Final

Abel Marin Jr.

1 a) For $t = 4.1$:

$$U = \frac{4.1 - 3.9}{5.1 - 3.9} = .1667 \qquad M = \begin{bmatrix} -1 & 1 \\ 1 & 0 \end{bmatrix}$$

$$G = \begin{bmatrix} -1 & -18 & -4 \\ 0 & -15 & -10 \end{bmatrix} \qquad U = [.1667 \quad 1]$$

$$MG = \begin{bmatrix} 1 & 3 & -6 \\ -1 & -18 & -4 \end{bmatrix}$$

$$Q(.1667) = UMG = [-.8333 \quad -17.4999, \quad -5.0002]$$

For $t = 4.7$:

$$U = \frac{4.7 - 3.9}{5.1 - 3.9} = .6667 \qquad M = \begin{bmatrix} -1 & 1 \\ 1 & 0 \end{bmatrix}$$

$$G = \begin{bmatrix} -1 & -18 & -4 \\ 0 & -15 & -10 \end{bmatrix} \qquad U = [.6667 \quad 1]$$

$$MG = \begin{bmatrix} 1 & 3 & -6 \\ -1 & -18 & -4 \end{bmatrix}$$

$$Q(.6667) = UMG = [-.3333 \quad -15.9999 \quad -8.002]$$

b) For $t = 4.1$:

$$U = .1667 \qquad U = [.0046 \quad .0278 \quad .1667 \quad 1]$$

$$G = \begin{bmatrix} -6 & -14 & -3 \\ -1 & -18 & -4 \\ 0 & -15 & -10 \\ 1 & -17 & -3 \end{bmatrix} \qquad M = \begin{bmatrix} -.5 & 1.5 & -1.5 & .5 \\ 1 & -2.5 & 2 & -.5 \\ -.5 & 0 & .5 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix}$$

$$MG = \begin{bmatrix} 2 & -6 & 9 \\ -4 & 9.5 & -11.5 \\ 3 & -.5 & -3.5 \\ -1 & -18 & -4 \end{bmatrix}$$

$Q(.1667) = UMG = [-.6019 \quad -17.8469 \quad -4.8619]$

For $t = 4.7$:

$u = .6667 \quad U = [.2963 \quad .4445 \quad .6667 \quad 1]$

$$G = \begin{bmatrix} -6 & -14 & -3 \\ -1 & -18 & -4 \\ 0 & -15 & -10 \\ 1 & -17 & -3 \end{bmatrix} \quad M = \begin{bmatrix} -.5 & 1.5 & -1.5 & .5 \\ 1 & -2.5 & 2 & -.5 \\ -.5 & 0 & .5 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix}$$

$$MG = \begin{bmatrix} 2 & 6 & 9 \\ -4 & 9.5 & -11.5 \\ 3 & -.5 & -3.5 \\ -1 & -18 & -4 \end{bmatrix}$$

$Q(.6667) = UMG = [-.1853 \quad -15.8884 \quad -8.7785]$

② $$W^{-1} = \begin{bmatrix} .1767 & 0 & .1769 & -10.6157 \\ 0 & .25 & 0 & -30 \\ -.1767 & 0 & .1767 & -21.2089 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$L'_N = W^{-1}C' = [2.6575 \quad 3 \quad 1.5854 \quad 1]$

$Q = \text{Clamped } L'_N = [3 \quad 3 \quad 3]$

$$Q' = WQ = \begin{bmatrix} -30.006 \\ 120 \\ 106.968 \\ 1 \end{bmatrix}$$

Finally, we check to see if Q'
is inside the BShere:

$$||Q' - C|| = ||(-3.066, -12, 4.968)|| = 13.3311$$

$13.3311 \nless 6$ Thus, they don't collide.

③ a) We would not update any, since
the only things that are changing
are the world and not the
camera.

b) We would need to update the
W2V matrix and not proj an NDC2SCR
since we are changing the camera's
field of view but not the proj or NDC2SCR

c) This depends on whether the player is
able to see more of the world in
full screen mode. If yes, then all
3 must be updated since cameras field
of view changed completly. If no,
then all matrices will remain the
same since the screen that the
player sees will stay the same.

d) None will be changed, since the
camera's field of view doesn't change.

e) All 3 matrices will be changed since the cameras field of view changed.

(4) a) We will begin by using the cameras position, orientation, and ortho projection to determine the matrix M_{ortho}. Next, we multiply this by the center of the BShere to find the center in the NDC. We then use this to determine if they intersect.

b) We need Bshere and M_{ortho} in order to the above algorithm. In order to calculate M_{ortho}, we do this by plugging in the clip plane values into the following matrix:

$$M_{ortho} = \begin{bmatrix} \frac{2}{r-l} & 0 & 0 & -\frac{r+l}{r-l} \\ 0 & \frac{2}{t-b} & 0 & -\frac{t+b}{t-b} \\ 0 & 0 & -\frac{2}{f-n} & -\frac{f+n}{f-n} \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

We would be working in camera space.

c) Same except M_{persp} instead of M_{ortho}.

⑤ We begin by calculating the normals:

$n = (b-a) \times (c-a)$

$n_1 = (0,-1,2) \times (1,-1,-1) = (3,2,1)$

$n_2 = (1,-1,-1) \times (-1,-1,-1) = (0,2,-2)$

$n_3 = (-1,-1,-1) \times (0,-1,2) = (-3,2,1)$

$n_4 = (-1,0,-3) \times (1,0,-3) = (0,-6,0)$

Next, we find $v_{los} \cdot n$, $V_{los} = pl - C_{pos}$

$V_{los\,1,2,3} = (0,1,0) - (-2,-3,-6) = (2,4,6)$

$V_{los\,4} = (0,0,2) - (-2,-3,-6) = (2,3,8)$

$V_{123} \cdot n_1 = (2,4,6) \cdot (3,2,1) = 20$

$V_{123} \cdot n_2 = (2,4,6) \cdot (0,2,-2) = -4$

$V_{123} \cdot n_3 = (2,4,6) \cdot (-3,2,1) = 8$

$V_4 \cdot n_4 = (2,3,8) \cdot (0,-6,0) = -18$

$20 \not< 0$ ~~CULLED~~ T1 CULL

$-4 < 0$ ~~NOT CULLED~~ T2 NOT CULL

$8 \not< 0$ ~~NOT CULLED~~ T3 CULL

$-18 < 0$ ~~NOT CULLED~~ T4 NOT CULL