CS 184: Computer Graphics and Imaging, Spring 2019

Project 2: Mesh Editor

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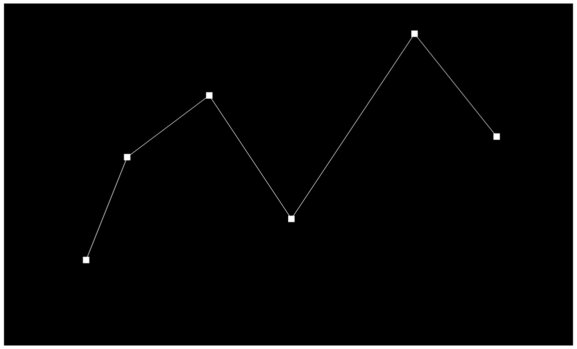
In this assignment, I implemented several mesh operations. Exploring the basic structure behind the mesh, I implemented edge splits, edge flips ,loop sibdivision and explored the visual effects of these operations.The most interesting part of the project is how basic oeprations like edge splits can have such a drastic effect after a few evaluation steps.

Overview

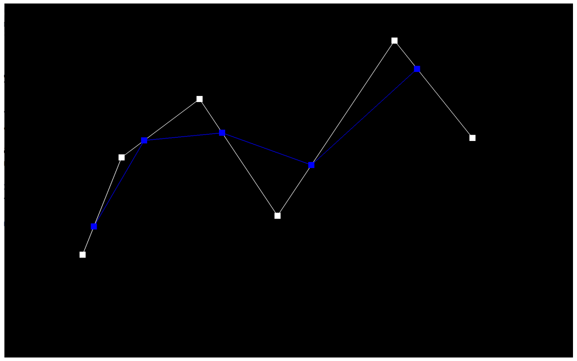
Section I: Bezier Curves and Surfaces

Part 1: Bezier curves with 1D de Casteljau subdivision

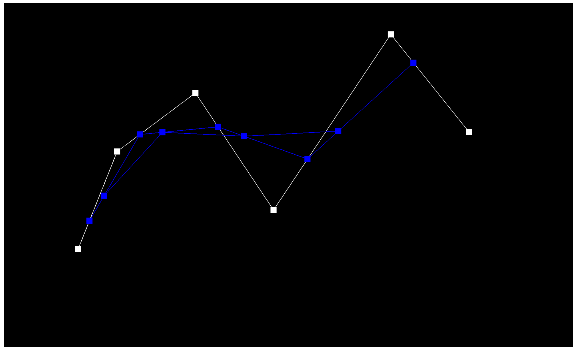
Bezier curves are created through interpolating the control points repeatly. In each step, the new points are calculated based on split value t,ranging from 0 to 1. Then the final curve, going from the first control point to the last, is determined and influnced by the control points in between.



Level 0.



Level 1.



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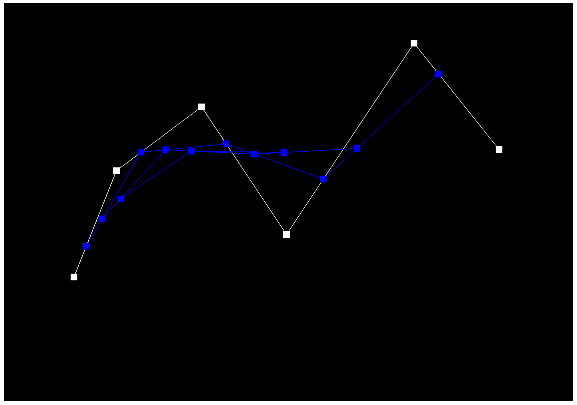

