CLUSTER 5 (Biophysics) GOALS

http://leopard.physics.ucdavis.edu/rts/cosmos/cosmos2012.html

What are the goals of the biophysics half of this cluster?

In your high school courses you may have been introduced to the idea of chemical reactions- how molecules $A, B, \cdots$ combine to form products $X, Y, \cdots$. You may even have learned rules for how the rate at which reactions occur depends on the concentration of the initial ingredients- roughly speaking the more $A, B, \cdots$ present, the faster $X, Y, \cdots$ get produced.

The specific objective of Cluster 5 is to examine this process in more detail and in particular to try to understand how biological molecules locate each other in a cell. Will they find each other rapidly enough if they simply randomly bump around inside the cell until they happen upon each other? Or do molecules need to be guided in some way to their destinations?

We will develop some answers to this question by writing computer programs which simulate the random walks that molecules take inside cells. After putting together initial programs we will be able to do 'numerical experiments' to generate data telling us, for example, whether molecules find each other more rapidly in long narrow cells or in more roundish environments. Alternately we can see how the size and shape of a molecule itself affect things.

This ultimate objective involves learning different things along the way.

- The linux operating system.
- Basics of cells/biological molecules.
- Random walks.
- Programming in C.
- Introduction to probability theory.
- Molecular motors.

Some of these intermediates involve generally useful skills: The 'gatekeeper' computer science course at UC Davis required for most engineering and science majors, for example, is a class in which students learn C and linux. Others involve concepts which appear in contexts other than biophysics. For instance, the diffusion and merger of defects which ultimately cause materials to break, the motion of electrons in solids which determine whether they are metals, insulators, or semiconductors, and many other situations, involve ideas of probability and random walks. Additionally, in learning C itself, we will write some 'warm-up' programs which illustrate interesting mathematics concepts. Examples include some which might already be familiar, like summing arithmetic and geometric series, and others which you probably have not encountered, like chaos in the logistic map. Many of the programming skills learned in the biophysics section will be carried over into the robotics section, and *vice-versa*.