

# TDT4195 Exercise 1

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## 1 Task 1

### 1.1 a)

In code

### 1.2 b)

In code

### 1.3 c)

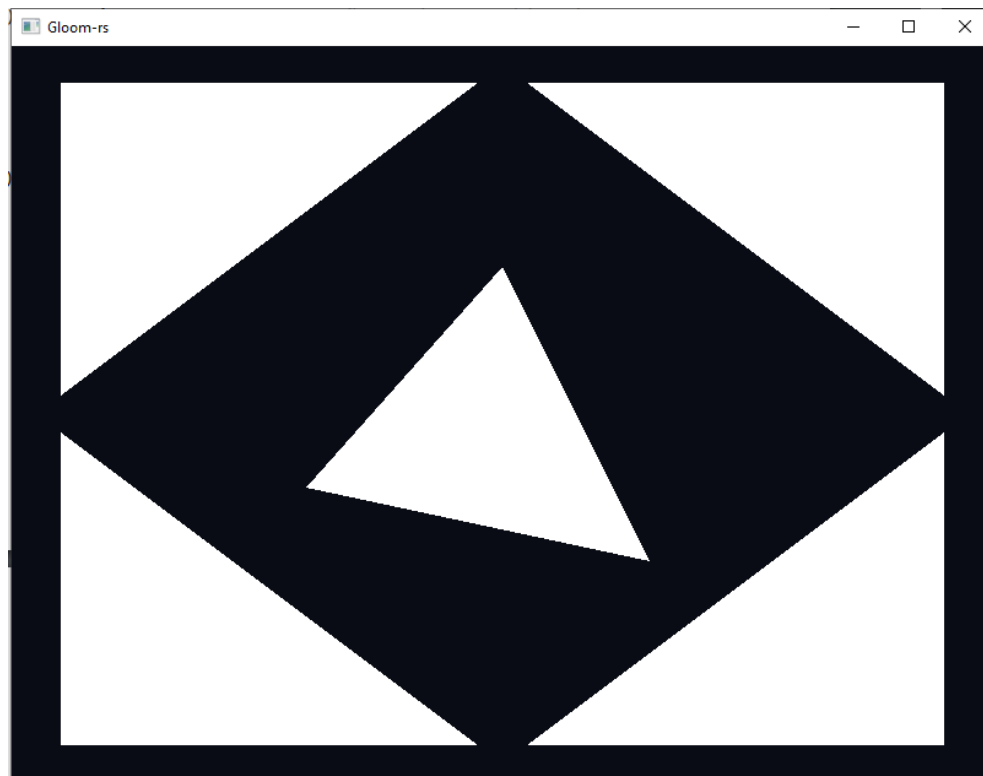


Figure 1: 5 distinct triangles

## 2 Task 2

### 2.1 a)

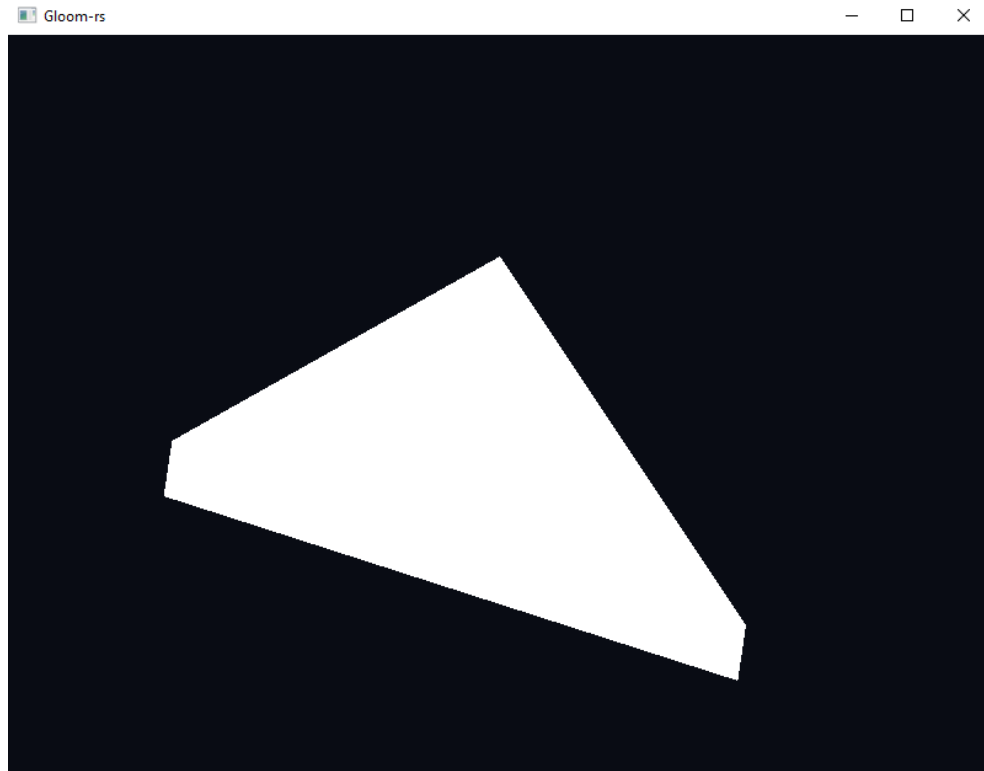


Figure 2: clipping

#### 2.1.1 i

The phenomenon is called clipping

#### 2.1.2 ii

Clipping occurs when the triangle is drawn outside the clip space, -1.0 to 1.0 in the x, y and z axis

