze^x$$

$$\blacksquare P = (0, 0, 0)$$

$$\blacksquare v = (5, 1, -2)$$

$$Df_u(0, 0, 0) = \nabla f(0, 0, 0) \cdot u$$

$$u = \frac{v}{\|v\|} = \frac{(5, 1, -2)}{\sqrt{30}} = \left(\frac{5}{\sqrt{30}}, \frac{1}{\sqrt{30}}, \frac{-2}{\sqrt{30}} \right)$$

$$\nabla f(0, 0, 0) = (f_x, f_y)$$

$$f_x = e^y + ze^x$$

$$f_y = e^z + xe^y$$

$$\nabla f(0, 0, 0) = (1, 1)$$

$$Df_u(0, 0, 0) = (1, 1) \cdot \left(\frac{5}{\sqrt{30}}, \frac{1}{\sqrt{30}}, \frac{-2}{\sqrt{30}} \right) = \left(\frac{5}{\sqrt{30}}, \frac{1}{\sqrt{30}}, \frac{-2}{\sqrt{30}} \right)$$