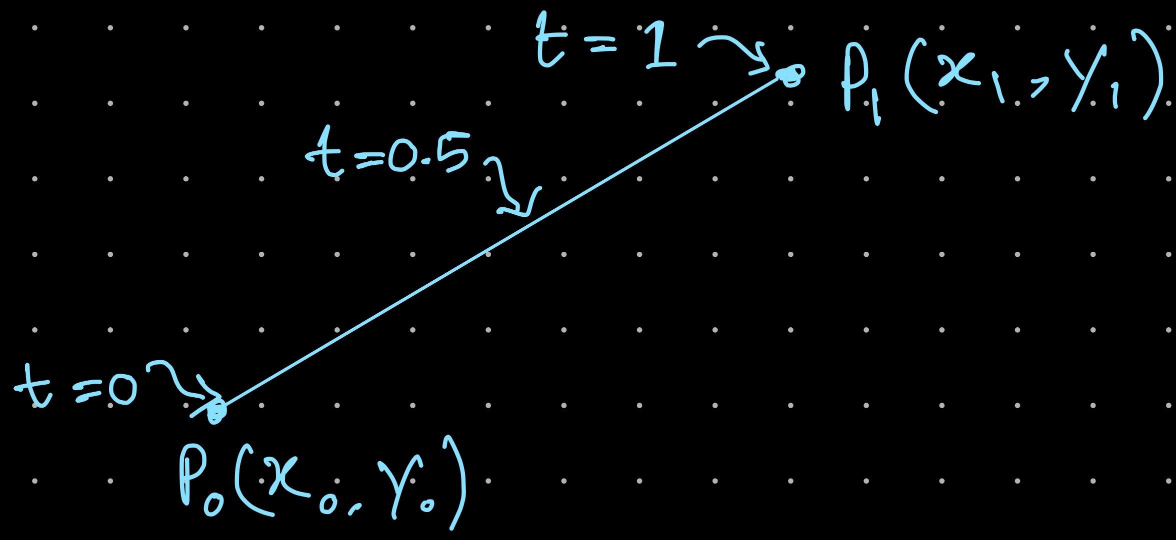
Cyrus-beck Algorithm

Step-1: Parametric equation of a line.



