1. DDA

a. titik awal   : $A(7, 10)$
   titik akhir   : $B(17, 16)$
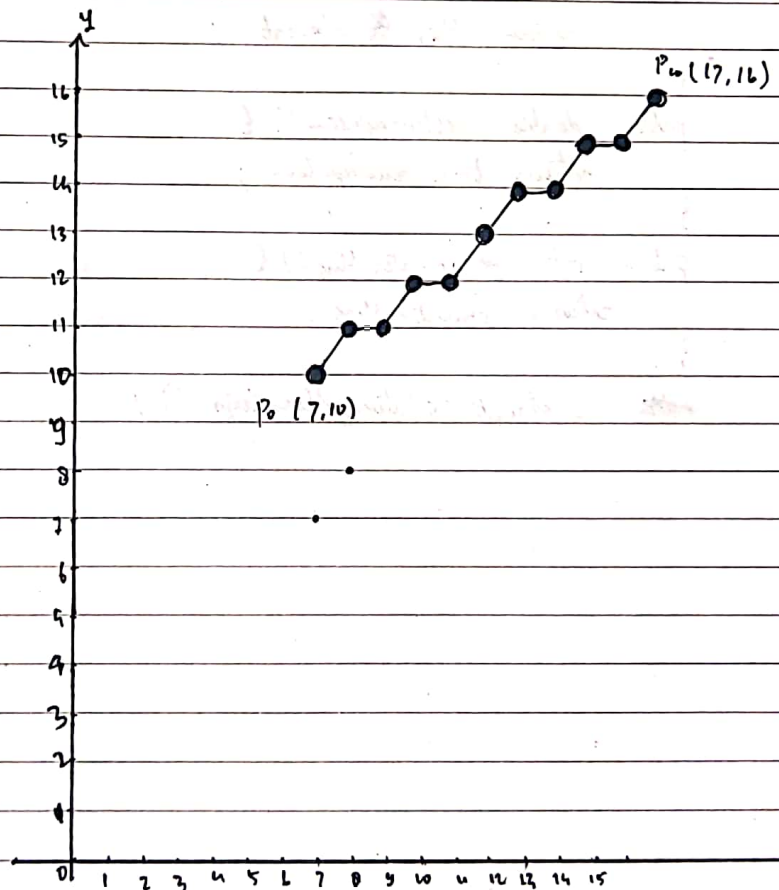
b. $dx = x_1 - x_0$ $dy = y_1 - y_0$
   $= 17 - 7$ $= 16 - 10$
   $= 10$ $= 6$

c. $dx > dy$, maka lebih banyak langkah pada sumbu x. steps = 10
   $X_{increment}$: $10/10 = 1$
   $Y_{increment}$: $6/10 = 0,6$

k	x_k	y_k	X_{plot}	Y_{plot}
0	7	10.	7	10
1	8	10.6	8	11
2	9	11.2	9	11
3	10	11.8	10	12
4	11	12.4	11	12
5	12	13	12	13
6	13	13.6	13	14
7	14	14.2	14	14
8	15	14.8	15	15
9	16	15.4	16	15
10	17	16	17	16

$P_{10}(17, 16)$

$P_0(7, 10)$

2. Lingkaran dengan pusat $A(3,4)$, dengan radius : 10. Step by step dengan Bresenham mid point

a) $(x = x \cdot x_c, y = y \cdot y_c)$

$x_0, y_0 = (0, 10)$ $(x_c, y_c) = (3, 14)$ initial point

b) $P_0 = 1 - r$

$= 1 - 10 = -9$

c) $P_k < 0 \to$ plot (x_{k+1}, y_k)

     $\llcorner P_{k+1} = P_k + 2(x_k + 1) + 1$

$P_k \geq 0 = $ plot (x_{k+1}, y_{k+1})

     $\llcorner P_{k+1} = P_k - 2(x_{k+1}) + 1 + 2(y_k + 1)$

d) Menentukan pixel

$k = 0, P_0 = -9, (0, 10)$

$k = 1, P_1 = -9 + 2(0 + 1) + 1$

     $= -6, (1, 10)$

$k = 2, P_2 = -6 + 2(1 + 1) + 1$

     $= -6 + 5$

     $= -1, (2, 10)$

$k = 3, P_3 = -1 + 2(2 + 1) + 1$

     $= -1 + 7$

     $= 6, (3, 9)$

$k = 4, P_4 = 6 + 2(3 + 1) + 1 - 2(9 - 1)$

     $= 6 + 9 - 16$

     $= -1, (4, 9)$

$k = 5, P_5 = -1 + 2(4 + 1) + 1$

     $= -1 + 11$

     $= 10, (5, 8)$

$k = 6, P_6 = 10 + 2(5 + 1) - 2(8 - 1) + 1$

     $= 10 + 13 - 14$

     $= 9, (6, 7)$

$k = 7, P_7 = 9 + 2(6 + 1) + 1 - 2(7 - 1)$

     $= 9 + 15 - 12$

     $= 12, (7, 6)$

e) Tabel pixel

k	P_k	(x_{k+1}, y_{k+1})	$2x_{k+1}$	$2y_{k+1}$	$(x + x_c, y + y_c)$
0	-9	(0, 10)	2	20	(4, 14)
1	-6	(1, 10)	4	20	(5, 14)
2	-1	(2, 10)	6	20	(6, 14)
3	6	(3, 9)	8	18	(7, 13)
4	-1	(4, 9)	10	18	(8, 13)

4.

k	Pk	(x_{k+1}, y_{k+1})	$2x_{k+1}$	$2y_{k+1}$	$(x+x_c, y+y_c)$
5	10	(5, 8)	10	16	(8, 12)
6	4	(6, 7)	12	14	(9, 11)
7	12	(7, 6)	14	12	(10, 10)

