셰이더프로그래밍

Lecture 6

이택희

지난 시간

- 버텍스 셰이더 사용 애니메이션
- 프레그먼트 셰이더 사용 애니메이션

개요

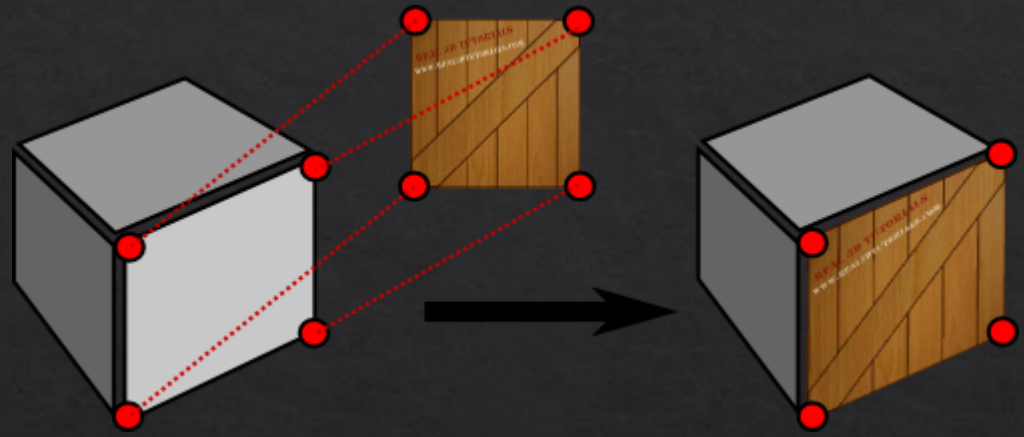
- 텍스쳐 매핑
- 텍스쳐 생성
- 텍스쳐 사용
- 실습

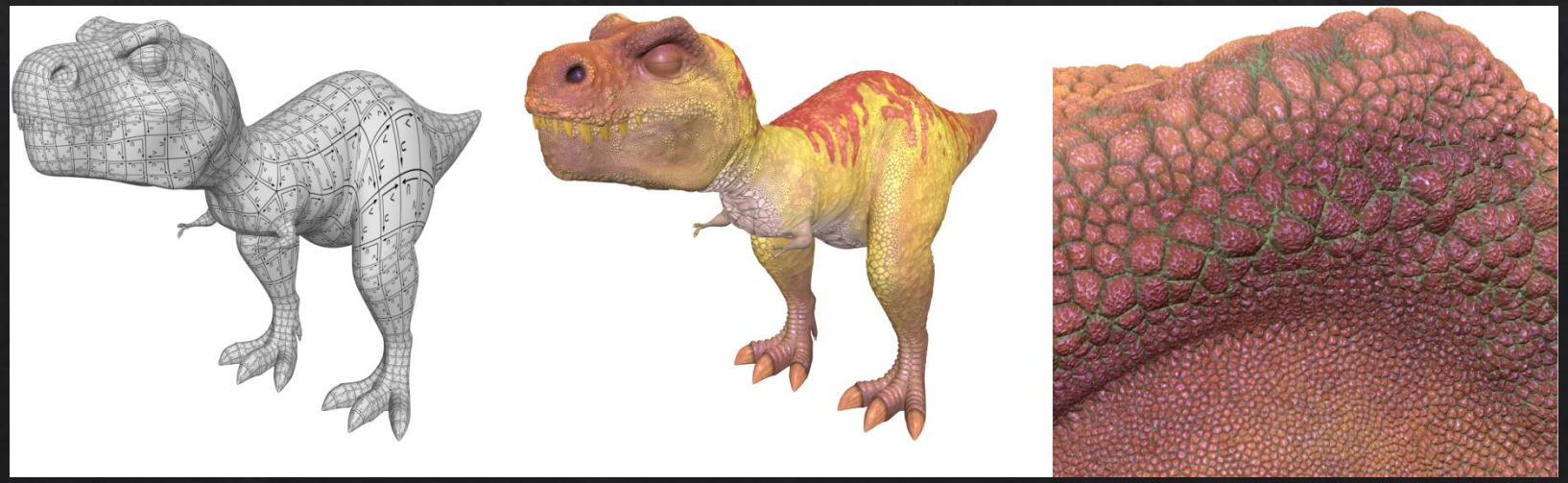
텍스쳐 매핑

텍스쳐 매핑

- 텍스쳐란?
  - 물체의 표면의 디테일을 표현하고자 할 때 모두 버텍스로 표현하기 위해선 매우 많은 데이터가 필요
  - 해당 부분을 이미지로 대체 할 경우 간단하게 복잡한 표면을 표현 할 수 있음
  - 이 이미지를 텍스쳐라 함

