

Problem 1.8.11

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Question

Question:

AOBC is a rectangle whose three vertices are vertices

A(0,3), **O**(0,0), **B**(5,0). The length of diagonal is _____.

Solution

Solution:

From the given information,

$$\mathbf{A} = \begin{pmatrix} 0 \\ 3 \end{pmatrix}, \mathbf{O} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \mathbf{B} = \begin{pmatrix} 5 \\ 0 \end{pmatrix} \quad (3.1)$$

Then the length of the diagonal AB is :

$$\mathbf{A}-\mathbf{B} = \begin{pmatrix} 0 \\ 3 \end{pmatrix} - \begin{pmatrix} 5 \\ 0 \end{pmatrix} = \begin{pmatrix} -5 \\ 3 \end{pmatrix}, \quad (3.2)$$

(3.3)

$$(\mathbf{A}-\mathbf{B})^T (\mathbf{A}-\mathbf{B}) = 34 \quad (3.4)$$

Thus the desired distance is

$$\Rightarrow AB = ||A - B|| = \sqrt{34} \quad (3.5)$$

Plot

`figs.png`

C Code

```
#include <stdio.h>
#include <math.h>
#include <stdlib.h>
#include "libs/matfun.h" // For createMat, freeMat

int main() {
    // Define points as column vectors
    double **A, **B;
    double dx, dy, diagonal;

    // Allocate 2x1 matrices for A and B
    A = createMat(2, 1);
    B = createMat(2, 1);

    // A = (0,3), B = (5,0)
    A[0][0] = 0; A[1][0] = 3;
    B[0][0] = 5; B[1][0] = 0;
```

C Code

```
// Calculate diagonal length = ||A - B||
dx = A[0][0] - B[0][0];
dy = A[1][0] - B[1][0];
diagonal = sqrt(dx*dx + dy*dy);

printf("Length of diagonal AB = %.2lf\n", diagonal);

// Free matrices
freeMat(A, 2);
freeMat(B, 2);

return 0;
}
```

Python Code for Plotting

```
import math
import sys

import numpy as np
import numpy.linalg as LA
import matplotlib.pyplot as plt
import matplotlib.image as mpimg
from line.funcs import *
#from triangle.funcs import *
#from conics.funcs import circ_gen
#if using termux
import subprocess
import shlex
#end if

A = np.array([0,3]).reshape(-1,1)
B = np.array([5,0]).reshape(-1,1)
O = np.array([0,0]).reshape(-1,1)
C = np.array([5,3]).reshape(-1,1)
```


Python Code for Plotting

```
coords = np.block([[A,B,0]])

AO = line_gen(A,0)
AB = line_gen(A,B)
BO = line_gen(B,0)
CO = line_gen(C,0)
AC = line_gen(A,C)

plt.plot(AO[0,:],AO[1,:])
plt.plot(AB[0,:],AB[1,:])
plt.plot(BO[0,:],BO[1,:])
plt.plot(CO[0,:],CO[1,:])
plt.plot(AC[0,:],AC[1,:])
plt.scatter(coords[0,:],coords[1,:])

plt.text(A[0],A[1],"A(0,3)")
plt.text(B[0],B[1],"B(5,0)")
```

Python Code for Plotting

```
plt.text(C[0],C[1],"C(5,3)")
plt.text(C[0],C[1],"O(0,0)")
plt.xlabel('$x$')
plt.ylabel('$y$')
plt.legend(loc='best')
plt.grid() # minor
plt.axis('equal')

plt.savefig('../figs/img.png')
```