MATH 253 – WORKSHEET 13
DIRECTIONAL DERIVATIVES

(1) In each case find $\vec{\nabla} f$ and $D_{\vec{u}} f$ at the given point.

(a) $f(x, y) = xe^y$, at $(1, 0)$ in the direction $\vec{u} = \left\langle \frac{3}{5}, -\frac{4}{5} \right\rangle$.

(b) $f(x, y, z) = x^2 + y^2 + z^2$ at $(1, 2, 3)$ in the direction $\vec{u} = \left\langle -\frac{6}{11}, \frac{7}{11}, \frac{6}{11} \right\rangle$.

(c) $f(x, y) = \sqrt{x^2 + y^2} + e^x$ at $(1, 1)$ in the direction making an angle $\frac{\pi}{4}$ to the horizontal.

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(2) You are driving your car towards the northeast at 72km/h along a terrain whose elevation at the point (x, y) is $\frac{1}{8+x^2+y^2}$ (all distances are measured in kilometres). What is your rate of ascent/descent when your car is at the location $(1, 1)$? What about if the location was $(1, -1)$?

(3) An ant is crawling along the curve $y = x^2$ at the rate of $v$cm/s (distances are measured in cm). The temperature in the xy plane is varying according to $T(x, y) = \frac{y}{1+x^2}$. What is the rate of change of the temperature the ant sees when it is located at (x, y)?