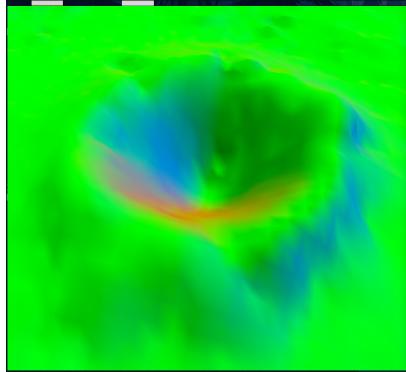


Assignment 3

Peter Johan Flått-Bjørnstad (Individual, Group 32)

Task 1

c)



File Edit Selection View Go Run Terminal Help

shaders > simple.vert

```
1 static mut uniform matrix_location: i32 = 0;
|     ^^^^^^^^^^^^^^^^^^ help: convert the identifier to upper case: 'UNIFORM_MATRIX_LOCATION'
warning: gloom-rs' (bin "gloom-rs") generated 21 warnings
    Finished dev [unoptimized + debuginfo] target(s) in 2.50s
    Running `target/debug/gloom-rs`
New window size! width: 800, height: 600
AMD: AMD Radeon Graphics (renoir, LLVM 15.0.7, DRM 3.52, 6.4.6 -76060a0e-generic)
OpenGL : 4.6 (Core Profile) Mesa 23.1.3-ipop0~1689084530~22.0
4-0618746
GLSL : 4.60
Loading terrain model...
New window size! width: 800, height: 637
New window size! width: 564, height: 512
Done in 609.200ms.
Loaded terrain with 47285 points and 93287 triangles.
Loading helicopter model...
Done in 865.710ms!
Loaded Main_Rotor_main_rotor with 2467 points and 1764 triangles.
Loaded Tail_Rotor_tail_rotor with 548 points and 312 triangles.
.
.
.
Loaded Body_body with 77988 points and 71736 triangles.
Loaded Door_door with 780 points and 662 triangles.
Resized
```

shaders > normalfrag.u

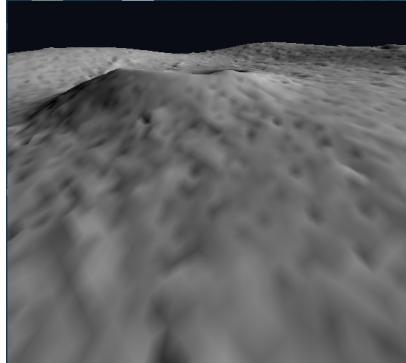
```
1 #version 430 core
2
3 in vec3 fragment_normal;
4 out vec4 color;
5
6 void main()
7 {
8     color = vec4(fragment_normal, 1.0f);
9 }
```

main.rs 9+M

```
src > main.rs > create_vao
152     if normals.len() > 0 {
153         let n_nbo: i32 = 1;
154         let mut nbo_ids: u32 = 0;
155
156         gl::GenBuffers(n_nbo, buffers:&mut nbo_ids);
157         gl::BindBuffer(target:gl::ARRAY_BUFFER, buffer:nbo_ids);
158
159         // Fill NBO with data
160         gl::BufferData(
161             target:gl::ARRAY_BUFFER,
162             size:byte_size_of_array(vals: normals),
163             data:pointer_to_array(vals: normals),
164             usage:gl::STATIC_DRAW,
165         );
166
167         // Configure a VAP for the vertex-color and enable it
168         gl::VertexAttribPointer(
169             index:vap_index + 2,
170             size:3,
171             type:gl::FLOAT,
172             normalized:gl::FALSE,
173             stride:0 * size_of::<i32>(),
174             pointer:offset::<i32>(0),
175         );
176         gl::EnableVertexAttribArray(index:vap_index + 2);
177     }
178 }
```

You, 43 seconds ago Ln 161, Col 28 Spaces: 4 UTF-8 LF Rust Prettier

d)



