Project Summary

I started off with just the desire to see the effects of having a black hole between two mirrors and see what patterns arise. I tried reading through papers on black holes and how light travels through them, but they were using math I really didn't understand so I switched modes to trying to solve it myself and come up with a heuristic. I wanted to use a parabolic equation in polar coordinates initially, but then I thought of using a sphere of influence to both catch incoming rays and to shoot them back out. It was simpler to think about especially with the refraction and reflection assignments we did. I knew that the closer to the center the ray was going, the more it was going to whip around the black hole, so I figured scaling around the dot product between the lookat and surface normal would help me get the desired whipping effect. Going around the entire sphere would lead to weird reflection-like properties, and I wasn't sure if I wanted that or not, so I made the max rotation a parameter to the black hole, calling it the 'whip'. I used this online simulation as a guide for my mathematical intuition:
http://spiro.fisica.unipd.it/~antonell/schwarzschild/live/

I wanted it to just slightly bend on the outer edges, but go around hard closer to the center. Using the reflection vector and rotating it around the center of the black hole made sense to grant the desired effect, but I ran into the issue that near the edges it would look more like it was reflecting the rays because it would hardly rotate around the black hole, but still be reflecting, so it would turn away from the center more than it is turned toward it.I solved this by raising the dot product to an exponent (I landed on about 1.5) to make the rotating start much faster. My initial equation for the angle to rotate was: whip * PI * dot which was then changed to whip * PI * ($dot^{1.5}$). It was a tight balancing act to find the right rate to rotate the vector, since the angle of incidence and the rotation angle were going against each other, and I think I got a nice configuration right now. It still has the issue of reflecting on the edges to a minor degree, but it has a good enough look in my opinion.

If I were to continue work on this, I would think about tuning the calculations to support more slight bending and include planets that only deflect the light a little bit. On top of that I'd want to do shapes other than spheres (like donuts and cylinders). Using this heuristic over realistic calculations would make this simpler and might lead to really cool patterns. Finally I think that messing with the heuristic could lead to other cool effects (like perhaps a white hole or non-rotational deflection). Honestly I'm probably just gonna think of ways I can make interesting desktop wallpapers with this effect, because it looks very abstract and trippy.