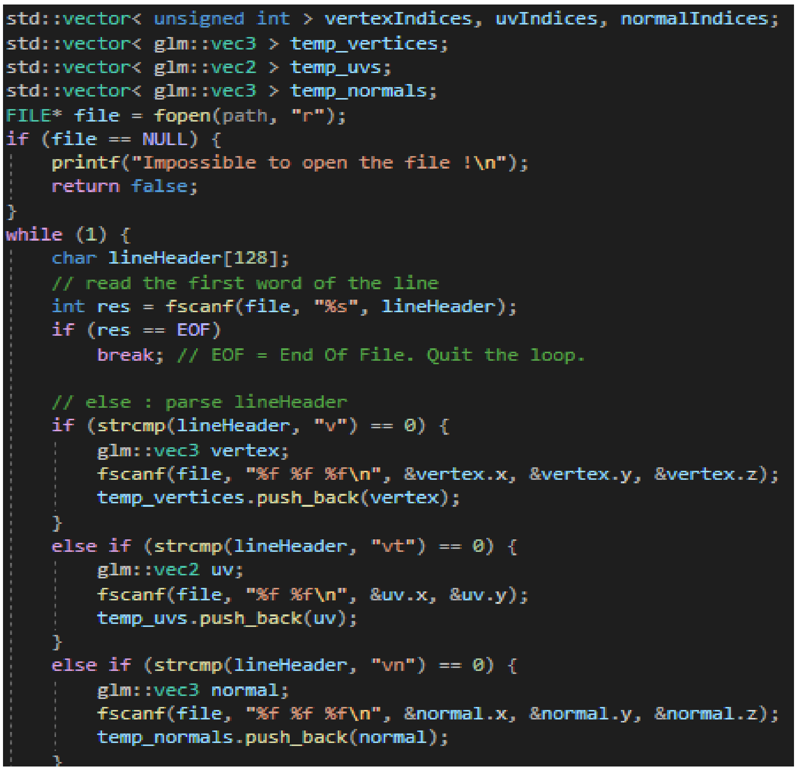
Grupa: IO gr.1	Ćwiczenie: Lab 8	Imię Nazwisko: Malwina Cieśla
Wizualizacja Danych		

Cel ćwiczenia:

Zapoznanie z zagadnieniami parsowania plików obj.

Przebieg ćwiczenia:

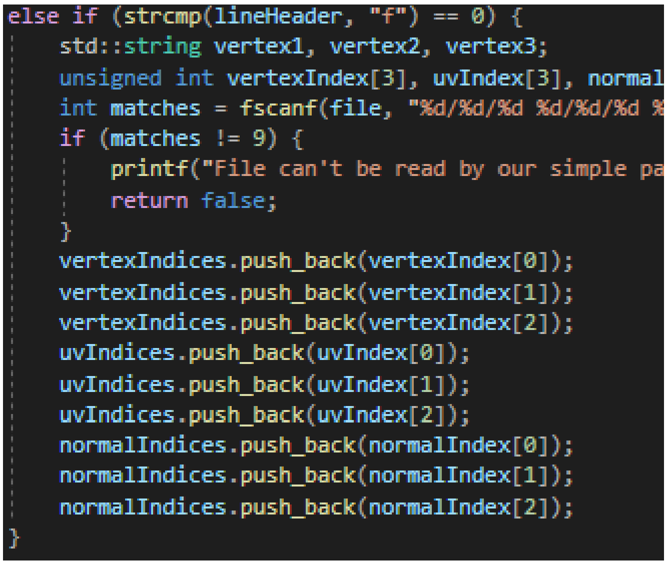
W celu realizacji ćwiczenia należało w programie Blender stworzyć figury stołu wraz z krzesłem, a następnie wyexportować do pliku .obj pamiętając o wcześniejszym pogrupowaniu obiektów oraz o kliknięciu triangulacji podczas exportowania. Następnie w kodzie należało stworzyć funkcję wczytującą plik z rozszerzeniem .obj:



```
std::vector< unsigned int > vertexIndices, uvIndices, normalIndices;
std::vector< glm::vec3 > temp_vertices;
std::vector< glm::vec2 > temp_uvs;
std::vector< glm::vec3 > temp_normals;
FILE* file = fopen(path, "r");
if (file == NULL) {
    printf("Impossible to open the file !\n");
    return false;
}
while (1) {
    char lineHeader[128];
    // read the first word of the line
    int res = fscanf(file, "%s", lineHeader);
    if (res == EOF)
        break; // EOF = End Of File. Quit the loop.

    // else : parse lineHeader
    if (strcmp(lineHeader, "v") == 0) {
        glm::vec3 vertex;
        fscanf(file, "%f %f %f\n", &vertex.x, &vertex.y, &vertex.z);
        temp_vertices.push_back(vertex);
    }
    else if (strcmp(lineHeader, "vt") == 0) {
        glm::vec2 uv;
        fscanf(file, "%f %f\n", &uv.x, &uv.y);
        temp_uvs.push_back(uv);
    }
    else if (strcmp(lineHeader, "vn") == 0) {
        glm::vec3 normal;
        fscanf(file, "%f %f %f\n", &normal.x, &normal.y, &normal.z);
        temp_normals.push_back(normal);
    }
```

