Presentation - Matgeo

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AI25BTECH11032
EE1030 - Matrix Theory

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Problem Statement

Find the distance between the points $A(0, 6)$ and $B(0, -2)$.

Description of Variables used

Input variable	Value
A	$\begin{pmatrix} 0 \\ 6 \end{pmatrix}$
B	$\begin{pmatrix} 0 \\ -2 \end{pmatrix}$

Table

Theoretical Solution

Represent the points as vectors:

$$\mathbf{A} = \begin{pmatrix} 0 \\ 6 \end{pmatrix}, \qquad \mathbf{B} = \begin{pmatrix} 0 \\ -2 \end{pmatrix} \tag{2.1}$$

The distance between $\mathbf{A}$ and $\mathbf{B}$ is

$$d(\mathbf{A}, \mathbf{B}) = \|\mathbf{B} - \mathbf{A}\| \tag{2.2}$$

Subtracting the vectors,

$$\mathbf{B} - \mathbf{A} = \begin{pmatrix} 0 \\ -2 \end{pmatrix} - \begin{pmatrix} 0 \\ 6 \end{pmatrix} = \begin{pmatrix} 0 \\ -8 \end{pmatrix} \tag{2.3}$$

Now, compute the Euclidean norm:

$$d(\mathbf{A}, \mathbf{B}) = \sqrt{(\mathbf{B} - \mathbf{A})^T (\mathbf{B} - \mathbf{A})} \tag{2.4}$$

Theoretical Solution

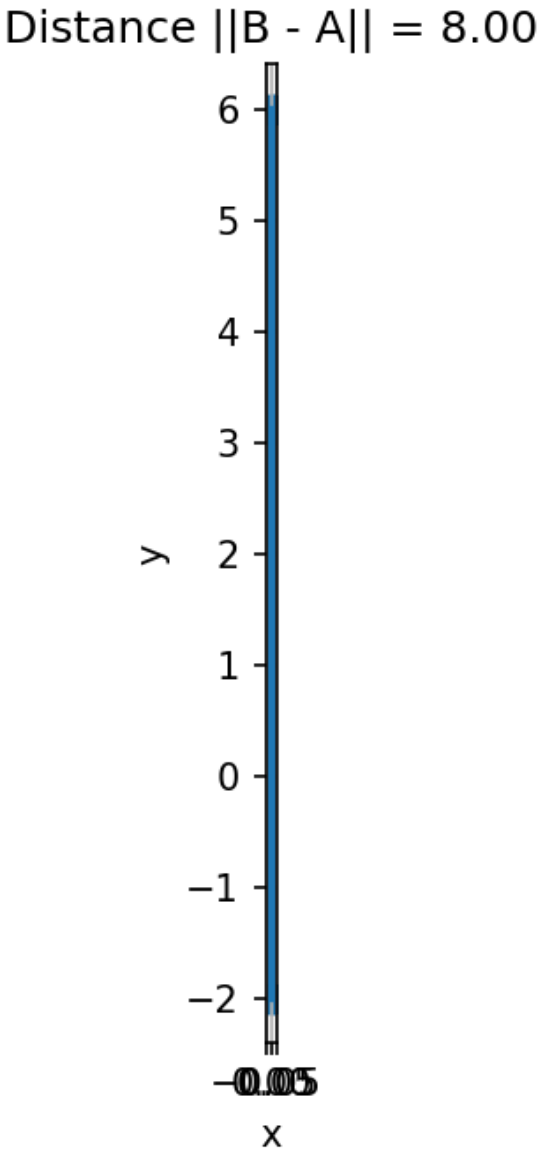
$$d(\mathbf{A},\mathbf{B}) = \sqrt{\begin{pmatrix}0 & -8\end{pmatrix}\begin{pmatrix}0\\-8\end{pmatrix}} = \sqrt{64} \tag{2.5}$$

$$d(\mathbf{A},\mathbf{B}) = 8 \tag{2.6}$$

Final Answer:

$$d(\mathbf{A},\mathbf{B}) = \|\mathbf{B}-\mathbf{A}\| = 8 \tag{2.7}$$

Plot



Code - C

```c
#include <math.h>

// Function to compute distance between two points
double distance2d(double x1, double y1, double x2, double y2) {
    double dx = x2 - x1;
    double dy = y2 - y1;
    return sqrt(dx*dx + dy*dy);
}
```

Code - Python(with shared C code)

The code to obtain the required plot is

```
import ctypes
import matplotlib.pyplot as plt

# Load the shared library (in the same folder)
lib = ctypes.CDLL("./libgeom.so")
lib.distance2d.argtypes = (ctypes.c_double, ctypes.c_double,
                           ctypes.c_double, ctypes.c_double)
lib.distance2d.restype = ctypes.c_double

# Points
A = (0.0, 6.0)
B = (0.0, -2.0)

# Call the C function
```

Code - Python(with shared C code)

```
d = lib.distance2d(A[0], A[1], B[0], B[1])
print("Distance ||B - A|| =", d)

# Plot
plt.scatter([A[0], B[0]], [A[1], B[1]], s=60)
plt.plot([A[0], B[0]], [A[1], B[1]], linewidth=2)
plt.title(f"Distance ||B - A|| = {d:.2f}")
plt.xlabel("x")
plt.ylabel("y")
plt.gca().set_aspect('equal', adjustable='box')
plt.grid(True)
plt.savefig("/sdcard/ee1030-2025/ai25btech11032/Matgeo/1.8.8/figs/
    distance.png", dpi=150)
plt.show()
```

Code - Python only

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

# Points as vectors
A = np.array([0, 6])
B = np.array([0, -2])

# Distance using vector norm: ||B - A||
d = np.linalg.norm(B - A)
print("Distance ||B - A|| =", d)

# Plot
plt.scatter([A[0], B[0]], [A[1], B[1]], s=60)
plt.plot([A[0], B[0]], [A[1], B[1]], linewidth=2)
```

Code - Python only

```
# Labels
plt.annotate("A(0,-6)", A + [0.2, 0.2])
plt.annotate("B(0,-−2)", B + [0.2, −0.5])

# Formatting
plt.title(f"Distance-||B-−-A||-=-{d:.2f}")
plt.xlabel("x")
plt.ylabel("y")
plt.gca().set_aspect('equal', adjustable='box')
plt.grid(True)

# Save + show
plt.savefig("distancenew.png", dpi=150)
plt.show()
```