#### 2.1.3 iii

Clipping is done for performance reasons, avoiding unnecessary rendering of geometry that the user cannot see.

### 2.2 b)

#### 2.2.1 i

The triangle disappears

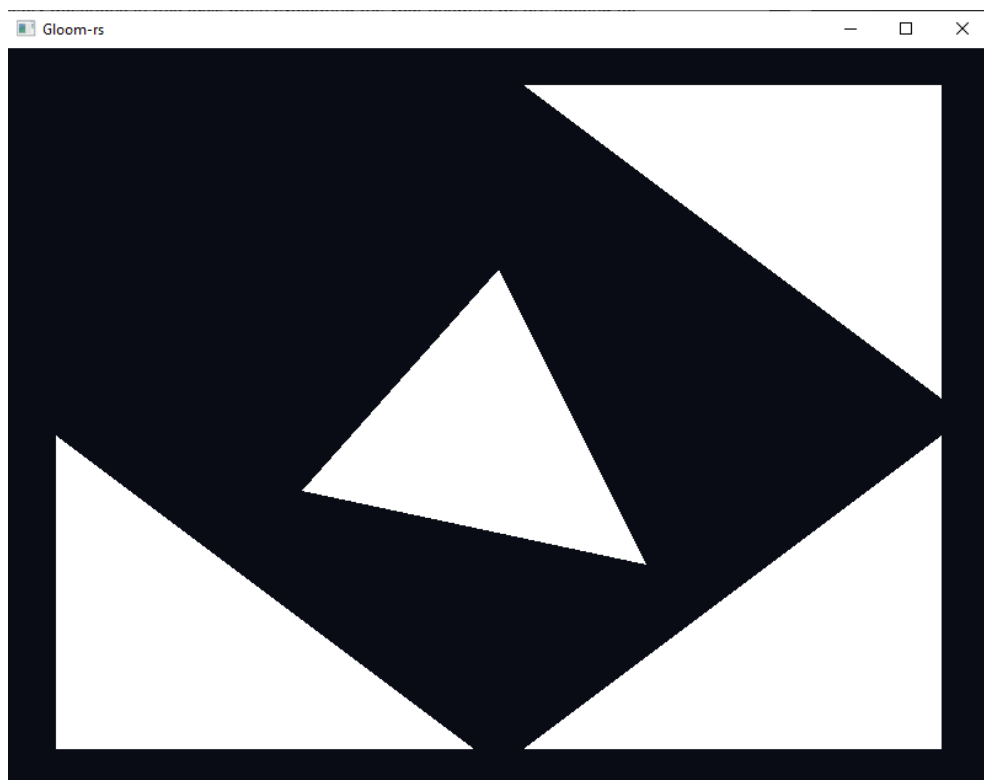


Figure 3: culling

### **2.2.2 ii**

It happens because of culling. Culling is a technique used to prevent drawing sides of a 3d object which are not visible to the user which increases performance.

### **2.2.3 iii**

By default culling happens if the vertices of a triangle are not rendered in counter-clockwise order.

## **2.3 c)**

### **2.3.1 i**

The depth buffer is used to know which triangles should render on top of the other so that the correct one is visible in that single frame. If we don't clear the buffer some triangles might compare to the previous frame, which could cause some triangles to render when they should not - or vice versa.

### **2.3.2 ii**

### **2.3.3 iii**

Vertex shaders and fragment shaders. The vertex shader transforms vertices and projects the scene to the camera. The fragment shader determines the color of every fragment in the scene.

### **2.3.4 iv**

Index buffers are used so that one vertex can be used multiple times as connecting triangles have overlapping vertices.

### **2.3.5 v**

The offset is used in case you want to have multiple different attributes in the same vertex buffer. You would then specify the offset this attribute starts on.

## **2.4 d)**

### **2.4.1 i**

Changed the values of the color vector in the fragment shader.

