CSC418 A2 Part a

Lingfei Gao

999273851

1.

(a)

P1=(0, 0.2828,1)

P2=(0.1818, 0.5143,1)

P3=(0.0952, 0.6734,1)

P4=(-0.1053, 0.4466,1)

L_{12}=p1xp2=(-0.2315,0.1818,-0.05141304)

L_{23}=p2xp3=(-0.1591,-0.0866,0.07346276)

L_{34}=p3xp4=(0.2268,-0.2005,0.11342534)

L_{41}=p4xp1=(0.1638,0.1053,-0.02977884)

The vanishing points are where l_{12} and l_{34} intersect, $l_{23}$and l_{41} intersect

l_{12} x l_{34} =(0.010312,0.014597,0.051835) or (1.9895,2.8161,1)

l_{23} x l_{41} = (-0.0051568,0.0072954,-0.0025682) or (2.00798,-2.84072,1)

then the points are (1.9895,2.8161) and (2.00798,-2.84072)

(b)

Line l_1 (x_1,y_1,z_1)+t(a,b,c)

Line $l_2(x_2,y_2,z_2)$+t(a,b,c)

Camera stay at origin facing z-axis:

$(A_1,B_1)=(\frac{x_1+t*a}{z_1+t*c},\frac{t*b}{z_1+t*c})$

$(A_2,B_2)=(\frac{x_2+t*a}{z_2+t*c},\frac{t*b}{z_2+t*c})$

Since t-> infinity

$(A_1,B_1)\to(\frac{t*a}{t*c},\frac{t*b}{t*c})$

$(A_2,B_2)\to(\frac{t*a}{t*c},\frac{t*b}{t*c})$ since x1+infinity=infinity so does x2,z1 and z2

Thus $(A_1,B_1)= (A_2,B_2)$

(c)

Consider vanishing points are (1.9895,2.8161) and (2.00798,-2.84072)

If $r_1*r_2=0$ then they are orthogonal

If rays passing through these points are orthogonal

Then v1*v2=0

But v1*v2 $\approx$-4 which is not equal to 0 thus rays passing through these points are not orthogonal

(d)

Distance from origin to v1 is $\sqrt{1.9895^2 + 2.8161^2}$=3.4480

Distance from origin to v2 is $\sqrt{2.00798^2 + (-2.84072)^2}$=3.4787

Distance between v1 to v2 $\sqrt{(2.00798 - 1.9895)^2 + (-2.84072 - 2.8161)^2}$=5.65685

So we got $3.4480^2=d^2+f^2$

$3.4787^2=(5.65685-d)^2+f^2$

Equation2 –equation1

Then 0.21265=31.9999-11.3137d

Then 11.3137d=31.78730192

d=2.80963

thus we got $f^2=3.4480^2-2.80963^2$

f=1.99868

thus focal length is 1.99868

(e) since vanishing line is parallel to the 3D rectangle, the normal of the rectangle is also the normal for the plane intersecting the vanishing line and camera so the normal is the cross product of v1 and v2

v1 x v2= (1.9895,2.8161,1) x (2.00798,-2.84072,1)

=(5.65682,0.01848,-11.3063)

2.

Since it is rotate the curve about the y –axis

Which means $x^2+z^2=1$

Thus we set another variable v thus we get equation

X(t,v)=$(\sin(2\pi t) + 2t) * \sin v$

Y(t,v)=t^2

Z(t,v)= $(\sin(2\pi t) + 2t) * \cos v$

Where $0 \le t \le 5$ $0 \le t \le 2\pi$

3.

(a)

$x_1(t)=x_2(u)$

$y_1(t)=y_2(u)$

$z_1(t)=z_2(u)$

$3\sin(2\pi t) = u$

$3\cos(2\pi t) = 0$

$2\sqrt{2} = \sqrt{u^2 - 1}$

$u^2 = 9$

$u = \pm 3$

when $u = 3$ $\quad 3\sin(2\pi t) = 3$ $\quad 3\cos(2\pi t) = 0$

$t = 0.25 + k$ where k is an integer

point$(3,0,2\sqrt{2})$
when $u=-3 \quad 3\sin(2\pi t)=-3 \quad 3\cos(2\pi t)=0$
$t=-0.25+k$ where k is an integer
point$(-3,0,2\sqrt{2})$

