Problem 1. *Consider the real valued function* $f(x,y,z) = (2-(x^2+y^2)^{1/2})^2+z^2$ *on* $\mathbb{R}^3\setminus\{(0,0,z)\}$. *Show that* 1 *is a regular value of* f. *Identify the manifold* $M = f^{-1}(1)$.

Proof. □

Problem 2. *Show that the manifold* M *of Problem 1 is transverse to the surface*

$$N = \{(x,y,z) \in \mathbb{R}^3 | x^2 + y^2 = 4\}$$

Identify the manifold $M \cap N$.

Proof. □

Problem 3. *Show that the manifold* M *of Problem 1 is not transverse to the surface*

$$N = \{(x,y,z) \in \mathbb{R}^3 | x^2 + y^2 = 1\}$$

Is $M \cap N$ *a manifold?*

Proof. □