Graphics programming Exercise 10

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Important

- If you didn’t do it last week, you must run the following command to update the submodules:
    - git submodule foreach git pull origin master

Exercise 10

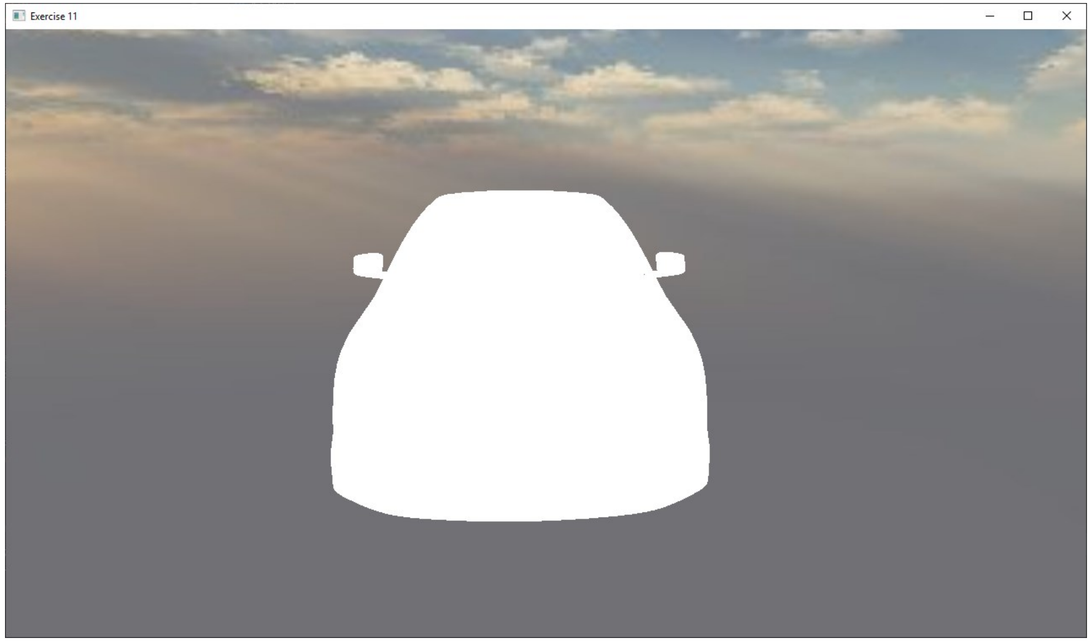
- Learning objectives
  - Implement reflection and refraction effects
  - Implement normal mapping effect

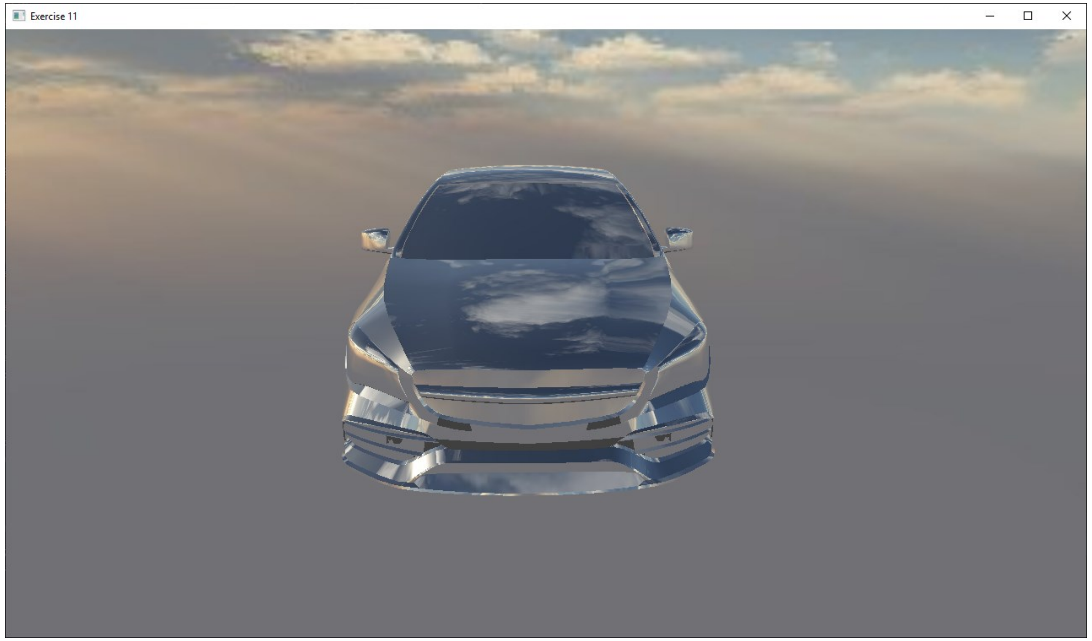
Exercise 10 - Additional resources

- LearnOpenGL
  - https://learnopengl.com/Advanced-OpenGL/Cubemaps
  - https://learnopengl.com/Advanced-Lighting/Normal-Mapping
- Other tutorials
  - https://developer.download.nvidia.com/CgTutorial/cg_tutorial_chapter07.html
  - https://developer.download.nvidia.com/CgTutorial/cg_tutorial_chapter08.html
  - https://docs.cryengine.com/display/SDKDOC4/Tangent+Space+Normal+Mapping

Exercise 10.1

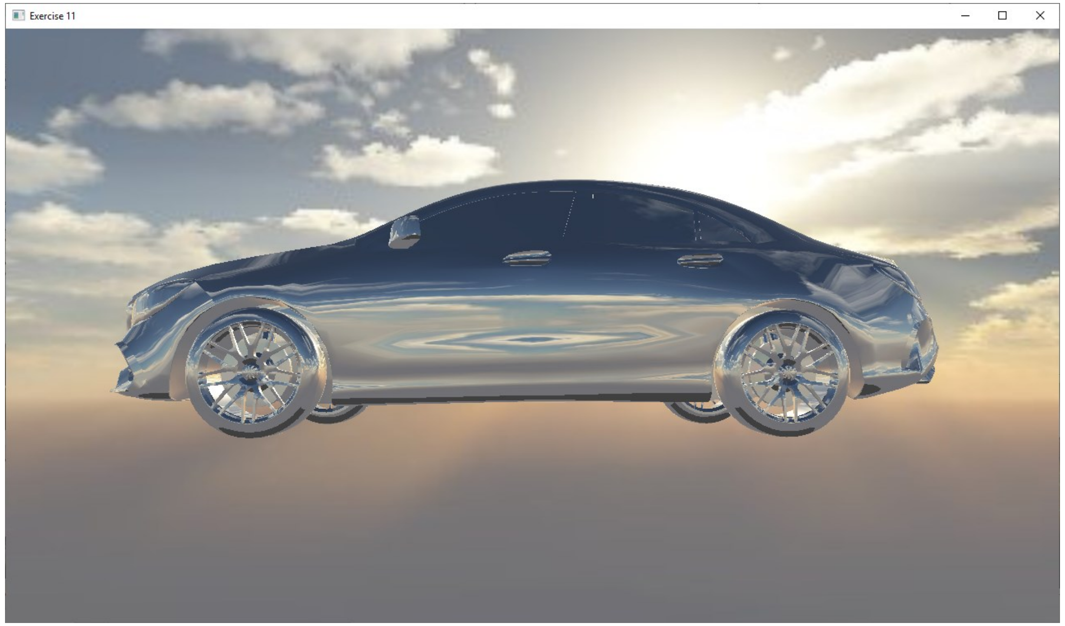
- Reflection
  - In the fragment shader, **reflect** the eye to fragment position incident vector;
  - Sample the skybox texture using the **reflected vec3**.