$$P(t) = P_0 + t(P_1 - P_0)$$

$$= (x_0, y_0) + t\{(x_1, y_1) - (x_0, y_0)\}$$

$$= (x_0, y_0) + t(x_1 - x_0, y_1 - y_0)$$

$t = 0$

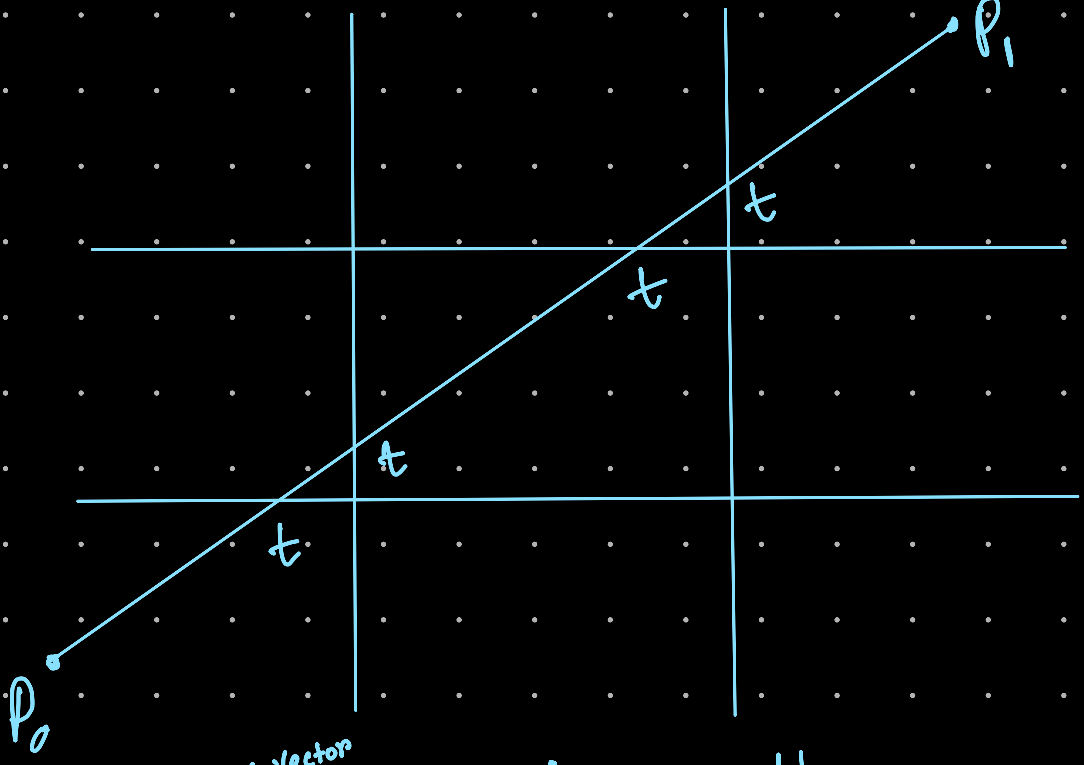
$$P(0) = (x_0, y_0) + 0\{(x_1, y_1) - (x_0, y_0)\}$$

