DIGITAL PHYSICS 6.895

Digital Physics is a graduate subject for both computer science and physics students. 6.895 is about relations between concepts of physics and concepts of computer science. Physicists must occasionally be computer users and computer scientists are aware of the results of solid state physics, but so far there has been very little intellectual communication between the two fields. Digital Physics is an attempt to bridge that gap by presenting to students from both fields results obtained by applying the ideas from one field to some of the most basic open questions of the other field. What has emerged is a new way of looking at both areas, and a new area of research called Digital Physics. Underlying the research are speculations about modelling some microscopic physical events more accurately by digital compututation than by the mathematics of continuous variables and that computation might be a basic phenomenon that is governed by the laws of physics.

So far, some of the more startling results of research in Digital Physics include the discovery that there is no theoretical minimum to the energy that must be dissipated by a computation. This means that a computer might be built that uses no energy except when communicating. Another result is that there are simple digital versions of fundamental equations of physics, such as the Schrodinger equation or Newton's laws, that can operate without ever losing any information or accumulating any long term error. This is surprising because during a computation there are small errors (roundoff and truncation) and information seems to disappear, yet the overall computation conserves information.

As is indicated by the course description and the lecture outline, a great deal of material will be covered. There will be some reading, in the Feynman Lectures, Volume III, in Computation, Finite and Infinite Machines by Minsky and in the lecture notes. There will be a few problem sets and each student will be required to write one paper. 6.895 will meet on Tuesday, Thursday and Friday at 2:00 PM in 36-153