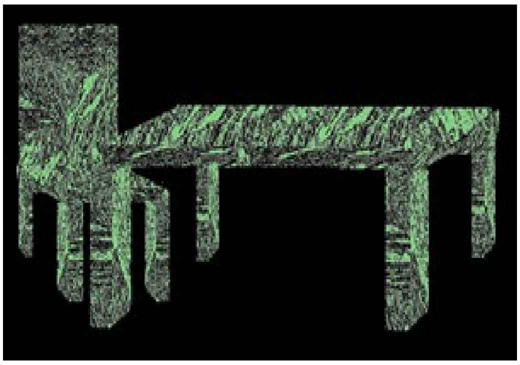
Ilustracja 1: Fragment funkcji



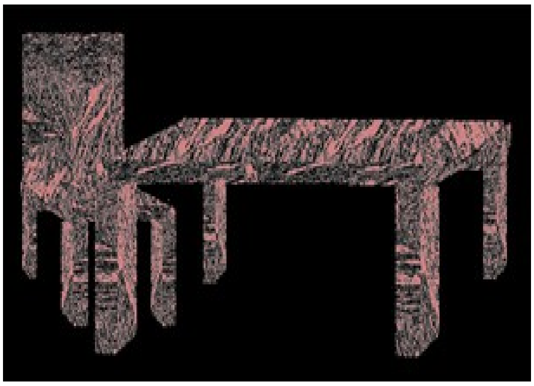
```
else if (strcmp(lineHeader, "f") == 0) {
    std::string vertex1, vertex2, vertex3;
    unsigned int vertexIndex[3], uvIndex[3], normal
    int matches = fscanf(file, "%d/%d/%d %d/%d/%d %
    if (matches != 9) {
        printf("File can't be read by our simple pa
        return false;
    }
    vertexIndices.push_back(vertexIndex[0]);
    vertexIndices.push_back(vertexIndex[1]);
    vertexIndices.push_back(vertexIndex[2]);
    uvIndices.push_back(uvIndex[0]);
    uvIndices.push_back(uvIndex[1]);
    uvIndices.push_back(uvIndex[2]);
    normalIndices.push_back(normalIndex[0]);
    normalIndices.push_back(normalIndex[1]);
    normalIndices.push_back(normalIndex[2]);
}
```

Ilustracja 2: Fragment funkcji

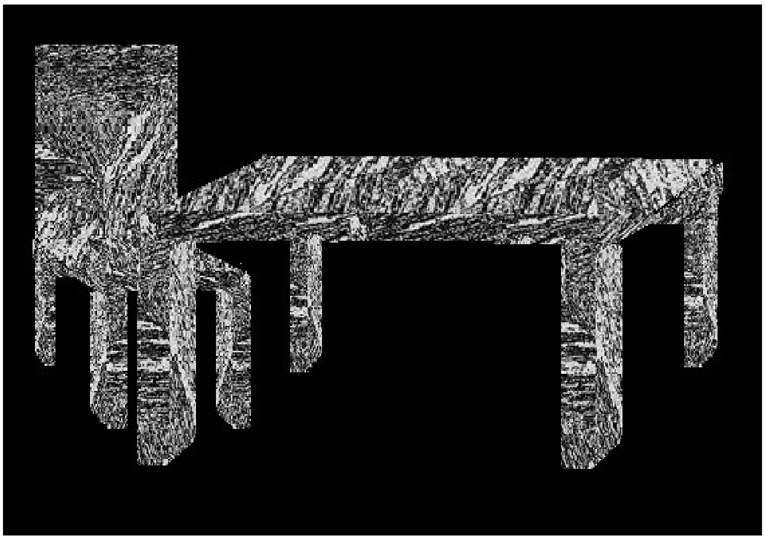
Następnie należało dodać możliwość wyświetlania obrazu w różnych kolorach, które uzyskałam przy zmianie klawiszy numerycznych. Użyłam kolorów czerwony, zielony oraz niebieski:



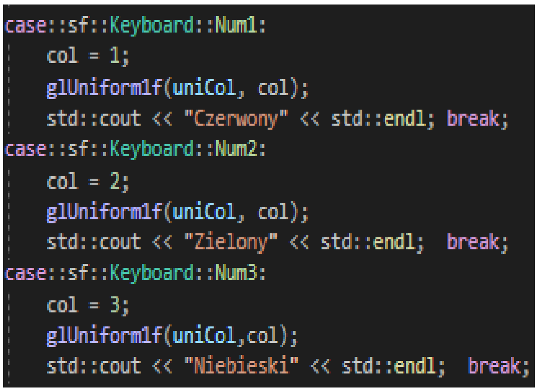
Ilustracja 4: Kolor zielony



Ilustracja 3: Kolor czerwony



Ilustracja 5: Obrazek bez zmienionych kolorów



```
case::sf::Keyboard::Num1:
    col = 1;
    glUniform1f(uniCol, col);
    std::cout << "Czerwony" << std::endl; break;
case::sf::Keyboard::Num2:
    col = 2;
    glUniform1f(uniCol, col);
    std::cout << "Zielony" << std::endl;  break;
case::sf::Keyboard::Num3:
    col = 3;
    glUniform1f(uniCol,col);
    std::cout << "Niebieski" << std::endl;  break;
```

Ilustracja 6: Fragment kodu

Dodatkowo przy użyciu klawisza „0” wykonuję buforowanie przy użyciu buforu szablonu poprzez wywołanie funkcji glEnable().

Wnioski:

Program do budowania obiektów 3D taki jak używany przeze mnie w tym zadaniu Blender jest bardzo pomocnym narzędziem do pracy z grafiką komputerową. Jest to prostszy oraz szybszy sposób na zbudowanie wymaganej figury, która po wczytaniu do programu OpenGl działa dokładnie tak samo jak opisanie figury od początku w programie OpenGl.

