1. Find the partial derivatives

   (a) f_x and f_y if $f(x,y) = 5x^2y^3 + 8xy^2 - 3x^2$
   (b) $\frac{\partial}{\partial y}(3x^5y^7 - 32x^4y^3 + 5xy)$
   (c) $\frac{\partial}{\partial x}(y\sqrt{x})$
   (d) F_v if $F = \frac{mv^2}{2}$
   (e) $\frac{\partial}{\partial x}\left(\frac{1}{\sqrt{2\pi}\sigma}e^{-(x-\mu)^2/(2\sigma^2)}\right)$
   (f) $\frac{\partial m}{\partial v}$ if $m = \frac{m_0}{\sqrt{1-v^2/c^2}}$
   (g) g_x if $g(x,y) = \ln(ye^{xy})$
   (h) $\frac{\partial z}{\partial y}|_{(1,0,5)}$ if $z = e^{x+2y}\sin y$
   (i) $\frac{\partial f}{\partial x}|_{(\pi/3,1)}$ if $f(x,y) = x\ln(y\cos x)$

2. Find the equation for the tangent plane to the following surfaces at given points

   (a) the surface $z = \sqrt{9 - x^2 - y^2}$, the point $(x_0, y_0, z_0) = (\sqrt{2}, -\sqrt{3}, 2)$
   (b) the surface $z = x^y$, the point $(x_0, y_0, z_0) = (2, 4, 16)$
   (c) the surface $z = \frac{arcsinx}{arccosy}$, the point $(x_0, y_0, z_0) = (-\frac{1}{2}, \frac{\sqrt{3}}{2}, -1)$

3. Compute the approximation of the following expressions

   (a) $\frac{arctg0.9}{sqrt4.02}$ (b) $\frac{0.98^{1.01}}{1.01^{2.01}}$

4. Calculate the directional derivative of $f(x,y) = x^2 + y^2$ at $(1,0)$ in the direction of the vector $\vec{v} = [1,1]$.

   (a) $f(x,y) = x^2 + xy + 3y - 1$ at $(x_0, y_0) = (1,1)$, in the direction of the vector $\vec{v} = [2,1]$
   (b) $f(x,y) = \sqrt[3]{xy^2}$ at $(x_0, y_0) = (0,0)$ in the direction of the vector $\vec{v} = [\frac{\sqrt{2}}{2}, \frac{\sqrt{2}}{2}]$
   (c) $f(x,y) = x^2 - y^2$ at $(x_0, y_0) = (-3,3)$ in the direction of the vector $\vec{v} = [\frac{12}{13}, \frac{5}{13}]$
   (d) $f(x,y) = \sin x \cos y$ at $(x_0, y_0) = (0, \pi)$ in the direction of the vector $\vec{v} = [-\frac{1}{2}, \frac{\sqrt{3}}{2}]$

5. Compute the four second-order partial derivatives of the following functions

   (a) $f(x,y) = x^2y^3 - x\sin y$,
   (b) $f(x,y) = x\sqrt{y} - e^z \ln y$,
   (c) $f(x,y) = (\sin x)^{\ln y}$,
   (d) $u(x,y) = f(3xy, y^2x, x)$,
   (e) $f(u,v) = e^{uv}$, gdzie $u = \ln x^2 + y^2$, $v = \operatorname{arc\,tg}(\frac{y}{x})$
   (f) $f(u,v) = \ln\frac{u}{v+1}$, gdzie $u = x\sin y$, $v = x\cos y$
   (g) $f(x,y) = xy^2z^3 - y\sin z$
   (h) $f(x,y) = x^y$, $x > 0$,
   (i) $f(x,y) = xy\ln(x^2 + y^2)$
   (j) $u(x,y,z) = f(z, xz^2, y)$

6. Compute

   (a) $\frac{\partial^5 f}{\partial x \partial y^4}$, for $f(x,y) = xe^{-y}$
   (b) $\frac{\partial^5 f}{\partial z^2 \partial x \partial y}$, for $f(x,y,z) = \ln(x^2 + 2y - z)$

7. Find the Taylor polynomials about (x_0, y_0) for the following functions

   (a) $f(x,y) = \sin^2(x+y)$, $(x_0, y_0) = (\pi, \pi)$, $n = 2$
   (b) $f(x,y) = -x^2 + +2xy + 3y^2 - 6x - 2y - 4$, $(x_0, y_0) = (-2, 1)$, $n = 3$
   (c) $f(x,y) = \sin(x^2 + y^2)$, $(x_0, y_0) = (0,0)$, $n = 3$
   (d) $f(x,y) = \sin(x)e^{2y}$, $(x_0, y_0) = (0,0)$, $n = 3$

8. Find the Jacobian matrix (A- matrix) for the following functions

   (a) $f(x,y) = (xy^2, 2x + y^2, 3xy)$
   (b) $f(x,y) = x^4y^2$
   (c) $f(x,y) = (xy^2, 2x + y^2, 3xy)$