7 Further Graphics (pb355)

(a) List at least five different visual cues which our brains use to infer depth. Give a one-sentence explanation of each. [5 marks]

(b) Consider the following signed distance field function:

\[

define \text{min3}(a, b, c) \quad \text{min}(a, \text{min}(b, c))
\]

\[

define \text{max3}(a, b, c) \quad \text{max}(a, \text{max}(b, c))
\]

float getSdf(vec3 p) {
    vec3 q = vec3(abs(p.x), abs(p.y), abs(p.z));
    return min3(
        max3(q.x / 3.0, q.y, q.z),
        max3(q.x, q.y / 3.0, q.z),
        max3(q.x, q.y, q.z / 3.0)) - 1.0;
}

(i) Draw the surface, including its dimensions [4 marks]

(ii) What is the Gaussian curvature of this surface at \((3, 0, 0)\)? [1 mark]

(iii) What is the Gaussian curvature of this surface at \((1, 1, 1)\)? [1 mark]

(iv) What is the total angle deficit of this surface? [2 marks]

(v) What is the angle deficit of this surface at \((1, 1, 1)\)? [2 marks]

(vi) What is the normal of this surface at \((1, 1, 1)\)? [2 marks]

(vii) By inserting a single line of code, how would you modify `getSdf()` so that the figure is repeated infinitely along the X axis, with each repetition exactly touching the previous instance? [3 marks]