File Edit Selection View Go Run Terminal Help

shaders > sunlight.frag

```
1 static mut uniform matrix_location: i32 = 0;
|     ^^^^^^^^^^^^^^^^^^ help: convert the identifier to upper case: 'UNIFORM_MATRIX_LOCATION'
warning: gloom-rs' (bin "gloom-rs") generated 21 warnings
    Finished dev [unoptimized + debuginfo] target(s) in 0.06s
    Running `target/debug/gloom-rs`
New window size! width: 800, height: 600
AMD: AMD Radeon Graphics (renoir, LLVM 15.0.7, DRM 3.52, 6.4.6 -76060a0e-generic)
OpenGL : 4.6 (Core Profile) Mesa 23.1.3-ipop0~1689084530~22.0
4-0618746
GLSL : 4.60
Loading terrain model...
New window size! width: 800, height: 637
New window size! width: 564, height: 512
Done in 593.351ms.
Loaded terrain with 47285 points and 93287 triangles.
Loading helicopter model...
Done in 828.029ms!
Loaded Main_Rotor_main_rotor with 2467 points and 1764 triangles.
Loaded Tail_Rotor_tail_rotor with 548 points and 312 triangles.
.
.
.
Loaded Body_body with 77988 points and 71736 triangles.
Loaded Door_door with 780 points and 662 triangles.
Resized
```

main.rs 9+M

```
src > main.rs > main
367     let mut scene_node: ManuallyDrop<PinBox<SceneNode>> = SceneNode::new();
368     scene_node.add_child(&terrain_node);
369
370     // === Set up your shaders here
371
372     // uniform time used for changing.frag
373     let mut uniform_time: f32 = 0.;
374     let mut uniform_matrix: glm::Mat4;
375     // Create shader object
376     let simple_shader: Shader = unsafe {
377         Shader::ShaderBuilder::new() ShaderBuilder
378             .attach_file(shader_path: "./shaders/simple.vert") ShaderBuilder
379             .attach_file(shader_path: "./shaders/sunlight.frag") ShaderBuilder
380             .link()
381     };
382
383     // Set bindings for shader, VAO and uniform variable
384     unsafe {
385         simple_shader.activate();
386         // gl::BindVertexArray(my_vao);
387         uniform_time_location = simple_shader.get_uniform_location(name: "time");
388         uniform_matrix_location = simple_shader.get_uniform_location(name: "matrix");
389     };
390
391     let fovy: f32 = 20.;
392     let near: f32 = 1.;
393     let far: f32 = 1000.;

        let mut camera_pos: Position = Position {
396         x: 0.,
397         y: 0.,
398         z: 0.
399     };

    GLSL Lint: Failed to spawn 'glslangValidator' binary. Error: spawn glslangValidator failed: No such file or directory
```