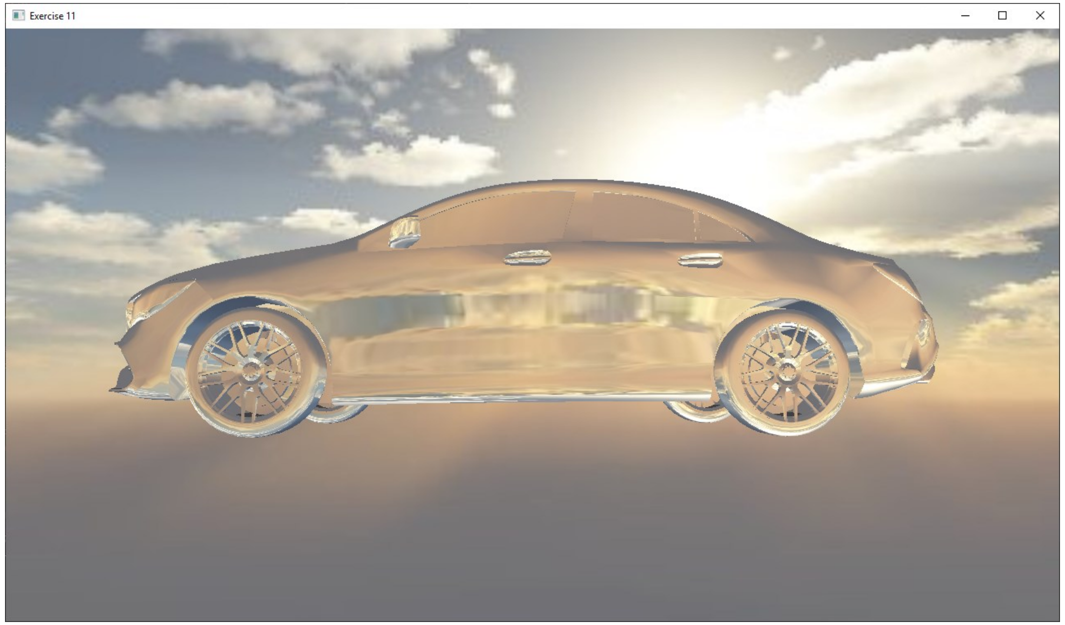




Exercise 10.2

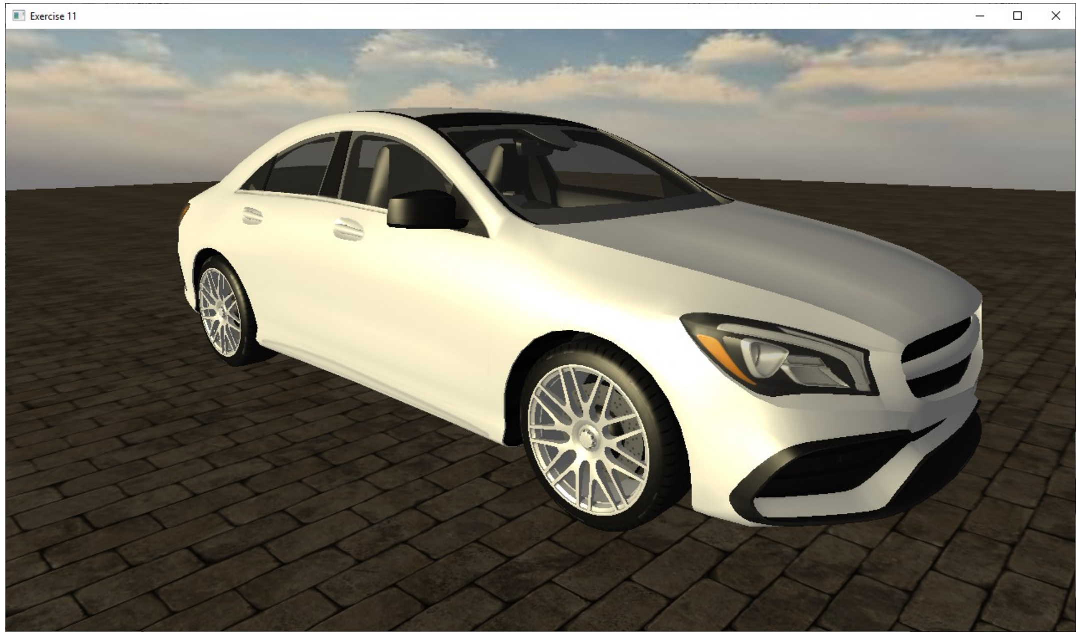
- Refraction
  - Using **Snell's law** and the **refractive index** of different materials;
  - In the fragment shader, **refract** the eye to fragment position incident vector;
  - Sample the skybox texture using the **refracted vec3**.