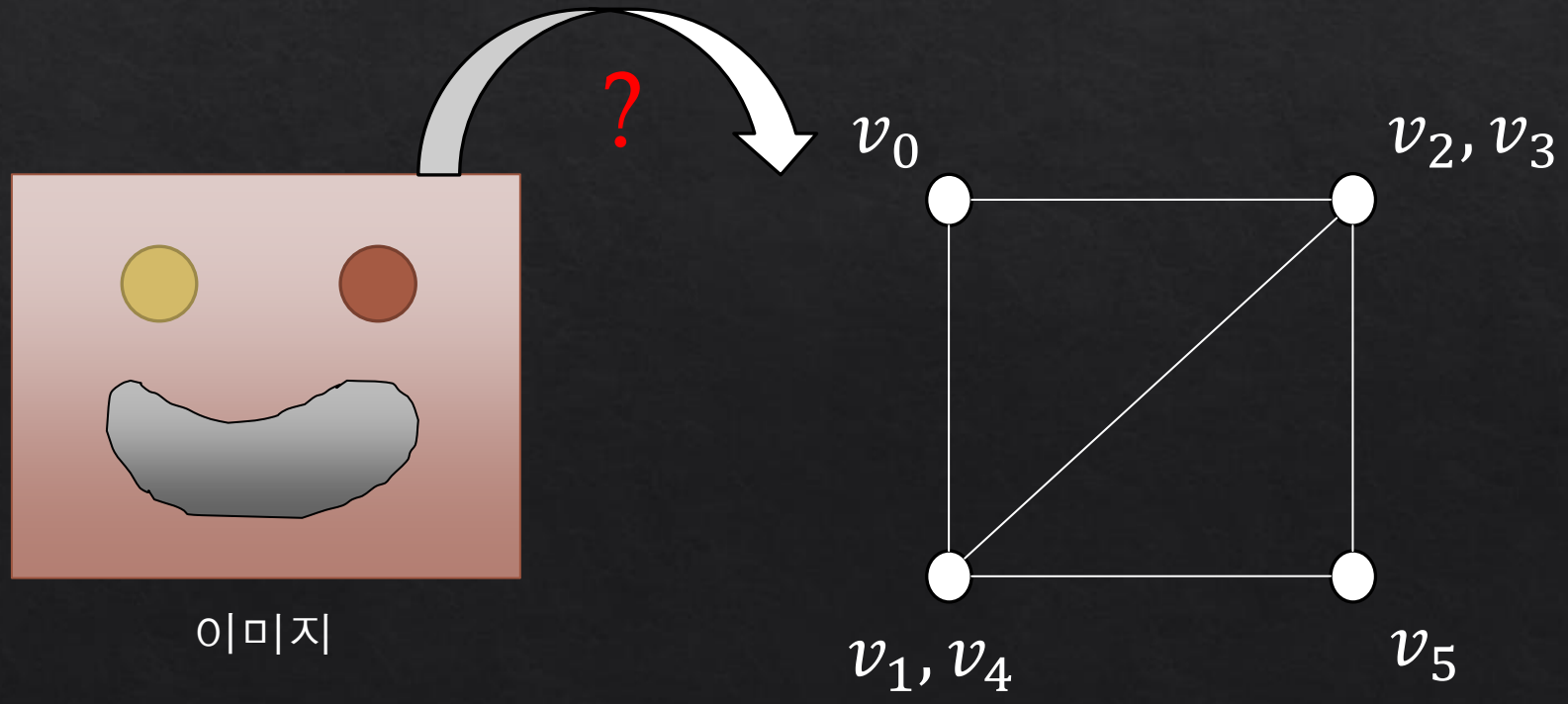
텍스쳐 매핑





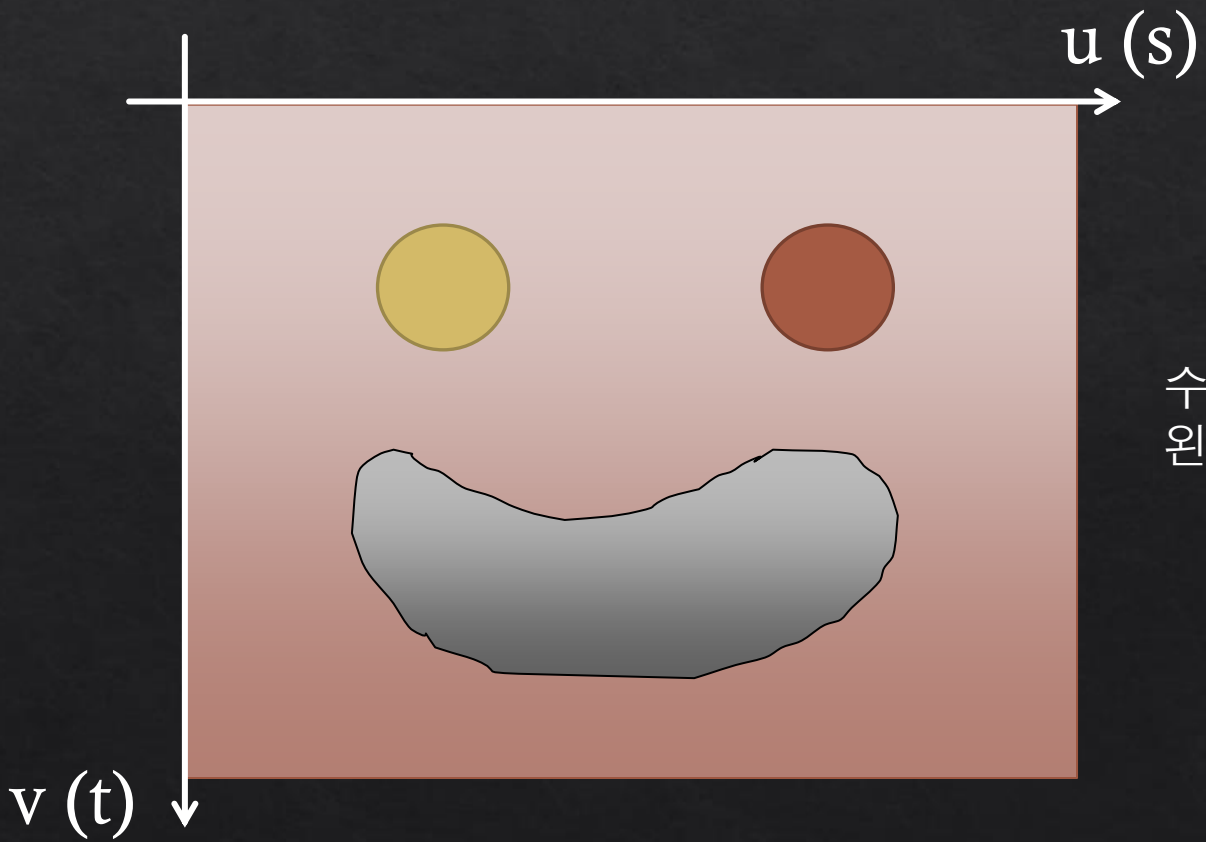
텍스쳐 매핑

- 필요한 데이터
  - 이미지 (jpg, bmp, png, tiff, …)
  - 매핑 위치



텍스쳐 매핑

- 텍스쳐 상에서 사용되는 좌표계는 u, v 혹은 s, t 로 표현 됨



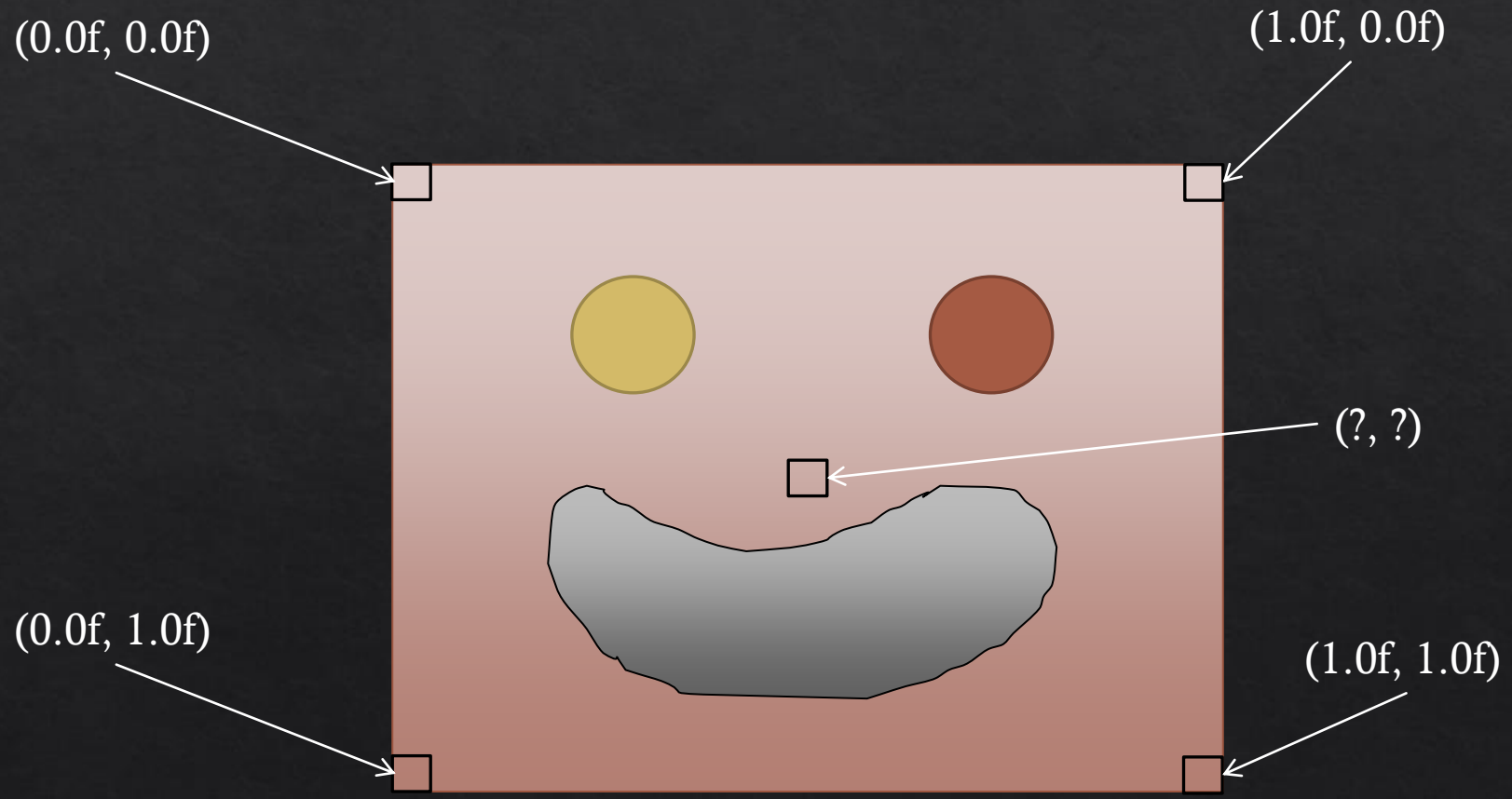
수업에선 u, v 의 축이
왼쪽 그림과 같다

텍스쳐 매핑