(b)
$f1'(t)=(6\,\pi\cos(2\pi t)\,,-6\,\pi\sin(2\pi t)\,,0)$

$f2'(u)=(1,0,\frac{u}{\sqrt{u^2-1}})$

when t=0.25+k   f1'(0.25+k)=(0,-6π,0)

f2'(3)=(1,0, $\frac{3\sqrt{2}}{4}$)

when t=-0.25+k   f1'(-0.25+k)=(0,6π,0)

f2'(-3)=(1,0,$-\frac{3\sqrt{2}}{4}$)

(c) when t=0.25+k

(1,0, $\frac{3\sqrt{2}}{4}$)x (0,-6π,0) =($\frac{9\sqrt{2}}{2}\pi, 0, 6\pi$)

Unit normal vector =($\frac{3\sqrt{17}}{17}$,0, $\frac{2\sqrt{34}}{17}$)

when t=-0.25+k

(0,6π,0) x (1,0,$-\frac{3\sqrt{2}}{4}$) =(-$\frac{9\sqrt{2}}{2}\pi, 0, -6\pi$)

Unit normal vector =($-\frac{3\sqrt{17}}{17}$,0, $-\frac{2\sqrt{34}}{17}$)

(d)Equation

$$\nabla(p)=\left(\frac{\partial p}{\partial x},\frac{\partial p}{\partial y},\frac{\partial p}{\partial z}\right)$$

Normal vector=(2x,2y,-2z)

(e)
Thus for point$(3,0,2\sqrt{2})$
Normal vector=(6,0,-4$\sqrt{2}$)

Normal unit vector=($\frac{3\sqrt{17}}{17}$,0, $-\frac{2\sqrt{34}}{17}$)

For point (-3,0,$2\sqrt{2}$)
Normal vector=(-6,0,-4$\sqrt{2}$)

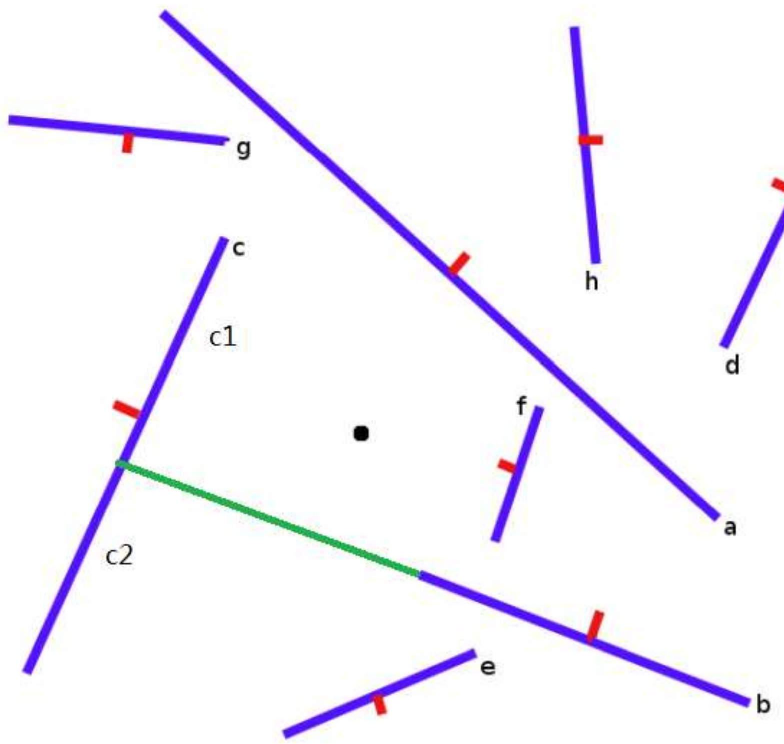
Normal unit vector=$(-\frac{3\sqrt{17}}{17}, 0, -\frac{2\sqrt{34}}{17})$

They are the same in (c).

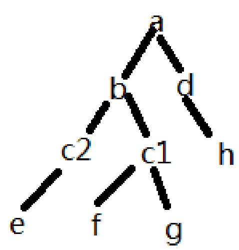
4.

(a)yes, it is possible since plane a c e h are all facing away the camera, they all can be removed by back-culling.

(b)



The BSP will be



(c)

The tree will be traversed in the following order d h a c2 e b g c1 f

If we consider back face culling then the order will be d b g f