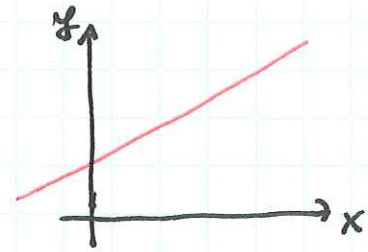
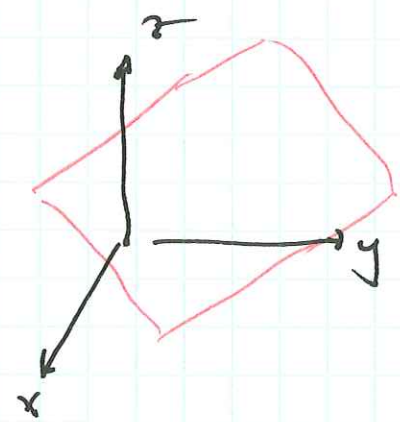
$Ax + By = C$ Eq'n of line



$By = C - Ax$

$y = \frac{C}{B} - \frac{A}{B}x$ Linear function

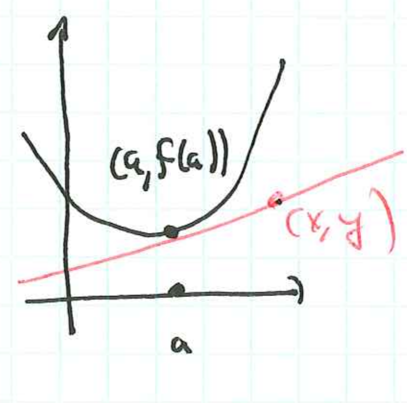
Eq'n of plane $ax + by + cz = d$



$cz = d - ax - by$

Linear function $z = \frac{d}{c} - \frac{a}{c}x - \frac{b}{c}y$

Tgt line



$(y - f(a)) = f'(a)(x-a)$

$y = f(a) + f'(a)(x-a)$

Ex: $f(x) = x^2$ $a = 2$ $f'(x) = 2x$ $f'(2) = 4$

$L(x) = 2^2 + 4(x-2)$

$= 4 + 4(x-2)$

$z = 2x^2 + y^2 - 5y$

(graph of $f(x,y) = 2x^2 + y^2 - 5y$)

will need!

$f_x(1,2) = 4$ $\qquad$ $f_y(1,2) = -1$

$f(1,2) = -4$

First find partial derivatives:

$f_x(x,y) = 4x$ $\qquad$ $f_y(x,y) = 2y - 5$

Linear approx to f at (a,b):

$$L(x,y) = f(a,b) + f_x(a,b)(x-a) + f_y(a,b)(y-b)$$

Eq of tgt plane:

$$z = f(a,b) + f_x(a,b)(x-a) + f_y(a,b)(y-b)$$

$$z = -4 + 4(x-1) + (-1)(y-2)$$

$f(x,y) = x^2 + y^2$

$(a,b) = (1,3)$

$f_x(x,y) = 2x$ $\quad$ $\cancel{f_y(2y)} = f_y(x,y) = 2y$

$f_x(1,3) = 2$ $\quad$ $f_y(1,3) = 6$

$f(1,3) = 1^2 + 3^2 = 10$

$$\boxed{L(x,y) = 10 + 2(x-1) + 6(y-3)}$$

$z = 10 + 2(x-1) + 6(y-3)$

$z = 10 + 2x + 6y - 18 - 2$

$z = -10 + 2x + 6y$

$$\boxed{-2x - 6y + z = -10}$$

② $f(x,y) = e^{x-y}$

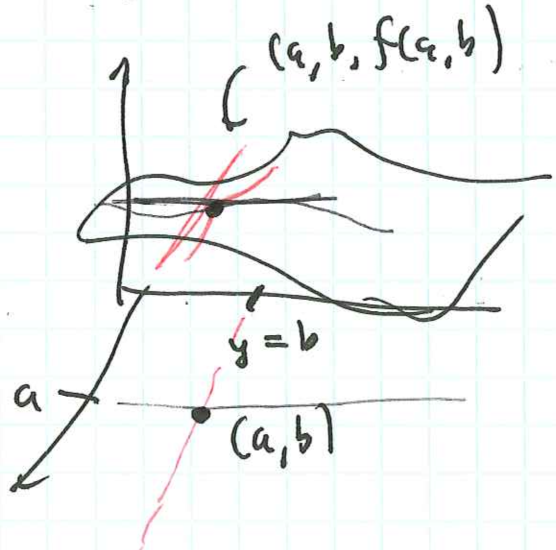
$f(2,2) = e^{2-2} = e^0 = 1$

$f_x(x,y) = e^{x-y}$ $\qquad$ $f_y(x,y) = -e^{x-y}$

$f_x(2,2) = e^0 = 1$ $\qquad$ $f_y(2,2) = -e^0 = -1$

$$z = 1 + (1)(x-2) + (-1)(y-2)$$

$f_x(a,b)$ = slope of the tgt to the graph of $f(x,b)$ at $x=a$



Find $L(x,y)$: linear approx to $f(x,y)$ at $(x,y) = (a,b)$:

1) Compute $f_x(x,y)$, $f_y(x,y)$

2) Evaluate $f_x(a,b)$, $f_y(a,b)$;

3) Evaluate $f(a,b)$

4) $L(x,y) = f(a,b) + f_x(a,b)(x-a) + f_y(a,b)(y-b)$

$f(x,y) = e^x \cos(xy)$

$f_x(x,y) = e^x \cos(xy) + -e^x \sin(xy) \cdot y$

$f_y(x,y) = -e^x\, x \cos(xy)$

$f_x(0,0) = 1$ $\qquad$ $f(0,0) = 1$

$f_y(0,0) = 0$

$L(x,y) = 1 + (1)(x-0) + 0 \cdot (y-0)$

$= 1 + x$

$f(2,5) = 6$

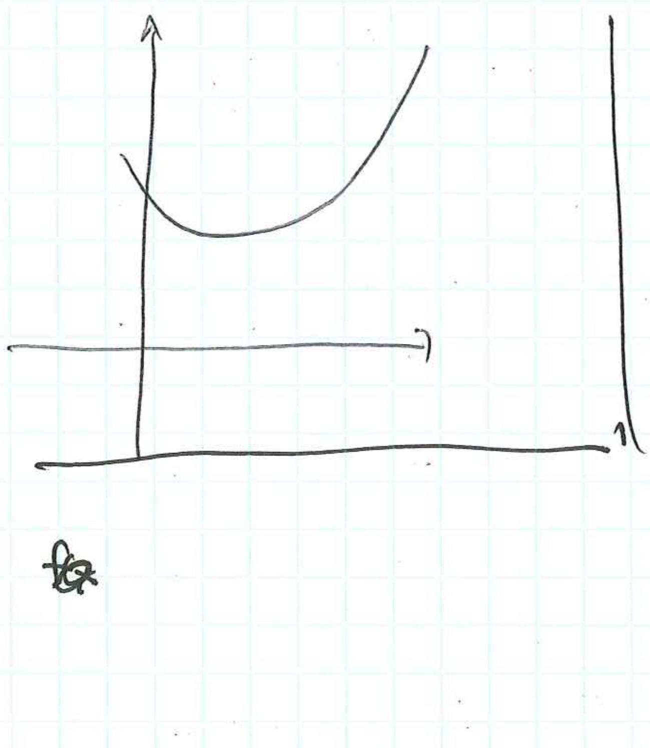
$f_x(2,5) = 1$

$f_y(2,5) = -1$

$L(x,y) = 6 + 1\,(x-2) + (-1)(y-5)$

$f(2.2, 4.9) \simeq L(2.2, 4.9)$

$= 6 + 1\cdot(0.2) + (-1)(-0.1)$



$f(x,y) = \sqrt{xy}$

$f_x(x,y) = \frac{1}{2}x^{-\frac{1}{2}}\cdot y^{\frac{1}{2}}$

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

$f(x,y) = x^{\frac{1}{2}}\cdot y^{\frac{1}{2}}$

~~fx~~

$\boxed{\text{IOU}}$!

$$f(x,y) = \frac{xy}{x^2+y^2}$$

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

$$= \frac{x^2y + y^3 - 2x^2y}{(x^2+y^2)^2}$$

$$f_y(x,y) = \frac{y^2x + x^3 - 2xy^2}{(x^2+y^2)^2}$$

$$f_x(0,0) = \lim_{h \to 0} \frac{f(h,0) - f(0,0)}{h}$$

$$= 0$$

$$f_y(0,0) = 0$$

$$A = \pi r^2$$

$$dA = 2\pi r \, dr$$

$$r = 10\,cm \qquad dr = 0.2\,cm$$

$$\Delta A = 2\pi (10\,cm)(0.2\,cm)$$

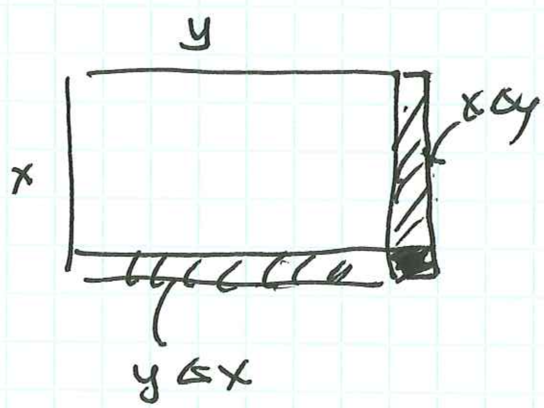
$$= 4\pi\, cm^2$$

$$A(x,y) = xy$$

$$dA = \frac{\partial A}{\partial x} \cdot dx + \frac{\partial A}{\partial y} \cdot dy$$

$$= y\,dx + x\,dy$$

$x = 30 \quad y = \cancel{40}\ 24$



$\Delta x = \Delta y = 0.1$ cm

$$\Delta A = 24 \cdot (0.1) + 30\,(0.1)$$

$$= 2.4 + 3 = 5.4\, cm^2$$