- u, v 혹은 s, t 의 범위는 0.0f ~ 1.0f 임

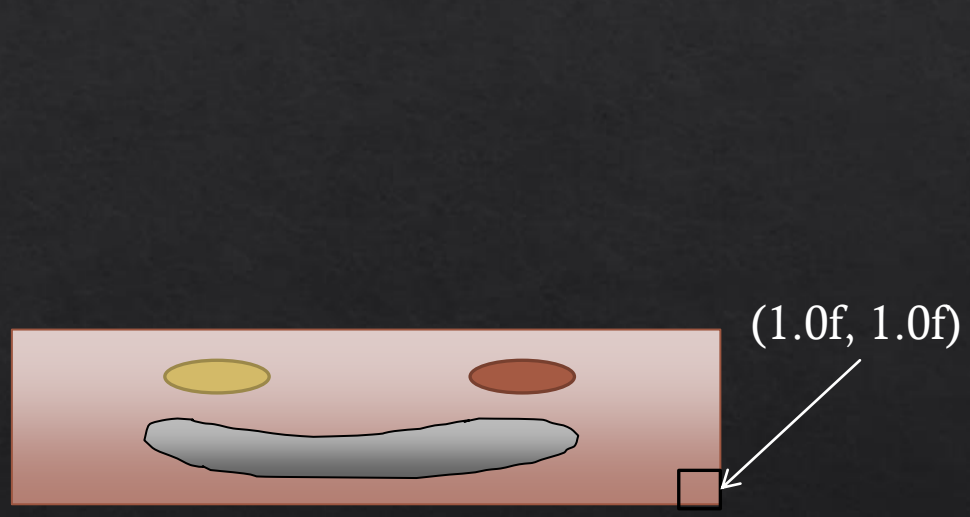
텍스쳐 매핑

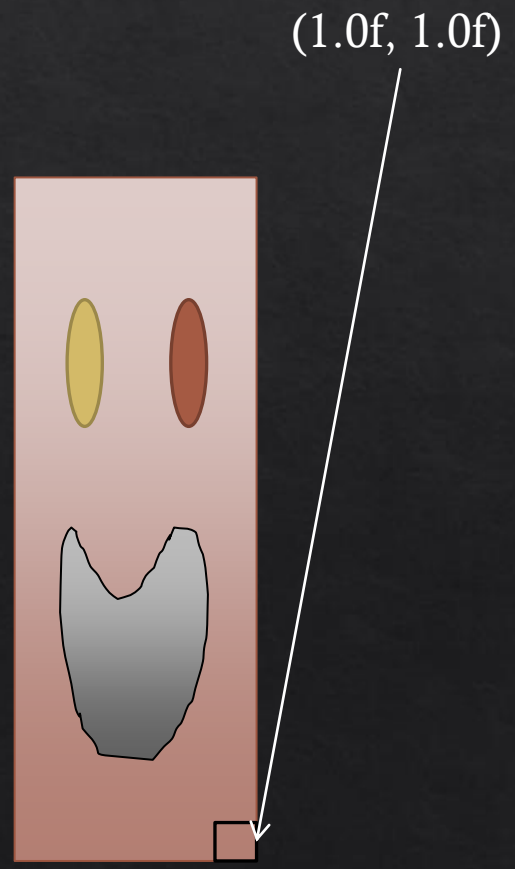
- u, v 혹은 s, t 의 범위는 0.0f ~ 1.0f 임



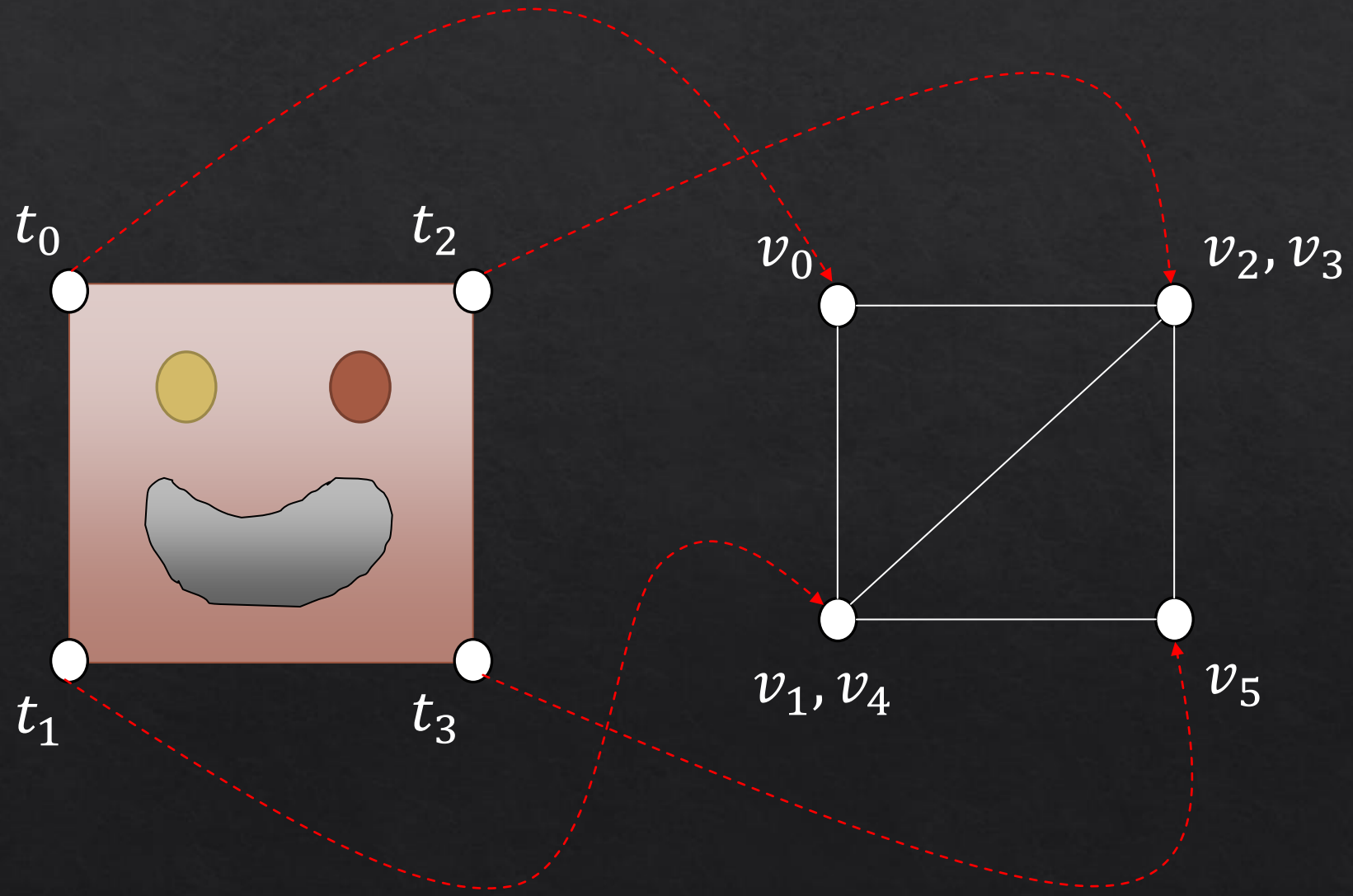
텍스쳐 매핑

- 텍스쳐 좌표는 0.0f ~ 1.0f 사이로 normalize 됨
- 이미지 해상도와 별개임

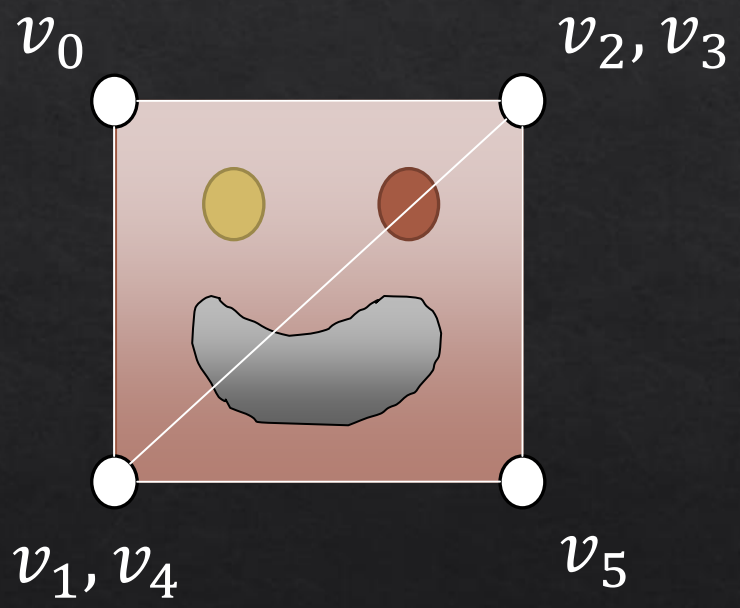