Ln 12, Col 2 Spaces: 4 UTF-8 LF GLSL Prettier

Task 2

c)



```
76 | static mut uniform_matrix_location: i32 = 0;
  ^^^^^^^^^^^^^^^^^^ help: convert the identifier to upper case: 'UNIFORM_MATRIX_LOCATION'
warning: `gloom-rs` (bin "gloom-rs") generated 21 warnings
  Finished dev [unoptimized + debuginfo] target(s) in 2.49s
    Running `target/debug/gloom-rs`
New window size! width: 800, height: 600
AMD: AMD Radeon Graphics (renoir, LLVM 15.0.7, DRM 3.52, 6.4.6
-76060406-generic)
OpenGL: 4.6 (Core Profile) Mesa 23.1.3-1pop0-1689084530-22.0
4-0618746
GLSL: 4.60
Loading terrain model...
New window size! width: 800, height: 637
New window size! width: 564, height: 512
Done in 595.561ms.
Loaded terrain with 47285 points and 93287 triangles.
Loading helicopter model...
Loaded Main_Rotor_main_rotor with 2467 points and 1764 triangles.
Loaded Tail_Rotor_tail_rotor with 548 points and 312 triangles
Loaded Body_body with 77908 points and 71736 triangles.
Loaded Door_door with 780 points and 662 triangles.
Resized
```

```
src > @ main.rs > main > draw_scene
453 unsafe fn draw_scene(
454     node: &SceneNode,
455     view_projection_matrix: &glm::Mat4,
456     transformation_so_far: &glm::Mat4,
457 ) {
458     // Check if node is drawable, if so: set uniforms, bind VAO and draw VAO
459     if node.vao_id != 0 {
460         gl::BindVertexArray(array: node.vao_id);
461         gl::DrawElements(
462             mode: gl::TRIANGLES,
463             node.index_count,
464             type: gl::UNSIGNED_INT,
465             indices: 0 as *const _,
466         );
467     }
468     // Recurse
469     for &child: *mut SceneNode in &node.children {
470         draw_scene(node: &child, view_projection_matrix, &transformation_so_far);
471     }
472 }
473
474 // The main rendering loop
475 let first frame time: Instant = std::time::Instant::now();
src > @ main.rs > main > draw_scene
476
477 gl::ClearColor(red: 0.035, green: 0.046, blue: 0.078, alpha: 1.0); // night sky, full opacity
478 gl::Clear(mask: gl::COLOR_BUFFER_BIT | gl::DEPTH_BUFFER_BIT);
479
480 // Issue the necessary gl:: commands to draw your scene here
481 perspective = glm::perspective(aspect: window.aspect_ratio, fovy, near, far);
482
483 // Update uniform variables
484 perspective *= pitch_camera;
485 perspective *= yaw_camera;
486 perspective *= translate_camera;
487 perspective *= move_z;
488
489 gl::Uniformf(uniform_time_location, v0: elapsed);
490
491 gl::UniformMatrix4fv(uniform_matrix_location, count: 1, transpose: gl::FALSE, value: perspective.as_ptr());
492
493 draw_scene(&scene_node, view_projection_matrix: &perspective, transformation_so_far: &glm::identity());
494
495 // Display the new color buffer on the display
496 context.swap buffers().unwrap(); // we use "double buffering" to avoid artifacts
497 }
```

You, 49 seconds ago Ln 470, Col 36 Spaces: 4 UTF-8 LF Rust Prettier

Task 5

a)

0 deg rotation:



```
76 | static mut uniform_matrix_location: i32 = 0;
  ^^^^^^^^^^^^^^^^^^ help: convert the identifier to upper case: 'UNIFORM_MATRIX_LOCATION'
warning: `gloom-rs` (bin "gloom-rs") generated 24 warnings
  Finished dev [unoptimized + debuginfo] target(s) in 2.98s
    Running `target/debug/gloom-rs`
New window size! width: 800, height: 600
AMD: AMD Radeon Graphics (renoir, LLVM 15.0.7, DRM 3.52, 6.4.6
-76060406-generic)
OpenGL: 4.6 (Core Profile) Mesa 23.1.3-1pop0-1689084530-22.0
4-0618746
GLSL: 4.60
Loading terrain model...
New window size! width: 800, height: 637
New window size! width: 564, height: 512
Done in 592.659ms.
Loaded terrain with 47285 points and 93287 triangles.
Loading helicopter model...
Done in 819.945ms!
Loaded Main_Rotor_main_rotor with 2467 points and 1764 triangles.
Loaded Tail_Rotor_tail_rotor with 548 points and 312 triangles
Loaded Body_body with 77908 points and 71736 triangles.
Loaded Door_door with 780 points and 662 triangles.
Resized
```

```
src > @ main.rs > main > draw_scene
418 unsafe fn draw_scene(
419     node: &SceneNode,
420     view_projection_matrix: &glm::Mat4,
421     transformation_so_far: &glm::Mat4,
422 ) {
423     let position transformation: Matrix<f32, Const<4>, Const<4>, ...> = glm::translation(&glm::vec3(
424         node.position.x,
425         node.position.y,
426         node.position.z,
427     ));
428
429     let rotation transformation: Matrix<f32, Const<4>, Const<4>, ...> = // Comment here to get nice formatting
430         glm::translation(&glm::vec3(
431             node.reference_point.x,
432             node.reference_point.y,
433             node.reference_point.z,
434         )) // Comment there to get nice formatting
435         * glm::rotation(angle: node.rotation.x, v: &glm::vec3(x: 1., y: 0., z: 0.))
436         * glm::rotation(angle: node.rotation.y, v: &glm::vec3(x: 0., y: 1., z: 0.))
437         * glm::rotation(angle: node.rotation.z, v: &glm::vec3(x: 0., y: 0., z: 1.))
438         * glm::translation(&glm::vec3(
439             -node.reference_point.x,
440             -node.reference_point.y,
441             -node.reference_point.z,
442         ));
443
444     // Perform any logic needed before drawing the node
445     let next_transformation: glm::Mat4 =
446         transformation_so_far * position_transformation * rotation_transformation;
447
448     // Check if node is drawable, if so: set uniforms, bind VAO and draw VAO
449     if node.vao_id != 0 {
450         let uniform matrix: Matrix<i32, Const<4>, Const<4>, ...> = view_projection_matrix * next_transformation;
451         gl::UniformMatrix4fv(
452             uniform_matrix_location,
453             count: 1,
454             transpose: gl::FALSE,
455             value: uniform_matrix.as_ptr(),
456         );
457
458         gl::BindVertexArray(array: node.vao_id);
459         gl::DrawElements()
460     }
461
462     unsafe {
463         heli_body.node.rotation.y = 0.5 * elapsed;
464     }
465 }
```

