## **Gradient and Directional Derivatives**

## Reading

Sections 15.5

## **Problems**

- Practice Problems 15.5: 1, 2, 5, 9, 13, 17, 23, 31, 35
- Problems to turn in 15.5: 6, 10, 24, 32, 36

## Topics to know

- 1. Definition of gradient vector
- 2. Draw gradient vectors for a function like  $f(x,y) = x^2 + y^2$
- 3. Algebraic properties of gradient (theorem 1)
- 4. Chain rule for gradients: F(f(x, y, z))
- **5.** Chain rule for paths:  $f(\vec{c}(t))$ ,  $\vec{c}(t) = \langle x(t), y(t), z(t) \rangle$
- 6. Proof of the chain rule for paths (page 821)
- 7. Gradient is perpendicular to level curves
- 8. Definition of directional derivative along the direction of a unit vector
- 9. Directional derivative formula via gradient
- 10. Directional derivative related to the angle between vector and gradient (theorem 4)
- 11. Consequences of theorem 4