MATH 249

Today

1. 14.6 The Directional Derivative (Understand how to interpret and compute directional derivatives. Solve problems involving the directional derivative.)

2. WeBWorK

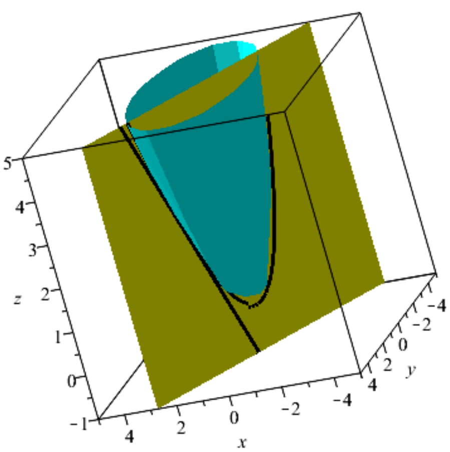
14.6 Directional Derivatives

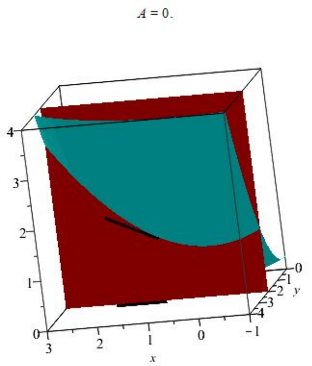
1. The **directional derivative** of f at (x_0, y_0) in the direction of the **unit vector** $\vec{u} =< a, b >$ is

$$D_u f(x_0, y_0) = \lim_{h \to 0} \frac{f(x_0 + ha, y_0 + hb) - f(x_0, y_0)}{h},$$

provided the limit exists.

2. If f is differentiable, then $D_u f(x, y) = f_x(x, y)a + f_y(x, y)b = \boxed{\nabla f(x, y) \cdot \vec{u}}$.





[See also Maple file 14-06 for other views.]

3. $\nabla f =< f_x, f_y >$ is the **gradient** of f.

4. $\nabla f(a, b)$ gives the (compass) direction of greatest increase of f at (a, b).

5. $|\nabla f(a, b)|$ is the maximum slope of f at (a, b).

6. ∇f is orthogonal to level curves/surfaces. (If f is a function of three variables, this means that $\nabla f(a, b, c)$ is the normal to the tangent plane to $f(a, b, c) = C$.)

7. The **normal line** to the graph of f at (a, b) is the line through $(a, b, f(a, b))$ perpendicular to the tangent plane to f at (a, b).

8. Examples p. : #6, 13, 22, 36, 38, 43, 52

9. WeBWorK: 6, 16

Next Time

1. Watch 14.7a [$\sim$ 49 minutes]

2. Homefun/Python