Math 214 HW#3, due 2/19/13 at 2:10 PM

1. Lee 4.6.

2. Lee 4.13.

3. Lee 5.1.

4. The *zero section* of the tangent bundle TM is the set of zero tangent vectors,

$$Z = \{(p, 0)\} \subset TM = \{(p, V) \mid p \in M, V \in T_pM\}.$$

   (a) Show that Z is a submanifold of TM which is diffeomorphic to M.

   (b) Show that if $(p, 0) \in Z$, then there is a canonical (not depending on a choice of coordinates) isomorphism

$$T_{(p,0)}TM = T_pM \oplus T_pM.$$

5. The *Hopf fibration* is the map $f : S^3 \to \mathbb{C}P^1$ sending $(z^1, z^2) \in \mathbb{C}^2$ with $(z^1)^2 + (z^2)^2 = 1$ to $[z^1 : z^2] \in \mathbb{C}P^1$. Show that the Hopf fibration is a submersion.

6. How difficult was this assignment?