Austin Graf

Pre-Proposal
Modeling a Double Pendulum

The purpose of this project is to show the motion of a double pendulum in two dimensions, beginning with a situation with equivalent lengths and masses on each pendulum and potentially working toward more complicated cases.

In any two-dimensional rigid double-pendulum with even mass distribution on each rod, the moments of inertia (as scalars) are given by

$$\mathrm{I}_1 = \frac{m_1 l_1^2}{12} \text{ and } \mathrm{I}_2 = \frac{m_2 l_2^2}{12}$$

where *m* and *l* give mass and length, respectively, and the subscript 1 refers to the top pendulum while the subscript 2 refers to the bottom pendulum.
When these are equivalent, the Lagrangian is given by

$$L = \frac{m(\dot{x}_1^2 + \dot{y}_1^2 + \dot{x}_2^2 + \dot{y}_2^2)}{2} + \frac{\mathrm{I}(\dot{\theta}_1^2 + \dot{\theta}_2^2)}{2} - mg(y_1 + y_2)$$

with θ representing the angle of the pendulum from the vertical, x representing the position of the center of mass along the x-axis, and y representing the position of the center of mass along the y axis (the subscripts again denote the top and bottom pendulum with 1 and 2, respectively). The equations of motion can thus be derived.

I will use VPython for graphical programming. I intend to implement an interface with which the user can choose the initial angles and center of mass positions. I would also like to display in separate colors the path that the tip of the second pendulum follows and the path that the joint connecting the pendulums follows.