1.5.37

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August 29, 2025

Question

The centre of a circle whose end points of a diameter are (6, 3) and (6, 4) is _____

Theoretical Solution

Let the given end points of the diameter of the circle be A and B, then

$$\mathbf{A} = \begin{pmatrix} -6 \\ 3 \end{pmatrix}, \mathbf{B} = \begin{pmatrix} 6 \\ 4 \end{pmatrix} \tag{1}$$

The midpoint of the two points is the center of the circle,
let the center be C, then

$$\mathbf{C} = \frac{1}{2}(\mathbf{A} + \mathbf{B}) \tag{2}$$

by substituting A and B

$$\mathbf{C} = \frac{1}{2}\left(\begin{pmatrix} -6 \\ 3 \end{pmatrix} + \begin{pmatrix} 6 \\ 4 \end{pmatrix}\right) \tag{3}$$

$$\mathbf{C} = \frac{1}{2}\begin{pmatrix} -6+6 \\ 3+4 \end{pmatrix} \tag{4}$$

Theoretical Solution

$$\mathbf{C} = \frac{1}{2}\begin{pmatrix} 0 \\ 7 \end{pmatrix} \tag{5}$$

$$\mathbf{C} = \begin{pmatrix} 0 \\ 3.5 \end{pmatrix} \tag{6}$$

Therefore the center of the circle is

$$\mathbf{C} = \begin{pmatrix} 0, 3.5 \end{pmatrix}$$

C Code- equidistant check function

```c
// circle.c
#include <math.h>

#ifdef _WIN32
#define API __declspec(dllexport)
#else
#define API
#endif

// Given endpoints (x1,y1), (x2,y2), returns center (cx,cy) and
    radius r
API void compute_circle(double x1, double y1,
                        double x2, double y2,
                        double *cx, double *cy, double *r) {
    *cx = 0.5 * (x1 + x2);
    *cy = 0.5 * (y1 + y2);
    double dx = x2 - x1, dy = y2 - y1;
    *r = 0.5 * sqrt(dx*dx + dy*dy);
}
```

Python Code using shared output

```
                import ctypes, os, numpy as np, matplotlib.pyplot
                    as plt

# load the shared library (adjust name for macOS: libcircle.dylib
    , Windows: circle.dll)
lib = ctypes.CDLL(os.path.abspath("./libcircle.so"))

lib.compute_circle.argtypes = [ctypes.c_double, ctypes.c_double,
                               ctypes.c_double, ctypes.c_double,
                               ctypes.POINTER(ctypes.c_double),
                               ctypes.POINTER(ctypes.c_double),
                               ctypes.POINTER(ctypes.c_double)]

def compute_circle(x1, y1, x2, y2):
    cx = ctypes.c_double()
    cy = ctypes.c_double()
    r = ctypes.c_double()
```

Python Code using shared output

```
    lib.compute_circle(x1, y1, x2, y2, ctypes.byref(cx), ctypes.
        byref(cy), ctypes.byref(r))
    return cx.value, cy.value, r.value

# given endpoints
x1, y1 = -6.0, 3.0
x2, y2 = 6.0, 4.0
cx, cy, r = compute_circle(x1, y1, x2, y2)
print("Center:", (cx, cy), "Radius:", r)

# make a circle for plotting
t = np.linspace(0, 2*np.pi, 400)
xc = cx + r*np.cos(t)
yc = cy + r*np.sin(t)
```

Python Code using shared output

```
fig, ax = plt.subplots()
ax.plot(xc, yc, label="Circle")
ax.plot([x1, x2], [y1, y2], 'o-', label="Diameter endpoints")
ax.plot(cx, cy, 'o', label="Center")

ax.set_aspect('equal', adjustable='box')
ax.grid(True, linestyle="--", alpha=0.5)
ax.legend()
ax.set_title(f"Circle with diameter [({x1},{y1})  ({x2},{y2})]\
    nCenter=({cx:.2f},{cy:.2f}), r={r:.4f}")
plt.show()
```

