Preface

It has been said that the great Hebrew philosopher and scholar Hillel was once confronted by the village smart-aleck who demanded of him: "A one sentence summary of all that exists in the sacred Talmud." According to legend after a moment's thought Hillel replied with: "Don't do unto others what you would not have them do unto you. All else is just commentary."

Without suggesting any flattering or unflattering comparisons I mention that throughout a long teaching career I have been asked by students and post-docs for a lecture or two on elements of: linear algebra; fourier analysis: dynamical systems and a vast number of other general and specific topics. To my best recollection I have, within the bounds of a busy life complied with these requests. An abiding lesson learned from these little experiments was that by replacing mathematical rigor with intuition, common sense and a geometrical perspective a great many mathematical concepts could be presented in a short period of time, as in what I deem to be a respectable manner. This is the premise of the lectures presented here.

It is my fear that these notes will be regarded as superficial, however I have endeavored mightily to show the students both the inner workings of the topics and the interplay of what I deemed to be the important topics for scientists wishing to leverage their research through mathematics, but in truth time constraints prevented plumbing the depths. My other fear is that the purists will accuse me of sullying the temple. Outside of family I regard mathematics as the most enriching part of my life, and in no way do I feel that I have diminished the subject. It is my contention that all of mathematics, no matter how abstract and refined it may be, has its origins in simple human size ideas. This certainly was the slant of my Lectures.

The very full and bulging mathematical cupboard that now exists is being explored at a vociferous rate especially by an immense community of biomedical scientists of checkered mathematical background. Their experiments in using mathematics is largely confined to taking "programs " off the shelf without any real sense of the contents. This recipe has potential for later embarrassing consequences. Avoidance of such outcomes is another goal of the Lectures.

Within the stated loose bounds of *proof*, the material that is presented is largely self-contained, and that odious phrase "it can be shown" rarely makes an appearance. However, it must be said that only an

exceptionally apt and highly motivated novice might successfully emerge from this course. These twelve two hour lectures are a record of the course given in Fall 2007 at Mt. Sinai, and in Fall 2008 at the Courant Institute. The impact of the course was proportional to the degree of prior exposure to mathematics. Better prepared students rewarded me by saying that I had "put it all together for them". Thus far I have been encouraged by the experience, and am optimistic that the approach presented in these notes can play an important teaching role in traditional, as well as developing sciences.

The world has been transformed by the computer, and perhaps the mathematical landscape has been more profoundly altered than other terrains. Mathematics has never been an armchair endeavor, and the ability to gain experience and inspiration, conceptually as well as computationally, has been greatly enhanced by the computer. In general mathematical insight has been facilitated by the widespread availability of Matlab, a tool for mathematical investigation that is both powerful and congenial. It was my impression that students quickly fell under the spell of Matlab. Computation via Matlab is an integral component of these Lectures and permitted accomplishment of another premise of the present approach, namely that mathematical analysis, numerical analysis and downright computation should be developed in parallel.

Many of the illustrations, in these lectures arise from *Biology*, in its widest definition. However, this is not a course in *Biomathematics*, which in common practice conveys biology to a well trained mathematical audience. By contrast, it is the objective of this course to teach mathematics to biologists, and as a result some scientific sophistication is assumed.