3. Find a vector of length 2 which is perpendicular to both
$$(1,1,1) \text{ amd } (2,1,2).$$

4. Find the equation of the plane through the point

(1,2,3)   which is parallel to the plane $2x - y + z = 1$.

5. Show that if the vectors $\vec{v} = (a_1, a_2)$ and $\vec{w} = (b_1, b_2)$ have the same length, then the vectors
$$\vec{v} + \vec{w} \text{ and } \vec{v} - \vec{w}$$
are perpendicular to one another.

1. Find the partial derivatives of the function
$$f(x, y, z) = \sin(xy) - (xy - yz)^3$$

2. Find the equation of the tangent plane to the graph of the function
$$f(x, y) = x^2 - 2xy - y^3$$
at the point (2,1,-1).

3. Find the rate of change of the function $f(x, y, z) = xy - yz + xz$, in the direction of the vector $(1/3, 2/3, -2/3)$, at the point (2,1,-2). In what direction is the function f increasing the fastest, at the point (2,1,-2)?

1. (20 pts.) Find the equation of the plane passing through the points
$$(1,1,1), (3,1,2), \text{ and } (-1,2,1)$$

2. (20 pts.) Sketch the level curves of the function
$$f(x, y) = 2y + x^3 - 1$$
In what direction is f increasing the fastest at the point (2,5) ?

3. Find the partial derivatives of the following functions:

(a) (5 pts.) $f(x, y) = (x + 2y) \cos(xy)$

(b) (5 pts.) $g(u, v) = \dfrac{u^2 v - 3u + 1}{u - v}$

4. (25 pts.) Find the directional derivative of the function
$$f(x, y, z) = x^2 z - 3yz^3 + 2y - 1$$
along the vector $\mathbf{v} = (1,-1,2)$, at the point $\mathbf{x_0} = (1,0,2)$.

Find the equation of the plane tangent to the level surface of f passing through the point $\mathbf{x_0}$ above.

5. (15 pts.) Calculate the first and second partial derivatives of the function
$$\frac{\sin(x + y)}{y}$$