Plot by python using shared output from c

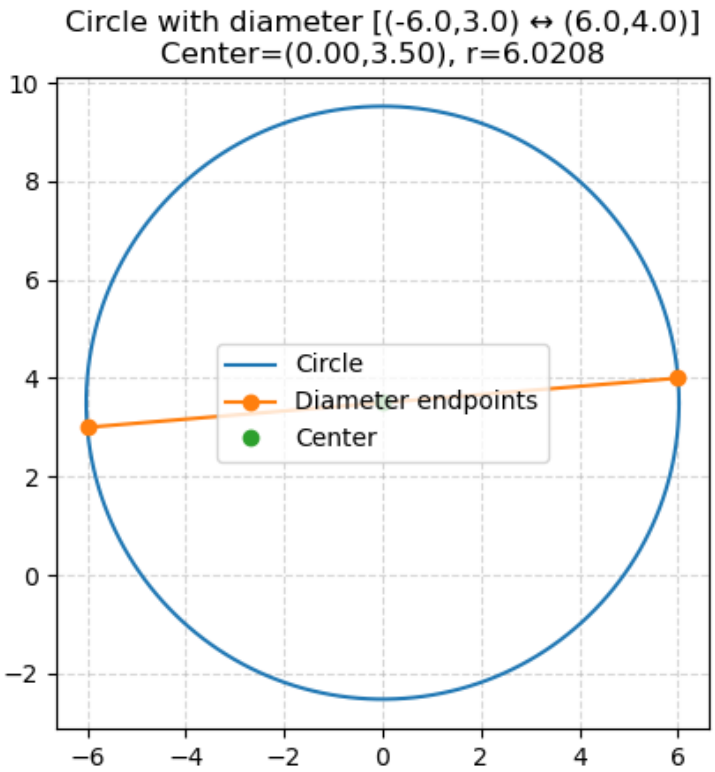

Figure: Plot of the center and ends of the diameter

Python code for the plot

```
    import numpy as np
    import matplotlib.pyplot as plt

# Endpoints of diameter
x1, y1 = -6, 3
x2, y2 = 6, 4

# Compute center (midpoint)
cx = 0.5 * (x1 + x2)
cy = 0.5 * (y1 + y2)

# Compute radius
dx, dy = x2 - x1, y2 - y1
r = 0.5 * np.sqrt(dx**2 + dy**2)
```

Python code for the plot

```
print("Center:", (cx, cy))
print("Radius:", r)

# Parametric circle
theta = np.linspace(0, 2*np.pi, 400)
xc = cx + r*np.cos(theta)
yc = cy + r*np.sin(theta)

# Plot
fig, ax = plt.subplots()

# Circle (blue)
ax.plot(xc, yc, color="blue", label="Circle")

# Diameter endpoints + line (green)
ax.plot([x1, x2], [y1, y2], 'o-', color="green", label="Diameter"
    )
```

python code for plot

```
      # Center (red point)
ax.plot(cx, cy, 'ro', label="Center")

# Formatting
ax.set_aspect('equal', adjustable='box')
ax.grid(True, linestyle="--", alpha=0.5)
ax.legend()
ax.set_title(f"Circle with diameter endpoints ({x1},{y1}) and ({
    x2},{y2})")

plt.show()
```

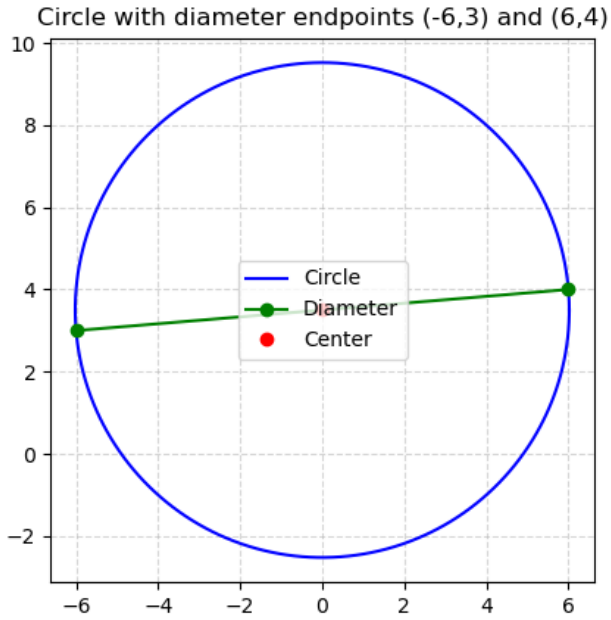

Figure: Plot for the center of the circle