KOD:

```
#include <iostream>
#include <windows.h>
#include <fstream>
#include <GL/glew.h>
#include <SFML/Window.hpp>
#include <glm/glm.hpp>
#include <glm/gtc/matrix_transform.hpp>
#include <glm/gtc/type_ptr.hpp>
#include <SFML/System/Time.hpp>
#define STB_IMAGE_IMPLEMENTATION
#include "stb_image.h"
#include "../../ConsoleApplication1/Common/objloader.hpp"

const GLchar* vertexSource = R"glsl(
#version 150 core
        in vec3  position;
        in vec3 color;
        out vec3 Color;
        uniform mat4 uniformModel;
        uniform mat4 uniformView;
        uniform mat4 uniformProj;
   in vec2 aTexCoord;
        out vec2 TexCoord;
        in vec3 aNormal;
        out vec3 Normal;
        out vec3 FragPos;
```

```
                void main(){
                        Color = color;
        TexCoord= aTexCoord;
                        Normal=aNormal;
                        gl_Position = uniformProj * uniformView * uniformModel * vec4(position,
1);
                        FragPos = vec3( uniformModel* vec4(position, 1.0));
                }
)glsl";

const GLchar* fragmentSource = R"glsl(
#version 150 core
        in vec3 Color;
        out vec4 outColor;
   in vec2 TexCoord;
        uniform sampler2D texture1;
        in vec3 Normal;
        in vec3 FragPos;
        in vec3 diffuse;
        uniform vec3 lightPos;
   uniform float turnOn;
   uniform float col;
   uniform float ambientStrength;

                void main() {
                vec3 ambientlightColor = vec3(1.0,1.0,1.0);
                vec4 ambient = ambientStrength * vec4(ambientlightColor,1.0);
                vec3 difflightColor = vec3(0.0,0.50,0.0);
                vec3 norm = normalize(Normal);
                vec3 lightDir = normalize(lightPos - FragPos);
                float diff = max(dot(norm, lightDir), 0.0);
                vec3 diffuse = diff * difflightColor;
                if(turnOn==0)
                outColor = (ambient+vec4(diffuse,1.0)) * texture(texture1, TexCoord);
                else if(turnOn==1 || col==0)
                outColor = texture(texture1, TexCoord);
                if(col==1)
                outColor = vec4(1.0,0.0,0.0,0.0)*texture(texture1, TexCoord);
                else if(col==2)
                outColor = vec4(0.0,1.0,0.0,0.0)*texture(texture1, TexCoord);
                else if(col==3)
                outColor = vec4(0.0,0.0,1.0,0.0)*texture(texture1, TexCoord);
                }
)glsl";
GLboolean isShaderCompiled(GLuint shader);

double obrot = 5;
glm::vec3 cameraPos = glm::vec3(0.0f, 1.0f, 3.0f);
glm::vec3 cameraFront = glm::vec3(0.0f, 0.0f, -1.0f);
glm::vec3 cameraUp = glm::vec3(0.0f, 1.0f, 0.0f);
float ambientStrength = 0.1;
float turnOn = 1;
float col=0;
bool fMouse = true;
int lastX, lastY;
double yaw = -90;
double pitch = 0;
void ustawKamereKlawisze(GLint view, float time) {

	float cameraSpeed = 0.000002f * time;

	if (sf::Keyboard::isKeyPressed(sf::Keyboard::Up))
		cameraPos += cameraSpeed * cameraFront;
	if (sf::Keyboard::isKeyPressed(sf::Keyboard::Down))
		cameraPos -= cameraSpeed * cameraFront;
	if (sf::Keyboard::isKeyPressed(sf::Keyboard::Left))
		cameraPos -= glm::normalize(glm::cross(cameraFront, cameraUp)) * cameraSpeed;
	if (sf::Keyboard::isKeyPressed(sf::Keyboard::Right))
		cameraPos += glm::normalize(glm::cross(cameraFront, cameraUp)) * cameraSpeed;

	glm::mat4 thisView;
	thisView = glm::lookAt(cameraPos, cameraPos + cameraFront, cameraUp);

	glUniformMatrix4fv(view, 1, GL_FALSE, glm::value_ptr(thisView));
}

void ustawKamereMysz(GLint uniformView, float time, const sf::Window& window) {
	sf::Vector2i localPosition = sf::Mouse::getPosition(window);
	bool reloc = false;
	sf::Vector2i position;
	if (localPosition.x <= 0) {
		position.x = window.getSize().x;
		position.y = localPosition.y;
		reloc = true;
	}
	if (localPosition.x >= window.getSize().x - 1) {
		position.x = 0;
		position.y = localPosition.y;
		reloc = true;
	}
	if (localPosition.y <= 0) {
		position.y = window.getSize().y;
		position.x = localPosition.x;
		reloc = true;
	}
	if (localPosition.y >= window.getSize().y - 1) {
		position.y = 0;
		position.x = localPosition.x;
		reloc = true;
	}
