Intro to Lecture 4 (Sept. 16, 2016)

Last time we explored derivatives of scalar and vector fields and how to integrate them over suitable subspaces, using Cartesian coordinates. We also mentioned that other coordinate systems were often more useful, and earlier we had investigated just one case, the gradient in cylindrical polar coordinates. We noted that we will want to describe our vector fields using basis vectors aligned with our coordinates, and we found that the form of the derivative operators underwent modifications when we did that. We will want to do the same more generally, for the other derivative operators and for other coordinate systems.

First we will discuss more formally the transformations on vector spaces. Last time we just began discussing vector spaces and their bases. Today we will start with linear transformations, matrices, and their rank. We will discuss norms and inner product spaces, dual spaces, and morphisms. Most of this you have seen before, but I will perhaps be a bit more formal, and throw in some interesting tidbits about complications when the space is infinite-dimensional, which may well be new for you.

Then, either today or next time, we will begin our discussion using the concepts of differential geometry, manifolds, forms, and the like.

Reminder: Homework 1 is due on Monday