Subject: CSCI420 - Computer Graphics
Assignment 2: Simulating a Roller Coaster
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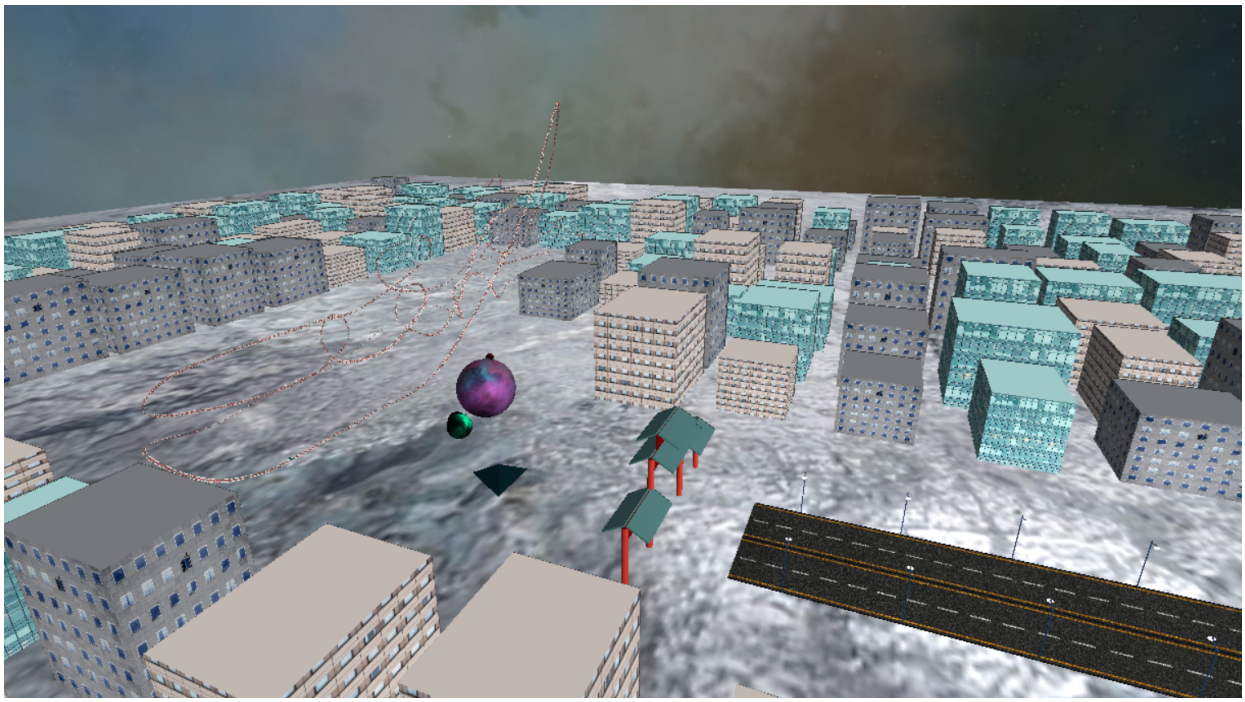
Platform: Windows 11, Visual Studio 2022.
c++ version: ISO C++17 Standard.

Description: In this assignment, we use Catmull-Rom splines along with OpenGL core profile shader-based texture mapping and Phong shading to create a roller coaster simulation.



Core Credit Features

1. Uses OpenGL core profile, version 3.2 or higher - Y
2. Completed all Levels:
   Level 1 : - Y
   Level 2 : - Y
   Level 3 : - Y
   Level 4 : - Y
   Level 5 : - Y
3. Rendered the camera at a reasonable speed in a continuous path/orientation - Y
4. Run at interactive frame rate (>15fps at 1280 x 720) - Y
5. Understandably written, well commented code - Y
6. Attached an Animation folder containing not more than 1000 screenshots - Y
7. Attached this ReadMe File - Y

Extra Credit Features

1. Render a T-shaped rail cross section - N
2. Render a Double Rail - Y
3. Made the track circular and closed it with C1 continuity - Y
4. Any Additional Scene Elements? (list them here) - Y. An animated planet model(texture-mapped), street lamps(point lights), road(texture-mapped), buildings(texture-mapped) and a paifang.
5. Render a sky-box - Y. Animated(Rotates with time).
6. Create tracks that mimic real world roller coaster - Y. Magic Mountain.
7. Generate track from several sequences of splines - N. Not used in this scene but the code supports this feature.
8. Draw splines using recursive subdivision - Y.
9. Render environment in a better manner - N.
10. Improved coaster normals - Y. Each face has its own normal.
11. Modify velocity with which the camera moves - Y.
12. Derive the steps that lead to the physically realistic equation of updating u - Y.

Additional Features: (Please document any additional features you may have implemented other than the ones described above)

1. Multiple light sources. (1 directional light and multiple point lights)
2. Controllable player and a world camera.
3. .sp contains only point positions, no need to include the number of points. track.txt contains only .sp file paths, no need to include the number of .sp files.
4. Most details can be found in Utility.h and Utility.cpp.

```
template<class T> class Singleton;
class Timer;
class SceneManager;
class Entity;

class Component;
class Transform;
class Renderer;
class Physics;
class Camera;
class Light;
class DirectionalLight;
class PointLight;
class PlayerController;
class RollerCoaster;

class VertexArrayObject;

class Texture;
class Texture2D;
class Cubemap;

struct Shape;
```

Open-Ended Problems: (Please document approaches to any open-ended problems that you have tackled)

Keyboard/Mouse controls: (Please document Keyboard/Mouse controls if any)

1. Press w, a, s, d to move player / world camera.
2. Press Spacebar to jump(player) / move upward(world camera).
3. Press c to move downward(world camera).
4. Press e to start a roller-coaster. (Need to get close enough. Distance = 5 by default)
5. Press r to lock / unlock player's view when riding a roller-coaster.
6. Press p to switch between player and world camera.
7. Rotate first-person view with mouse drag.
8. Press x to toggle screenshots recording.

Names of the .cpp files you made changes to:

1. basicPipelineProgram.cpp
2. pipelineProgram.cpp
3. hw2.cpp
4. Utility.cpp