	if (reloc) {
		sf::Mouse::setPosition(position, window);
		fMouse = true;
```

```
    }

    localPosition = sf::Mouse::getPosition(window);

    if (fMouse) {
        lastX = localPosition.x;
        lastY = localPosition.y;
        fMouse = false;
    }

    float xoffset = localPosition.x - lastX;
    float yoffset = localPosition.y - lastY;
    lastX = localPosition.x;
    lastY = localPosition.y;

    double sensitivity = 0.3f;
    xoffset *= sensitivity;
    yoffset *= sensitivity;
    yaw += xoffset;
    pitch -= yoffset;

    if (pitch > 89.0f) pitch = 89.0f;
    if (pitch < -89.0f) pitch - -89.0f;

    glm::vec3 front;

    front.x = cos(glm::radians(yaw)) * cos(glm::radians(pitch));
    front.y = sin(glm::radians(pitch));
    front.z = sin(glm::radians(yaw)) * cos(glm::radians(pitch));

    cameraFront = glm::normalize(front);

    glm::mat4 view;
    view = glm::lookAt(cameraPos, cameraPos + cameraFront, cameraUp);
    glUniformMatrix4fv(uniformView, 1, GL_FALSE, glm::value_ptr(view));
}

bool loadOBJ(const char* path, std::vector < glm::vec3 >& out_vertices, std::vector < glm::vec2
>& out_uvs, std::vector < glm::vec3 >& out_normals) {
    std::vector< unsigned int > vertexIndices, uvIndices, normalIndices;
    std::vector< glm::vec3 > temp_vertices;
    std::vector< glm::vec2 > temp_uvs;
    std::vector< glm::vec3 > temp_normals;
    FILE* file = fopen(path, "r");
    if (file == NULL) {
        printf("Impossible to open the file !\n");
        return false;
    }
    while (1) {
        char lineHeader[128];
        // read the first word of the line
        int res = fscanf(file, "%s", lineHeader);
        if (res == EOF)
            break;

        if (strcmp(lineHeader, "v") == 0) {
            glm::vec3 vertex;
            fscanf(file, "%f %f %f\n", &vertex.x, &vertex.y, &vertex.z);
            temp_vertices.push_back(vertex);
        }
        else if (strcmp(lineHeader, "vt") == 0) {
            glm::vec2 uv;
            fscanf(file, "%f %f\n", &uv.x, &uv.y);
            temp_uvs.push_back(uv);
        }
        else if (strcmp(lineHeader, "vn") == 0) {
            glm::vec3 normal;
            fscanf(file, "%f %f %f\n", &normal.x, &normal.y, &normal.z);
            temp_normals.push_back(normal);
        }
        else if (strcmp(lineHeader, "f") == 0) {
            std::string vertex1, vertex2, vertex3;
            unsigned int vertexIndex[3], uvIndex[3], normalIndex[3];
            int matches = fscanf(file, "%d/%d/%d %d/%d/%d %d/%d/%d\n",
&vertexIndex[0], &uvIndex[0], &normalIndex[0], &vertexIndex[1], &uvIndex[1],
&normalIndex[1], &vertexIndex[2], &uvIndex[2], &normalIndex[2]);
            if (matches != 9) {
                printf("File can't be read by our simple parser : ( Try exporting with
other options\n");
                return false;
            }
            vertexIndices.push_back(vertexIndex[0]);
            vertexIndices.push_back(vertexIndex[1]);
            vertexIndices.push_back(vertexIndex[2]);
            uvIndices.push_back(uvIndex[0]);
            uvIndices.push_back(uvIndex[1]);
            uvIndices.push_back(uvIndex[2]);
            normalIndices.push_back(normalIndex[0]);
            normalIndices.push_back(normalIndex[1]);
            normalIndices.push_back(normalIndex[2]);
        }
    }
    for (unsigned int i = 0; i < vertexIndices.size(); i++) {
        unsigned int vertexIndex = vertexIndices[i];
        glm::vec3 vertex = temp_vertices[vertexIndex - 1];
        out_vertices.push_back(vertex);
    }
    for (unsigned int i = 0; i < uvIndices.size(); i++) {
        unsigned int uvIndex =uvIndices[i];
        glm::vec3 uvvertex = temp_vertices[uvIndex - 1];
        out_vertices.push_back(uvvertex);
    }
    for (unsigned int i = 0; i < normalIndices.size(); i++) {
        unsigned int normalIndex = normalIndices[i];
        glm::vec3 normalvertex = temp_vertices[normalIndex - 1];
        out_vertices.push_back(normalvertex);
    }
}

int main(){
    sf::ContextSettings settings;
    settings.depthBits = 24;
    settings.stencilBits = 8;

    sf::Window window(sf::VideoMode(800, 800, 32), "OpenGL", sf::Style::Titlebar | sf::Style::Close, settings);

