mean-value theorem for several variables

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The mean-value theorem for a function of one real variable may be generalised for functions of arbitrarily many real variables; for the sake of concreteness, we here formulate it for the case of three variables:

Theorem. If a function $f(x, y, z)$ is continuously differentiable in an open set of $\mathbb{R}^3$ containing the points (x_1, y_1, z_1) and (x_2, y_2, z_2) and the line segment connecting them, then an equation

$$f(x_2, y_2, z_2) - f(x_1, y_1, z_1) = f_x'(a, b, c)(x_2 - x_1) + f_y'(a, b, c)(y_2 - y_1) + f_z'(a, b, c)(z_2 - z_1),$$

where (a, b, c) an interior point of the line segment, is .