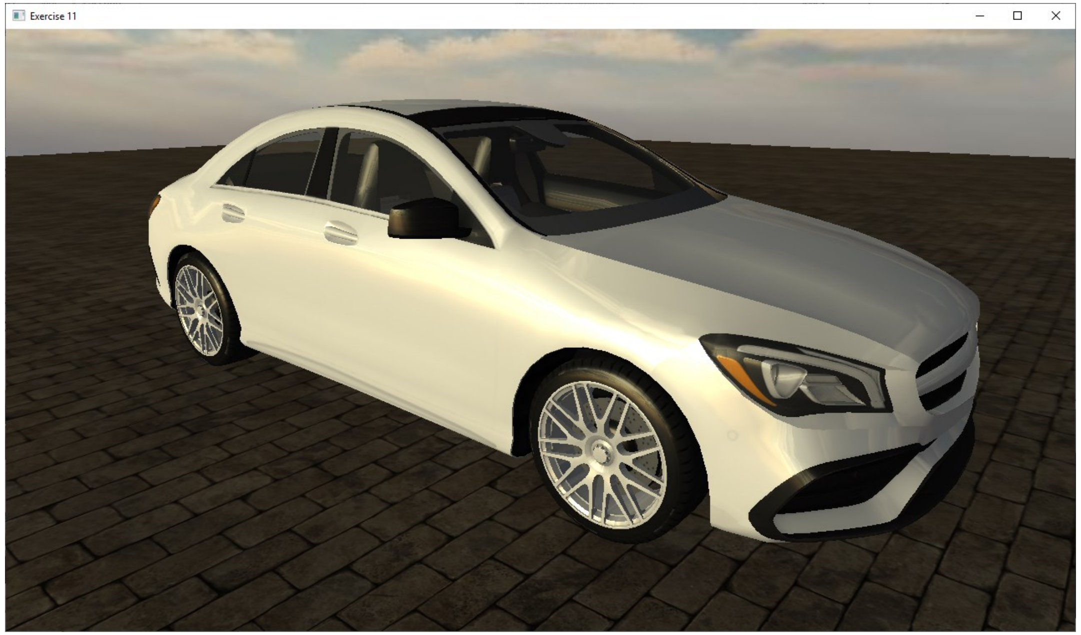




Exercise 10.3

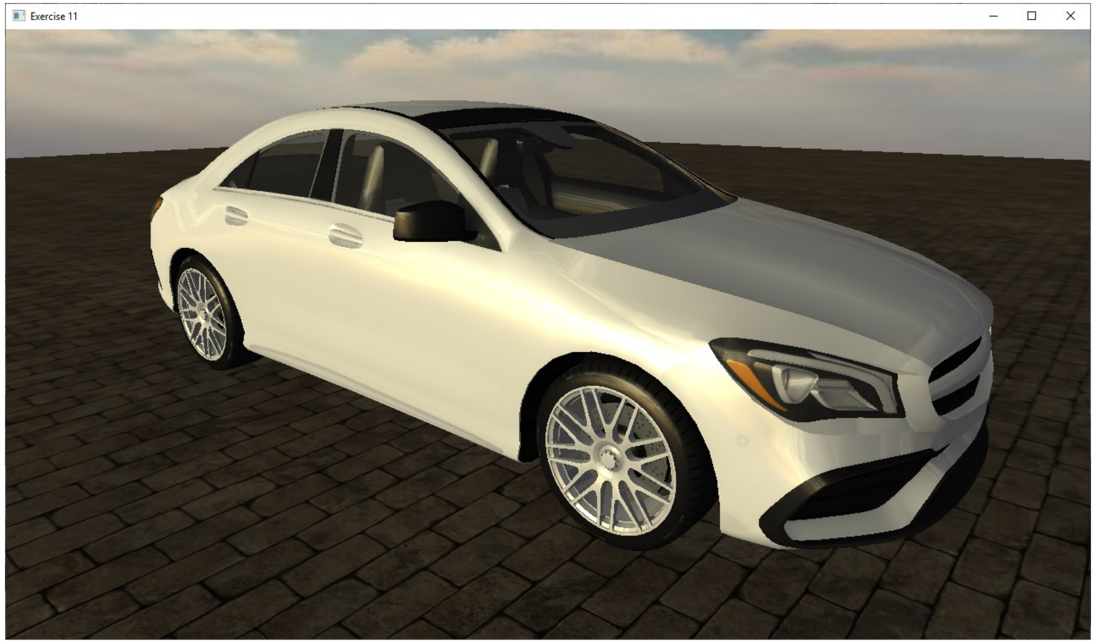
- Reflection
  - In the fragment shader, **reflect** the eye to fragment position incident vector;
  - Sample the skybox texture using the **reflected vec3**.