3. Transformasi 3D 45° garis AB

$A(6,1,-1)$ $B(6,4,0)$

step 1   Translasi   A ke origin

$$T = \begin{bmatrix} 1 & 0 & 0 & -x_1 \\ 0 & 1 & 0 & -y_1 \\ 0 & 0 & 1 & -z_1 \\ 0 & 0 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & -6 \\ 0 & 1 & 0 & -1 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

step 2 $T R_x(\alpha)_x$ $B(0, 3, -1)$

$$\sin \alpha = \frac{b}{\sqrt{b^2+c^2}} = \frac{b}{d} \qquad \cos\alpha = \frac{c}{\sqrt{b^2+c^2}} = \frac{c}{d}$$

$$= \frac{3}{\sqrt{9+1}} = \frac{3}{\sqrt{10}} \qquad = \frac{1}{\sqrt{10}}$$

$$R_x(\alpha) = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & -\frac{1}{\sqrt{10}} & -\frac{3}{\sqrt{10}} & 0 \\ 0 & \frac{3}{\sqrt{10}} & -\frac{1}{\sqrt{10}} & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

step 3

$$\sin \beta = \frac{a}{d} \qquad \cos\beta = \frac{d}{d} \qquad \sin\beta = 0 \qquad \sin\alpha = \frac{\sqrt{10}}{\sqrt{10}} = 1$$

$$d^2 = a^2 + b^2 + c^2 = a^2 + d^2$$
$$d^2 = 0^2 + \sqrt{10}^2$$
$$d^2 = 10 \qquad d = \sqrt{10}$$

$$R_y(\beta) = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

step 4

$$R_z(45°) = \begin{bmatrix} \cos 45° & -\sin 45° & 0 & 0 \\ \sin 45° & \cos 45° & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

step 5

$$
\begin{bmatrix} 1 & 0 & 0 & b \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & -1 \\ 0 & 0 & 0 & 1 \end{bmatrix}
\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & -\frac{1}{\sqrt{10}} & \frac{3}{\sqrt{10}} & 0 \\ 0 & \frac{3}{\sqrt{10}} & -\frac{1}{\sqrt{10}} & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}
\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}
$$

$$
R(\theta) =
\begin{bmatrix} 1 & 0 & 0 & b \\ 0 & 1 & 0 & 1 \\ 0 & 0 & \phi & -1 \\ 0 & 0 & 0 & 1 \end{bmatrix}
\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \frac{-1}{\sqrt{10}} & \frac{3}{\sqrt{10}} & 0 \\ 0 & \frac{-3}{\sqrt{10}} & \frac{-1}{\sqrt{10}} & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix},
\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}
\begin{bmatrix} 0 & -1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}
$$

$$
\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}
\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \frac{-1}{\sqrt{10}} & \frac{-3}{\sqrt{10}} & 0 \\ 0 & \frac{3}{\sqrt{10}} & \frac{-1}{\sqrt{10}} & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}
\begin{bmatrix} 1 & 0 & 0 & -b \\ 0 & 1 & 0 & -1 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix}
$$

4. Garis AB

A = 1000   (-1,6)
B = 1010   (5,5)
1000   Tidak di Clipping

Garis CD $m = \frac{5-2}{-1-5}$
C = 1000   (-1,5) $= \frac{3}{-6}$
D = 0010   (5,2) $= -\frac{1}{2}$
0000   kandidat

Top $x_{p_2} = x_1 + (y_{max} + y_1)/m$
       $= -1 + (4-5)/-\frac{1}{2}$
       $= -1 + -1 \cdot -2$
       $= -1 + 2$
       $= 1$ ∴ titik potong (1,4)

Right $y_{p_2} = y_1 + m \times (x_{max} - x_1)$
        $= 2 + (-\frac{1}{2}) \times (3-5)$
        $= 2 + \frac{(-2)}{2}$
        $= 2 + 1$
        $= 3$ ∴ titik potong (3,3)

Hasil clip = (1,4) dan (3,3)

Garis EF
E = 0000   (1,2) $m = \frac{1-2}{5-1}$
F = 0010   (5,1) $= -\frac{1}{4}$
0000   kandidat

Right $y_{p_2} = y_1 + m (x_{max} - x_1)$
        $= 1 + (-\frac{1}{4})(3-5)$
        $= 1 + \frac{-2}{-4}$
        $= 1 + \frac{1}{2}$
        $= 1,5$ ∴ titik potong (3,1,5)

Hasil Clip adalah (1,2) dan (3, 1.5)

Garis GH
G = 0000   (-1,3)
H = 0000   (1,1)
0000   Diterima

Garis IJ

I : 1001   (-3,7)
J : 0101   (-1,-1)
0000   kandidat

$m = \frac{-1 - 7}{-1 + 3}$
$= \frac{-8}{2}$
$= -4$

Top $x_{p_2} = x_1 + (y_{max} - y_1)/m$
      $= -3 + (4-7)/-4$
      $= -3 + \frac{-3}{-4}$
      $= -3 + 0,75$
      $= -2,25$ ∴ (-2,25, 4)

Left $y_{p_1} = y_1 + m(x_{min} - x_1)$
       $= 7 + (-4)(-2+3)$
       $= 7 + (-4) \cdot 1$
       $= 3$ ∴ (-2, 3)

Bottom $x_{p_1} = x_1 + (y_{min} - y_1)/m$
         $= -1 + (0+1)/-4$
         $= -1 + (-\frac{1}{4})$
         $= -1,25$ ∴ (-1,25, 0)

Hasil clip adalah (-2,3) dan (-1.25,0)

Garis KL
K : 0101   (-4,-2)
L : 0110   (4,-1)
0100   Tidak di clipping