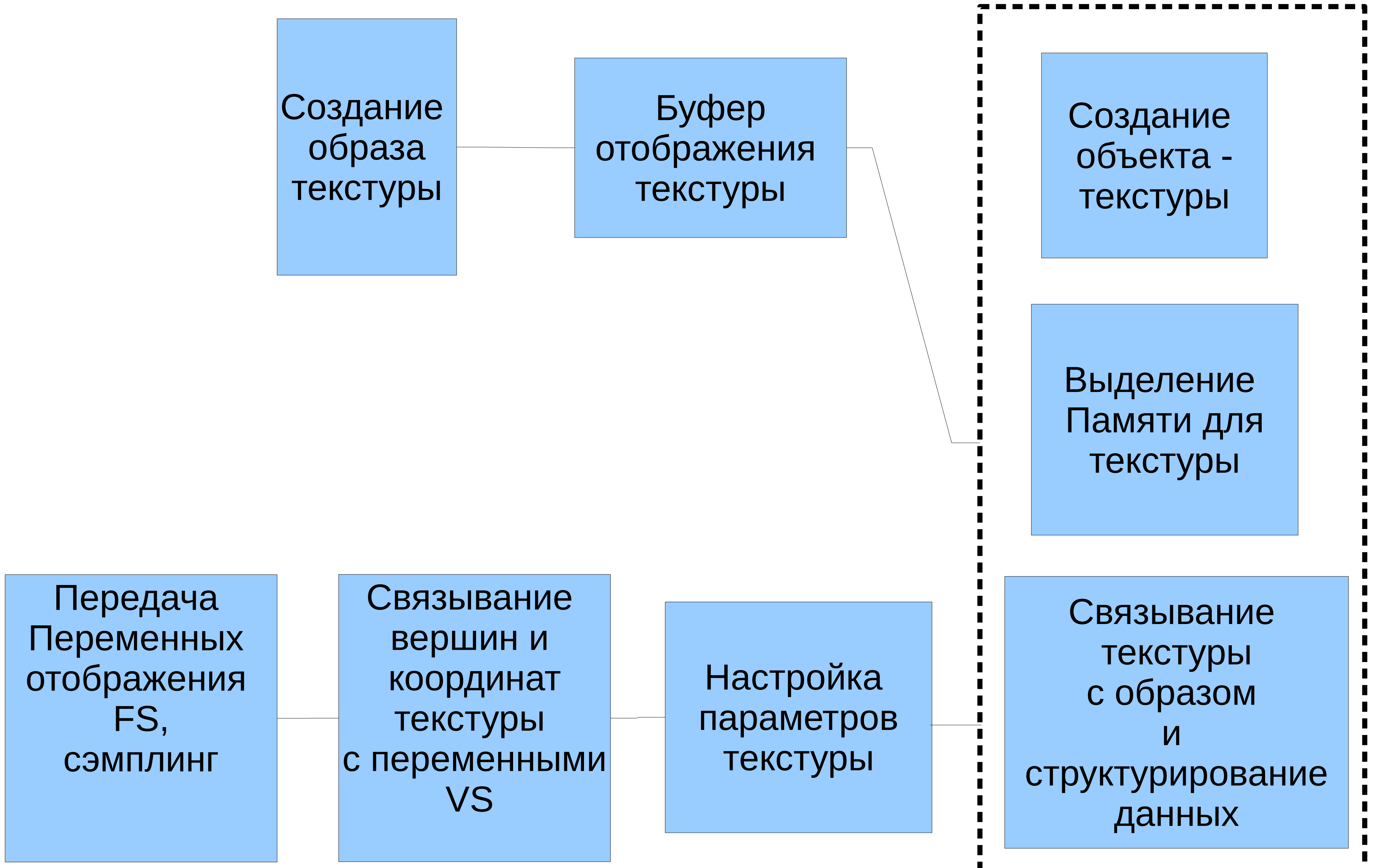
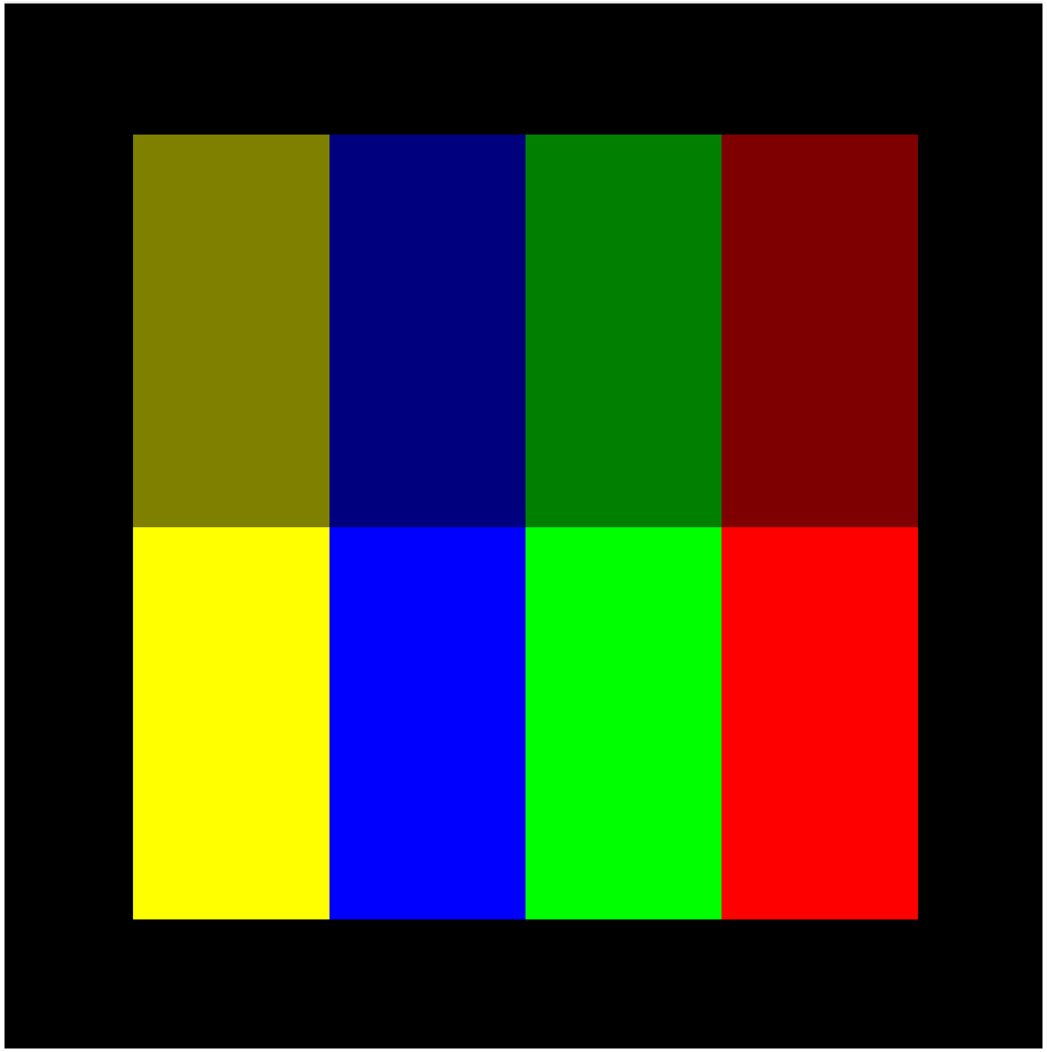
Лекция 13

