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Matplotlib and Bertini_real

Goals: After introductory C++ in Scientific Computing, I found programming to be an activity that I both struggled with and enjoyed. I wanted to continue programming and learn about its applications in applied mathematics and statistics. I started the Bertini_real research project with two main goals: familiarity with Python and a deeper understanding of general programming concepts.

1. *Familiarity with Python:* I wanted to learn Python because of its wide use in industry. Job descriptions often listed Python, or an alternative language, as a required or recommended skill.
2. *Acquisition of general programming concepts:* I wanted a better understanding of concepts such as lists, arrays, loops, and data manipulation. A better programming foundation would allow me to pick up additional languages, and learn how to learn how to program.

Accomplishments: This semester I acquired many new skills, directly and indirectly related to my original goals.

1. *Base knowledge of Bertini_real numerical cellular composition:* I learned how to create input files with various curves and surfaces, and decompose them with Bertini and Bertini_real. Additionally I used Matlab to visualize these curves, and their vertices and edges.
2. *New Python and Matplotlib skills:* I became familiar with basic Python syntax and skills such as writing functions, printing information, **lists**, **for** loops, and **if** statements. I learned how to use the Python environment and work with multiple files simultaneously. Additionally, I used Matplotlib to visualize curve data in Bertini_real. For a given curve, the **Plotter.py** file will plot the curve, its vertices, and give each individual edge a different color. The plot also appears with labeled axes and the name of the working directory as the graph title. These skills will be very applicable for my internship this upcoming summer. I will be working at l'Institut Pasteur programming an image analysis plug-in which is based on Python.
3. *Statistics and Data manipulation:* In addition to the Bertini_real research, I used Matplotlib to visualize data. I learned to generate a set of random normally distributed data and to plot the data points as a normal curve. Lastly, I learned to plot the data as a frequency histogram. Post graduation, I'm looking for a career in applied statistics and data analysis, and this experience has given me the necessary skills to manipulate and visualize data points and statistics.

Future Research: If I were to keep working on this project, I would continue developing my skills in Python, improve the curve visualization capabilities, and expand the program to plot surfaces.

1. *Python skills*: I want to be more confident with working with multiple files at once. Additionally, I want to be familiar with Python naming conventions, and interpreting data stored in each variable.
2. *Visualization interface*: When the user mouses over the curve to view it from different angles, it is very choppy. I would change the visualization so that the user can smoothly and continuously change the viewing angle.
3. *Surface plotting*: Currently, the program can successfully plot curves. I next would like to expand the program to be able to plot surfaces, with each face having a unique color.

Curve examples:

