C++ ANIMATION

a. Description

It is an animation of the planets mercury, venus, earth, and mars, an asteroid belt, and the stars. Mars has two moons and earth has one moon. Also, all the planets and moons have elliptical orbits and the orbits are outlined for all the planets.

The animation zooms out until you can completely see all the planets and asteroid belt. Then a spaceship takes off from earth, travels to mars, and lands.

b. Algorithms

- It uses the conics algorithms for circles to draw the circles for the planets, moons, asteroids, stars, and part of the spaceship.

  $$(x-h)^2 + (y-k)^2 = r^2$$

- It uses the conics algorithm for ellipses to draw the ellipses for the orbits and part of the spaceship. To draw the orbits a black ellipse was drawn inside a white ellipse.

  $$\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$$

- When rotating the planets around the sun and the moons around the planets, it uses the polar form of the equation of an ellipse to calculate the radius at different points on the orbit.

  $$r = \frac{ab}{\sqrt{a^2 \sin^2\theta + b^2 \cos^2\theta}}$$

- To zoom in and out the objects were resized in every frame based off a zoom factor.
- To create multiple stars the seed was used to generate the same set of random numbers that determined each stars intensity, radius, and position.
- To create multiple asteroids the seed was used to generate the same set of random numbers that determined each asteroids radius and position in the orbit. It was rotated a different amount for every frame to show the asteroids orbiting the sun.

Further Details of the Algorithms can be found in the comments in the source code.

c. Running Instructions

```
//This compiles all the classes
g++ -c Color.cpp
g++ -c Circle.cpp
g++ -c Stars.cpp
//This creates the object files
g++ -o trip_to_mars stars.o Color.o Circle.o
//This runs the program to create the bmp files, converts the bmps to jpegs, and then puts it together in the final mp4 file
./trip_to_mars
```