Текстуры.

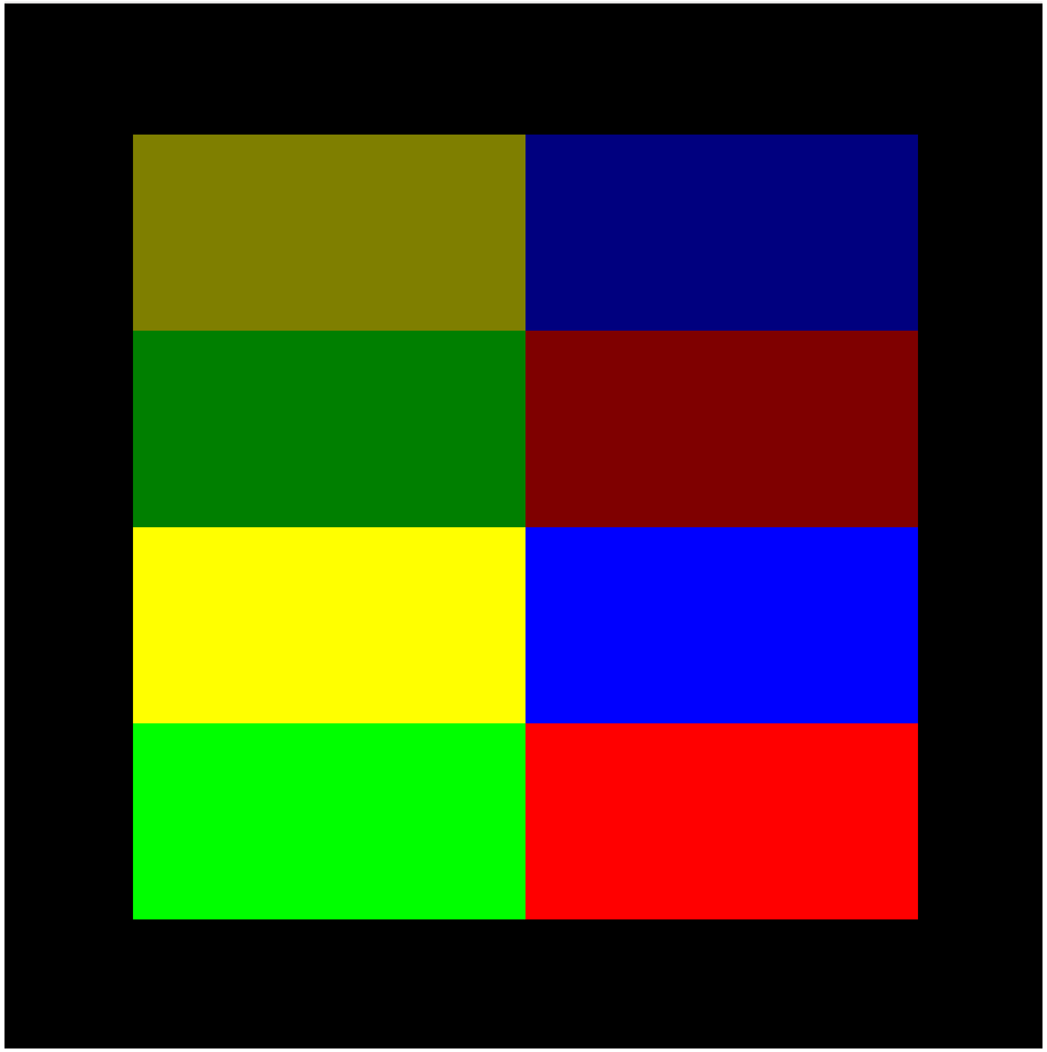
- Основные понятия.
- Текстурные координаты, отображение текстур.
- Загрузка текстур: из памяти CPU и из буфера.