텍스쳐 매핑

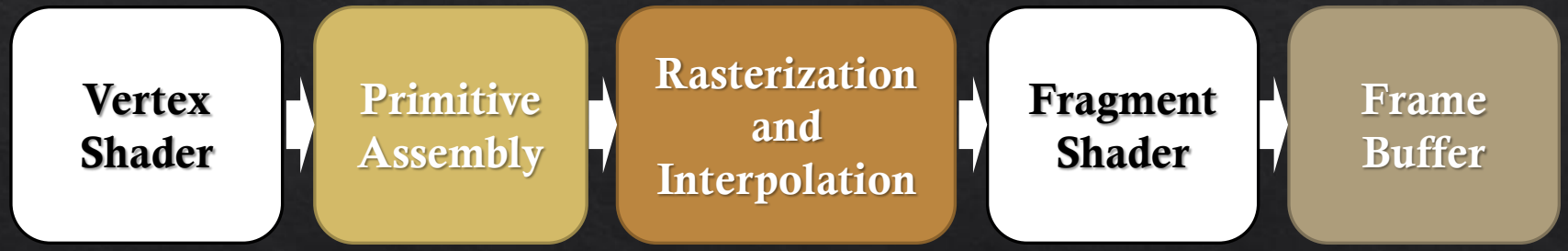


텍스쳐 매핑

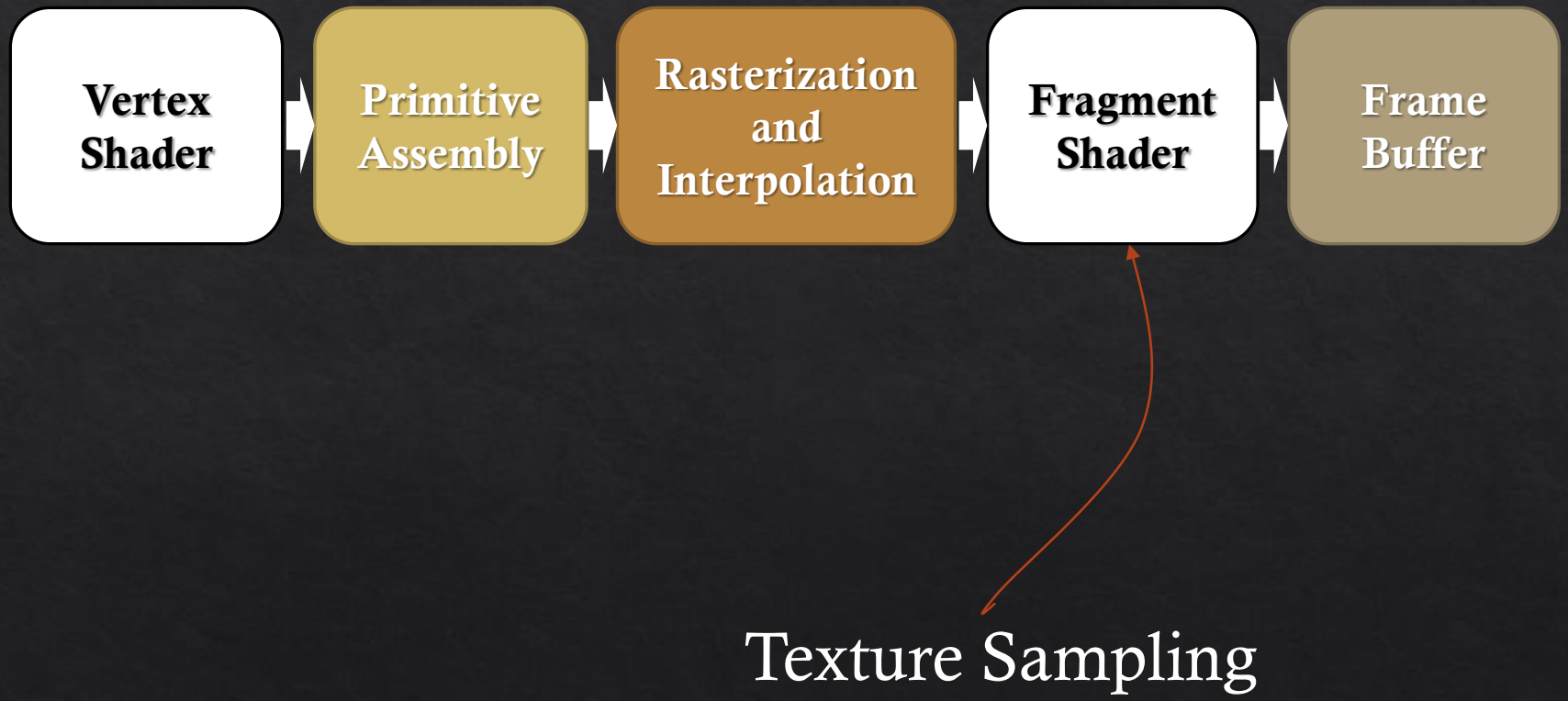


텍스쳐 매핑

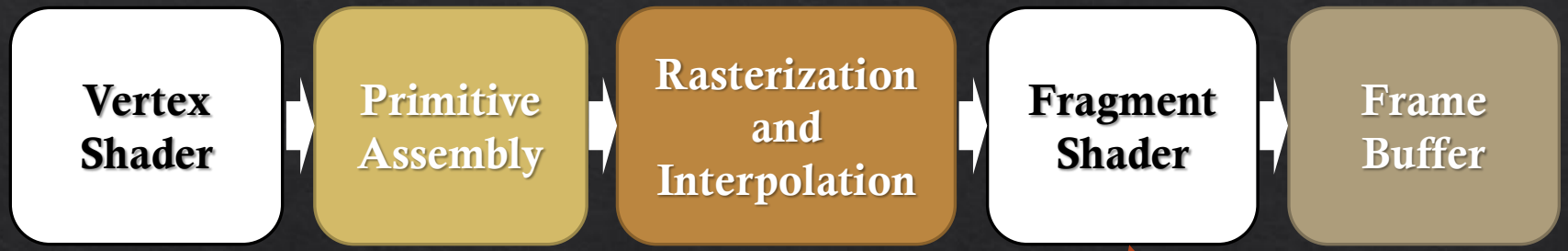
- 텍스쳐 샘플링은 어느 단계에서 이루어 질까?



텍스쳐 매핑


Vertex Shader
Primitive Assembly
Rasterization and Interpolation
Fragment Shader
Frame Buffer
Texture Sampling

