Design Proposal

CMU 15-112: Fundamentals of Programming
and Computer Science,
Carnegie Mellon University
Fall 2021

Updates

TP2:

No updates have been made to the design proposal.

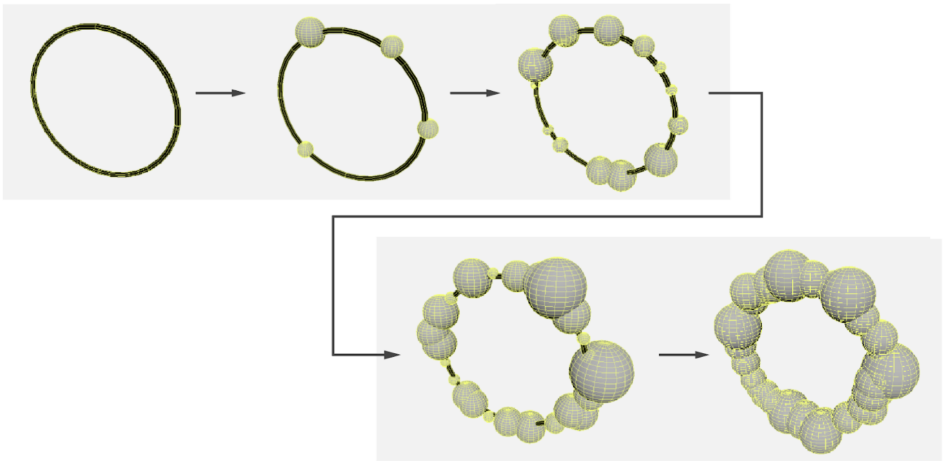
Project Proposal

In the following lines I will describe my 15112 term project proposal

Project Description :

Name: **hnX ring**

This project will be a ring generator. The output of his program will be a .stl file of the 3D model that the user created using the program.
The user will interact with the program so an aesthetic shape is achieved. To do so, this program will be a simple 3d modelling software. The program will display the current shape of the ring to the user, who will be able to make changes to it. This includes adding new elements to the mesh or editing it.



Competitive Analysis:

This program is similar to the following two projects

- Nervous systems:
    - This generative design studio combines scientific research, computer graphics, mathematics, and digital fabrication to explore a new paradigm of product design and manufacture. Instead of designing objects, they craft computational systems

that result in a myriad of distinct creations. These forms are realized using computer-controlled manufacturing techniques such as 3D printing, laser cutting, and CNC routing.
My project is also a computational system that results in a ring that the user can 3D print.

https://n-e-r-v-o-u-s.com/projects/sets/custom-jewelry/

- Autodesk:

  Their Maya program or their web based application tinkercad, are examples of a 3D modelling software. The mesh editing on my term project can be understood as a very simple version of the one on these programs.

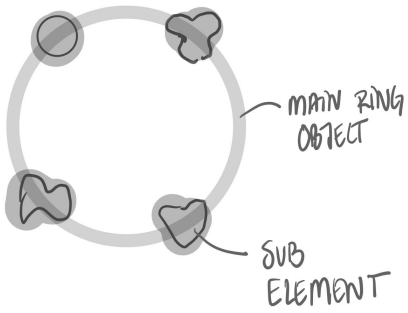
  https://www.autodesk.com/products/maya/overview
  https://www.tinkercad.com/

Structural Plan:

A structural plan for how the finalized project will be organized in different functions, files and/or objects.

- Functions:
  - Isometric graphics
  - Basic mesh editing (clicking/dragging vertices around)
  - Rotation of object with user dragging
  - Draw curved objects using spline or bezier curves
  - Control some parameters (ex. sizes, number of subdivisions) with sliders
  - Combining multiple 3D models
  - Zooming in/out
  - Reading/writing to STL files

- Objects:
  - General object (the ring)
    - Will save the general information of the ring such as the diameter, the number of subdivisions of the mesh, will also save the



subelements (spheres, or 3D Bezier meshes) of the ring

- Sub Elements: the spheres or Bezier Rotated surfaces.
    - These objects will save information such as the bezier 2Dpoints control points, the number of subdivisions.
    - They will also have their own methods such as the generation of the bezier curve given the bezier control points or the possibility to change a control point location

Algorithmic Plan:

A detailed algorithmic plan of the trickiest parts of my project can be found in this section

- Generating the mesh:
  To do this I will looping through the 3D shape on the mesh will i keep track of:
    - Points: defining the vertices matrix of the mesh
    - Faces: defining the faces matrix using the indexes of points that compose it, I have to be carful on how the three vertices are listed so the normal of the face goes in the right direction.

- Generating the bezier curves:
    - Using De Casteljau's algorithm in a recursive form
      https://en.wikipedia.org/wiki/De_Casteljau%27s_algorithm

- Point rotation:
    - Using a matrix rotation
      https://en.wikipedia.org/wiki/Rotation_matrix

- Displaying the 3D object:
  I will display the objects using the 112 graphics.

Timeline Plan:

TP1- now

TP2- due Tue 23-Nov at 8pm

- Working Demo. Reach the MVP status. Develop the main functions of the project.

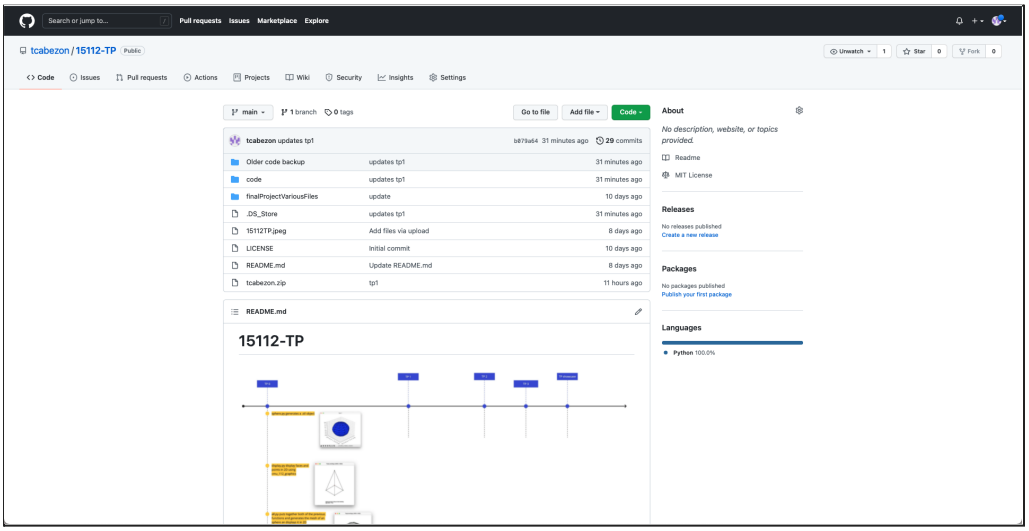
TP3- due Wed 01-Dec at 5pm

- Project Codebase
- Readme File
- Project Demo (video)

- Design and Documentation
- Style: comments and functions and file organization

Version Control Plan

I am saving my code on github, the repository can be found in the following link: https://github.com/tcabezon/15112-TP



Module List:

I am currently using the following libraries. However, by the end of the project i will only use numpy.

- Numpy: for operations with matrices
    - https://numpy.org/
- Numpy stl: to generate the stl object from the point and faces matrix
    - https://pypi.org/project/numpy-stl/
- Matplot: to plot the .stl mesh
    - https://matplotlib.org/

Storyboard

The following page shows the storyboard that demonstrates how a user would interact with the finished project.