Intermediate Computer Graphic

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Game: Super Mario Bros
Description: The chosen game is Super Mario bros, the player will be controlling Mario, and will need to avoid the goombas in order to reach the flag at the end.

Result: Even

Explanation of concepts

▪ **Select the playable character and use it to explain the graphics pipeline stages associated with Vertex shader, Geometry Shader, and fragment shader.**
For constructing Mario's Body, we need to compute the vertex to get the specific coordinate of the Mario because vertex shader is responsible for geometric relations of vertices. Then we can get geometry primitives created by the geometry shader to confirm Mario's body shape. At last, the fragment shader is able to color Mario with these values.

▪ **Explain how the Phong lighting model allows you to create a metallic feel for objects within the game.**
Phong lighting model is the sum of the three components, ambient, diffuse and specular. For using the Phong lighting model, we need to compute ambient light firstly to get the average light area for the object, then compute diffuse light secondly to get the light from one single direction and compute the specular light lastly to get the highlight area. And for creating a metallic feel of an object, we just need to higher the intensity of the specular value to get a stronger metallic feeling.

```
float specularStrength = 0.5;
```

(We see the strength of the specular value)

```
float spec = pow(max(dot(viewDir, reflectDir), 0.0), 32);
vec3 specular = specularStrength * spec * lightColor;
```

(Compute the direction of view and reflect, then multiplied with light color to determined whether the object is looking like a metal)

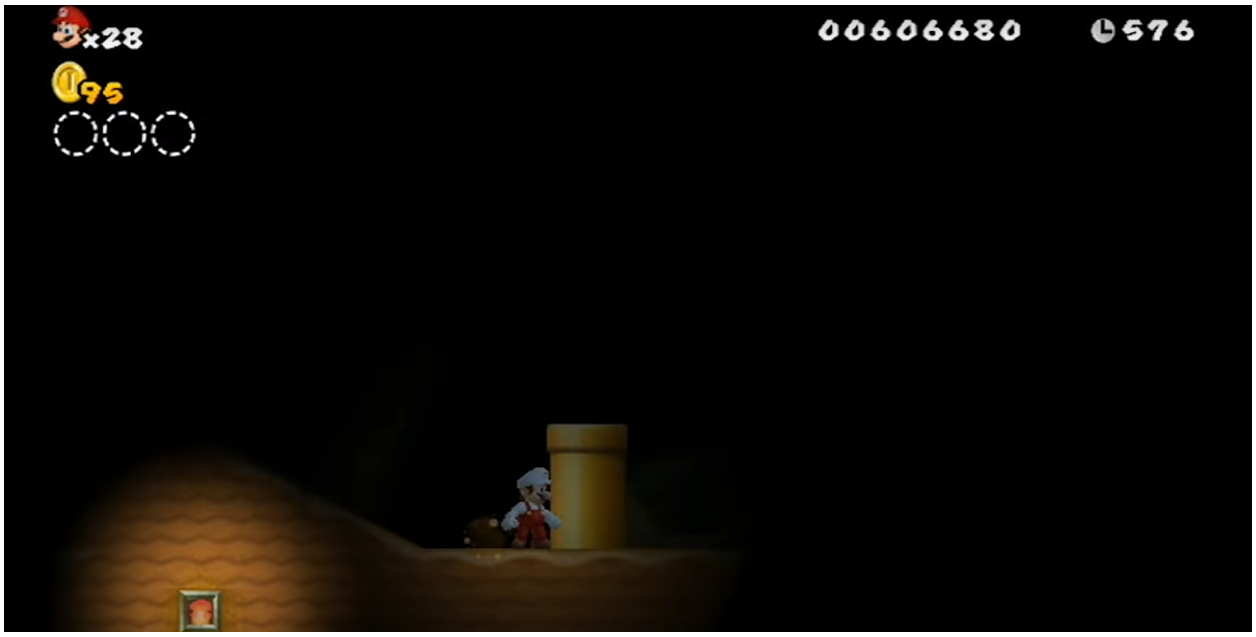
▪ Explain what approach allows you to create a winter feel using shaders.

Creating snow by using the particles. By implementing a snow, we need to set a position about where the particles respawned to make sure the snow is coming from above, and set the particle color to white with fixed movement and speed. Moreover, do not kill particles until they reach the ground. Then we can generate one single VBO to render all particles and keep generating it to make a snow therefore to create the winter feeling.

Explanation of how to implement

A dynamic light that gives the effect of changing the scene (e.g., day passing, seasonal changes, etc.).This includes proper light behavior when moving away or closer to objects.

Dynamic lighting can be done using different light sources, whether it is due to the environment such As the sun in an open environment or torches/lanterns in a closed or indoor environment. Dynamic Lighting can also be implemented onto a character model, and if the character has abilities, such as a Fireball, when ejected from the player, will emit a light source so the ability will be seen, and when it Collides with another object or enemy.



Screenshot taken from this video: New Super Mario Bros. Wii Worlds 1 - 9 Full Game (100%)
https://www.youtube.com/watch?v=5yOQVYyEFDs&t=2271s&ab_channel=NintendoCentral

This screenshot shows a great example of dynamic lighting implemented in an indoors environment Using two different sources. We can see that Mario himself has a character lighting around him to Make sure that he is still visible within the level. However, there is also other light sources within the Level to make sure some aspects of the level can be seen.

Screenshot taken from this video: New Super Mario Bros. Wii Worlds 1 - 9 Full Game (100%)
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This screenshot shows how the lighting in the same level changes according to the lighting around Mario himself. When he fires out a fireball, the lighting around Mario brightens up compared to the Previous screenshot of a stationary Mario being dimly lit. This also applies to the fireballs fired from The fire piranha plants scattered throughout the level.

▪ Explain how you implemented the shader for this Midterm and Indicate why this choice was made.

The shader used was a classic toon shader, this shader was implemented easily by using a LUT. The shader would replace parts of the texture based on their RGB values with the LUT's RGB values.