    window.setMouseCursorGrabbed(true);
    window.setMouseCursorVisible(false);

    glewExperimental = GL_TRUE;
    glewInit();
    unsigned int texture1;
    glGenTextures(1, &texture1);
    glBindTexture(GL_TEXTURE_2D, texture1);
    glTexParameteri(GL_TEXTURE_2D, GL_TEXTURE_WRAP_S, GL_REPEAT);
    int width, height, nrChannels;
    stbi_set_flip_vertically_on_load(true);
    unsigned char* data = stbi_load("met.bmp", &width, &height, &nrChannels, 0);
    if (data){
        glTexImage2D(GL_TEXTURE_2D, 0, GL_RGB, width, height, 0, GL_RGB, GL_UNSIGNED_BYTE, data);
        glGenerateMipmap(GL_TEXTURE_2D);
    }
    else
        std::cout << "Failed to load texture" << std::endl;
    stbi_image_free(data);

    GLuint vao;
    glGenVertexArrays(1, &vao);
    glBindVertexArray(vao);

    GLuint vbo;
    glGenBuffers(1, &vbo);

    std::vector< glm::vec3 > vertices;
    std::vector< glm::vec2 > uvs;
    std::vector< glm::vec3 > normals;
    bool res = loadOBJ("cube.obj", vertices, uvs, normals);
    glBufferData(GL_ARRAY_BUFFER, vertices.size() * sizeof(glm::vec3), &vertices[0], GL_STATIC_DRAW);
    glBindTexture(GL_TEXTURE_2D, texture1);

    GLuint vertexShader = glCreateShader(GL_VERTEX_SHADER);
    glShaderSource(vertexShader, 1, &vertexSource, NULL);
    glCompileShader(vertexShader);
```

```
if (isShaderCompiled(vertexShader) == GL_FALSE)
        std::cout << "Vertex shader compilation error" << std::endl;
else
        std::cout << "Vertex shader compilation OK" << std::endl;

GLint status;
glGetShaderiv(vertexShader, GL_COMPILE_STATUS, &status);

GLuint fragmentShader = glCreateShader(GL_FRAGMENT_SHADER);
glShaderSource(fragmentShader, 1, &fragmentSource, NULL);
glCompileShader(fragmentShader);

if (isShaderCompiled(fragmentShader) == GL_FALSE)
        std::cout << "Fragment shader compilation error" << std::endl;
else
        std::cout << "Fragment shader compilation OK" << std::endl;

GLuint shaderProgram = glCreateProgram();
glAttachShader(shaderProgram, vertexShader);
glAttachShader(shaderProgram, fragmentShader);
glBindFragDataLocation(shaderProgram, 0, "outColor");
glLinkProgram(shaderProgram);
glUseProgram(shaderProgram);

glm::mat4 glmModel = glm::mat4(1.0f);
glmModel = glm::rotate(glmModel, glm::radians(15.0f), glm::vec3(0.0f, 0.0f, 1.0f));

GLint modelTransition = glGetUniformLocation(shaderProgram, "uniformModel");
glUniformMatrix4fv(modelTransition, 1, GL_FALSE, glm::value_ptr(glmModel));

GLint uniformView = glGetUniformLocation(shaderProgram, "uniformView");

glm::mat4 glmProj = glm::perspective(glm::radians(45.0f), (800.0f / 800.0f), 0.06f, 100.0f);
GLint uniformProj = glGetUniformLocation(shaderProgram, "uniformProj");
glUniformMatrix4fv(uniformProj, 1, GL_FALSE, glm::value_ptr(glmProj));

GLint primitive = GL_TRIANGLES;
GLint mouseX = 0, mouseY = 0;
sf::Clock clock;
sf::Time time;
window.setFramerateLimit(20);

int counter = 0;
glEnable(GL_DEPTH_TEST);

GLint posAttrib = glGetAttribLocation(shaderProgram, "position");
glEnableVertexAttribArray(posAttrib);
glVertexAttribPointer(posAttrib, 3, GL_FLOAT, GL_FALSE, 8 * sizeof(GLfloat), 0);


GLint colAttrib = glGetAttribLocation(shaderProgram, "color");
glEnableVertexAttribArray(colAttrib);
```

```
    glVertexAttribPointer(colAttrib, 3, GL_FLOAT, GL_FALSE, 8 * sizeof(GLfloat), (void*)(3
* sizeof(GLfloat)));



    GLint texCoord = glGetAttribLocation(shaderProgram, "aTexCoord");
    glEnableVertexAttribArray(texCoord);
    glVertexAttribPointer(texCoord, 2, GL_FLOAT, GL_FALSE, 8 * sizeof(GLfloat), (void*)(6
* sizeof(GLfloat)));

    GLint NorAttrib = glGetAttribLocation(shaderProgram, "aNormal");
    glEnableVertexAttribArray(NorAttrib);
    glVertexAttribPointer(NorAttrib, 3, GL_FLOAT, GL_FALSE, 8 * sizeof(GLfloat), (void*)(3
* sizeof(GLfloat)));

    glm::vec3 lightPos(1.2f, 1.0f, 2.0f);
    GLint uniLightPos = glGetUniformLocation(shaderProgram, "lightPos");
    glUniform3fv(uniLightPos, 1, &lightPos[0]);

    GLint uniTurnOn = glGetUniformLocation(shaderProgram, "turnOn");
    glUniform1f(uniTurnOn, turnOn);

    GLint uniCol = glGetUniformLocation(shaderProgram, "col");
