Due Date

The due date for this lab will be set by your lecturer or recitation instructor. Late submissions will not be accepted.

You are encouraged to discuss this assignment with other students and with the instructors, but the work you hand in should be your own.

Getting Help

For helpful background material, see the web page

http://sites.math.rutgers.edu/courses/251/Maple/Lab1/Vectors.html

The goal of this assignment is to give a feel for what an arc length parametrization is and why it is useful. Lectures in class can give some of the intuition, but looking at animations and playing with an actual curve can help to improve your intuition about this.

INSTRUCTIONS

For this assignment, you will be given individualized data from your instructor. This will be a curve $\vec{r}_1(t)$ in three-dimensions, given as $\langle x(t), y(t), z(t)\rangle$ and a end time T_{final}.

- **Use Maple, Matlab, or Mathematica to**
  - Draw and visualize a curve in three-dimensions, compute the length of this curve from $t = 0$ to $t = T_{final}$, and animate a point moving along the curve,
  - Find an arc-length parametrization for the curve, and
  - Animate the curve with this new parametrization and see how the point moves around the curve.
- **Your code should consist of the following:**
  - Storing the curve $\vec{r}_1(t)$ and the final time T_{final}.
  - Two plots of the curve $\vec{r}_1(t)$ showing the curve from different angles.
  - Code for an animation of a point moving around the curve at evenly spaced t values. You can comment this out when you go to print your final document, as printing an animation won't work out very well.
  - Compute the length of this curve.
  - In words/equations, answer the following questions:
    - If I were to give you two values $t = a$ and $t = b$, what would the length of the curve $\vec{r}_1$ be between these points?
    - How would you find a **unit** tangent vector to the curve $\vec{r}_1(t)$?
  - Compute the function $g(s)$ that is needed to find an arc-length parametrization of this curve, following all of the standard steps for doing this.
  - Find a formula (using the computer) for an arc-length parametrization $\vec{r}_2(s)$. Define and store this function $r_2(s)$. What are the bounds on s?

- Draw a plot of the curve $\vec{r}_2(s)$ (it might look familiar), and write code to animate a point moving around this curve at evenly spaced s values.
- Find the length of this curve. Hint: This should match your answer from earlier.
- In words/equations, answer the following questions:
  * If I were to give you two values $s = a$ and $s = b$, how would you compute the length of the curve $\vec{r}_2$ be between these points?
  * How would you find a **unit** tangent vector to the curve $\vec{r}_2(s)$?
  * What do you notice about the animations for r_1 and r_2? What is the difference between them?

- **Hand in a printout of your work. In this printout:**
  - Label all pages with your name and section number. Also, please *staple together* all the pages you hand in.
  - *Clean up your submission by removing the instructions that had errors.*