Создание образа текстуры
Буфер отображения текстуры
Создание объекта - текстуры
Выделение Памяти для текстуры
Связывание текстуры с образом и структурирование данных
Настройка параметров текстуры
Связывание вершин и координат текстуры с переменными VS
Передача Переменных отображения FS, сэмплинг

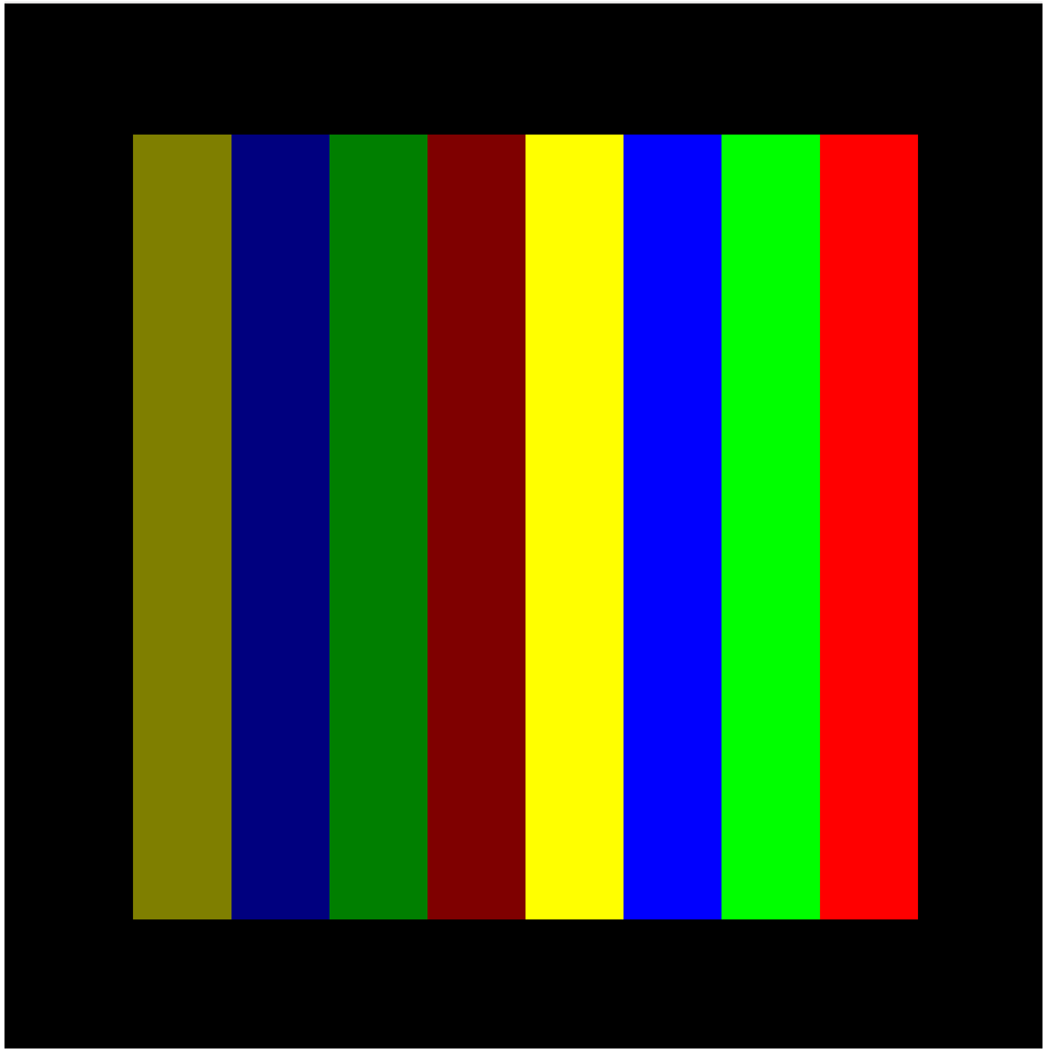
L=4, M=2

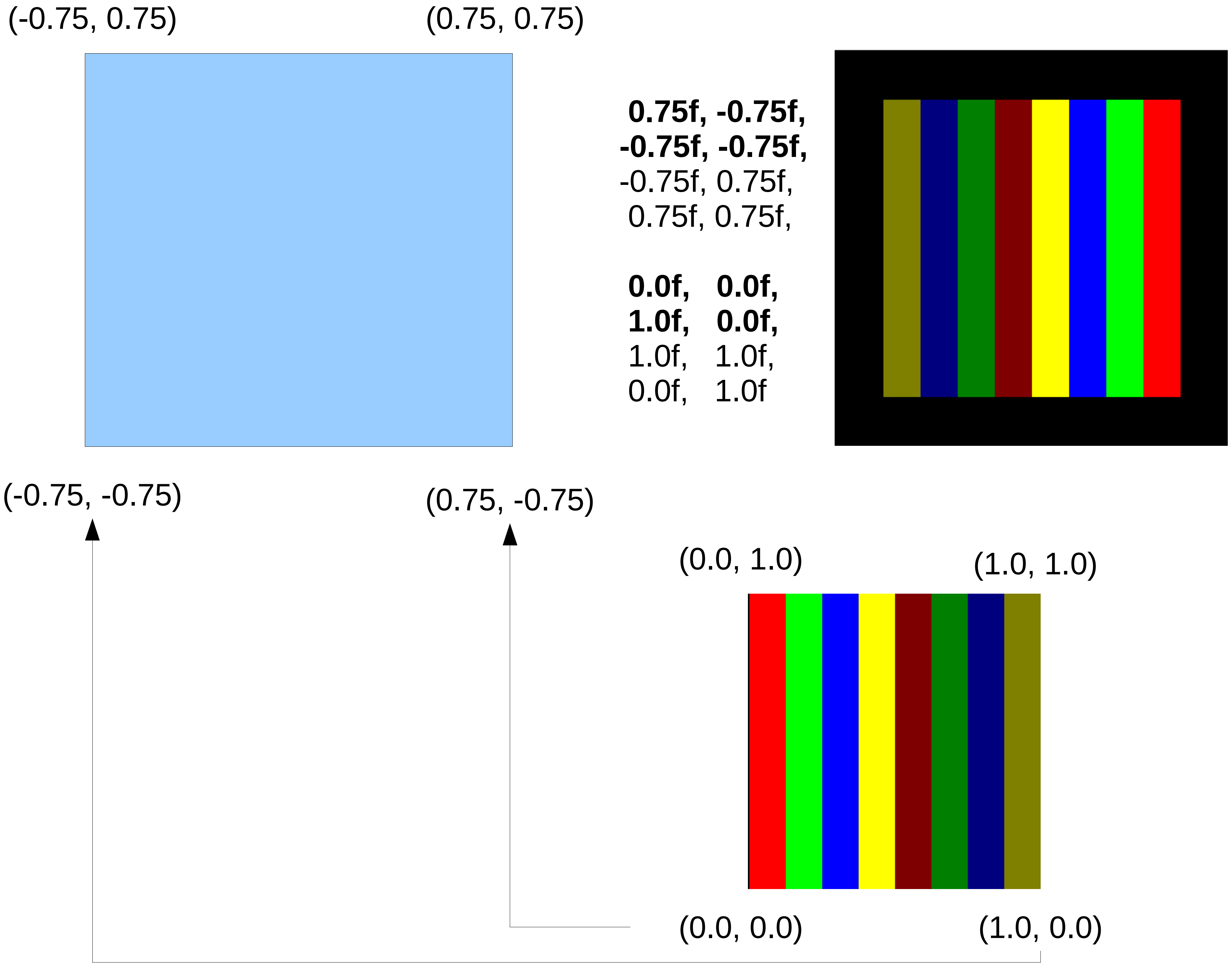


L=2, M=4



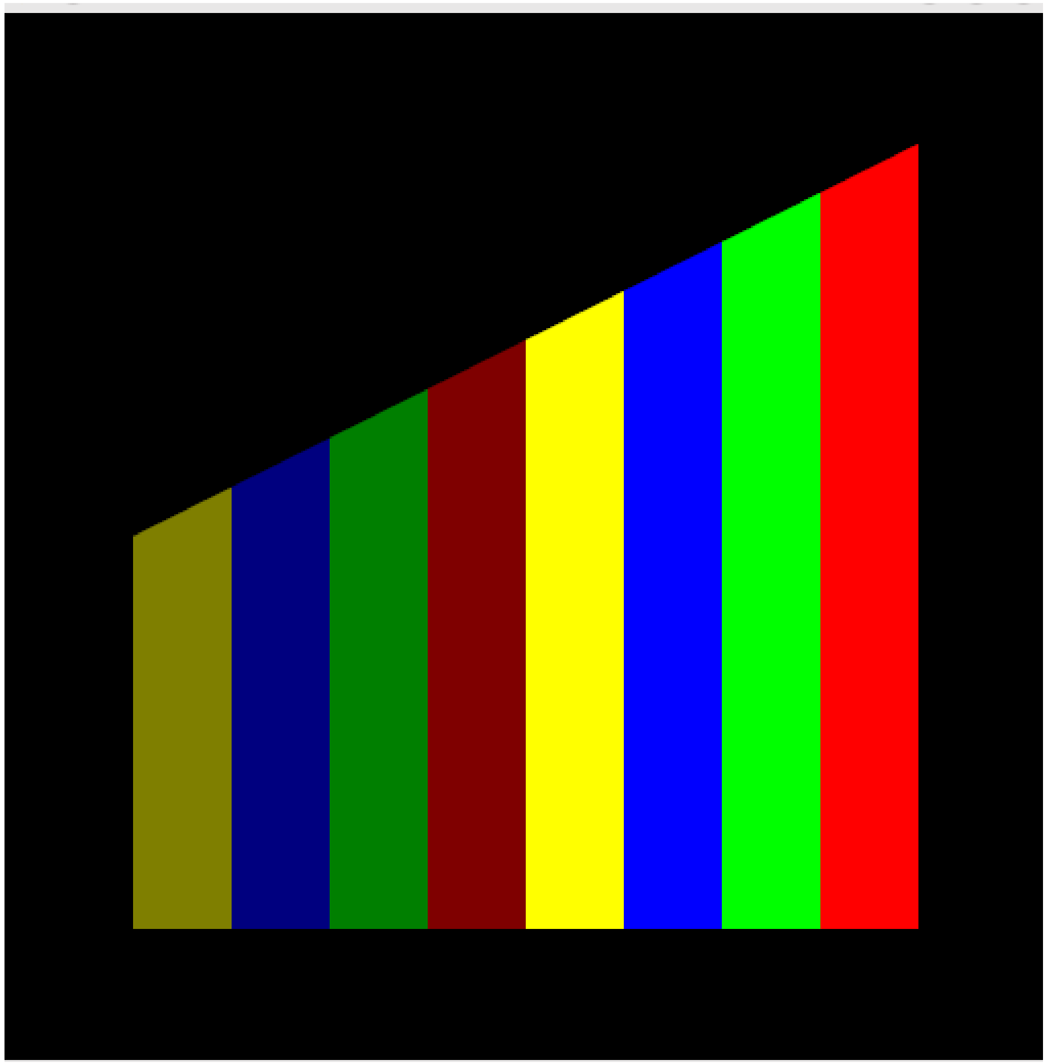
L=8, M=1





```
 0.75f, -0.75f,
-0.75f, -0.75f,
-0.75f, 0.75f,
 0.75f, 0.75f,

 0.0f,   0.0f,
 1.0f,   0.0f,
 1.0f,   1.0f,
 0.0f,   1.0f
```