Peder Bergbakk Sundt, 24 months ago Ln 606, Col 44 Spaces: 4 UTF-8 LF Rust Prettier

180 deg rotation:

```
76 | static mut UNIFORM_MATRIX_LOCATION: i32 = 0;
    ^^^^^^^^^^^^^^^^^^^^^^ help: convert identifier to upper case: "UNIFORM_MATRIX_LOCATION"
warning: gloom-rs` (bin "gloom-rs") generated 24 warnings
  Finished dev [unoptimized + debuginfo] target(s) in 2.98s
  Running `target/debug/gloom-rs`
New window size! width: 800, height: 600
AMD RADEON Graphics (renoir, LLVM 15.0.7, DRM 3.52, 6.4.6-16890846-generic)
OpenGL 4.6 (Core Profile) Mesa 23.1.3-1pop0-1689084530-20.0.4-618746
GLSL: 4.60
Loading terrain model...
New window size! width: 800, height: 637
New window size! width: 564, height: 512
Done in 592.65ms.
Loaded terrain with 47285 points and 93287 triangles.
Loading helicopter model...
Done in 819.945ms!
Loaded Main_Rotor_main_rotor with 2467 points and 1764 triangles.
Loaded Tail_Rotor_tail_rotor with 548 points and 312 triangles.
Loaded Body_body with 77988 points and 21736 triangles.
Loaded Door_door with 780 points and 662 triangles.
Resized
```



Screenshot captured

```
src > @ main.rs > .....
```

```
418     unsafe fn draw_scene(
419         node: &SceneGraph::SceneNode,
420         view_projection_matrix: &glm::Mat4,
421         transformation_so_far: &glm::Mat4,
422     ) {
423         let position_transformation: Matrix<f32, Const<4>, Const<4>, _> = glm::translation(&glm::vec3(
424             node.position.x,
425             node.position.y,
426             node.position.z,
427         ));
428
429         let rotation_transformation: Matrix<f32, Const<4>, Const<4>, _> = // Comment here to get nice formatting
430             glm::translation(&glm::vec3(
431                 node.reference_point.x,
432                 node.reference_point.y,
433                 node.reference_point.z,
434             )) // Comment there to get nice formatting
435             * glm::rotation(angle: node.rotation.x, v: &glm::vec3(x: 1., y: 0., z: 0.))
436             * glm::rotation(angle: node.rotation.y, v: &glm::vec3(x: 0., y: 1., z: 0.))
437             * glm::rotation(angle: node.rotation.z, v: &glm::vec3(x: 0., y: 0., z: 1.))
438             * glm::translation(&glm::vec3(
439                 -node.reference_point.x,
440                 -node.reference_point.y,
441                 -node.reference_point.z,
442             ));
443
444         // Perform any logic needed before drawing the node
445         let next_transformation: glm::Mat4 =
446             transformation_so_far * position_transformation * rotation_transformation;
447
448         // Check if node is drawable, if so: set uniforms, bind VAO and draw VAO
449         if node.vao_id != 0 {
450             let uniform_matrix: Matrix<f32, Const<4>, Const<4>, _> = view_projection_matrix * next_transformation;
451             gl::UniformMatrix4fv(
452                 uniform_matrix_location,
453                 count: 1,
454                 transpose: gl::FALSE,
455                 value: uniform_matrix.as_ptr(),
456             );
457
458             gl::BindVertexArray(array: node.vao_id);
459             gl::DrawElements(

