

Computer Graphics

Assignment-5

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Question 1

I have added texture mapping to the sphere primitive.

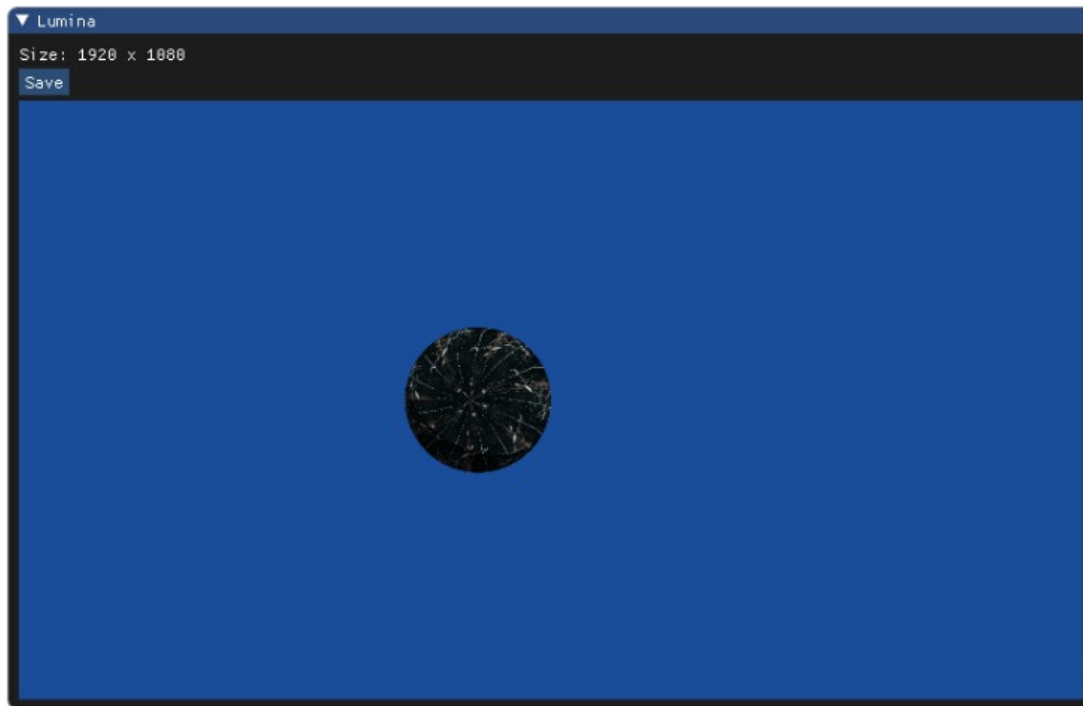
This is the image of the texture used by me.



To calculate the UV coordinates of the sphere, we use the following formula from the slides.

$$u = \frac{\phi + \pi}{2\pi},$$
$$v = \frac{\theta}{\pi}$$

We replace the base color during specular and diffuse shading with texture at UV coordinates. We get the following output.



Question 2

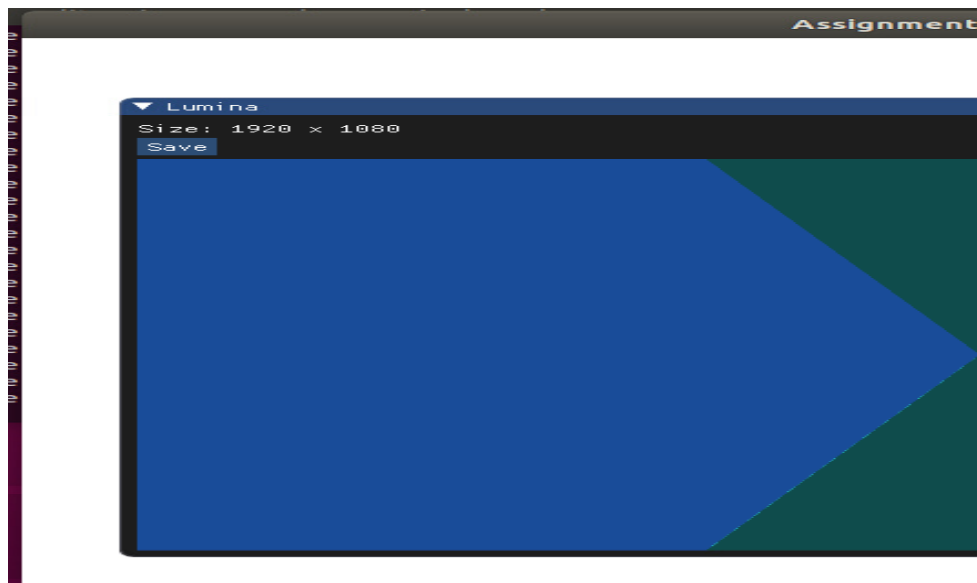
I have implemented the naive ray marching algorithm, which keeps increasing the step size for the t-parameter of the ray until we meet a change of sign in the previous step and the current step value of the function.

We also calculate the normals at each point using partial derivatives.

```
double dfbydx = 2*y*(1-z*z)*(-6*x) + 2*(x*x + y*y)*(2*x);  
double dfbydy = 2*(y*y - 3*x*x)*(1-z*z) + 2*y*(1-z*z)*2*(y) + 2*(x*x + y*y)*(2*y);  
double dfbydz = -2*z*(2*y*(y*y - 3*x*x)) - 18*z*(1-z*z) + 2*z*(9*z*z - 1);
```

After we get a change of sign between points, let's say, P1 and P2 with P1 as positive and P2 as negative, then we use binary search to find a good enough value of t. (Using threshold = 0.1).

Using this method, we get the following output.



But we also find that this method is very slow and requires many iterations to find the correct step size and the maximum distance of t.