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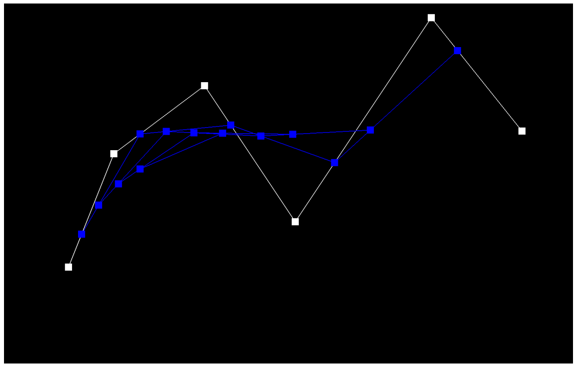
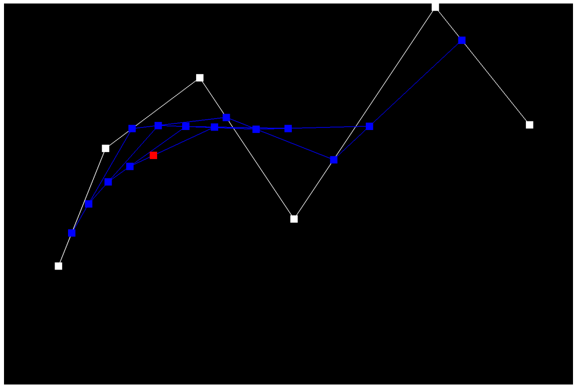
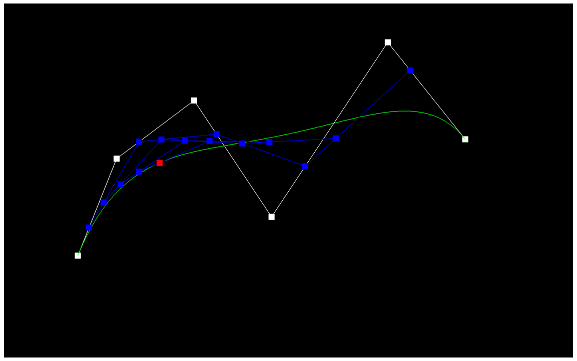


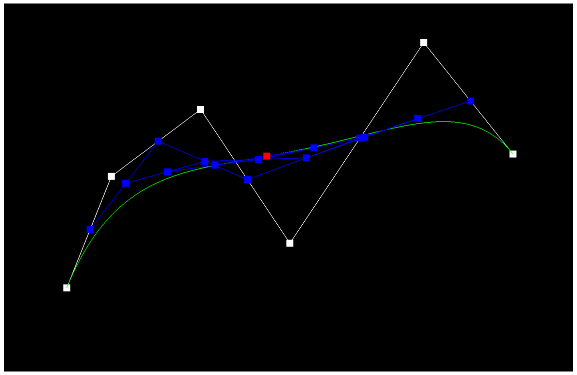
Level 4.



Level 5.



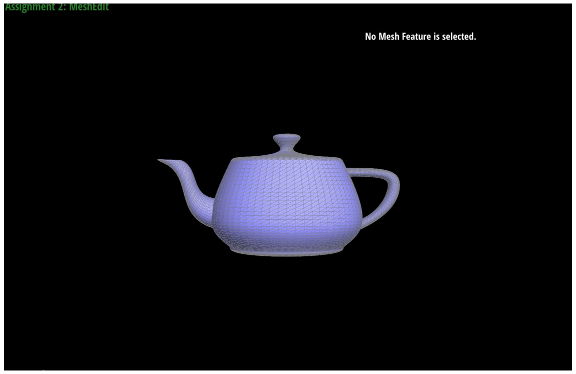
Completed curve.



Modified curve by modifying t-value.

Part 2: Bezier surfaces with separable 1D de Casteljau subdivision

de Casteljau's algorithm extends to Bezier surfaces by creating parallel Bezier curves along one axis first, and then using points from these curves to create Beizer curve along the other vertex. And this gives us a Bezier surface in 3D space.


Assignment 2: MeshEdit

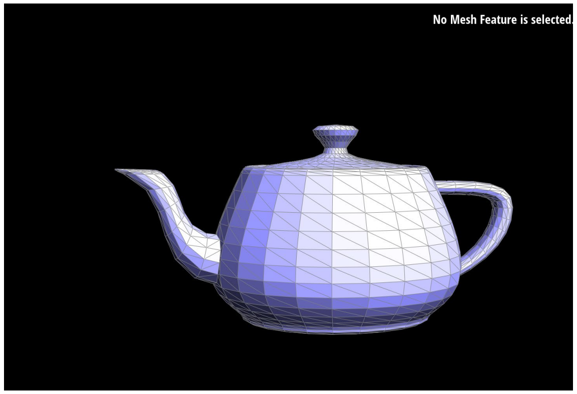
No Mesh Feature is selected.

The teapot.

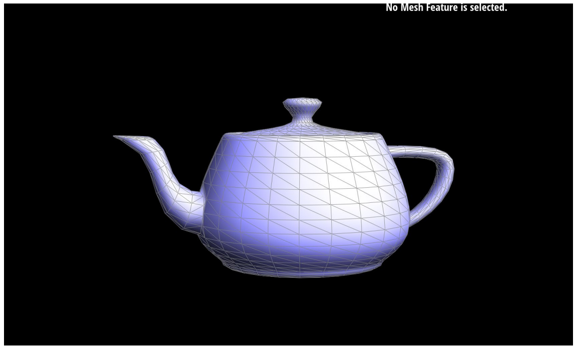
Section II: Sampling

Part 3: Average normals for half-edge meshes

For each vertex, I found the normals for all of its neighbouring faces. This is achived by taking the cross product of the two edges the vertex has in that face. Then I compute the unit normal of the sum of these normal vectors.


