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ASSIGNMENT 5

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EXERCISE 1:

For the intersection with the cone, we realized that we need to calculate the gamma(t) = origin + t * direction.

Here we know that origin and directions are from the ray but already passed to local coordinates (because the ray is given in the local). So we need to calculate the t. So we did the next calculations:

We know that for the cone $x^2+z^2=y^2$ and also:

$$x = o.x + td.x$$
$$y = o.y + td.y$$
$$z = o.z + td.z$$

So we can just clear the ecuation in order to obtain the t:

$$x^2+z^2=y^2 \; ; \quad x^2+z^2-y^2=0 \; ;$$

$$(o.x+td.x)^2+(o.z+td.z)^2-(o.y+td.y)^2=0 \; ;$$

$$(o.x^2+2\cdot o.x td.x+t^2d.x^2)+$$
$$(o.z^2+2\cdot o.z td.z+t^2d.z^2)-$$
$$(o.y^2+2\cdot o.y t dy+t^2dy^2)=0 \; ;$$

$$(o.x^2+o.z^2-o.y^2)+$$
$$(2\cdot o.x td.x+2oztdz-2oytdy)+$$
$$(t^2dx^2+t^2dz^2-t^2dy^2)=0 \; ;$$

$$(o.x^2+o.z^2-o.y^2)+$$
$$(ox\,dx+oz\,dz-oy\,dy)\cdot 2t+$$
$$(dx^2+dz^2-dy^2)\,t^2=0 \; ;$$

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To get t, we need to use cuadratic ecuation formula, so:

$$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

where:

$$a = dx^2 + dz^2 - dy^2$$

$$b = 2(oxdx + ozdz - oydy)$$

$$c = ox^2 + oz^2 - oy^2$$

And then, we just need to implement it.

Also, we need to make the y component be between 0 and 1, otherwise, it will draw an infinite cone.

Another problem that we found was about doing the transformation from local to global correctly. But this was easy to fix when we realized that we just need to apply the transformation matrix to the intersection, the normal matrix to the normal and calculate the distance again with the correct parameters.

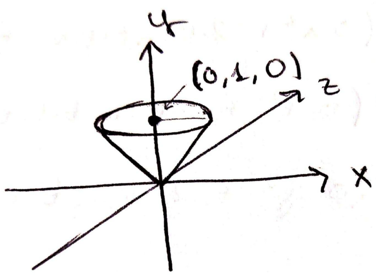
Furthermore, to obtain the transformation matrix, we need to put the transformations (rotation, scalar and translation) in the correct order for every cone.

And the last problem with this exercise was about getting the correct highlights. But we just need to normalize the normal vector at the correct point.

EXERCISE 2:

In order to obtain the disk which closes the cone we need to figure out which is the plane we are looking for.

When we are doing the intersection, we are working with the local coordinates, so we are working with the next cone:



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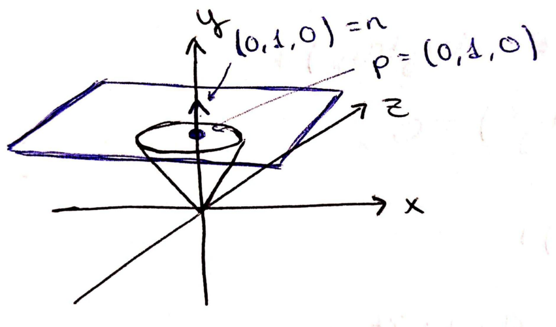
And we want to obtain the disk which closes the cone, so we want to create the plane which “closes” the cone, which is the next plane:



So now, we know that the normal of the plane that we are looking for is (0,1,0) and a point of the plane is (0,1,0), so now, we can create the plane.
But, we just only want to draw one part, the part which makes the disk which closes the cone.
For that, we realized that there is an interception only when y is greater than 1. Then, if y is greater than 1, we need to change our value of hit for the new one calculated by doing the intersection with the plan.

FINAL RESULT: