Problem 1.8.11

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Question

Question:

AOBC is a rectangle whose three vertices are vertices

 $\mathbf{A}(0,3),\mathbf{O}(0,0),\mathbf{B}(5,0)$. The length of diagonal is _____

Solution

Solution:

From the given information,

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

Then the length of the diagonal AB is :

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

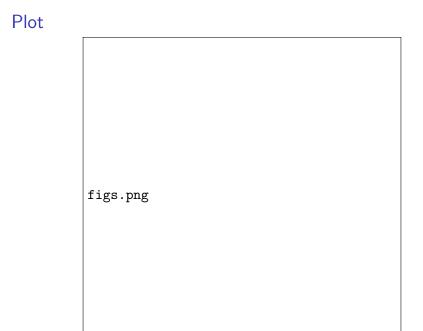
$$(\mathbf{A}\mathbf{-B})^{T}(\mathbf{A}\mathbf{-B}) = 34$$

Thus the desired distance is

$$\Rightarrow AB = ||A - B|| = \sqrt{34} \tag{3.5}$$

(3.2)

(3.4)



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 = %.21f\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)
0 = 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(B0[0,:],B0[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')
```