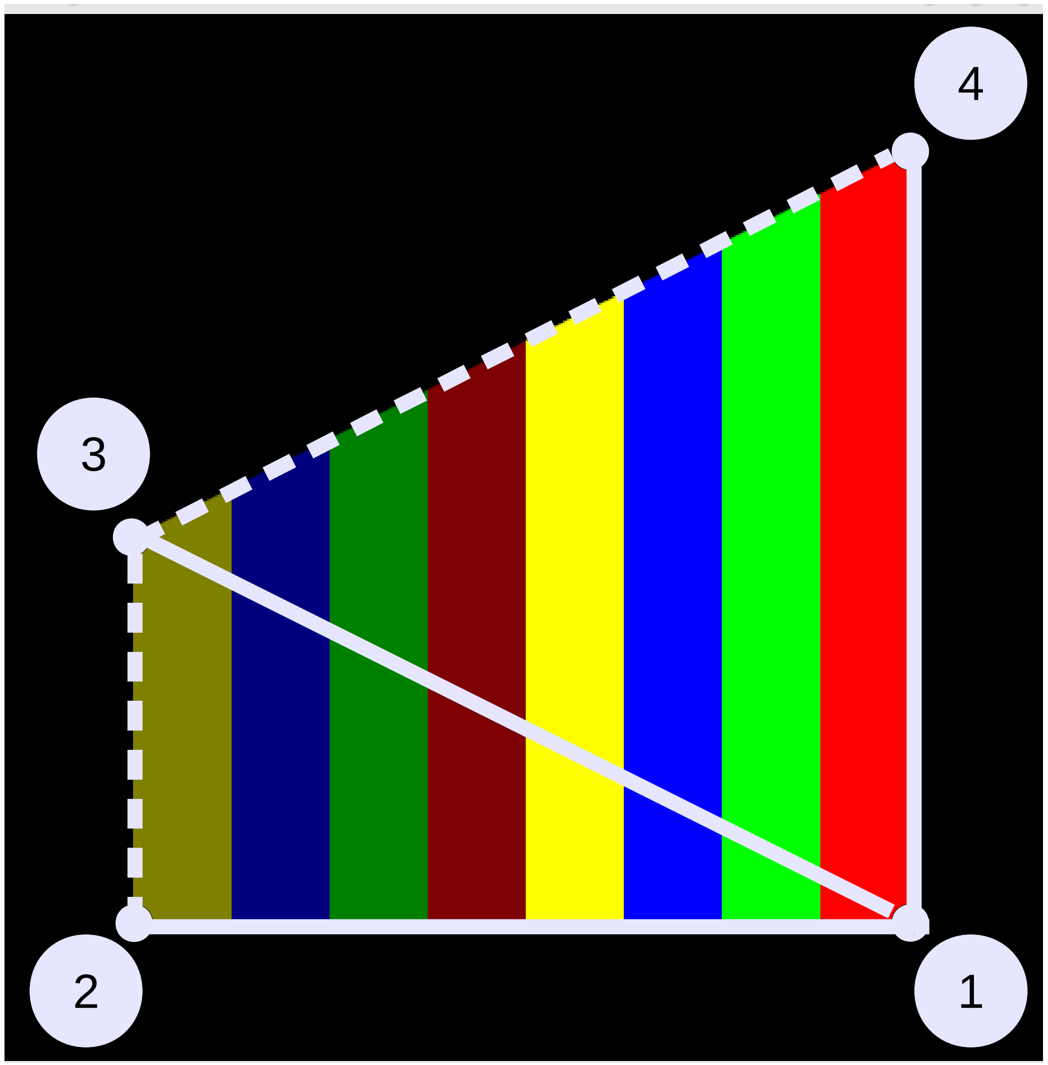


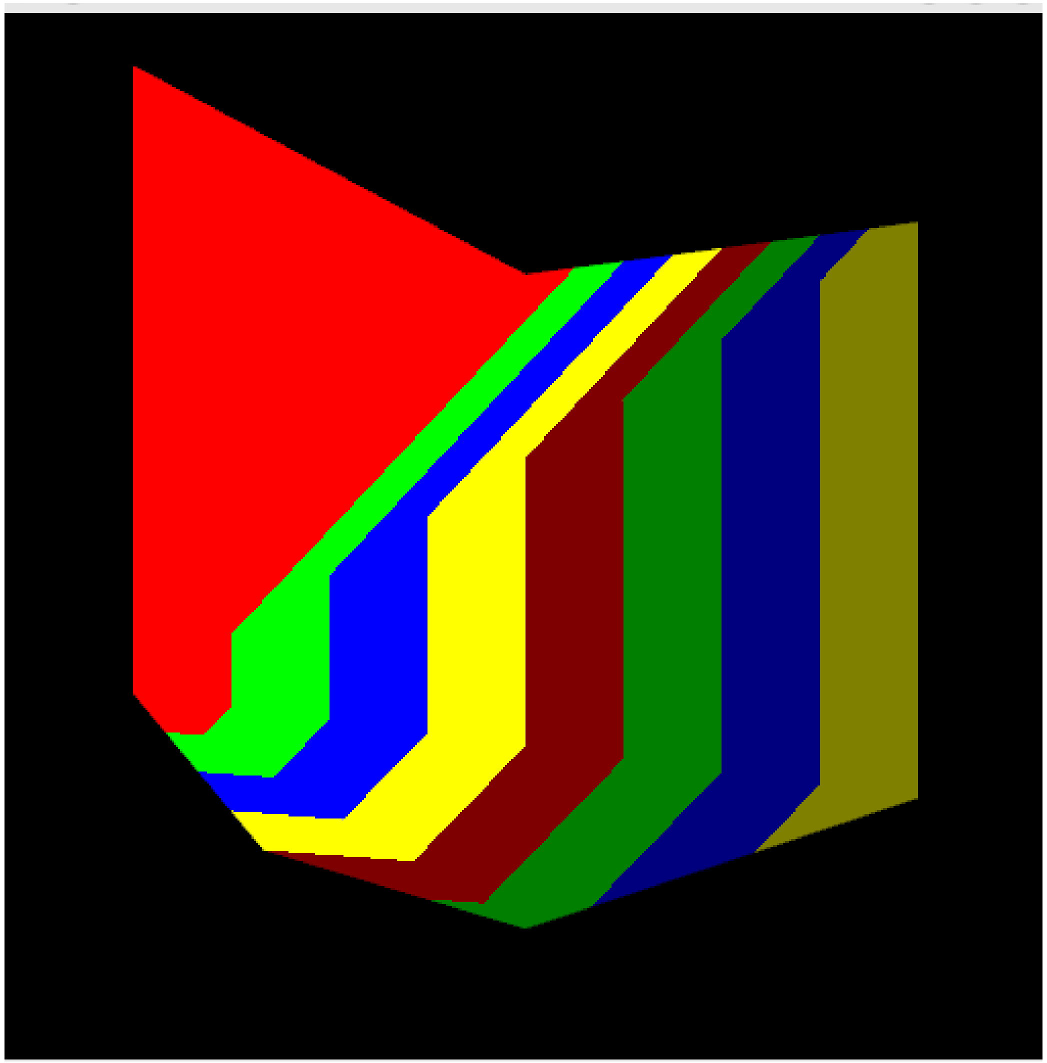
```
 0.75f, -0.75f,
-0.75f, -0.75f,
-0.75f, 0.0f,
 0.75f, 0.75f,

 0.0f,   0.0f,
 1.0f,   0.0f,
 1.0f,   1.0f,
 0.0f,   1.0f
```

```
glVertexAttribPointer(1, 2, GL_FLOAT, GL_FALSE, 0, (GLvoid*)(8 *
                                                        sizeof(float)));
glDrawArrays(GL_TRIANGLE_FAN, 0, 4);
```

