Lecture 24
MDU

02/07/18

$W_{xmin} = 10$

$W_{xmax} = 20$

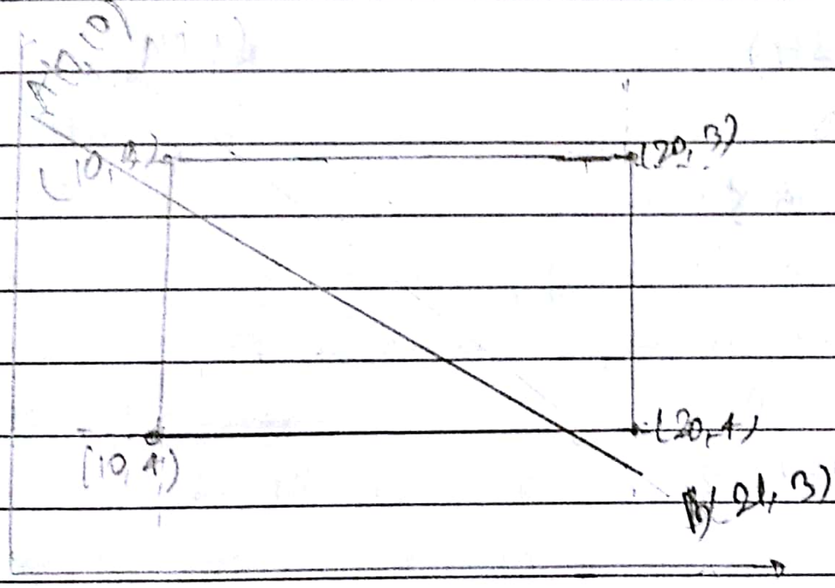
$W_{ymin} = 4$

$W_{ymax} = 9$

Line : A (7, 10)   B (21, 3)

Bit 1 = $x - xw_{min}$

= 1



Bit 1 = $x - xw_{min}$

= 7 - 10 = -3

Bit 2 = $xw_{max} - x$ = 20 - 7 = 13

Bit 3 = $y - yw_{min}$ = 10 - 4 = 6

Bit 4 = $yw_{max} - y$ = 9 - 10 = -1

Cohen-Sutherland line clipping

- ~~Intersection Points~~ Intersection points with a clipping boundary can be calculated using the slope intercept form of the line eq^n.
- For a line with the end point coordinates (x_1, y_1) and (x_2, y_2) the y-coordinate of the intersection point with a vertical boundary can be obtained with calculation, $y = y_1 + m(x - x_1)$ where x is either xw_{min} or xw_{max}.
- For the intersection with a horizontal boundary, the x coordinate can be calculated as $x = x_1 + (y - y_1)/m$, where y is either yw_{min} or yw_{max}.

$m = \cancel{\frac{21-7}{8-10}} \cancel{= 7}$ $\quad \frac{8-10}{21-7} = -1/2$

$y = y_1 + m(x - x_1)$
$= 10 - 0.5(10-7)$
$= 8.5$

$y = y_1 + m(x - x_1)$
$= 10 - \frac{1}{2}(20-7)$

$= 10 - 13/2 = 3.5$

$x = x_1 + \frac{(y - y_1)}{m}$

$= 7 + \frac{(4-10)}{-1} \times 2$

$= 7 + 6 \times 2 = 19$

Scanned by CamScanner

Liang-Barsky line clipping

- Faster line clippers based on parametric eq^n

$$\boxed{\begin{aligned} x &= x_1 + u\Delta x \\ y &= y_1 + u\Delta y \end{aligned}}$$

u: parameter
$0 \leq u \leq 1$

where $\Delta x = x_2 - x_1$ & $\Delta y = y_2 - y_1$

- Using these eq^{ns} Cyrus & Beck developed their improved algo.

- Then Liang-Barsky improved that further

$$\boxed{\begin{aligned} xw_{min} &\leq x_1 + u\Delta x \leq xw_{max} \\ yw_{min} &\leq y_1 + \Delta y \leq yw_{max} \end{aligned}}$$

$up_k \leq q_k \qquad k = 1, 2, 3, 4$

where parameters p & q are defined as

$p_1 = -\Delta x \qquad p_2 = \Delta x$

$p_3 = -\Delta y \qquad p_4 = \Delta y$

$q_1 = x_1 - xw_{min}$

$q_2 = xw_{max} - x_1$

$q_3 = y_1 - yw_{min}$

$q_4 = yw_{max} - y_1$

- Any line ∥ to the clipping boundaries has $p_k = 0$.
- If for that value of k, we also find $q_k < 0$, then line is completely inside the boundary.
- If $q_k \geq 0$, then line is inside the parallel clipping boundary.
- When $p_k < 0$, the infinite extension of line proceeds from the outside to the inside of the infinite extension of the line.
- If $p_k > 0$, it proceeds from inside to outside

For non zero value of p_k, we can calculate r

$$u = \frac{q_k}{p_k}$$

For each line we can calculate parameter u_1, u_2.

$$r_k = q_k / p_k$$

The value of u_1 is taken as the largest of r_k with $p_k < 0$
" " u_2 " " " smallest of r_k for $p_k > 0$.

Initially, $u_1 = 0$, $u_2 = 1$.
If updating u_1 or u_2 results in $u_1 > u_2$, we reject the line. Otherwise we update the appropriate u parameter only if the new value results in a shortening of the line.
When $p = 0$, $q < 0$, we can discard the line since it's parallel to and outside of the boundary.
If the line has not been rejected, the endpoints of clipped line are determined from u_1, u_2.

The two endpoints of the window are $(0, 0)$ and $(15, 15)$.
Line is $A(-15, -30)$ to $B(30, 60)$

$p_1 = -\Delta x = -45$ $\quad$ $q_1 = x_1 - xw_{min} = 15 - 0 = 15$
$p_2 = 45$ $\quad$ $q_2 = xw_{max} - x_1 = 30 - 0 = 30$
$p_3 = -\Delta y = -90$ $\quad$ $q_3 = y_1 - yw_{min} = -30 - 0 - (-10) = 30$
$p_4 = 90$ $\quad$ $q_4 = yw_{max} - y_1 = 15 - -30 = 45$

$u_1 \Rightarrow r_1, r_3$
$r_1 = \frac{1}{3}$ $\Big\}$ max
$r_3 = 1/3$

$u_2 \Rightarrow r_2, r_4$
$r_2 = 2/3$ $\Big\}$ min
$r_4 = 1/2$

$u_1 = 1/3$ $\quad$ $\therefore u_2 = 1/2$

$x_1' = x_1 + (\Delta x \times u_1) = 0$

$y_1' = y_1 + (\Delta y \times u_1) = 0$

$x_2' = x_1 + (\Delta x \times u_2) = 7.5$

$x_2 ..$