$$= (x_0, y_0)$$

$$P(1) = (x_0, y_0) + \{(x_1, y_1) - (x_0, y_0)\}$$

$$= (x_0 + x_1 - x_0, y_0 + y_1 - y_0)$$

$$= (x_1, y_1)$$



Normal Vector

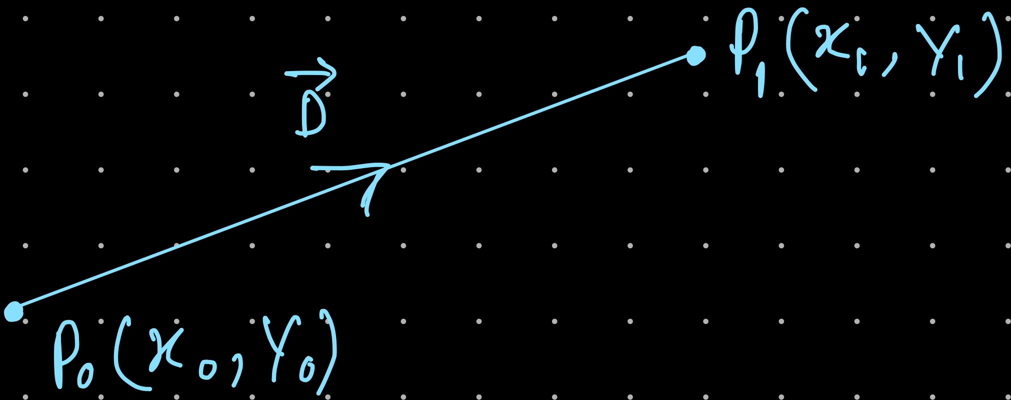
These are the vector Dot product

$$t = \frac{N \cdot (P_0 - P_E)}{-N \cdot D}$$

$(P_0 - P_E) \rightarrow (x_0, Y_0)$

$D \rightarrow (x_1 - x_0, Y_1 - Y_0)$

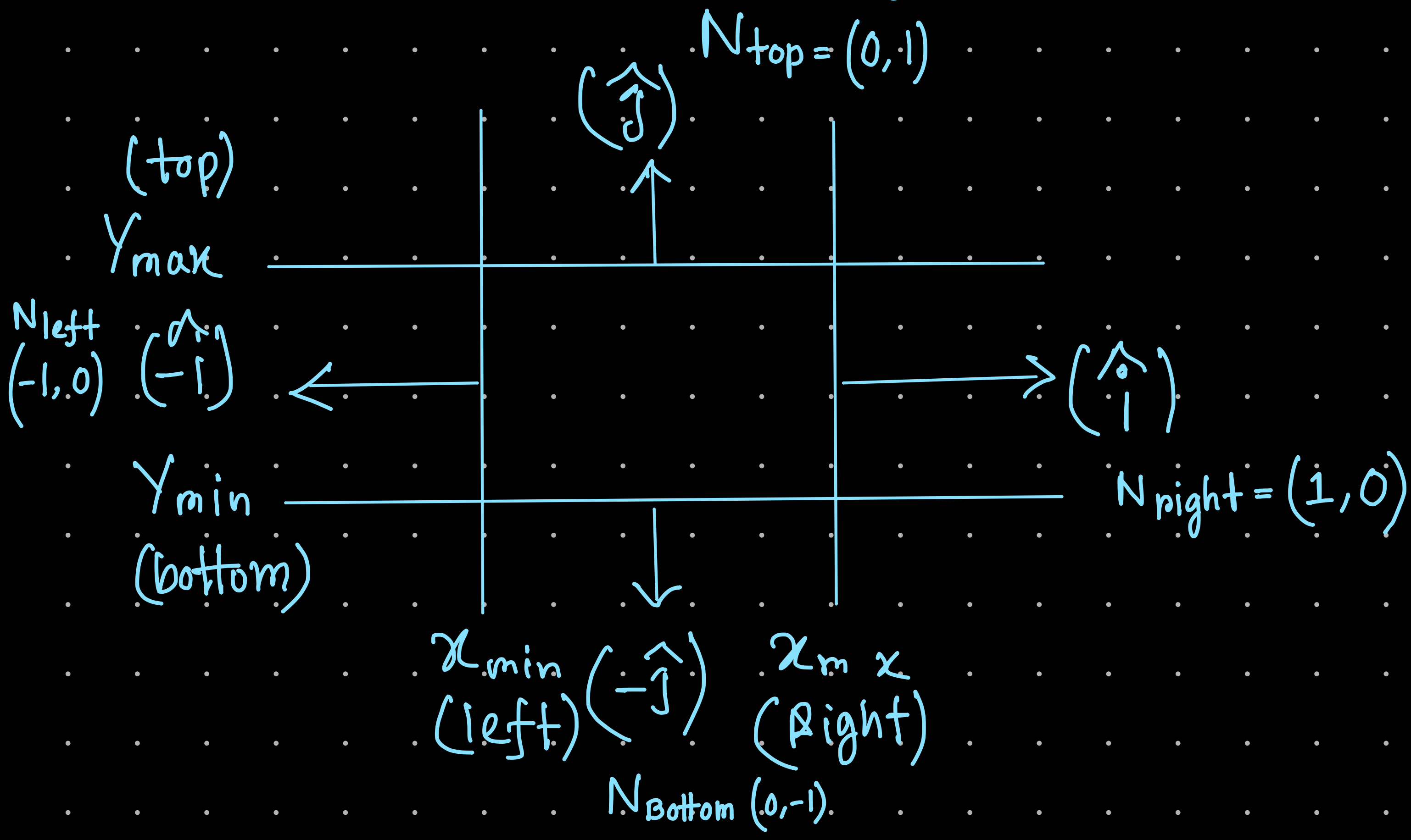
Step-2 Vector Representation of a line



