Problem 0: If necessary, follow the instructions 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 initially show a vaguely umbrella-shaped object hanging in space.

The screenshot on the right shows what the object should look like after Problem 1 is solved correctly.

Press digits 1 through 2 to initialize different scenes, the program starts with scene 2. Scene 1 shows a balls connected in a rectangular spiral. 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 1 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 hw03.cc for documentation on other keys.

In the previous assignment, and in the demos given so far in class, the physical model consisted of point masses connected by ideal springs, and these were rendered using spheres and cylinders.

This assignment code simulates a world that includes spheres that are connected either by links attached to the sphere surface or ideal springs “attached” to the sphere center (as in the prior homework). The links that connect to the sphere surface can apply linear force and torque, and they can bend. In the physical model each link consists of two perfectly rigid pieces, one end connected to the respective balls and the other end connected to each other by ideal springs arranged in a circle. (The total length of the two rigid pieces serves as the relaxed distance of the link itself.) The links bend around this connection.

Since a link can bend it would not make sense to render it as a cylinder. Instead they are rendered as cubic Hermite curves. Consider a link that connects balls $B_1$ and $B_2$ with centers at $C_1$ and $C_2$. Let $P_1$ and $P_2$ denote the coordinate where the link attaches to $B_1$ and $B_2$. The link is rendered as a cubic Hermite curve parametrically described by $L(t) = (2t^3 - 3t^2 + 1)\vec{0}P_1 + (-2t^3 + 3t^2)\vec{0}P_2 + s(t^3 - 2t^2 + 1)C_1\vec{P}_1 + s(t^3 - t^2)\vec{P}_2C_2$, where $s$ is the stiffness of the links and is set to $s = \|2.5\vec{P}_1\vec{P}_2\|$ in the code.

In hw03.cc routine render_link_1 and render_link_2 render these new curved links as triangle strips. The i loop moves along the curve, the value of $L(t)$ is assigned to variable $ctr$. 
The derivative $\frac{dL(t)}{dt}$ gives the direction of the curve. That is assigned to \texttt{tan}. The \texttt{j} loop draws a cylinder (sort of) around the curve.

**Problem 1:** Modify \texttt{render\_link\_1} so that the link is textured. The texture unit and texture objects are already set up, all that needs to be done is to emit texture coordinates. The texture is an image of this assignment handout. Emit the texture coordinates so that text is along the links. The size of the text should be constant in object space. That is, long links (such as the ones that connect to the uppermost ball) should not have stretched-out text and short links (such as the vertical links, see the screenshot above) should not have compressed text. Pressing \texttt{v} will toggle between the ordinary view and one where triangles stand out. This may help in debugging.

\textit{Note: As originally assigned, Homework 3 had an additional problem. That problem is now part of Homework 4.}