```

Background is obviously lit while the helicopter is not

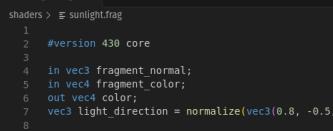
c)

0 deg rotation:

```
77 | static_mut uniform_normal_matrix_location: i32 = 0;
| ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^ help; convert t
he identifier to upper case: `UNIFORM_NORMAL_MATRIX_LOCATION`  

warning: 'gloom-rs' (bin "gloom-rs") generated 25 warnings
  Finished dev [unoptimized + debuginfo] target(s) in 3.25s
    Running `target/debug/gloom-rs`
New window size! width: 800, height: 600
AMD: Amd Radeon Graphics (renoir, LLVM 15.0.7, DRM 3.52, 6.4.6
-7666640e-generic)
OpenGL : 4.6 (Core Profile) Mesa 23.1.3-ipop0-1689084530-22.0
-6818746
Resizing to 4x4
Loading terrain model...
New window size! width: 800, height: 637
New window size! width: 564, height: 512
Done in 582.378ms
Loaded terrain with 47285 points and 93287 triangles.
Loading helicopter model...
Done in 823.282ms!
Loaded Main_Rotor_main_rotor with 2467 points and 1764 triangles.
Loaded Tail_Rotor_tail_rotor with 548 points and 312 triangles
.
Loaded Body_body with 77988 points and 71736 triangles.
Loaded Door_door with 780 points and 662 triangles.
Resized
```





```
File Edit Selection View Go Run Terminal Help
sunlight.frag x
Shaders > sunlight.frag
1 #version 430 core
2
3 in vec3 fragment_normal;
4 in vec4 fragment_color;
5 out vec4 color;
6
7 vec3 light_direction = normalize(vec3(0.8, -0.5, 0.6));
8
9 uniform mat4 normal_matrix;
10
11 void main()
12 {
13     color = fragment_color * vec4(vec3(1.0f, 1.0f, 1.0f));
14 }
15
```

```
src / main.rs > main
452 let uniform_matrix: Matrix<f32, Const<4>,
453     gl::UniformMatrix4fv(
454         uniform_matrix_location,
455         count: 1,
456         transpose: gl::FALSE,
457         value: uniform_matrix.as_ptr(),
458     );
459
460
461 gl::UniformMatrix4fv(
462     uniform_normal_matrix_location,
463     count: 1,
464     transpose: gl::FALSE,
465     value: next_transformation.as_ptr());
466
467 gl::BindVertexArray(array: node.vao_id);
468 gl::DrawElements(
469     mode: gl::TRIANGLES,
470     node.index_count,
471     type: gl::UNSIGNED_INT,
472     indices: 0 as *const _,
473 )

```

180 deg rotation:



File Edit Selection View Go Run Terminal Help

sunlight.frag.v x

```
shaders > sunlight.frag
1 #version 430 core
2
3 in vec3 fragment_normal;
4 in vec4 fragment_color;
5 out vec4 color;
6
7 vec3 light_direction = normalize(vec3(0.8, -0.5, 0.6));
8
9 uniform mat4 normal_matrix;
10
11 void main()
12 {
13     color = fragment_color * vec4(fragment_color * vec3(1.0f, 1.0f, 1.0f) * max(0, dot(normalize(normal_matrix * fragment_normal), -light_d
14 })
15 }
```

main.rs * M x

```
src > main.rs > main
let uniform matrix: Matrix<f32, Const<4>, Const<4>, _> = view_projection_matrix * next_transformation;
gl::UniformMatrix4fv(
    uniform_matrix_location,
    count: 1,
    transpose: gl::FALSE,
    value: UniformMatrix.as_ptr(),
);
gl::UniformMatrix4fv(
    uniform_normal_matrix_location,
    count: 1,
    transpose: gl::FALSE,
    value: next_transformation.as_ptr(),
);
gl::BindVertexArray(array: node.vao_id);
gl::DrawElements(
    mode: gl::TRIANGLES,
    node.index_count,
    type: gl::UNSIGNED_INT,
    indices: 0 as *const _,
)
```

main.rs * M x

```
src > main.rs > main
```

Ln 12, Col 2 Spaces: 4 UTF-8 LF GLSL ✓ Prettier

It works!

Task 6

a)



File Edit Selection View Go Run Terminal Help

main.rs * M x

```
src > main.rs > main
let helicopter_mesh: Helicopter = mesh::Helicopter::load(path: "./resources/helicopter.obj");
let heli_body_vao: U32 = unsafe { create_vao_from_mesh(&helicopter_mesh.body) };
let heli_door_vao: U32 = unsafe { create_vao_from_mesh(&helicopter_mesh.door) };
let heli_main_rotor_vao: U32 = unsafe { create_vao_from_mesh(&helicopter_mesh.main_rotor) };
let heli_tail_rotor_vao: U32 = unsafe { create_vao_from_mesh(&helicopter_mesh.tail_rotor) };

let mut helicopter_nodes: Vec<HelicopterNode> = Vec::new();
for _ in 0..5 {
    let mut heli_body_node: ManuallyDrop<PinBox<SceneNode>> =
        SceneNode::FromVao(vao_id: heli_body_vao, index_count: helicopter_mesh.body.indices.len() as i32);
    let mut heli_door_node: ManuallyDrop<PinBox<SceneNode>> =
        SceneNode::FromVao(vao_id: heli_door_vao, index_count: helicopter_mesh.door.indices.len() as i32);
    let mut heli_main_rotor_node: ManuallyDrop<PinBox<SceneNode>> =
        SceneNode::FromVao(vao_id: heli_main_rotor_vao, index_count: helicopter_mesh.main_rotor.indices.len() as i32);
    let mut heli_tail_rotor_node: ManuallyDrop<PinBox<SceneNode>> =
        SceneNode::FromVao(vao_id: heli_tail_rotor_vao, index_count: helicopter_mesh.tail_rotor.indices.len() as i32);

    heli_main_rotor_node.reference_point = gl::vec3(x: 0.35, y: 2.3, z: 10.4);

    heli_body_node.add_child(&mut heli_door_node);
    heli_body_node.add_child(&mut heli_main_rotor_node);
    heli_body_node.add_child(&mut heli_tail_rotor_node);
}
helicopter_nodes.push(HelicopterNode {
    body: heli_body_node,
}
```

main.rs * M x

```
src > main.rs > main
for (i: usize, h: &mut HelicopterNode) in helicopter_nodes.iter_mut().enumerate() {
    let lap: f32 = 2. * std::f32::consts::PI;
    let heading: Heading = toolbox::simple_heading_animation(
        time: elapsed + lap / (helicopter_nodes_n as f32) * (i as f32),
    );
    h.body.position.x = heading.x;
    h.body.position.z = heading.z;
    h.body.rotation.x = heading.pitch;
    h.body.rotation.z = heading.roll;
    h.body.rotation.y = heading.yaw;
}
```