텍스쳐 매핑

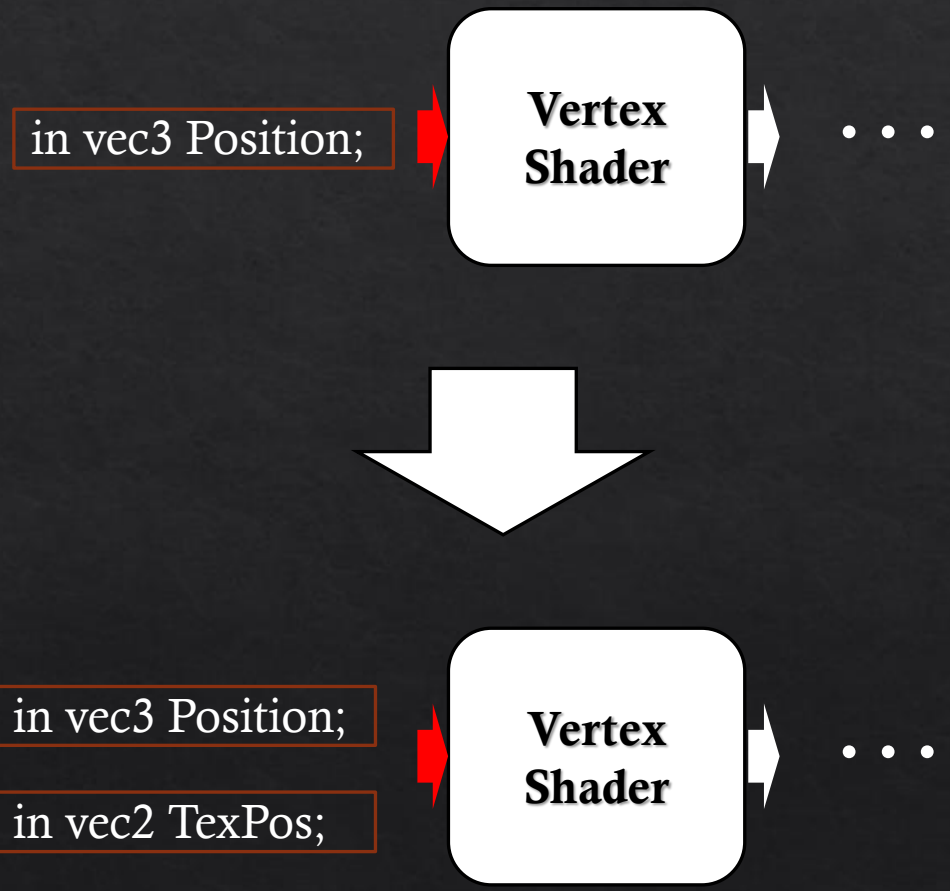


Sampling 을 위해선 텍스쳐 좌표가
필요하고 좌표를 얻기 위해선
버텍스 쉐이더로 부터 받아야 함

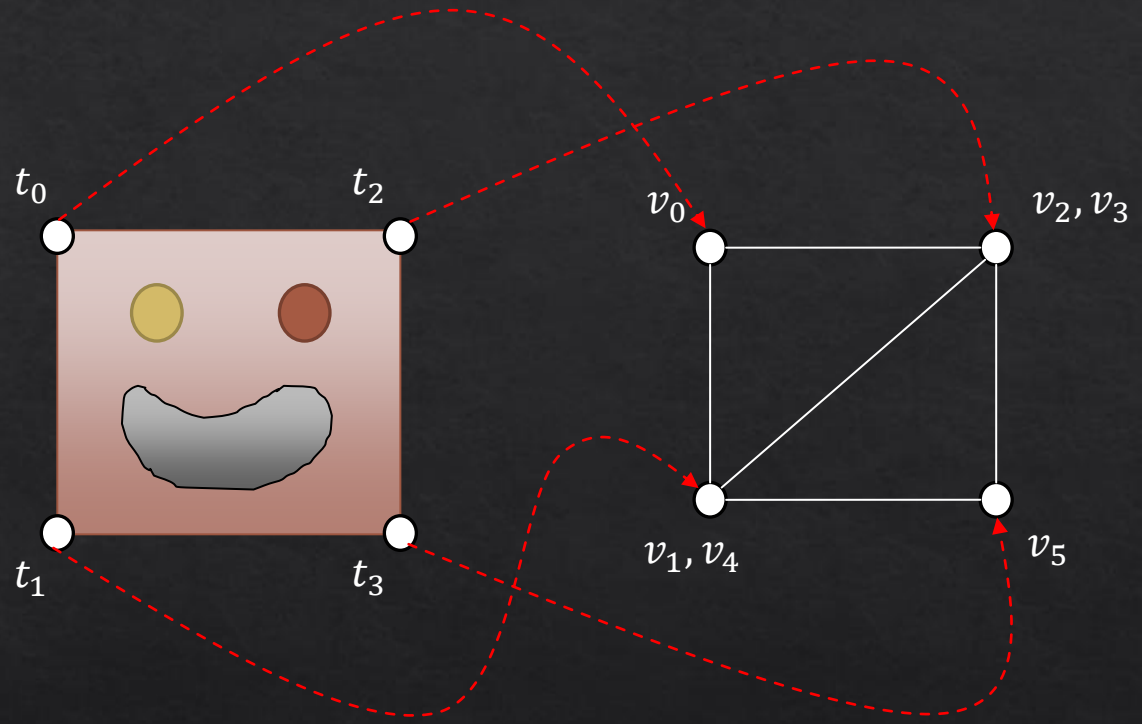
→ Attribute

Texture Sampling

텍스쳐 매핑

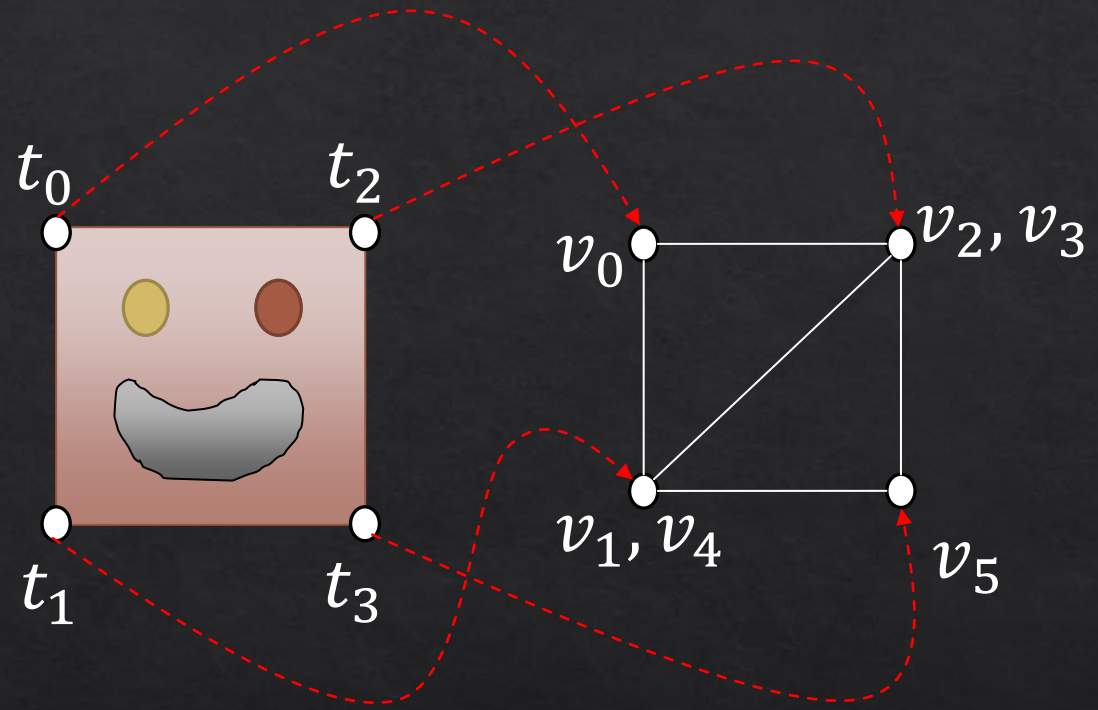

in vec3 Position;
Vertex Shader
. . .
in vec3 Position;
in vec2 TexPos;
Vertex Shader
. . .

텍스쳐 매핑



버텍스당 텍스쳐 좌표 하나씩 필요함
→ 버텍스 정보에 텍스쳐 좌표 추가 필요

텍스쳐 매핑



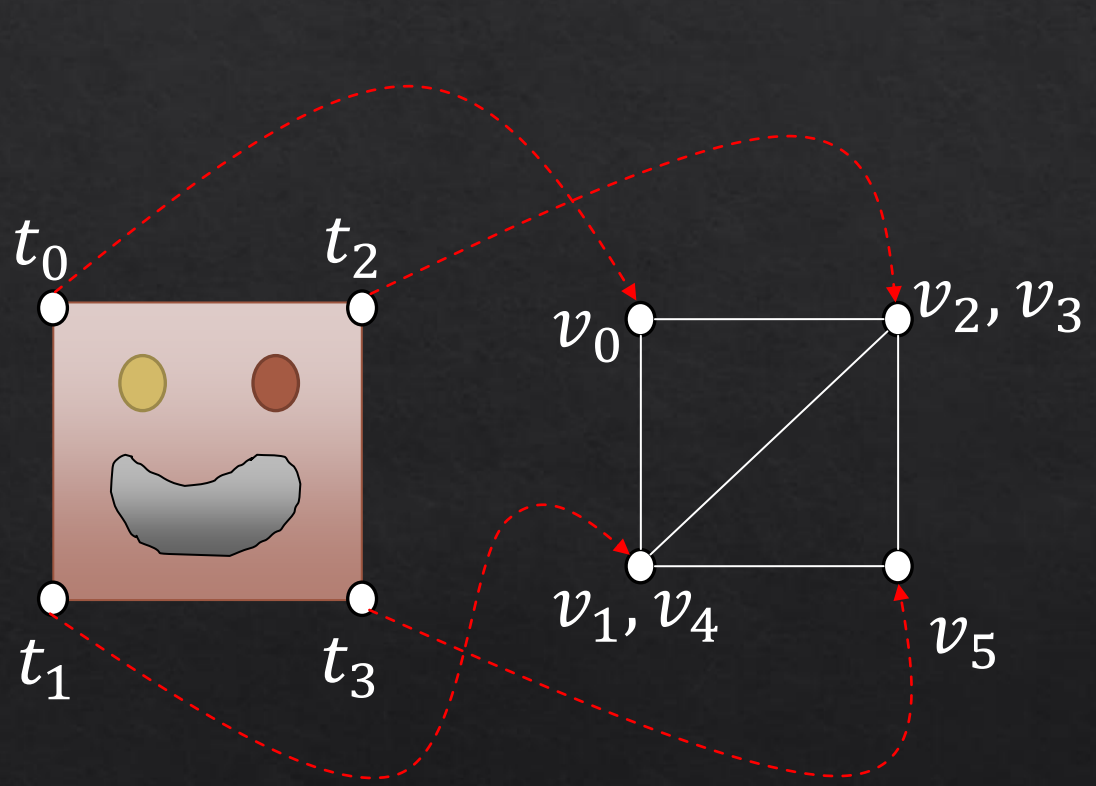
v_0 = (-0.5f, 0.5f, 0.0f)
v_1 = (-0.5f, -0.5f, 0.0f)
v_2 = (0.5f, 0.5f, 0.0f)

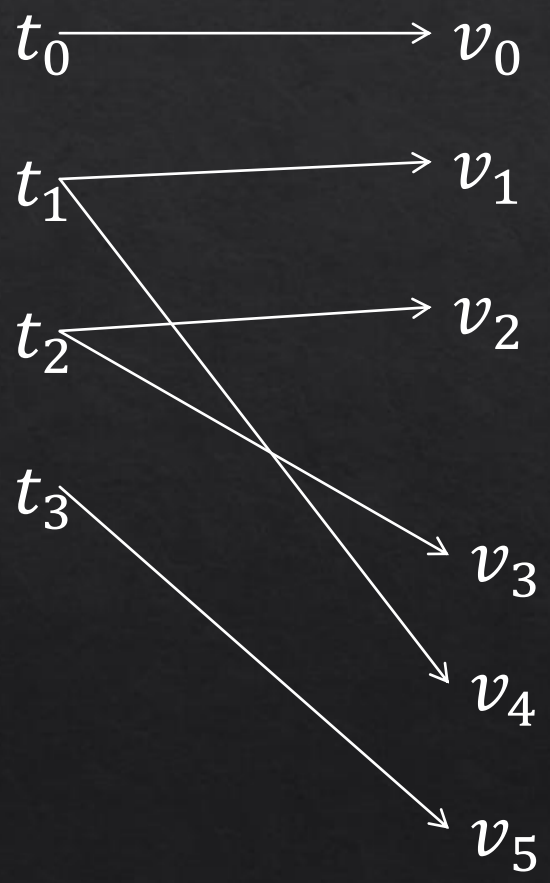
v_3 = (0.5f, 0.5f, 0.0f)
v_4 = (-0.5f, -0.5f, 0.0f)
v_5 = (0.5f, -0.5f, 0.0f)

t_0 = (0.0f, 0.0f)　　t_2 = (1.0f, 0.0f)