### **2.4.2 ii**

Multiplied the position vector in the vertex shader by a `vec4[-1,-1,1,1]` to invert the x and y axis

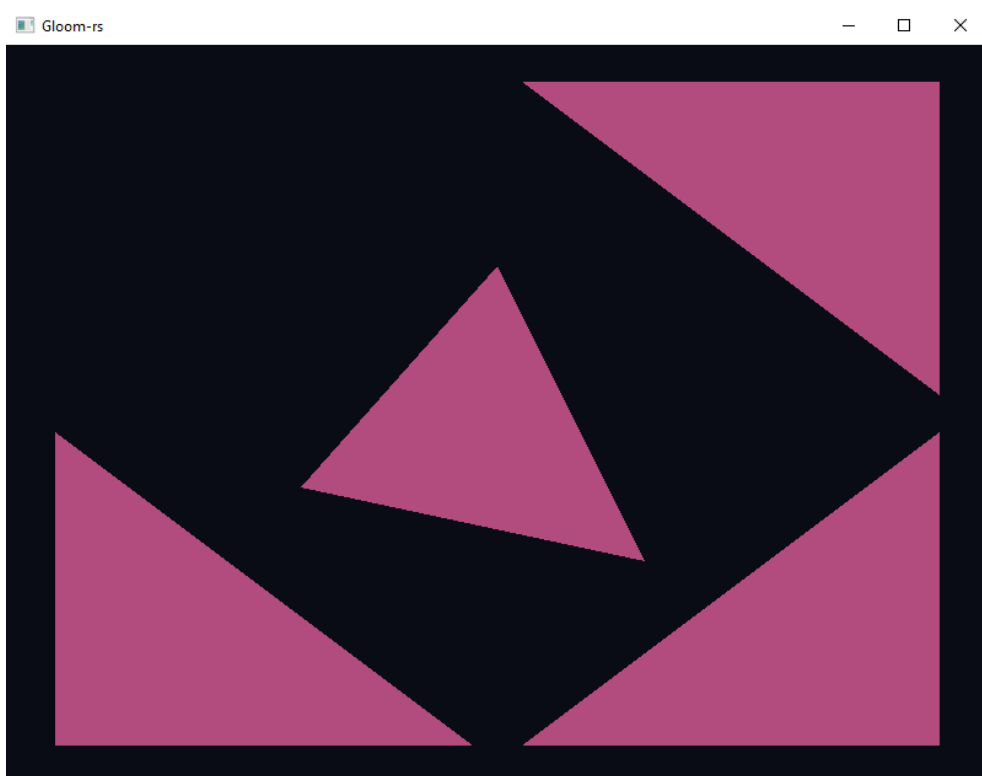


Figure 4: Colored triangles

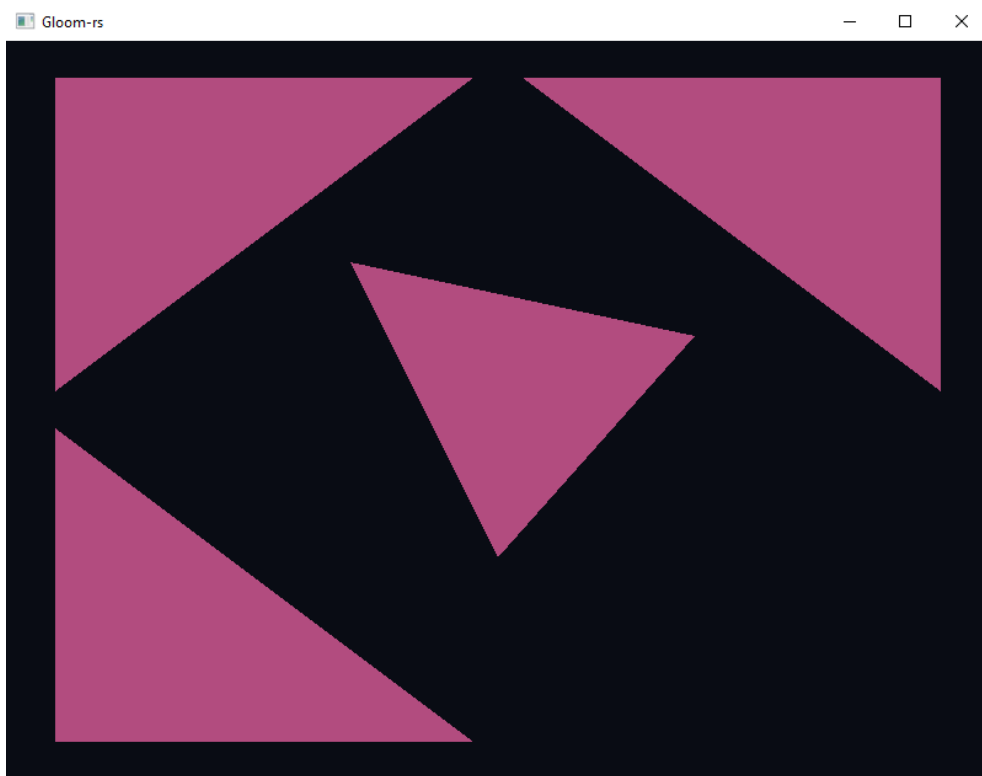


Figure 5: Mirrored and flipped image