GL_TRIANGLE_FAN



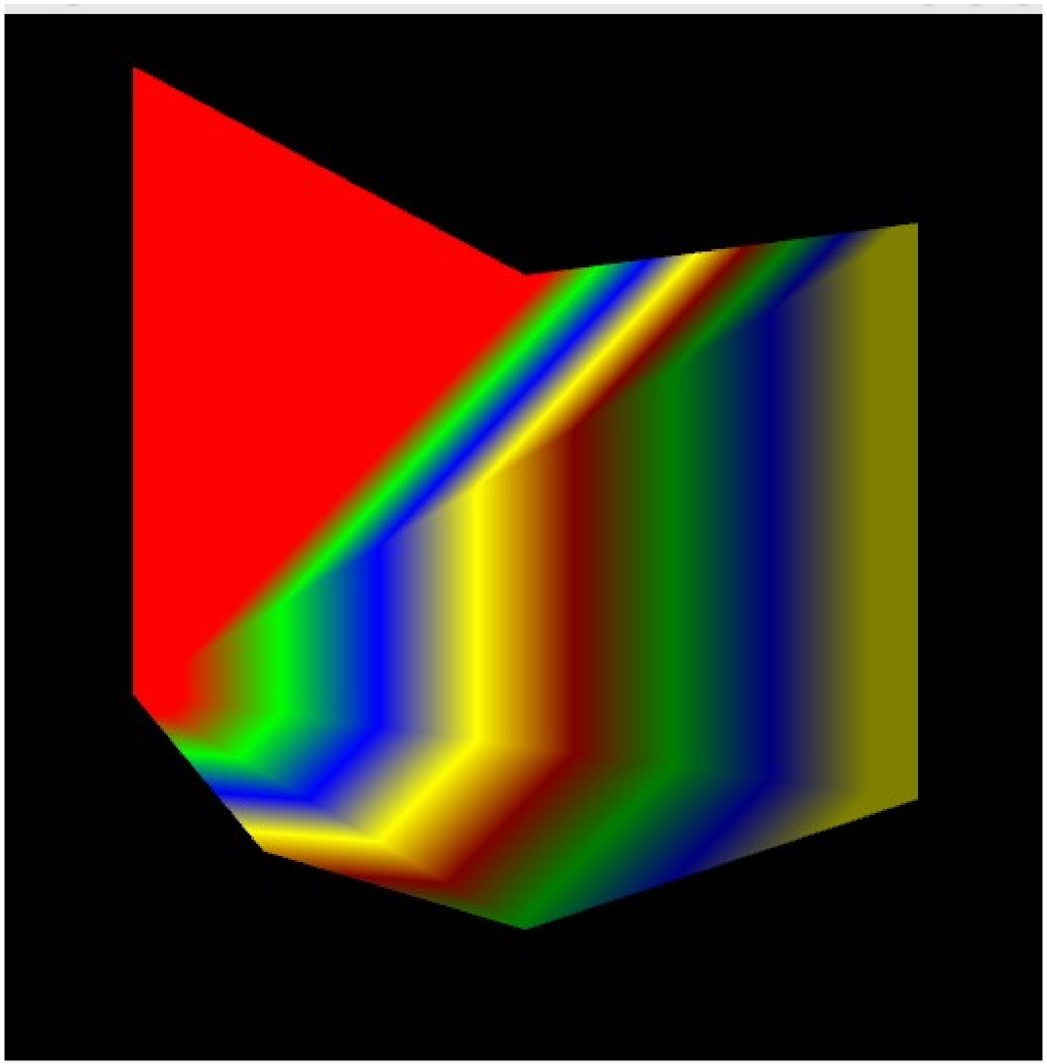


```
-0.75f, -0.3f,
-0.50f, -0.6f,
 0.0f,  -0.75f,
  0.75f, -0.5f,
 0.75f,  0.6f,
 0.0f,    0.5f,
-0.75f,  0.9f,

  0.0f, 0.0f,
 0.5f, 0.0f,
 0.7f, 0.0f,
  1.0f, 0.0f,
  1.0f, 1.0f,
 0.0f,0.5f,
 0.0f,1.0f
```

```
glVertexAttribPointer(1, 2, GL_FLOAT, GL_FALSE, 0, (GLvoid*)(14 *
                                                    sizeof(float)));
glDrawArrays(GL_TRIANGLE_FAN, 0, 7);
```

Линейная фильтрация



main.cpp

```
#include <GL/glew.h>
#include <GLFW/glfw3.h>

#include <stdio.h>
#include <string>
#include <stdlib.h>

void checkErrors(std::string desc) {
	GLenum e = glGetError();
	if (e != GL_NO_ERROR) {
		fprintf(stderr, "OpenGL error in \"%s\": %s (%d)\n", desc.c_str(),
			gluErrorString(e), e);
		exit(20);
	}
}

GLFWwindow* window;
const unsigned int window_width  = 512;
const unsigned int window_height = 512;
```

```
void  initGL();
void initTexture();
GLuint genRenderProg();
void display();

int main(){
  initGL();
  initTexture();
  do{
    glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);

    display();

    glfwSwapBuffers(window);
    glfwPollEvents();
  }while( glfwGetKey(window, GLFW_KEY_ESCAPE ) != GLFW_PRESS &&
        glfwWindowShouldClose(window) == 0 );
  glfwSetInputMode(window, GLFW_STICKY_KEYS, GL_TRUE);

  glfwTerminate();
  return 0;
}
```

```
void initGL(){
    if( !glfwInit() )
    {
        fprintf( stderr, "Failed to initialize GLFW\n" );
        getchar();
        return;
    }
    glfwWindowHint(GLFW_CONTEXT_VERSION_MAJOR, 4);
    glfwWindowHint(GLFW_CONTEXT_VERSION_MINOR, 3);
    glfwWindowHint(GLFW_OPENGL_FORWARD_COMPAT, GL_TRUE);
    glfwWindowHint(GLFW_OPENGL_PROFILE,
                                    GLFW_OPENGL_COMPAT_PROFILE);
    glfwWindowHint(GLFW_SAMPLES, 4);
    window = glfwCreateWindow( window_width, window_height, "Dummy
                                                window", NULL, NULL);
    if( window == NULL ){
        fprintf( stderr, "Failed to open GLFW window.\n" );
        getchar();
        glfwTerminate();
        return;
    }
    glfwMakeContextCurrent(window);
    glewExperimental = true;
    if (glewInit() != GLEW_OK) {
        fprintf(stderr, "Failed to initialize GLEW\n");
        getchar();
        glfwTerminate();
        return;
    }
    return;
}
```

```
void display(){
  GLuint progHandle;
  progHandle=genRenderProg();
  glUseProgram(progHandle);


  glVertexAttribPointer(0, 2, GL_FLOAT, GL_FALSE, 0, (GLvoid*)0);
  glVertexAttribPointer(1, 2, GL_FLOAT, GL_FALSE, 0, (GLvoid*)(8 *
                                                              sizeof(float)));

  glEnableVertexAttribArray(0);
  glEnableVertexAttribArray(1);

  glDrawArrays(GL_TRIANGLE_FAN, 0, 4);

  glDisableVertexAttribArray(0);
  glDisableVertexAttribArray(1);
}
```