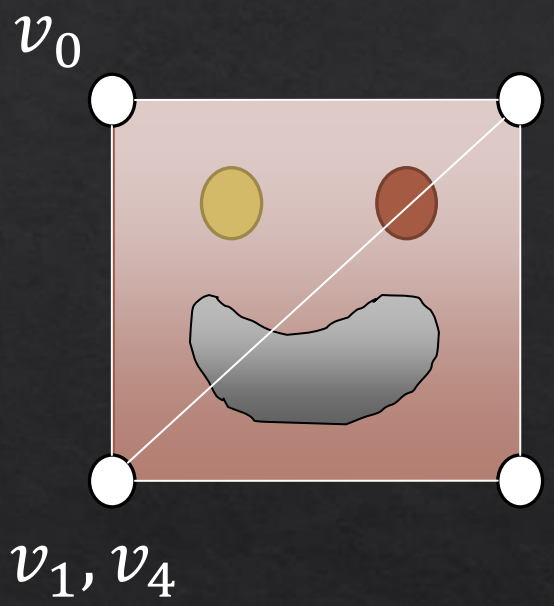
t_1 = (0.0f, 1.0f)　　t_3 = (1.0f, 1.0f)

텍스쳐 매핑

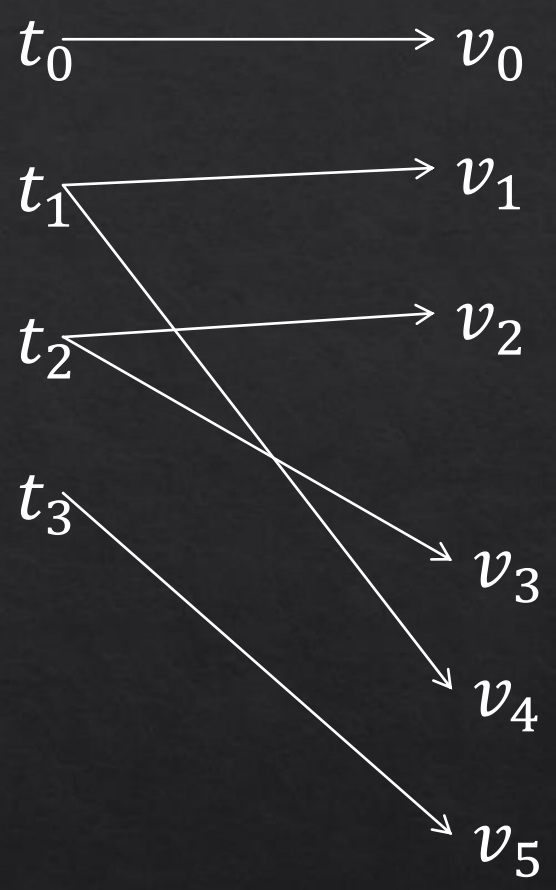




텍스쳐 매핑



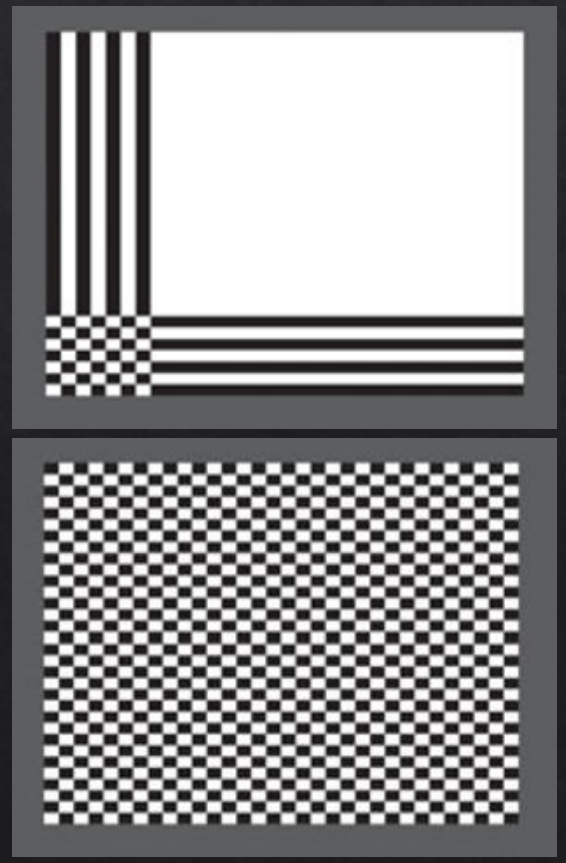
t_0 = (0.0f, 0.0f)
t_1 = (0.0f, 1.0f)
t_2 = (1.0f, 0.0f)
t_3 = (1.0f, 1.0f)

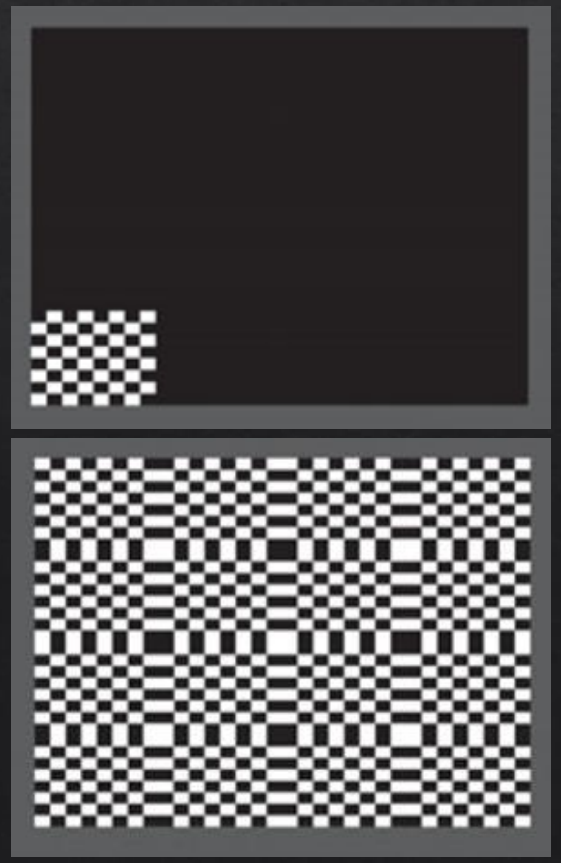


v_0 = (-0.5f, 0.5f, 0.0f, 0.0f, 0.0f)
v_1 = (-0.5f, -0.5f, 0.0f , 0.0f, 1.0f)
v_2 = (0.5f, 0.5f, 0.0f , 1.0f, 0.0f)
v_3 = (0.5f, 0.5f, 0.0f , 1.0f, 0.0f)
v_4 = (-0.5f, -0.5f, 0.0f , 0.0f, 1.0f)
v_5 = (0.5f, -0.5f, 0.0f , 1.0f, 1.0f)

텍스쳐 매핑

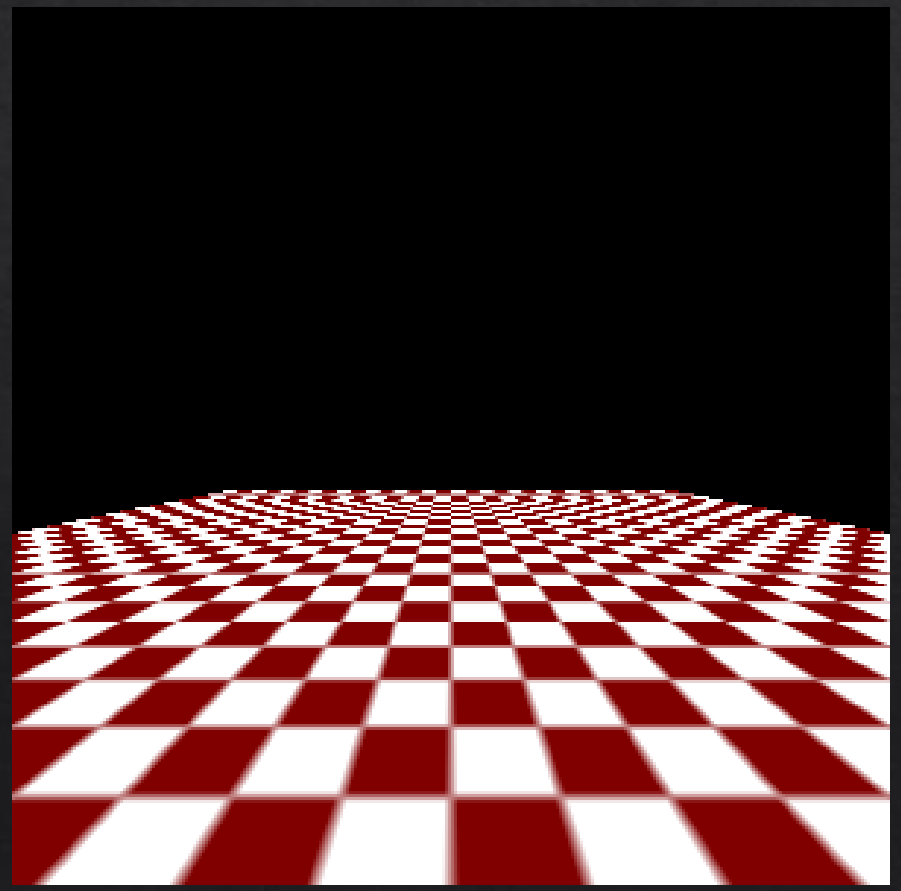
- u, v 좌표가 0보다 작거나 1보다 클 경우
  - wrap 형식에 따라 채워짐