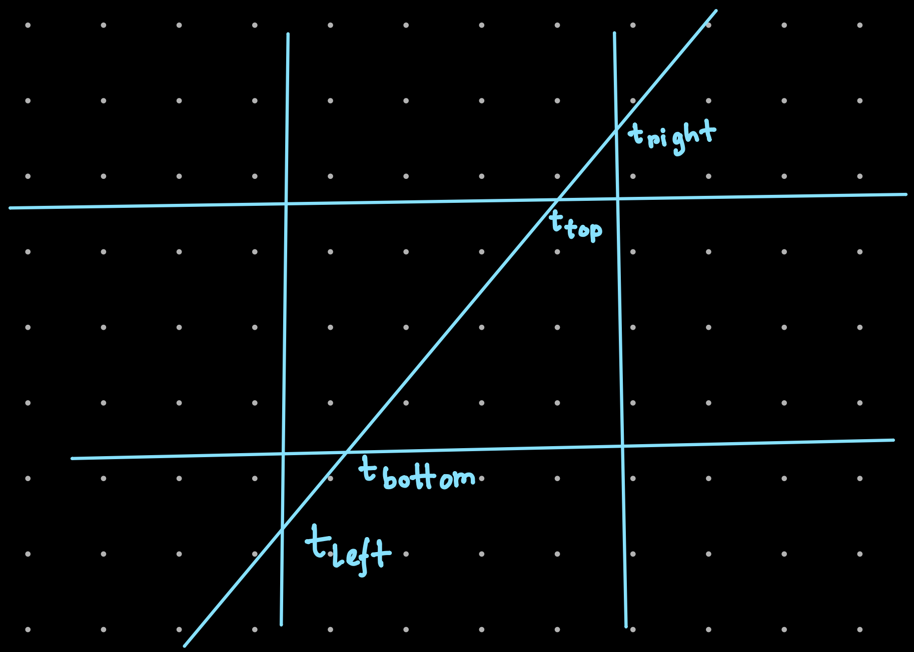
$$\vec{D} = \text{final} - \text{initial}$$
$$= P_1 - P_0$$
$$= (x_1, Y_1) - (x_0 - Y_0)$$

$$D = (x_1 - x_0, Y_1 - Y_0)$$

Step-3: Normal vectors of boundaries



Step-4: Find out the t for each of the boundaries (4 times)



$$t_{left} = \frac{(-1,0)\cdot(x_0, y_0) - (x_{min}, y_1)}{-(-1,0)\cdot(x_1 - x_0, y_1 - y_0)}$$

$$= \frac{(-1,0)\cdot(x_0 - x_{min}, y_0 - y_1)}{(1,0)\cdot(x_1 - x_0, y_1 - y_0)}$$

