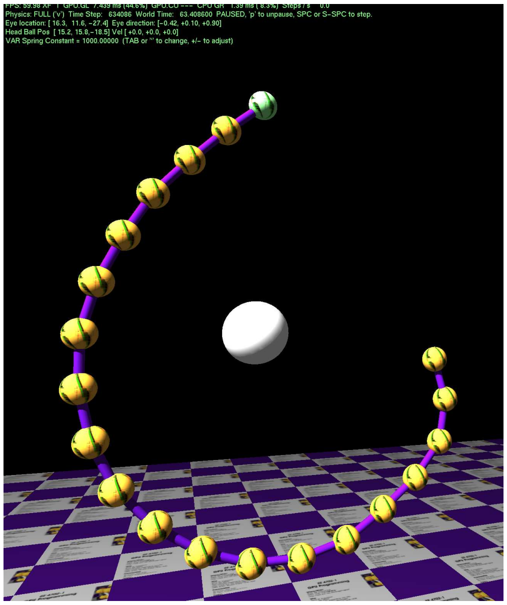
LSU EE 4702-1 Homework 1 Due: 9 September 2016

Some of the effort for this homework assignment is in learning to use the various pieces of software, such as a text editor. Those less familiar with Linux software development procedures might seek out a more knowledgeable classmate to minimize frustration and wasted time.



```
FPS: 59.98 XF 1 GPU.GL 7.439 ms (44.6%) GPU.CU --- CPU GR 1.39 ms ( 8.3%) Steps / s 0.0
Physics: FULL ('v')  Time Step:   634086  World Time:   63.408600  PAUSED, 'p' to unpause, SPC or S-SPC to step.
Eye location: [ 16.3,  11.6, -27.4]  Eye direction: [-0.42, +0.10, +0.90]
Head Ball Pos  [ 15.2, 15.8,-18.5] Vel [ +0.0, +0.0, +0.0]
VAR Spring Constant = 1000.00000  (TAB or '`' to change, +/- to adjust)
```

Problem 0: Follow the instruction on the `http://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 show a swinging string of beads, generated by code very similar to demo-2-springs.cc used in class. One difference with the classroom demo code is The Globe, a fixed white ball in the center of the scene. Pressing `o` toggles The Globe between white and yellow, but has no other effect—until Problem 3 is solved correctly. The illustration to the right is from the solution to Problem 3, in which The Globe repels other balls.

Press digits `1` through `4` to initialize different scenes, the program starts with scene 2. Initially Scenes 1 and 2 are identical, and Scene 3 shows the circle code done in class. *Promptly report any problems.*

Use key `h` to toggle between the first (head) ball being locked in place and free. Use key `t` to do the same for the last (tail) ball.

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).

Look at the comments in the file `hw01.cc` for documentation on other keys. One fun thing to do is to lock both the first and last ball, move the head ball until the spring is stretched tight, then release one of the balls. Press `p` to pause, then the space bar to single step. *Note: There is nothing to turn in for this first problem.*

Problem 1: The code in `ball_setup_2` contains a coordinate `top_pos` and a normal vector `dir`. Modify `ball_setup_2` so that the balls are arranged in a straight line starting at `top_pos` and in the direction `dir` spaced `distance_relaxed` units apart. If the problem is solved correctly (and before Problem 2 is solved) the balls should smoothly swing and only gradually become disorganized.

Note: this is an easy problem.

Problem 2: In `ball_setup_2` (some as Problem 1) set the initial velocity so that the balls rotate around the axis passing through `top_pos`, going straight down. All balls should rotate around the axis at the same rate (*e.g.*, in revolutions per second, radians per second). If the problem is solved correctly the scene should start with the balls smoothly rotating around the axis.

This problem is similar to problems assigned in past semesters. Please make a strong effort to solve it yourself, rather than seeking a solution. If necessary ask the instructor for help.

Problem 3: Now to The Globe. Modify the code in `time_step_cpu_full` so that when variable `opt_globe` is true the balls will be repelled by The Globe. The repulsion force on a ball should be

$\overrightarrow{f} = \frac{q_g m_b}{r^2}\widehat{GB}$, where q_g is the value of variable `opt_globe_charge`, m_b is the mass of the ball (in member `mass`), r is the distance between the centers of The Globe and the ball, and $\widehat{GB}$ is a unit vector pointing from The Globe to the ball. The force affects the ball, but not The Globe, it is fixed in place.

The position of The Globe can be found in `globe.position`. Variable `opt_globe_charge` can be adjusted using the user interface with the `TAB`, `+`, and `-` keys.

If solved correctly the string of balls should avoid The Globe.