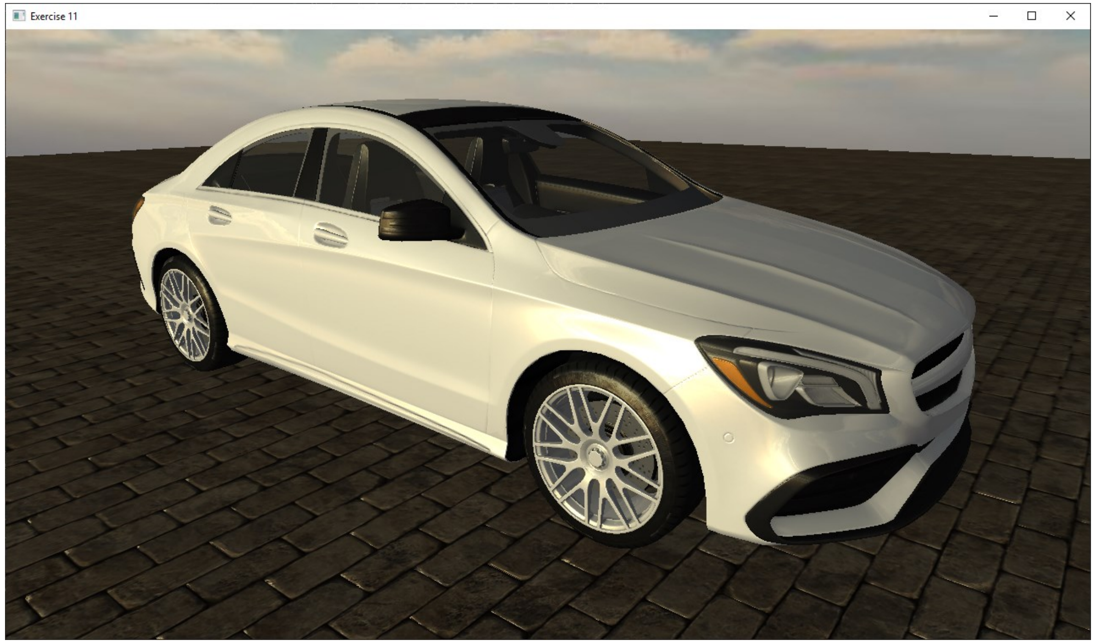




Exercise 10.4 part 1

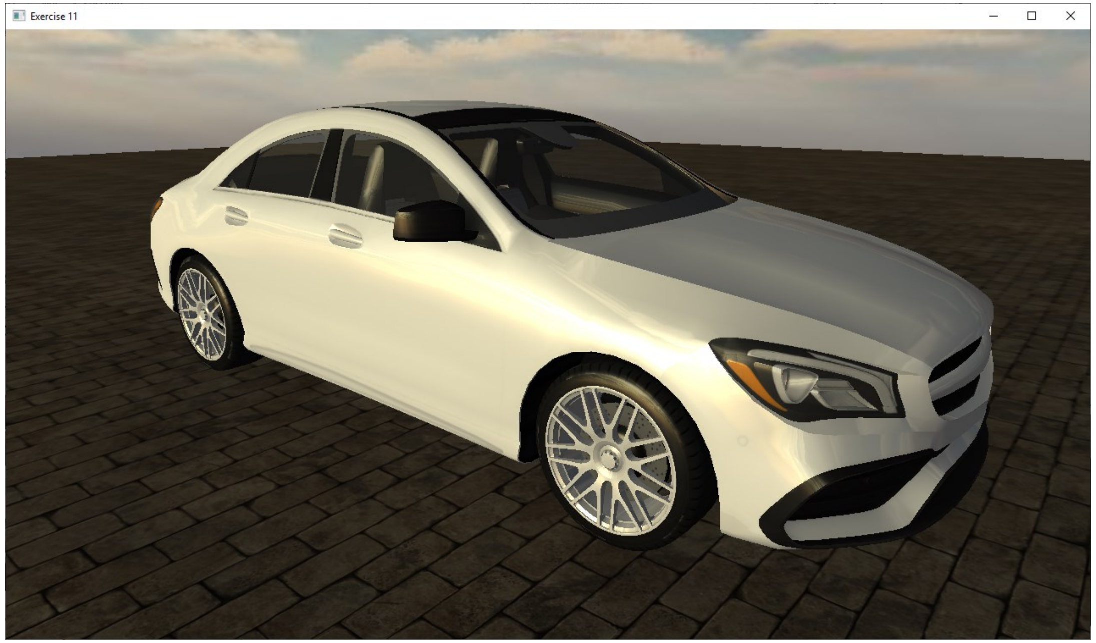
- Normal mapping
  - In the vertex shader:
    - Build a **TBN matrix** that transforms from world space to tangent space;
    - **Transform vectors and positions** used for light calculation from world space to tangent space;
  - In the fragment shader
    - **Sample the normal map** texture and use it for light calculation;

