LSU EE 4702-1 **Homework 1** **Due: 6 September 2018**

Problem 0: Follow the instruction on the `https://www.ece.lsu.edu/koppel/gpup/proc.html` page for account setup and programming homework work flow. Compile and run the homework code unmodified. It should initially show a string of beads stretched out vertically and falling to a platform. Pressing `h` (head) will grab or release one end (to be precise, the ball at one end) and pressing `t` (tail) will grab or release the other end. (Actually, those keys toggle the fixed-in-space status of their respective balls.)

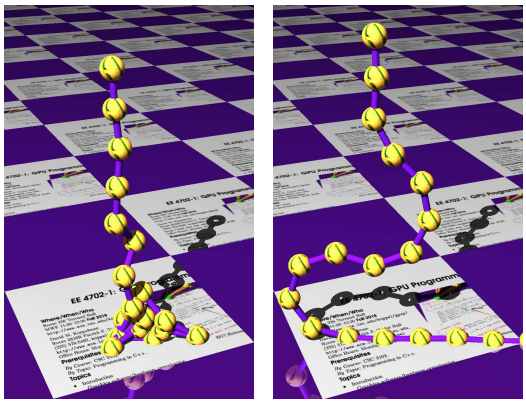
User Interface

Press digits `1` through `4` to initialize different scenes, the program starts with scene 1. Scene 1 starts with the balls arranged almost vertically, and they fall into a jumbled mess. Scene 2 starts with the balls arranged horizontally, and they will start swinging. Scenes 3 and 4 are initially similar to scene 1, they are to be modified for this assignment.

Press `Ctrl=` to increase the size of the green text and `Ctrl-` to decrease the size. Initially the arrow keys, PageUp, and PageDown can be used to move around the scene. Press (lower-case) `b` and then use the arrow and page keys to move the first ball around. Press `l` to move the light around and `e` to move the eye (which is what the arrow keys do when the program starts).

The `+` and `-` keys can be used to change the value of certain variables to change things like the light intensity, spring constant, and variables needed for this assignment. The variable currently affected by the `+` and `-` keys is shown in the bottom line of green text. Pressing `Tab` cycles through the different variables. Those who want to increase the spring constant to the point that the scene explodes may be disappointed to learn that there is a protection mechanism that increases the mass of balls when the spring constant is high enough to make the system go unstable, such balls turn red.

Look at the comments in the file `hw01.cc` for documentation on other keys.

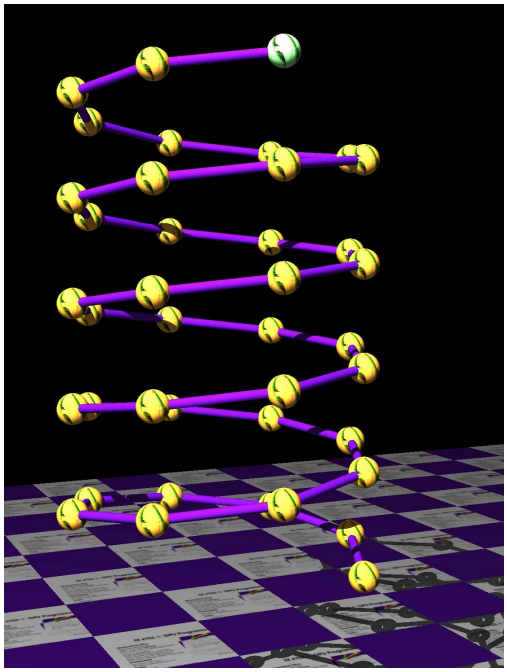


Problem 1: Scene 1 starts with the balls falling into a jumbled mess because the links connecting the balls can attach to the balls at any angle, see the left screen-shot to the right. (Press `1` to reset the scene and see the balls fall again.) In the right-hand screen shot the cord connecting the balls appears stiffer. The stiffer cord is modeled by adding springs between balls at a distance of 2, these are in addition to the springs at a distance of 1. (Balls `ball[0]` and `ball[1]` are at a distance of 1, balls `ball[0]` and `ball[2]` are at a distance of 2.

Modify routine `time_step_cpu_hw01` so that it models the stiffer cord as described above. A correct solution will require modifying only three lines of code.

The simulation has two time step routines, `time_step_cpu_hw01`, which needs to be modified for this problem, and `time_step_cpu_orig`, which should be left unchanged. Initially the two routines are identical (except for the comments). Press `v` to switch between the two time step routines.

Problem 2: Routine `hw01` has three arguments, coordinate `center`, vector `dir`, and scalar `r`. It currently places the balls in a straight line starting at `center` in the direction `dir`. Modify the routine so that it arranges the centers of the balls in a spiral on the surface of a cylinder as described below. See the screenshot to the right. Coordinates `center` and `center + dir` are both on the cylinder axis. The cylinder has a radius of `r`. The first ball should be placed on the cylinder on a point closest to `center`, the last ball should be on the cylinder on a point closest to `center + dir`, and the balls should form a spiral. Set `distance_relaxed` to the distance between adjacent balls.



Routine `hw01` is used both in Scene 3 and Scene 4. In Scene 3 `dir` point straight down, in Scene 4 `dir`, `center`, and `r` are randomly chosen.

The cylinder mentioned above is only meant to describe where the balls should be. But to actually see the cylinder, press `c`.

Problem 3: The following is a preview problem, no credit will be given for Homework 1, but it may appear in a future assignment or as a test question. Modify the simulation so that the cylinder is a solid object and so the balls bounce off it, just as they do the platform.