1. Find the points on the cone $z^2 = x^2 + y^2$ that are closest to the point $(1, 1, 0)$.

(a) **Solution:** The distance from a point $(x, y, z)$ on the cone to the point $(1, 1, 0)$ is

\[(x - 1)^2 + (y - 1)^2 + z^2 = (x - 1)^2 + (y - 1)^2 + (x^2 + y^2)\]

Thus we can write this distance as a function of $x$ and $y$:

\[f(x, y) = (x - 1)^2 + (y - 1)^2 + (x^2 + y^2) = 2x^2 + 2y^2 - 2x - 2y + 2\]

The critical point of $f$ can be found by solving $f_x = 0, f_y = 0$, which gives $x = 1/2$ and $y = 1/2$. By geometric consideration, we can see that $(1/2, 1/2)$ does indeed give the minimum distance.