Intro to Lecture 5 (Sept 21, 2016)

By now we have reviewed vector spaces, and also differential operators and integration in terms of cartesian coordinates. A lot of this course involves the differential equations in flat three dimensional space, using the more general orthogonal curvilinear coordinates, of which spherical and cylindrical polar are examples. We could do this simply by changing bases. But we will take a broader approach, first discussing manifolds, which is the general way to discuss differentiable fields in general spaces. Then we will specialize to three dimensional Euclidean space and orthogonal coordinates for most of our applications, but we will have laid the groundwork for general relativity, Lie groups, gauge field theories, and other exciting applications of high-brow mathematics to physics.

Differentiable manifolds are curved spaces viewed by themselves, rather than as necessarily embedded in a larger Euclidean space. We need to learn how to parameterize points in the space, and define directional objects, such as vectors. This brings us charts and atlases, geodesics, metric tensors, co- and contra-variance, n-forms, and the generalized Stokes' theorem.

Let's get started.

Note: Homework #2 due Monday at 5:00 PM in my mailbox or office. Be on time!