Ex. No. : 9 **Date:**

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Bresenham's Line Algorithm, Midpoint Circle Algorithm, and Midpoint Ellipse Algorithm

AIM:

To implement:

- Bresenham's Line Drawing Algorithm
- Midpoint Circle Drawing Algorithm
- Midpoint Ellipse Drawing Algorithm And draw geometric shapes on the screen.

Procedure:

1. Initialize graphics mode using suitable graphics libraries (e.g., OpenGL in C++, turtle or matplotlib in Python).
2. For each algorithm:
   - Accept user input for coordinates or radius.
   - Implement the plotting logic using the respective algorithm.
   - Plot the pixels on the screen.

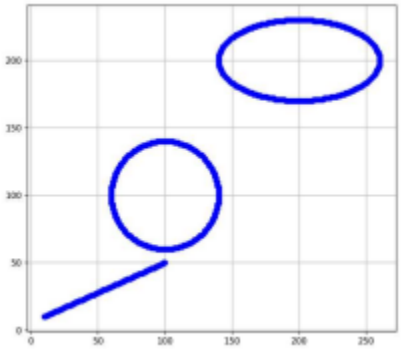
Program:

```
import matplotlib.pyplot as plt

def plot_point(x, y):
    plt.plot(x, y, 'bo')  # blue dot

def bresenham_line(x1, y1, x2, y2):
    dx = abs(x2 - x1)
    dy = abs(y2 - y1)
    x, y = x1, y1
    sx = 1 if x2 > x1 else -1
    sy = 1 if y2 > y1 else -1
```

```
    if dx > dy:
        err = dx / 2.0
        while x != x2:
            plot_point(x, y)
            err -= dy
            if err < 0:
                y += sy
                err += dx
            x += sx
    else:
        err = dy / 2.0
        while y != y2:
            plot_point(x, y)
            err -= dx
            if err < 0:
                x += sx
                err += dy
            y += sy
    plot_point(x, y)  # plot final point

def midpoint_circle(xc, yc, r):
    x = 0
    y = r
    p = 1 - r
    while x <= y:
        for a, b in [(x, y), (y, x), (-x, y), (-y, x),
                     (-x, -y), (-y, -x), (x, -y), (y, -x)]:
            plot_point(xc + a, yc + b)
        x += 1
        if p < 0:
            p += 2 * x + 1
        else:
            y -= 1
            p += 2 * (x - y) + 1

def midpoint_ellipse(rx, ry, xc, yc):
```

```
    x, y = 0, ry
    rx2, ry2 = rx**2, ry**2
    p1 = ry2 - (rx2 * ry) + (0.25 * rx2)
    dx = 2 * ry2 * x
    dy = 2 * rx2 * y

    # Region 1
    while dx < dy:
        for a, b in [(x, y), (-x, y), (x, -y), (-x, -y)]:
            plot_point(xc + a, yc + b)
        x += 1
        dx = 2 * ry2 * x
        if p1 < 0:
            p1 += dx + ry2
        else:
            y -= 1
            dy = 2 * rx2 * y
            p1 += dx - dy + ry2

    # Region 2
    p2 = (ry2 * (x + 0.5)**2) + (rx2 * (y - 1)**2) - (rx2 * ry2)
    while y >= 0:
        for a, b in [(x, y), (-x, y), (x, -y), (-x, -y)]:
            plot_point(xc + a, yc + b)
        y -= 1
        dy = 2 * rx2 * y
        if p2 > 0:
            p2 -= dy + rx2
        else:
            x += 1
            dx = 2 * ry2 * x
            p2 += dx - dy + rx2

# Plot all
plt.figure(figsize=(8, 8))
plt.title("Bresenham Line, Midpoint Circle & Ellipse Drawing")
```

```
bresenham_line(10, 10, 100, 50)
midpoint_circle(100, 100, 40)
midpoint_ellipse(60, 30, 200, 200)

plt.gca().set_aspect('equal', adjustable='box')
plt.grid(True)
plt.xlim(0, 300)
plt.ylim(0, 300)
plt.show()
```



Result:

Thus, the line, circle, and ellipse were successfully drawn using Bresenham's and Midpoint algorithms.