No Mesh Feature is selected.

Without smoothed normals.


No Mesh Feature is selected.

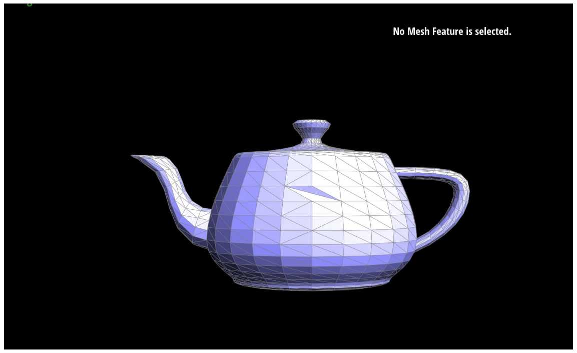
With smoothed normals.

Part 4: Half-edge flip

I flip the edges of the mesh by colleting and reassigning the corresponding pointers of each vertex, face, edge and halfedge. I drew out the corresponding diagram on paper and reassigned my pointers based on it.

```
No Mesh Feature is selected.
```

Original teapot.

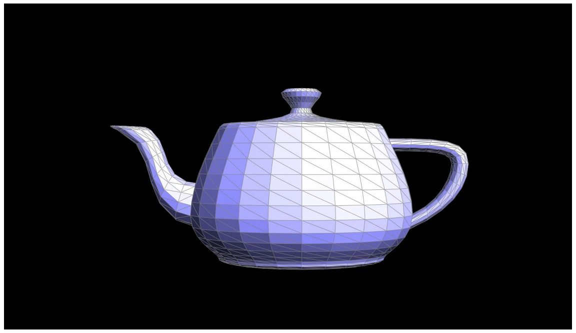


```
No Mesh Feature is selected.
```

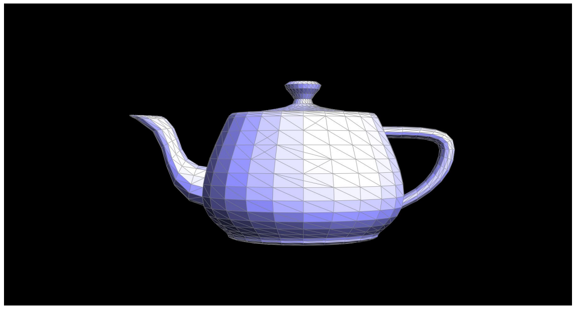
After flipping some edges.

Part 5: Half-edge split

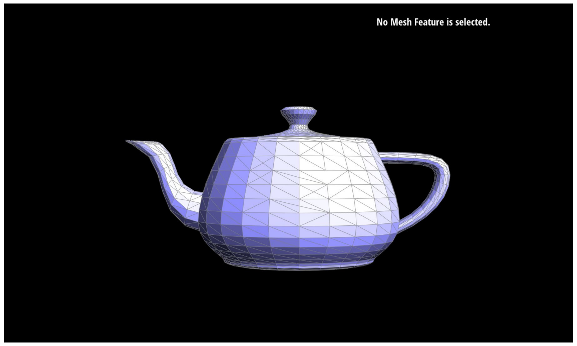
I split the half-edges by colleting and reassigning the corresponding pointers of each vertex, face, edge and halfedge the split might have affected.



Original teapot.



After splitting some edges.



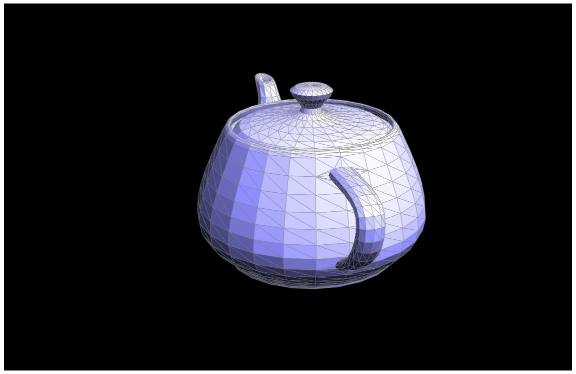
```
No Mesh Feature is selected.
```

After a combination of edge flips and splits.

