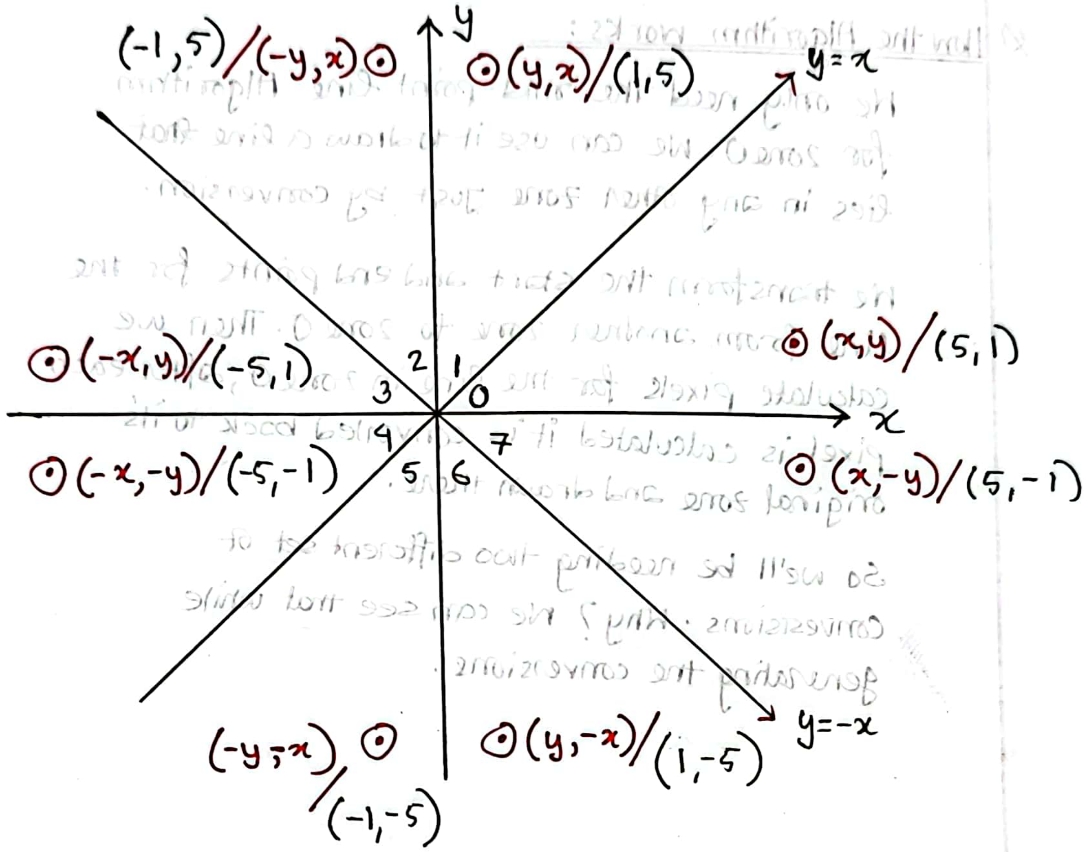
(8-way Symmetry)

LECTURE 5



Reason for use:

In MPL Algorithm, each individual zone has a different algorithm as it lacks optimization. For this reason we end up writing a lot of redundant lines of code. Using 8 way symmetry is one way to making MPL Algorithm more optimized.

Explanation:

If an arbitrary point is selected at zone 0, as (x,y) then we can derive its corresponding coordinates in the other zones by using reflection in the lines $(y=x)$ & $(y=-x)$ along with the (x-axis) & (y-axis).

From the figure above it can be determined that any point in another zone can be traced back to zone 0 (x,y), by going through the corresponding rearrangement of the x & y coordinates in the other zones.

How the Algorithm works:

We only need the mid-point line Algorithm for zone 0. We can use it to draw a line that lies in any other zone just by conversion.

We transform the start and end points for the line from another zone to zone 0. Then we calculate pixels for the line in zone 0; after each pixel is calculated it is converted back to it's original zone and drawn there.

So we'll be needing two different set of convesrsions. Why? We can see that while generating the conversions.

Converting from Any Other Zone to Zone 0:

Zones	For x	For y
Zone 0	New x = x	New y = y
Zone 1	New x = y	New y = x
Zone 2	New x = y	New y = $-x$
Zone 3	New x = $-x$	New y = y
Zone 4	New x = $-x$	New y = $-y$
Zone 5	New x = $-y$	New y = $-x$
Zone 6	New x = $-y$	New y = x
Zone 7	New x = x	New y = $-y$

if there is a minus sign, it needs to be multiplied with the current coordinate to get the new one.

The conversion are almost similar except for zone 2 & zone 6.

Converting from zone 0 to the original zones:

Zones	For x	For y
Zone 0	New x = x	New y = y
Zone 1	New x = y	New y = x
Zone 2	New x = $-y$	New y = x
Zone 3	New x = $-x$	New y = y
Zone 4	New x = $-x$	New y = $-y$
Zone 5	New x = $-y$	New y = $-x$
Zone 6	New x = y	New y = $-x$
Zone 7	New x = x	New y = $-y$

Q1) Draw $(-13,-5)$ to $(-20,-10)$ using MPL along with 8-way symmetry?

$dy = -5$ $\therefore$ $|dx| > |dy|$

$dx = -7$, $dy < 0$ & $dx < 0$ → line is in Zone 4

Conversion: (zone 4 to zone 0) → $(x = -x, y = -y)$

Start $(13, 5)$ end $(20, 10)$

So the new, $dy = 5$

$dx = 7$

$d_{init} = 2dy - dx = 3$

$\Delta E = 2dy = 10$

$\Delta NE = 2(dy - dx) = -4$

We know,

$d(+ve) \rightarrow \Delta NE$

$d(-ve) \rightarrow \Delta E$

Conversion: (zone 0 to zone 4) → $(x = -x, y = -y)$

x	y	d	ΔE/ΔNE	Actual Pixel in Zone 4
13	5	3	ΔNE	(-13, -5)
14	6	-1	ΔE	(-14, -6)
15	6	9	ΔNE	(-15, -6)
16	7	5	ΔNE	(-16, -7)
17	8	1	ΔNE	(-17, -8)
18	9	-3	ΔE	(-18, -9)
19	9	7	ΔNE	(-19, -9)
20	10	N/A	N/A	(-20, -10)