For more on partial derivatives, see section 14.3.

1) Calculate the following partial derivatives:

$$\frac{\partial}{\partial x}(3x-y+4) \qquad \frac{\partial}{\partial y}(3x-y+4)$$

$$\frac{\partial}{\partial x}\left(\frac{x^2}{y}+ln(1+x^2y^2)\right) \qquad \frac{\partial}{\partial y}\left(cos(y\,e^{-xy}\right)$$

$$\frac{\partial}{\partial x}\left(\frac{\partial}{\partial x}(x^3y+xy)\right) \qquad \frac{\partial}{\partial y}\left(\frac{\partial}{\partial x}(x^3y+xy)\right)$$

2) Find the tangent plane to

$$g(x,y)=xy^2+sin(\pi\sqrt{x})$$

at the point $(4,1)$. Use this to approximate $g(1.01,1.99)$

3) Find $\frac{\partial}{\partial x}f$ and $\frac{\partial}{\partial y}f$ at $(0,0)$ where

$$f(x,y)=\begin{cases} 0 & |y|\geq x^2 \\ (x^2-y)^2 & |y|\leq x^2 \end{cases}$$

4) You are given a function $w=h(x,y,z)$. Explain, using the definitions, what $\frac{\partial h}{\partial z}$ should mean at $(1,2,-1)$. (For instance what slope?).

5) Suppose that $f(x,y)$ is differentiable at (a,b). If $f(a,b)\geq f(x,y)$ (local max) for all (x,y) in an open neighborhood of (a,b), explain why the both partial derivatices of $f(x,y)$ must vanish at (a,b).