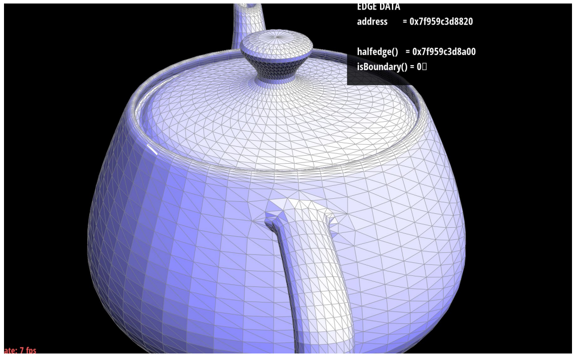
Part 6: Loop subdivision for mesh upsampling

To implement Loop subdivision, I calculated new vertex and edge position according to subdivision rule in the project spec. I split every edge in the orginal mesh. I flipped all new edges connected to an old vertex on one end and an new vertex on the other. And I made sure that the vertex positions are correct after all the updates.

It could result in asymmetrical subdivisions if the original mesh has asymmetrical triangles.



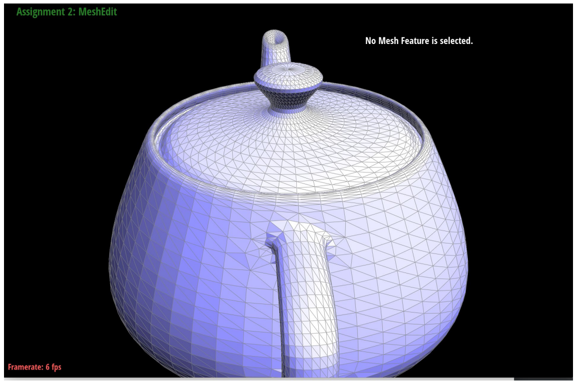
original tea pot.



```
EDGE DATA
address      = 0x7f959c3d8820

halfedge()   = 0x7f959c3d8a00
isBoundary() = 0
ate: 7 fps
```

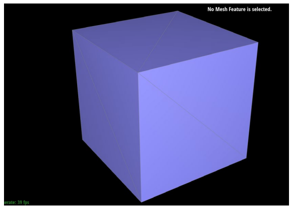
subdivision without pre-splitting.



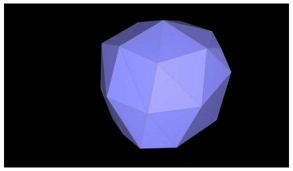
```
No Mesh Feature is selected.
Framerate: 6 fps
```

subdivision with pre-splitting.

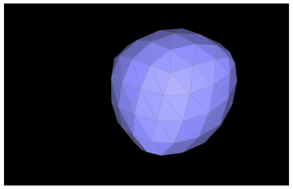
dae/cube.dae without pre-splliting


No Mesh Feature is selected.

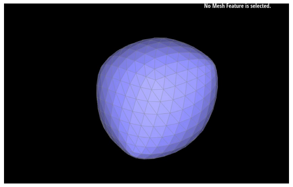
Level 0.



Level 1.

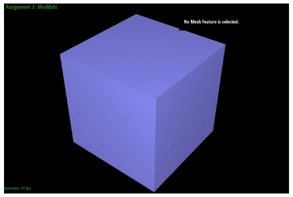


Level 2.


No Mesh Feature is selected.

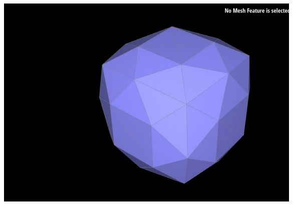
Level 3.

With pre-splitting of some edges

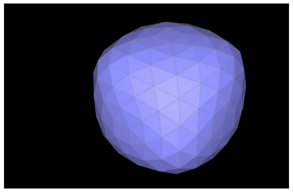

Assignment 2: MeshEdit

No Mesh Feature is selected.

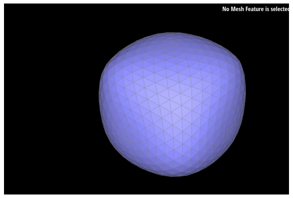
Level 0.


No Mesh Feature is selecte

Level 1.



Level 2.


No Mesh Feature is selecte

Level 3.

By pre-splitting the mesh before all the subdivisions, I got a more symmetric image. This is becasue the orginal mesh will create sharp corners in asymmetric postions. And pre-splitiing can alleiate the effect.

Section III: Mesh Competition

If you are not participating in the optional mesh competition, don't worry about this section!

Part 7: Design your own mesh!