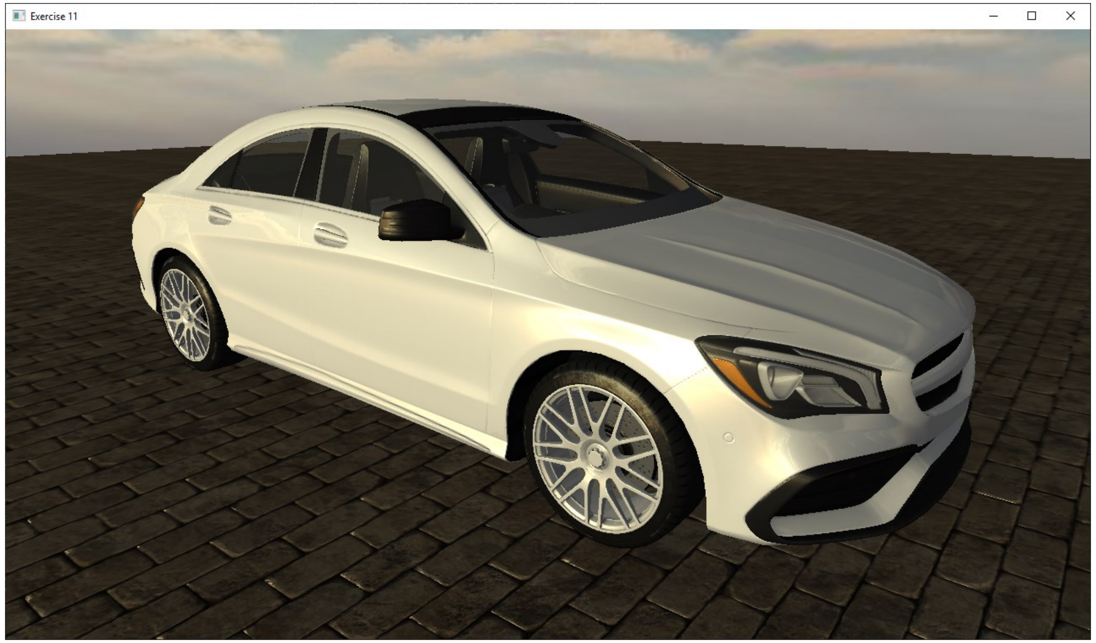




Exercise 10.4 part 2

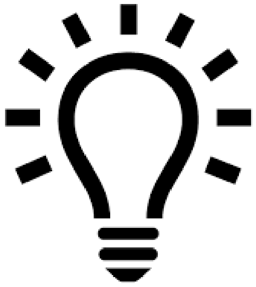
- Normal mapping
  - Environment mapping reflection will break since sampling direction is defined in world coordinates:
    - Send the **inverse TBN matrix** to the fragment shader;
    - Transform the normal from **tangent to world space** and use it for reflection mapping.



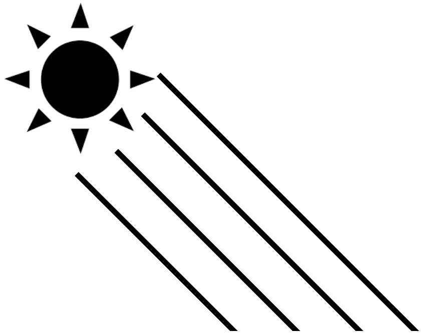


New light caster

- Point source
  - Model with position and color



- Directional light
  - Distant source = infinite distance away (parallel rays)
  - No attenuation



More at https://learnopengl.com/Lighting/Light-casters