tex_gen.cpp

```
#include <GL/glew.h>
#include <string>
void checkErrors(std::string desc);

int L=4, M=2;

GLuint genTexBuffer(){
  GLuint tex_buf;
  glGenBuffers(1, &tex_buf);

  static const GLfloat tex_color_data[] ={
            1.0f, 0.0f, 0.0f, 1.0f,
            0.0f, 1.0f, 0.0f, 1.0f,
            0.0f, 0.0f, 1.0f, 1.0f,
            1.0f, 1.0f, 0.0f, 1.0f,

            0.5f, 0.0f, 0.0f, 1.0f,
            0.0f, 0.5f, 0.0f, 1.0f,
            0.0f, 0.0f, 0.5f, 1.0f,
            0.5f, 0.5f, 0.0f, 1.0f,
          };
```

Внутренний формат RGBA8

```
  glBufferData(GL_PIXEL_UNPACK_BUFFER , sizeof(tex_color_data),
                                                   tex_color_data, GL_STATIC_DRAW);

  return tex_buf;
}
```

```
GLuint genMapBuffer(){
  GLuint map_buf;
  glGenBuffers(1, &map_buf);

  static const GLfloat map_data[] = {
         0.75f, -0.75f,
        -0.75f, -0.75f,
        -0.75f, 0.75f,
         0.75f, 0.75f,

         0.0f, 0.0f,
         1.0f, 0.0f,
         1.0f, 1.0f,
         0.0f, 1.0f
    };

  glBindBuffer(GL_ARRAY_BUFFER, map_buf);
  glBufferData(GL_ARRAY_BUFFER, sizeof(map_data), map_data,
                                                GL_STATIC_DRAW);

    return map_buf;
}
```

```
GLuint genTexture(){
  GLuint texHandle;
  glGenTextures(1, &texHandle);
  glBindTexture(GL_TEXTURE_2D, texHandle);
  glTexStorage2D(GL_TEXTURE_2D, 1, GL_RGBA8, L, M);

  glTexSubImage2D(GL_TEXTURE_2D,
                  0,
                  0, 0,
                  L, M,
                  GL_RGBA, GL_FLOAT,
                  NULL);
```

```
 glTexParameteri(GL_TEXTURE_2D, GL_TEXTURE_MIN_FILTER,
                                        GL_NEAREST);//GL_LINEAR);
  glTexParameteri(GL_TEXTURE_2D, GL_TEXTURE_MAG_FILTER,
                                        GL_NEAREST);//GL_LINEAR);
  glTexParameteri(GL_TEXTURE_2D, GL_TEXTURE_WRAP_S,
                                             GL_CLAMP_TO_EDGE);
  glTexParameteri(GL_TEXTURE_2D, GL_TEXTURE_WRAP_T,
                                             GL_CLAMP_TO_EDGE);



  checkErrors("Gen texture");

  return texHandle;
};

void initTexture(){
  genMapBuffer();
  genTexBuffer();
  genTexture();
}
```

tex_sh.cpp

```
#include <GL/glew.h>
#include <stdio.h>
#include <string>
#include <stdlib.h>

void checkErrors(std::string desc);

GLuint genRenderProg() {
    GLuint progHandle = glCreateProgram();
    GLuint vp = glCreateShader(GL_VERTEX_SHADER);
    GLuint fp = glCreateShader(GL_FRAGMENT_SHADER);

      const char *vpSrc[] = {
        "#version 430\n",
        "layout (location = 0) in vec2 in_position;\
         layout (location = 1) in vec2 in_tex_coord;\
         out vec2 tex_coord;\
         void main(void){\
            gl_Position = vec4(in_position, 0.5, 1.0);\
            tex_coord = in_tex_coord;\
       }"
      };
```

```
   const char *fpSrc[] = {
     "#version 430\n",
     "in vec2 tex_coord;\
      layout (location = 0) out vec4 color;\
      uniform sampler2D tex;\
      void main(void){\
       color = texture(tex, tex_coord);\
      }"
     };

 glShaderSource(vp, 2, vpSrc, NULL);
 glShaderSource(fp, 2, fpSrc, NULL);

 glCompileShader(vp);
 int rvalue;
 glGetShaderiv(vp, GL_COMPILE_STATUS, &rvalue);
 if (!rvalue) {
     fprintf(stderr, "Error in compiling vp\n");
     exit(30);
 }
 glAttachShader(progHandle, vp);
```

```
    glCompileShader(fp);
    glGetShaderiv(fp, GL_COMPILE_STATUS, &rvalue);
    if (!rvalue) {
        fprintf(stderr, "Error in compiling fp\n");
        exit(31);
    }
    glAttachShader(progHandle, fp);


    glLinkProgram(progHandle);

    glGetProgramiv(progHandle, GL_LINK_STATUS, &rvalue);
    if (!rvalue) {
        fprintf(stderr, "Error in linking sp\n");
        exit(32);
    }

    checkErrors("Render shaders");

    return progHandle;
}
```

Спасибо за внимание!