$$\therefore t_{left} = \frac{-(x_0 - x_{min})}{x_1 - x_0}$$

$$t_{right} = \frac{-(x_0 - x_{max})}{x_1 - x_0}$$

$$t_{top} = \frac{-(Y_0 - Y_{max})}{Y_1 - Y_0}$$

$$t_{bottom} = \frac{-(Y_0 - Y_{min})}{Y_1 - Y_0}$$

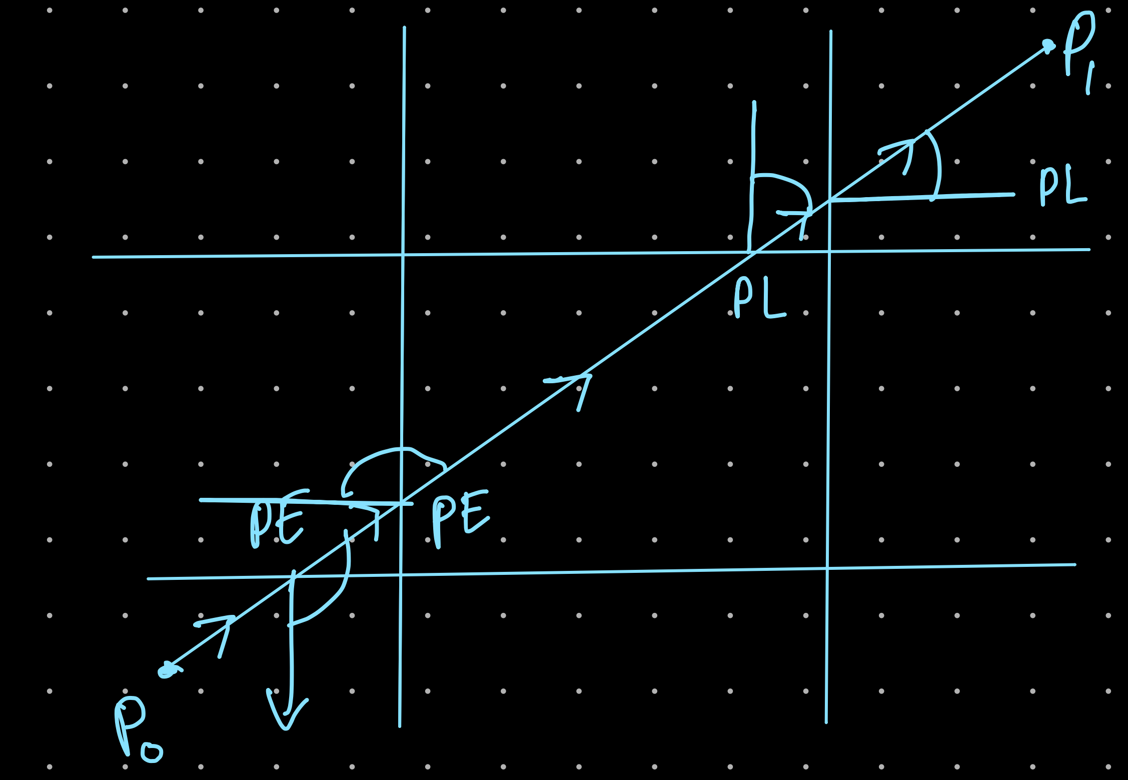
Step-5 : Find out, when to draw and when to discard

PE (Potential Entering): Angle between N and D is greater than 90° [obtuse]

