NAME:- KRUNAL RANK

ROLL NO:- U18C0081

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Computer Graphics
Tutorial 3

Ans 1:

1. (35, 40) to (43, 45)

$\Delta x = x_2 - x_1 = 43 - 35 = 8$

$\Delta y = y_2 - y_1 = 45 - 40 = 5$

Since, $abs(\Delta y) < abs(\Delta x)$, $step = \Delta x = 8$

$dx_{step} = \Delta x / step = 1$ $dy_{step} = 5/8 = 0.625$

x	y	Plot x	Plot y
35	40	35	40
36	40.625	36	41
37	41.25	37	41
38	41.875	38	42
39	42.5	39	43
40	43.125	40	43
41	43.75	41	44
42	44.375	42	44
43	45	43	45

2. (1,1) to (6,7)

$\Delta x = x_2 - x_1 = 6 - 1 = 5$

$\Delta y = y_2 - y_1 = 7 - 1 = 6$

Since $abs(\Delta x) > abs(\Delta y)$, then, $step = \Delta y = 6$

$dx = \Delta x / step = 5/6 = 0.833$

$dy = \Delta y / step = 1$

$P_1(1,1)$ $\quad \Delta y = 6$ $\quad 2\Delta y - 2\Delta x = 12 - 10 = 2$

$P_2(6,7)$ $\quad \Delta x = 5$ $\quad d_i' = 2\Delta x - 2\Delta y = -2$

Major axis = y $\quad d_i'' = 2\Delta x = 10$

x_i	y_i	d_i	d_{i+1}
1	1	4	2
2	2	2	0
2	3	0	10
3	4	10	8
4	5	8	6
5	6	6	4
6	7	4	-

3. $P_1(2,8)$ $\quad \Delta x = +2$

$P_2(4,1)$ $\quad \Delta y = -7$

$S_i \Rightarrow -2\Delta x = 4$

$T_i \Rightarrow -2\Delta y - 2\Delta x = -10$

So, swap P_1 & P_2. Hence,

$P_1(4,1)$ $\quad \Delta x = -2$

$P_2(2,8)$ $\quad \Delta y = 7$

$d_0 = -\Delta y = -7$

Major axis = y

x_i	y_i	d_i	d_{i+1}
4	1	-7	-3
4	2	-3	+10
3	3	1	-9
3	4	-9	-5
3	5	-5	-1
3	6	-1	3
2	7	3	-7
2	8	-7	-3

4. $P_1(8,8)$
$P_2(2,2)$
Here $\Delta y = -6$
$\Delta x = -6$
Hence, swap P_1 & P_2.
$P_1(2,2)$
$P_2(8,8)$ $d_0 = 2\Delta y - \Delta x = 6$
If $S_i \Rightarrow$ 12
$T_i \Rightarrow$ 0

x_i	y_i	d_i	d_{i+1}
2	2	6	6
3	3	6	6
4	4	6	6
5	5	6	6
6	6	6	6
7	7	6	6
8	8	6	6

Ans 2.
1. Given $R = 10$
Centre = (0,0)
$P_0 = 1 - r = -9$

When $P_i <= 0$ Add $2(y_i+1)+1$
When $P_{i+1} > 0$, Add $2(y_i+1)+1-2(x_i-1)$

P_i	x_i	y_i	P_{i+1}
-9	10	0	-6
-6	10	1	-1
-1	10	2	6

Points
(10,0) (0,10) (-10,0) (0,-10)
(10,1) (1,10) (-10,1) (1,-10)
(-1,10) (+10,-1) (-10,-1) (-1,-10)
(10,2) (2,10) (-10,2) (2,-10)
(-2,10) (10,-2) (-10,-2) (-2,-10)

P_i	x_i	y_i	P_{i+1}	Points
6	9	3	-1	(9,3) (3,9) (-9,3) (3,-9) (-3,9) (9,-3) (-3,-9) (-9,-3)
-1	9	4	10	(9,4) (4,9) (-9,4) (4,-9) (-4,9) (9,-4) (-9,-4) (-4,-9)
10	8	5	9	(8,5) (5,8) (-8,5) (-5,8) (-5,8) (8,-5) (-8,-5) (-5,-8)
9	7	6	12	(7,6) (6,7) (-7,6) (-6,7) (-6,7) (7,-6) (-7,-6) (-6,-7)
12	6	7	-	break loop.

2. Given R=9
Centre (2,2)
$P_0 = 1-9 = -8$

When $P_i <= 0$ Add $2(y_i+1)+1$
Else, Add $2(y_i+1)+1-2(x_i-1)$

Increment them by (2,2)

P_i	x_i	y_i	P_{i+1}	Points
-8	9	0	-5	(9,0) (0,9) (-9,0) (0,-9)
-5	9	1	0	(9,1) (1,9) (-9,1) (1,-9) (-1,9) (9,-1) (-9,-1) (-1,-9)
0	9	2	7	(9,2) (2,9) (-9,2) (+2,-9) (-2,9) (9,-2) (-9,-2) (-2,-9)
7	8	3	2	(8,3) (3,8) (-8,3) (3,-8) (-3,8) (8,-3) (-3,-8) (-8,-3)
2	7	4	1	(7,4) (4,7) (-7,4) (4,-7) (-4,7) (7,-4) (-4,-7) (-7,-4)
1	6	5	4	(6,5) (5,6) (-6,5) (5,-6) (-5,6) (6,-5) (-6,-5) (-5,-6)
4	5	6	-	Break loop

Ans 3:

i. Given,

$r_x = 8 \quad r_y = 6$

$P_{1_0} = r_y^2 - \frac{1}{4} r_x^2 - r_x^2 r_y = 36 - 16 - 384 = -364$

If $P_{1_i} < 0$, add $2r_y^2(x_{i+1}) + r_y^2$

Else, add $2r_y^2(x_{i+1}) + r_y^2 - 2r_x^2(y_{i+1})$

P_{1_i}	x_i	y_i	P_{i+1}	Points
-364	-332	0	6	-256 -224 (0,6) (0,-6)
-256	-224	1	6	-76 -44 (1,6) (-1,6) (+1,-6) (-1,-
-36	-44	2	6	176 208 (2,6) (-2,6) (2,-6) (-2,-
176	208	3	6	-108 288 (3,6) (-3,6) (3,-6) (-3,-
-212	-108	4	5	116 (4,5) (-4,5) (4,-5) (-4,-
116	288	5	5	break loop (5,5) (-5,-5)

Last Point: (4,5)

$P_{2_0} = -244$

$P_{2i} > 0 \Rightarrow$ next point $(x_i, y_i - 1)$

add $-r_x^2(y_i - 1) + r_x^2$

$P_{2i} < 0 \Rightarrow$ next point $(x_i + 1, y_i - 1)$ add $2r_y^2(x_{i+1}) - 2r_x^2(y_i - 1) + r_y^2$

P_{2_i}	x_i	y_i	P_{i+1}	Points
-244	6	4	-23	(6,4) (-6,4) (6,-4)
-23	7	3	361	(7,3) (-7,3) (7,-3)
361	8	2	297	(8,2) (-8,2) (8,-2) (-8,-
297	8	1	361	(8,1) (-8,1) (8,-1) (-8,-
361	8	0	-	(8,0) (0,8)

2. Given

$x_H = 10$

$y_y = 8$

P_i	x_i	y_i
-711	0	8
-519	1	8
-199	2	8
+249	3	8
-575	4	7
129	5	7
-239	6	6
721	7	6
-176	8	5
276	9	4
-224	9	3
756	10	2
656	10	1
756	10	0