Presentation - Matgeo

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EE1030 - Matrix Theory

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Problem Statement

Draw a quadrilateral in the Cartesian plane, whose vertices are $A(-4, 5)$, $B(0, 7)$, $C(5, -5)$ and $D(-4, -2)$.

Theoretical Solution

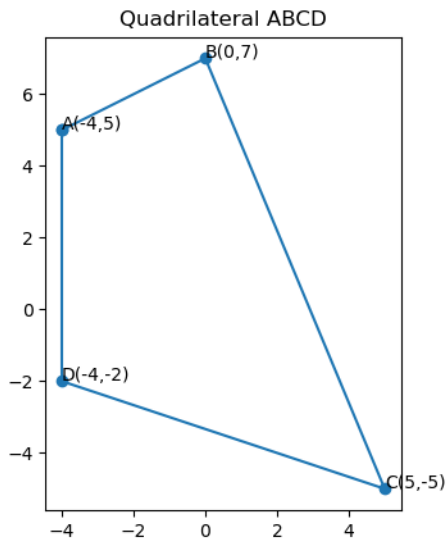The position vectors of the vertices are

$$\mathbf{A} = \begin{pmatrix} -4 \\ 5 \end{pmatrix}, \tag{3.1}$$

$$\mathbf{B} = \begin{pmatrix} 0 \\ 7 \end{pmatrix}, \tag{3.2}$$

$$\mathbf{C} = \begin{pmatrix} 5 \\ -5 \end{pmatrix}, \tag{3.3}$$

$$\mathbf{D} = \begin{pmatrix} -4 \\ -2 \end{pmatrix}. \tag{3.4}$$

Plot

Quadrilateral ABCD

Code - C

```c
void get_vertices(double out[8]) {
    // A(−4,5), B(0,7), C(5,−5), D(−4,−2)
    out[0] = −4.0; out[1] = 5.0; // A
    out[2] = 0.0; out[3] = 7.0; // B
    out[4] = 5.0; out[5] = −5.0; // C
    out[6] = −4.0; out[7] = −2.0; // D
}
```

Code - Python(with shared C code)

The code to obtain the required plot is

```python
import ctypes
import matplotlib.pyplot as plt

# 1) load the compiled C library
lib = ctypes.CDLL("./libquad.so")

# tell Python about the function signature
lib.get_vertices.argtypes = [ctypes.POINTER(ctypes.c_double * 8)]
lib.get_vertices.restype = None

# 2) create an array of 8 doubles and call C
vertices = (ctypes.c_double * 8)()
lib.get_vertices(vertices)
```

Code - Python(with shared C code)

```
# 3) convert to Python list of tuples [(x,y),...]
coords = [(vertices[i], vertices[i+1]) for i in range(0, 8, 2)]
A, B, C, D = coords

# 4) plotting
xs = [A[0], B[0], C[0], D[0], A[0]]
ys = [A[1], B[1], C[1], D[1], A[1]]

fig, ax = plt.subplots()
ax.plot(xs, ys, marker='o')
```

Code - Python(with shared C code)

```
labels = ['A(−4,5)', 'B(0,7)', 'C(5,−5)', 'D(−4,−2)']
for (x, y), lab in zip(coords, labels):
    ax.annotate(lab, (x, y))

ax.set_aspect('equal', adjustable='box')
ax.set_title('Quadrilateral-ABCD')
plt.savefig("quad_only.png")
plt.show()
```

Code - Python only

```
import matplotlib.pyplot as plt

# vertices
A = (−4, 5)
B = (0, 7)
C = (5, −5)
D = (−4, −2)

# polygon coordinates (close by repeating A at end)
xs = [A[0], B[0], C[0], D[0], A[0]]
ys = [A[1], B[1], C[1], D[1], A[1]]
```

Code - Python only

```python
# plot
fig, ax = plt.subplots()
ax.plot(xs, ys, marker='o')
labels = ['A(-4,5)', 'B(0,7)', 'C(5,-5)', 'D(-4,-2)']
for (x, y), lab in zip([A, B, C, D], labels):
    ax.annotate(lab, (x, y))

ax.set_aspect('equal', adjustable='box')
ax.set_title('Quadrilateral-ABCD')

# save and show
out_file = "quad.png"
plt.savefig(out_file)
plt.show()

print("Saved-image-to", out_file)
```