main.rs * M x

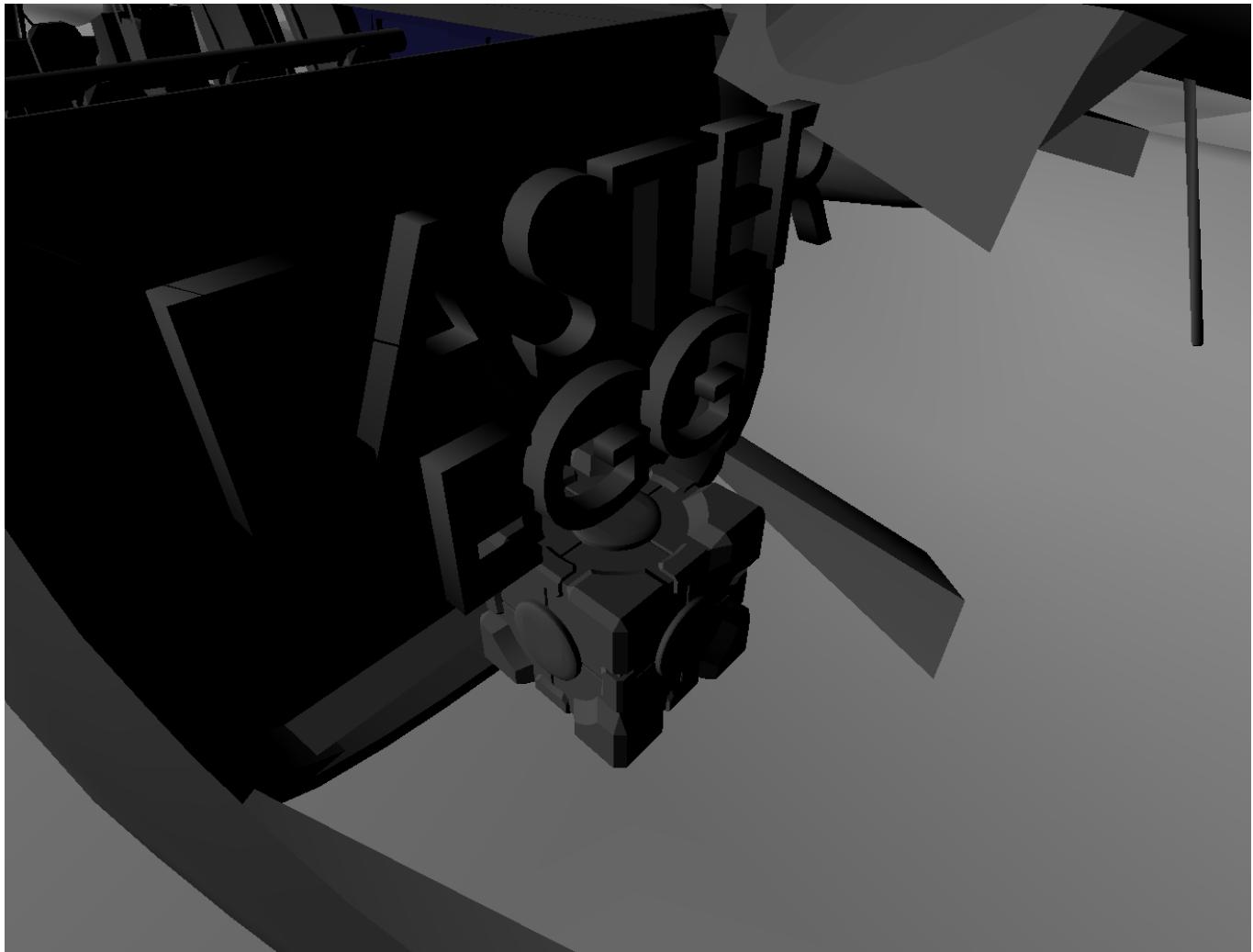
```
src > main.rs > main
unsafe {
```

You, 26 seconds ago · Uncommitted changes

Ln 380, Col 1 Spaces: 4 UTF-8 LF Rust ✓ Prettier

Task 7

f)



Companion aquired<3