Turn in the homework by 11:00am in lecture on Monday. Late homework will not be accepted.

1. Exercise 3.7 on p. 56 in Lee.
2. Problem 3-1 on p. 75 in Lee.
3. Problem 3-3 on p. 75 in Lee.
4. Exercise 3-5 on p. 75 in Lee.
5. Exercise 3-8 on p. 76 in Lee.
6. Exercise 8.29 on p. 188 in Lee.
11. Exercise 9.5 on p. 208 in Lee.

16. Let $M$ be a smooth manifold, and let $X, Y \in \mathfrak{X}(M)$ be smooth vector fields. Complete the following simpler proof that the Lie derivative $\mathcal{L}_Y(X) = [Y, X]$. Let $\theta$ be the flow of $Y$, and for fixed $p \in M$ and all sufficiently small $s, t \in \mathbb{R}$, define

$$\alpha(s, t) = X_{\theta_s(p)}(f \circ \theta_{-t}).$$

Note that $\alpha$ is a map from an open set in $\mathbb{R}^2$ into $\mathbb{R}$. Show that

$$\frac{\partial \alpha}{\partial s}(0, 0) = -X_p(Y f), \quad \frac{\partial \alpha}{\partial t}(0, 0) = Y_p(X f).$$

Now calculate $\frac{d}{dt}|_{t=0} \alpha(t, t)$ to complete the proof.