

Tut 7

Qn 1

An image has $n \times m$ pixels. A scene consists of p objects. Each object can be described by q polygons. (For example, if an object is described by a 31×31 quadrilateral mesh. Then $q = 30 \times 30 = 900$.)

- a) Find the computational complexity of
 - i) Z buffering
 - ii) Ray casting if the objects are simple
 - iii) Ray casting if the objects are complicated
- b) Find the memory complexity of the above.

(When expressing computational complexity and memory complexity, it is popular to use the $O()$ notation https://en.wikipedia.org/wiki/Big_O_notation.

However, note that there are also other commonly used notations. See the wiki article for more details.)

Qn 2

A scene is ray casted. The projection reference point is $(0, 0, 2)$. The X-Y plane is the view plane. The pixel to be ray traced is $(2, 4)$. The scene consists of a sphere with equation

$$(X - 10)^2 + (Y - 24)^2 + (Z + 10)^2 = 84$$

- a) Write down the pixel ray equation.
- b) Find the intersection point of the ray with the sphere.
- c) The sphere is specular with $W(\theta) = k_s = 1$ and $n_s = 2$. The lighting direction is the positive Z direction with intensity 1 unit. Find the intensity of the pixel.

Qn 3

A point light source is placed at $(0, 200, 200)$. It is desired to cast a shadow of an object on the X-Y plane. Write an OpenGL program for doing so.

Qn 4

Suppose the light source is replaced by a light at infinity, with lighting direction $(1, 1, 1)$. Modify your OpenGL program to cast a shadow on the X-Y plane.

OpenGL Mini-project Progress

You should now understand the meaning of the Z buffer code in OpenGL Ex 1 – 3.

Now, you should add shadow(s) to your object.

You may like to read ahead to start program the texture.