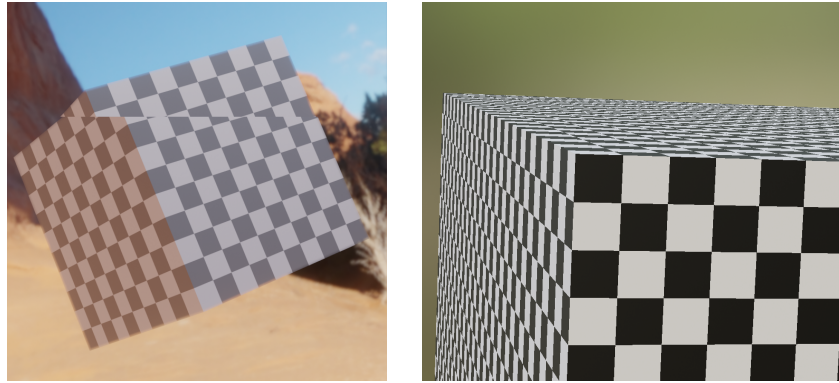


4 Introduction to Graphics (rkm38)

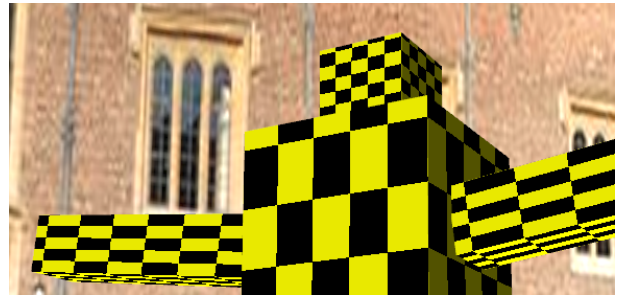
- (a) The two screenshots below show two different OpenGL rendering artifacts. Identify the artifacts, explain their cause and how to avoid them. [6 marks]



- (b) The simple GLSL shader below puts a yellow diffuse material on an object:

```
in vec3 N;
in vec2 tex_uv;
in vec3 wc_frag_pos;
out vec3 color;
```

```
void main() {
    const vec3 I_a = vec3(1, 1, 1) * .008;
    const float k_d = 0.4;
    const vec3 I = vec3(1, 1, 0.9);
    const vec3 L = vec3(1, -3, 1);
    vec3 C_d = vec3(1, 1, 0);
    vec3 linear_color = C_d*I_a + C_d*k_d*I*max(0, dot(N, L));
    color = tonemap(linear_color);
}
```



Add a few lines of code that generate a black-and-yellow checkerboard pattern as shown in the image next to the code. Assume that the correct  $uv$  coordinates have been passed from the vertex shader but no texture has been specified. You may use an arbitrary scale of the pattern on the surface. [7 marks]

- (c) You measure red, green and blue primaries of a standard dynamic-range display to be  $[X_r \ Y_r \ Z_r]$ ,  $[X_g \ Y_g \ Z_g]$ ,  $[X_b \ Y_b \ Z_b]$ . The gamma of the display is  $\gamma$ . Write the equation for mapping from linear colour  $[R_{in} \ G_{in} \ B_{in}]$  in the ITU-R 2020 colour space to the display-encoded RGB in the native colour space of the display. You are provided with the matrix  $M_{R2020toXYZ}$  mapping from ITU-R 2020 to XYZ colour space. [7 marks]