CS 184 ~ Project 4 Write Up

# Part 1

In this part of the project, I constructed the wireframe which is used to simulate the mesh. This wireframe consists of a system of point masses connected by springs which is able to simulate a piece of cloth/ fabric with an accuracy such that it is indistinguishable to the human eye than a regular cloth.

# Part 2

In this part of the project, I implemented the kinematics which determine how the system of springs and point masses interact with each other when inflicted with external forces (gravity being the sole external force in the renders produced for this part of the project).

These kinematic calculations were constructed such that the value of the spring constant, density of the cloth and damping.

Spring Constant Change: As the spring constant increases the cloth will sag less when it reaches its final position and will sag more at the final position when the spring constant decreases.

Density Change: The density of the cloth will mean that there is more force that the spring in the wireframe must react with. Due to Newtons force equation, F = ma, density change will have the inverse effect of spring constant change.

Damping Change: When the damping is higher the cloth maintains less of its momentum as there is more energy loss between time steps. As the damping approaches zero, the cloth will maintain more of this momentum/ energy from the previous time step and take longer to come to a rest.

/// NEED TO TAKE MORE SCREENSHOTS TOMORROW!

# Part 3

In this part of the project, I implemented support for collisions in the virtual 3D environment. I added support for collision between the point masses in the cloth and spheres and between the point masses and the plane.

The below photos compare the cloth resting on the sphere with different spring constants. The higher the spring constant, the stiffer the cloth is. As you can see as the spring constant get higher, the cloth doesn’t drape as far down from the sphere. As the spring constant approaches infinity, the cloth will get closer to being a flat plane. As the spring constant gets closer to 0, the cloth will eventually stop changing as each spring cannot exceed 110% of its rest length.

# Part 4

As explained in part 3, due to Newton’s second law, F = ma, the spring constant (which is proportional to the force that the spring exerts) has an inverse relationship with the density of the cloth (or mass each point mass). As the spring constant increases, the folds in the cloth get wider as there is more force from the springs resisting the downward forces caused by gravity. Should the density be higher, the load on the springs becomes larger and means that the folds become smaller. If the density is lowered, the folds become bigger, if the spring constant is lower, then this will cause the folds to become smaller.

# Part 5

A shader is a generalized way to speed up giving a mesh object a texture/ lighting effect. Vertex shaders can change the geometric properties of the mesh like vector position. Fragment shaders determine the mesh’s color at each point on it by taking information determined by the vertex shader. This can change theoretical properties of the mesh like vector normals and vector tangents. It can also determine the light sources used in the scene.

The Bling Phong lighting model lights the 3D model by adding together the ambient, diffuse, and specular components of light. Ambient light is the color of the object, specular light is a reflection that comes off the cloth and diffuse lighting is light that is sampled uniformly across the point of intersection between the ray and the object that it is being intersected with. A diffuse lighted object looks matt whereas specular light is closer to resembling a mirror.