텍스쳐 매핑

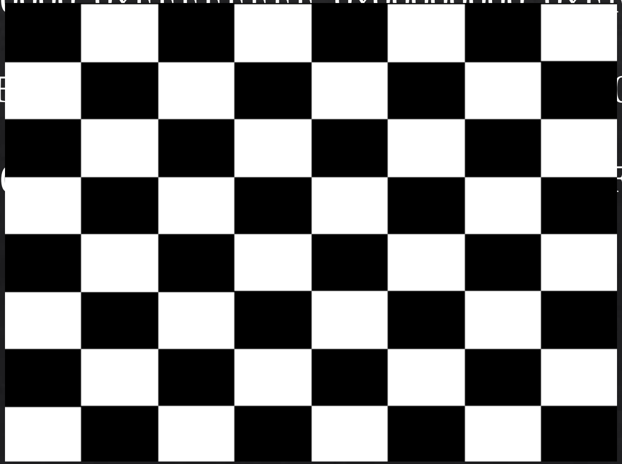
- 텍스쳐 샘플링



텍스쳐 생성

텍스쳐 생성

```
static const GLulong checkerboard[] =
{
0xFFFFFFFF, 0x00000000, 0xFFFFFFFF, 0x00000000, 0xFFFFFFFF, 0x00000000, 0xFFFFFFFF,
0x00000000,
0x00000000, 0xFFFFFFFF, 0x00000000, 0xFFFFFFFF, 0x00000000, 0xFFFFFFFF, 0x00000000,
0xFFFFFFFF,
0xFFFFFFFF, 0x00000000, 0xFFFFFFFF, 0x00000000, 0xFFFFFFFF, 0x00000000, 0xFFFFFFFF,
0x00000000,
0x00000000, 0xFFFFFFFF, 0x00000000, 0xFFFFFFFF, 0x00000000, 0xFFFFFFFF, 0x00000000,
0xFFFFFFFF,
0xFFFFFFFF, 0x00000000, 0xFFFFFFFF, 0x00000000, 0xFFFFFFFF, 0x00000000, 0xFFFFFFFF,
0x00000000,
0x00000000, 0xFFFFFFFF, 0x00000000, 0xFFFFFFFF, 0x00000000, 0xFFFFFFFF, 0x00000000,
0xFFFFFFFF,
0xFFFFFFFF, 0x00000000, 0xFFFF                                00000000, 0xFFFFFFFF,
0x00000000,
0x00000000, 0xFFFFFFFF, 0x0000                                FFFFFF, 0x00000000,
0xFFFFFFFF
};
```



텍스쳐 생성

- 전체적인 순서는 VBO 생성하는 법과 비슷함
  - glGenTextures(1, &gTextureID);
  - glBindTexture(GL_TEXTURE_2D, gTextureID);
  - glTexImage2D(GL_TEXTURE_2D, 0, GL_RGBA, 8, 8, 0, GL_RGBA, GL_UNSIGNED_BYTE, checkerboard);

텍스쳐 생성

GL_LINEAR 라는 옵션도 있음
보간을 한다. 뿌옇게 됨.

- glTexParameteri(GL_TEXTURE_2D, GL_TEXTURE_MIN_FILTER, GL_NEAREST);
- glTexParameteri(GL_TEXTURE_2D, GL_TEXTURE_MAG_FILTER, GL_NEAREST);
- glTexParameteri(GL_TEXTURE_2D, GL_TEXTURE_WRAP_S, GL_CLAMP_TO_EDGE);
- glTexParameteri(GL_TEXTURE_2D, GL_TEXTURE_WRAP_T, GL_CLAMP_TO_EDGE);

특정 지점을 어떻게 따와서 그릴 것이냐.

텍스쳐 사용

텍스쳐 사용

```
#version 330

in vec3 Position;
in vec2 TexPos;

out vec2 vTexPos;

void main()
{
    gl_Position = vec4(Position, 1.0);
    vTexPos = TexPos;
}
```

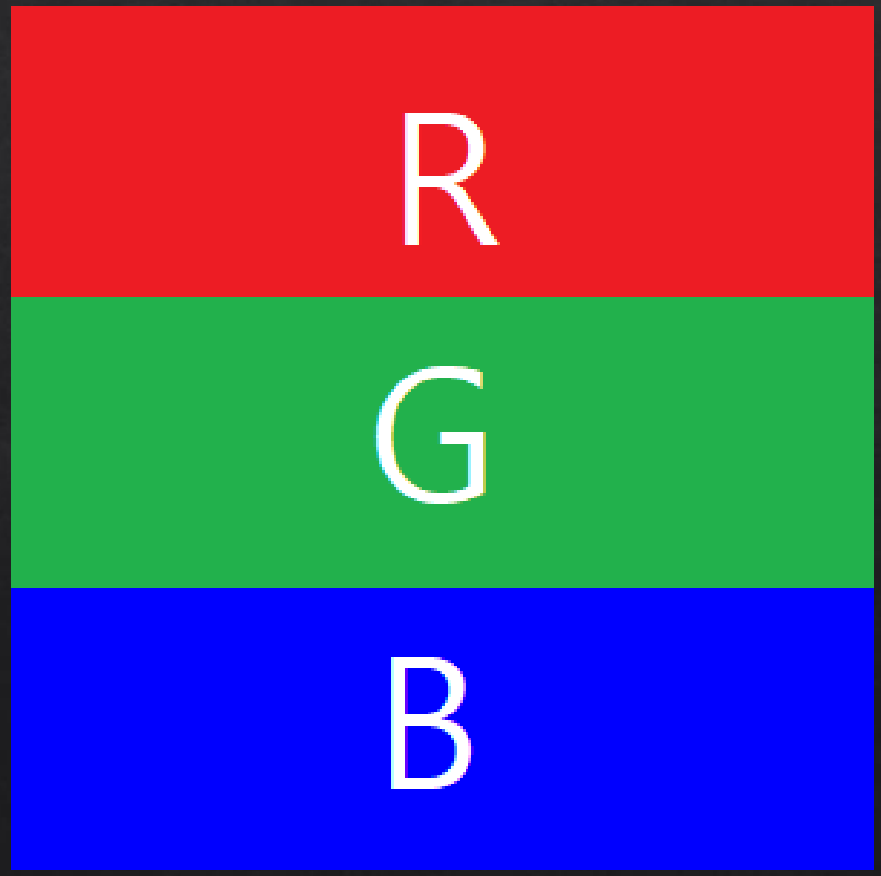
```
#version 330

uniform sampler2D uTexSampler;
in vec2 vTexPos;

out vec4 FragColor;

void main()
{
    FragColor = texture(uTexSampler, vTexPos);
}
```

```
int uniformTex = glGetUniformLocation(gShaderProgram, "uTexSampler");
glUniform1i(uniformTex, 0);
glActiveTexture(GL_TEXTURE0);
glBindTexture(GL_TEXTURE_2D, gTextureID);
```

실습

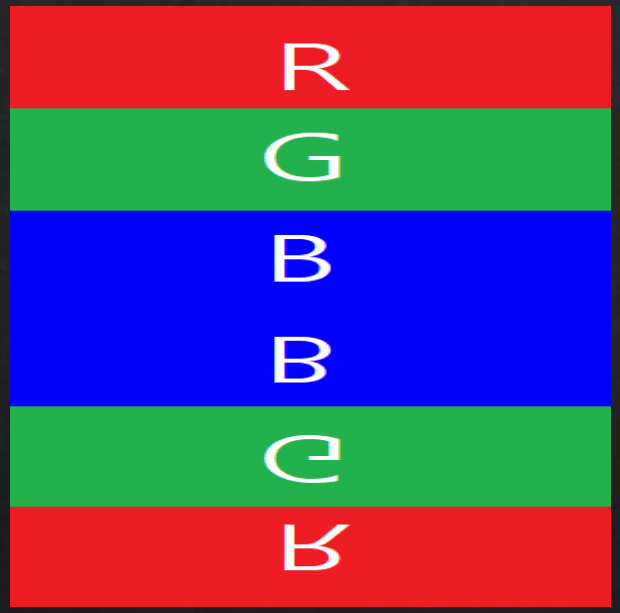
실습

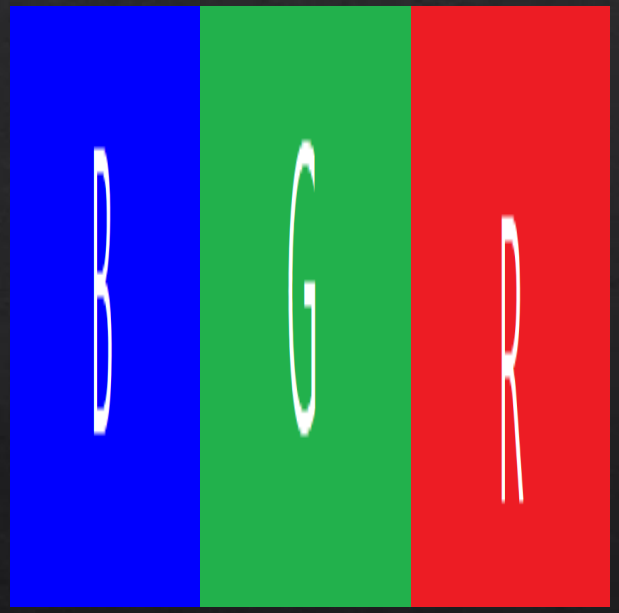
- 새로운 Shader 및 API 생성 후 구현
- 문제 : 블러 효과 구현 해보기
- 문제 : 좌표 꼬아 보기

