Spiral Gumball Machine
Project Breakdown

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VSFX 350
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Houdini Version: 18.0.287

Important Statistics:

- Render Information:
    - renderer: mantra
    - average render time: 25 minutes/frame
    - image resolution: 1280 x 720
    - noise level: 0.01
    - min/max ray samples: 3/9
    - overall samples: 3
    - stochastic samples: 7
    - diffuse quality: 2
    - reflection/refraction quality: 4
- Lights: 1 environment light with HDRI, 1 skylight, 1 sphere light, 1 area light,
- Geometry Complexity:
    - 1000 gumball points
    - Main Body Geometry: 826 polygons, 841 primitives, 960 points
   - Gumball Sphere Container: 1 packed primitive

## Project Description:

- **Final Result:**

My goal for this project was to take reference images of gumball machines and make my own version with many gumballs falling down the spiral at once using RBDs to create visual interest and believability.

Technical Guide:

- **Using Rigid Body Dynamics Instanced Objects with Points:**
    - I created the initial points for the gumball RBD by using the isooffset and scatter nodes on a sphere so that the points would only be within the sphere shape. Then, a single sphere for the gumballs was copied to the points as an RBD instance object.
        - This can be done in an AutoDopNetwork by using the shelf tool options for Rigid Bodies.
    - All RBD simulations must be to-scale to appear accurate, so I calculated my scene using the measure node and scaled my gumball machine according to measurements I found online for spiral gumball machines.
    - Lastly, I made the container sphere and the spiral/body into collision objects set to concave so that the RBD gumballs would stay within the geometry I wanted. I also added a ground plane object as a collision source so that the gumballs would roll on the ground.
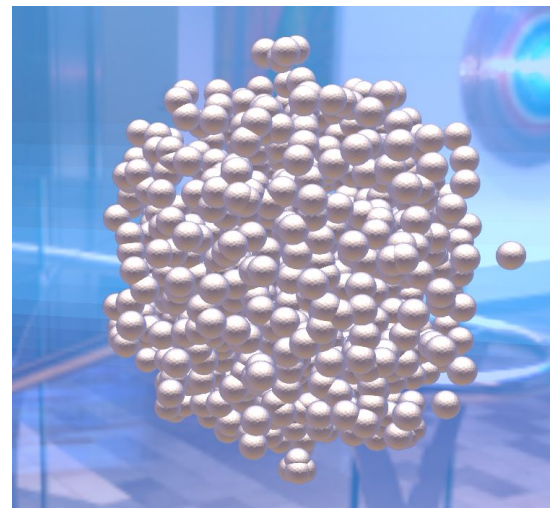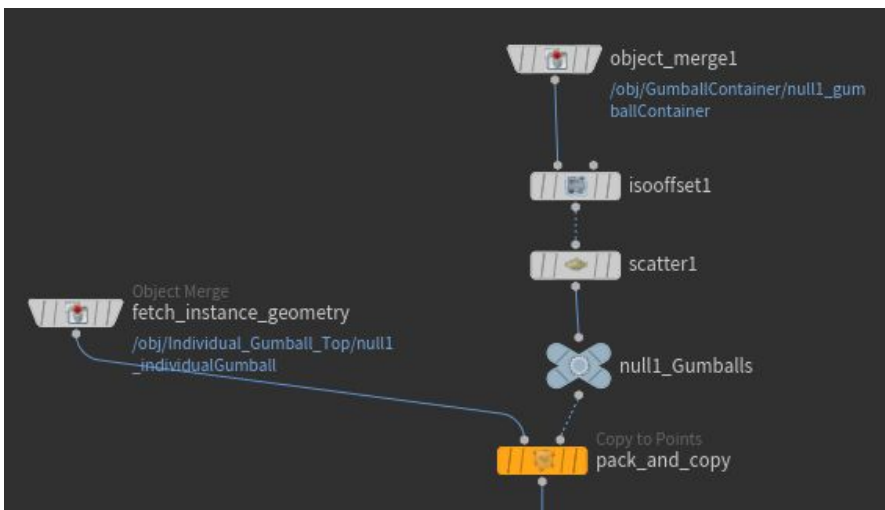

- **Modeling:**
    - **Gumball Sphere Container:**
        - I used a clip node at the bottom of the gumball container sphere in order to cut a hole that allowed the gumball RBDs to fall out and realistically shift the remaining ones on top.
    - **Spiral:**
        - To model the spiral piece, I started with 2 circles that I modified with a point node following a tutorial I found at: https://vimeo.com/309402617 . This allowed me to manipulate the circle's points into the helix shape. I then scaled one of the spirals inward and used a skin node to create geometry over both spirals for the final look.
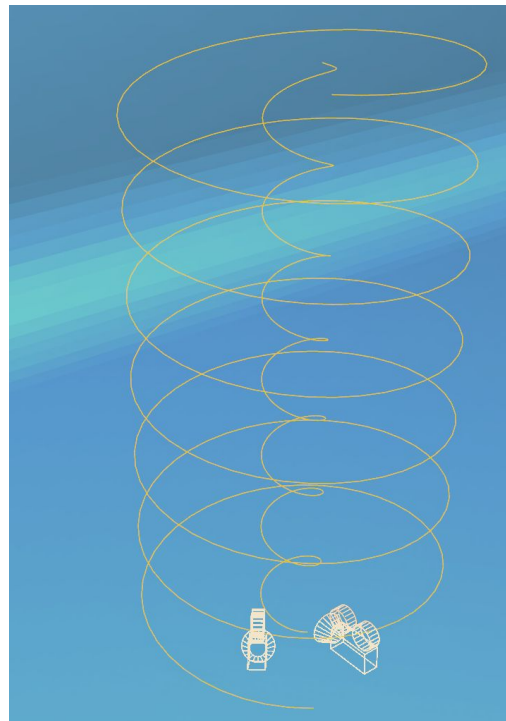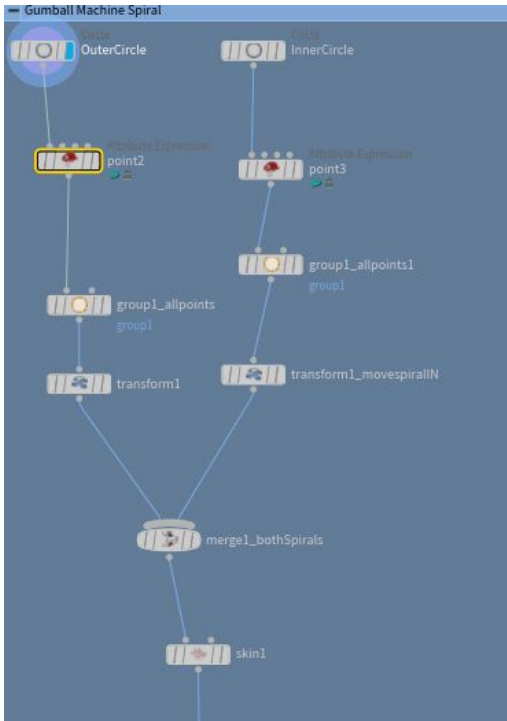
Problems and Solutions:

- **Render Optimization:**
  - Because RBD simulations are active and updating constantly, it saves a lot of time to cache them out using the file cache node. I cached out 2 different simulations and then switched between them using a switch node. This allowed me to have a static cache of the gumballs for the beginning while the dial turns and a moving cache for the rest.
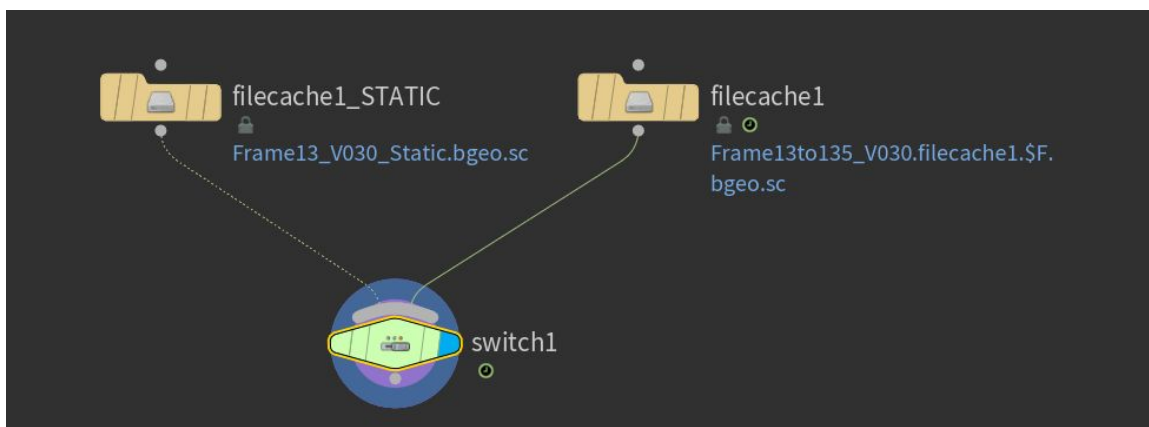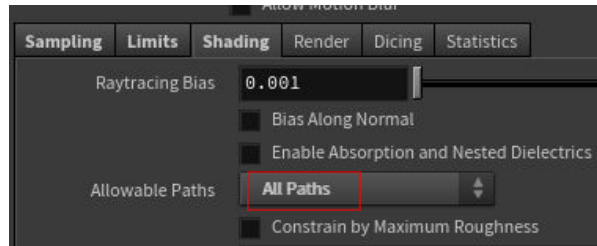

- **Creating the Gumball Machine Base Exit:**
  - Initially, I wanted to make the gumballs come out of a flap at the bottom through more RBD interactions; however, I ran out of time for this and ended up making the cup shape at the bottom instead by referencing a different gumball machine. The cup still feels believable and interacts with the gumballs during the animation.

- **Making the Glass Shader:**
  - Creating the glass shader gave me a lot of problems. At first, I just used a plastic shader but it ended up being too foggy and opaque. Using this tutorial from https://www.youtube.com/watch?v=tycS-xTcvLw as a base, I modified the glass until I got it where I wanted it for my project. Once I finished, I noticed that the glass was tinting the gumballs into a brown color, which was fixed by going into the mantra out node and changing the shading tab "Allowable Paths" to "All Paths".

Glass Before and After