    glUniform1f(uniCol, col);

    GLint uniAmbientStrength = glGetUniformLocation(shaderProgram, "ambientStrength");
    glUniform1f(uniAmbientStrength, ambientStrength);

    bool isRunning = true;
    while (isRunning) {
        time = clock.getElapsedTime();
        clock.restart();
        counter++;
        float fps = 1000000 / time.asMicroseconds();
        if (counter > fps) {
            window.setTitle(std::to_string(fps));
            counter = 0;
        }
        sf::Event winEvent;
        while (window.pollEvent(winEvent)) {
            switch (winEvent.type) {
            case sf::Event::Closed:
                isRunning = false;
                break;
            case sf::Event::KeyPressed:
                switch (winEvent.key.code) {
                case sf::Keyboard::Escape:
                    isRunning = false;
                    break;

                case::sf::Keyboard::Num1:
                    col = 1;
                glUniform1f(uniCol, col);
                std::cout << "Czerwony" << std::endl; break;
            case::sf::Keyboard::Num2:
                col = 2;
                glUniform1f(uniCol, col);
                std::cout << "Zielony" << std::endl;  break;
            case::sf::Keyboard::Num3:
                col = 3;
                glUniform1f(uniCol,col);
                std::cout << "Niebieski" << std::endl;  break;
            case::sf::Keyboard::Num4:
                primitive = GL_LINE_LOOP;
                std::cout << "LINE LOOP" << std::endl;  break;
            case::sf::Keyboard::Num5:
                primitive = GL_TRIANGLES;
                std::cout << "TRIANGLES" << std::endl;  break;
            case::sf::Keyboard::Num6:
                primitive = GL_TRIANGLE_STRIP;
                std::cout << "TRAINGLES STRIP" << std::endl;  break;
            case::sf::Keyboard::Num7:
                primitive = GL_TRIANGLE_FAN;
                std::cout << "TRIANGLE FAN" << std::endl;  break;
            case::sf::Keyboard::Num8:
                primitive = GL_QUADS;
                std::cout << "QUADS" << std::endl;  break;
            case::sf::Keyboard::Num9:
                primitive = GL_QUAD_STRIP;
                std::cout << "QUAD STRIP" << std::endl;  break;
            case::sf::Keyboard::Num0:
                glEnable(GL_STENCIL_TEST);
                std::cout << "Fragment" << std::endl; break;
            case sf::Keyboard::Z:
                if (turnOn == 0)
                    turnOn = 1;
                else if (turnOn == 1)
                    turnOn = 0;
                glUniform1f(uniTurnOn, turnOn);
                break;
            case sf::Keyboard::W:
                ambientStrength += 0.1;
                glUniform1f(uniAmbientStrength, ambientStrength);
                break;
            case sf::Keyboard::S:
                ambientStrength -= 0.1;
                glUniform1f(uniAmbientStrength, ambientStrength);
                break;

            }
            break;

        case sf::Event::MouseMoved:
            ustawKamereMysz(uniformView, time.asMicroseconds(), window);
```

```
                break;

            }
        }

        ustawKamereKlawisze(uniformView, time.asMicroseconds());

        glClearColor(0.0f, 0.0f, 0.0f, 1.0f);
        glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);

        glDrawArrays(primitive, 0, 36);

        window.display();
    }

    glDeleteProgram(shaderProgram);
    glDeleteShader(fragmentShader);
    glDeleteShader(vertexShader);
    glDeleteBuffers(1, &vbo);
    glDeleteVertexArrays(1, &vao);

    window.close();
    return 0;
}
GLboolean isShaderCompiled(GLuint shader) {
    GLint isCompiled = 0;
    glGetShaderiv(shader, GL_COMPILE_STATUS, &isCompiled);
    if (isCompiled == GL_FALSE)
    {
        GLint maxLength = 0;
        glGetShaderiv(shader, GL_INFO_LOG_LENGTH, &maxLength);
        std::string log(maxLength, ' ');
        glGetShaderInfoLog(shader, maxLength, &maxLength, &log[0]);
        std::cout << "Error log: " << log << std::endl;
        glDeleteShader(shader);
        return GL_FALSE;
    }
    else
        return GL_TRUE;
}
```