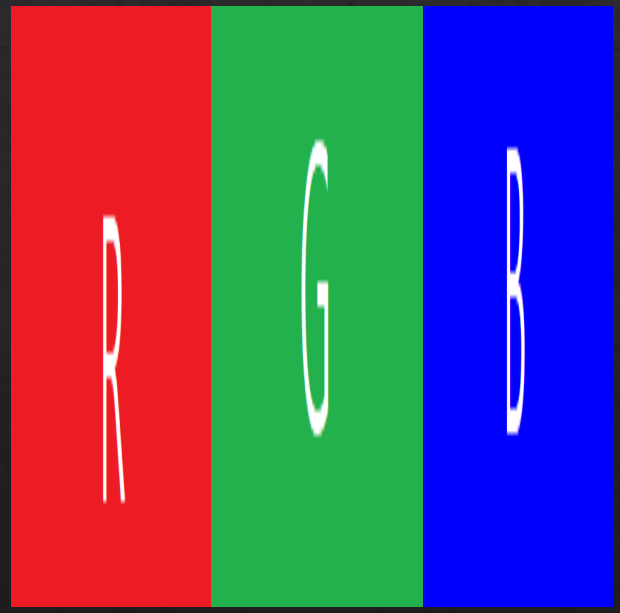


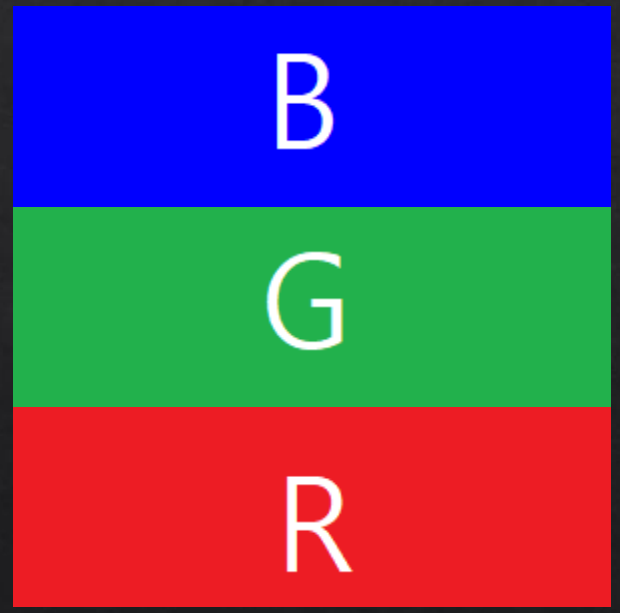
실습

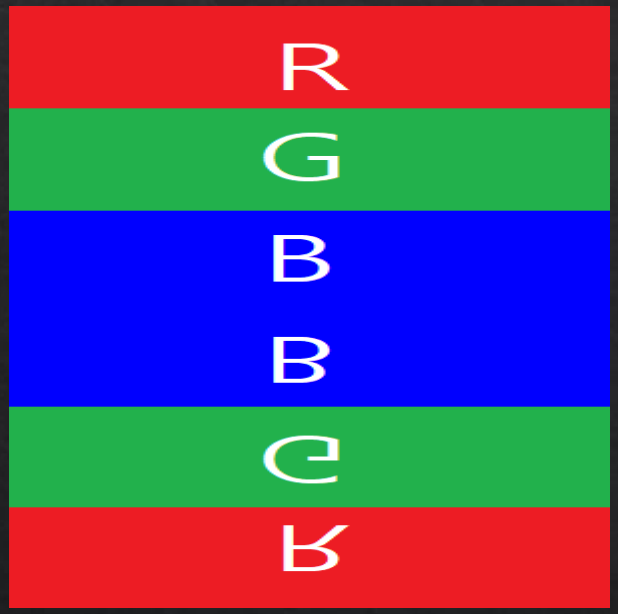
문제 : 좌표 꼬아 보기





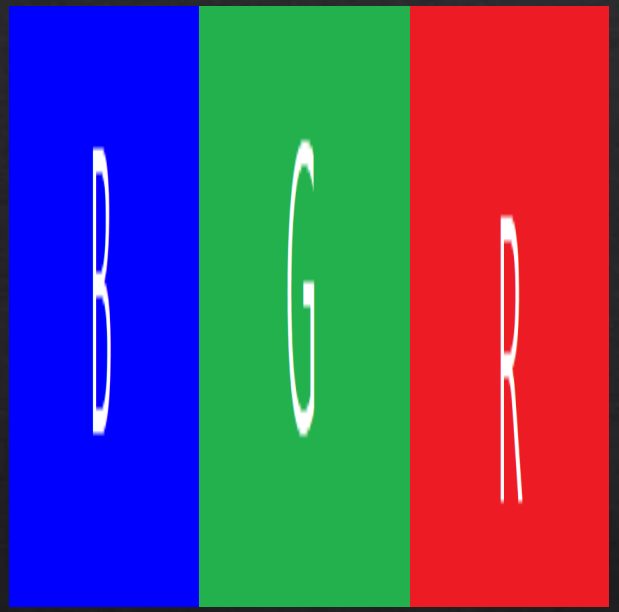






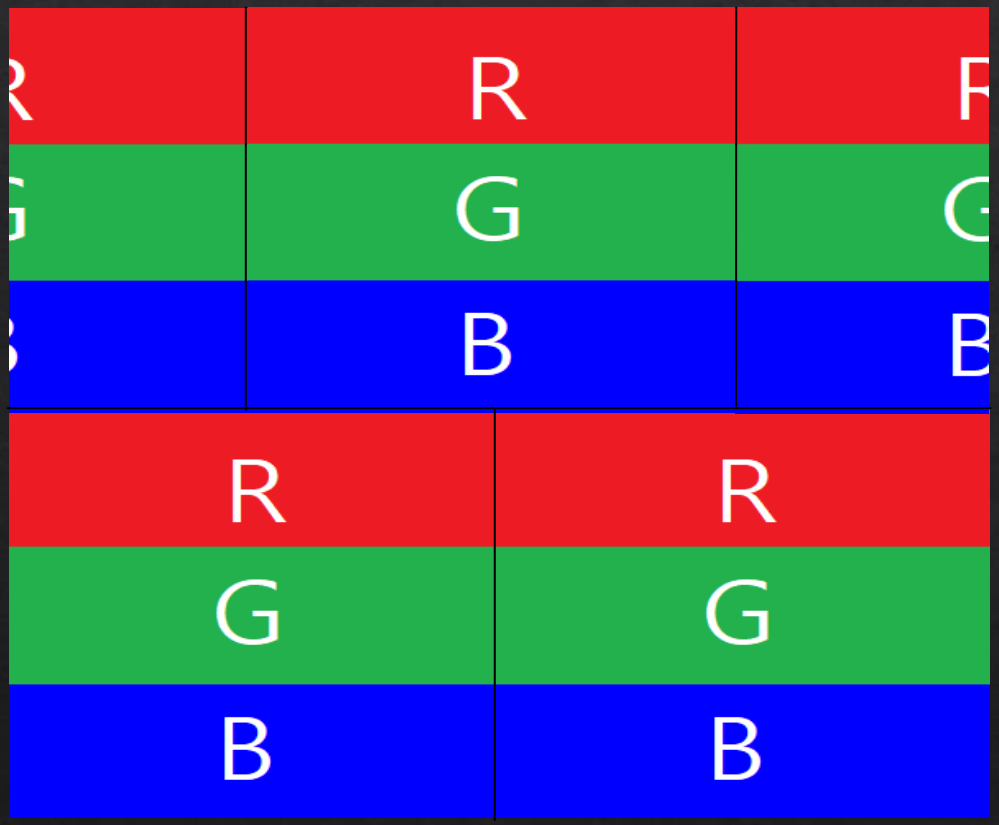
R
G
B

R
G
B



R
G
B

실습




```
float x = fract(v_TexPos.x * 2.0);
float y = fract(v_TexPos.y * 2.0);
float y2 = (1 - floor(v_TexPos.y * 2.0)) * 0.5;

x = x + y2;
```

R
G
B

실습