1. (a) Suppose that $A : \mathbb{R}^k \to \mathbb{R}^n$ is a linear map and $V$ is a vector subspace of $\mathbb{R}^n$. Check that $A \cap V$ is equivalent to $A(\mathbb{R}^k) + V = \mathbb{R}^n$.

(b) If $V$ and $W$ are linear subspaces of $\mathbb{R}^n$, check that $V \cap W$ is equivalent to $V + W = \mathbb{R}^n$.

2. For which values of $R$ does the hyperboloid defined by $x^2 + y^2 - z^2 = 1$ intersect the sphere $x^2 + y^2 + z^2 = R$ transversely? What does the intersection look like for different values of $R$?

3. (Lee Second 6-9) Let $F : \mathbb{R}^2 \to \mathbb{R}^3$ be the map defined by

$$F(x, y) = (e^y \cos x, e^y \sin x, e^{-y}).$$

(a) For which positive numbers $r$ is $F$ transverse to the 2-sphere of radius $r$, $S_r(0) \subset \mathbb{R}^3$?

(b) For which positive numbers $r$ is $F^{-1}(S_r(0))$ an embedded submanifold of $\mathbb{R}^2$?

* Which problems provided a worthwhile learning experience? How many hours did you spend on it?