

Directional Derivatives

GROUP MEMBERS:

1. _____
2. _____
3. _____
4. _____

Goal: To calculate the rate of change of temperature $T(x,y) = x^2 + y^2$ degrees C as you move from the point $p = (2,3)$ in the direction given by the vector $u = \left(\frac{\sqrt{3}}{2}, \frac{1}{2}\right)$. The units for position are meters.

Person 1: Make an xy plane and draw the point p.

Person 2: At the point p, draw the vector u (in the above picture).

Person 3: What angle does the vector u make with the horizontal axis?

We now wish to calculate $D_u T$ = rate of change of temperature as we move in the u direction and evaluate this derivative at the point $p = (2,3)$.

Person 4: For $T(x, y) = x^2 + y^2$ degrees C, and $x(t) = 2 + \frac{\sqrt{3}}{2}t, y(t) = 3 + \frac{1}{2}t$ and time is in seconds.

Calculate $\frac{\partial T}{\partial t}$ using the chain rule.

Person 1: Evaluate $\frac{\partial T}{\partial t}$ at the point $p = (x=2, y=3)$.

Person 2: What are the units for $\frac{\partial T}{\partial t}$?

Person 3: Calculate the speed of motion = magnitude of the velocity vector = $|(x'(t), y'(t))|$.
What are the units for velocity in this problem?

Person 4: Combine the last two answers to figure out the rate of change of temperature as the position changes. Your answer should have units of degrees C/ meter. This number is the value of $D_u T$.