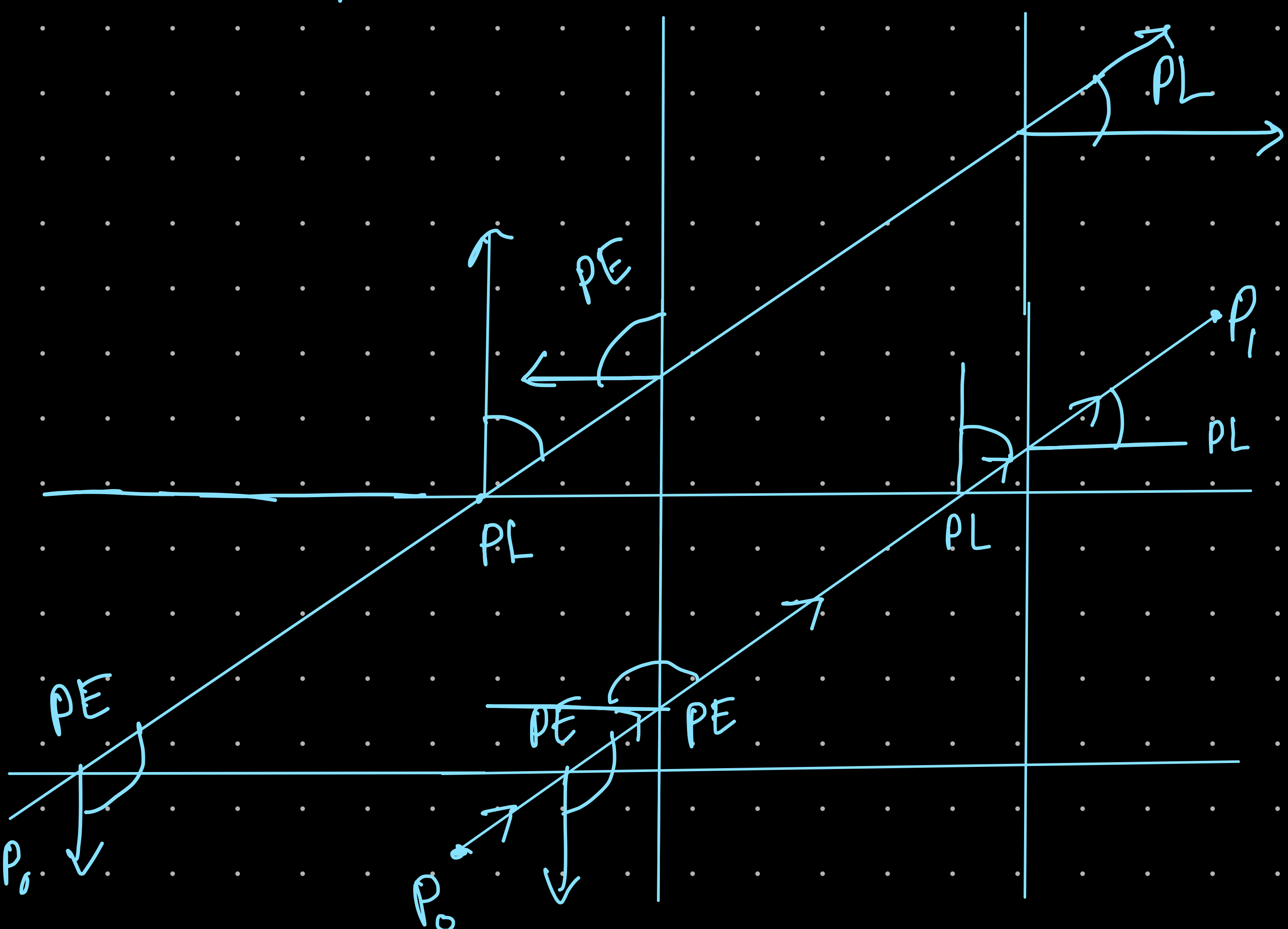
N → Normal Vector

D → Line Vector

PL (Potential Leaving): less than 90° [acute]



if $\max(PE) < \min(PL)$
draw from $\max(PE)$ to $\min(PL)$



if $\max(PE) < \min(PL)$

draw from $\max(PE)$ to $\min(PL)$

$\max(PE) > \min(PL)$

discard

$\boxed{\begin{array}{l} PE \rightarrow N.D < 0 \\ PL \rightarrow N.D > 0 \end{array}}$

Clip Region $(-100, -120)$ to $(150, 200)$

$-100 \rightarrow x_{min}$, $-120 \rightarrow Y_{min}$, $150 \rightarrow x_{max}$, $200 \rightarrow x_{min}$

i) Clip $P_0(-125, 260)$ to $P_1(195, -140)$

$-125 \rightarrow x_0$, $260 \rightarrow Y_0$, $195 \rightarrow x_1$, $-140 \rightarrow Y_1$

line vector, $D = (x_1 - x_0, Y_1 - Y_0)$

$= (195 - (-125), -140 - 260)$

$= (320, -400)$

boundary	N	Ni.D	PE/PL	t	$t_E \rightarrow 0$	$t_L \rightarrow 1$
left	$(-1,0)$	-320	PE	t_{left} 0.078	max(0, 0.78) 0.078	1
right	$(1,0)$	320	PL	0.859	0.078	min 1, 0.859) 0.859
top	$(0,1)$	-400	PE	0.15	max(0.078, 0.15) 0.15	0.859
bottom	$(0,-1)$	400	PL	0.859	0.15	min(0.859, 0.859) 0.859

for $t_{left} = \frac{-(x_0 - x_{min})}{x_1 - x_0}$

$$= \frac{-(-125 - (-100))}{195 - (-125)}$$

$$= 0.078$$

$$p(t) = P_0 + t(P_1 - P_0)$$

$$= (-125, 260) + t(320, -400)$$

$$P(0.15) = (-77, 00)$$

$$P(0.859) = (150, -84)$$