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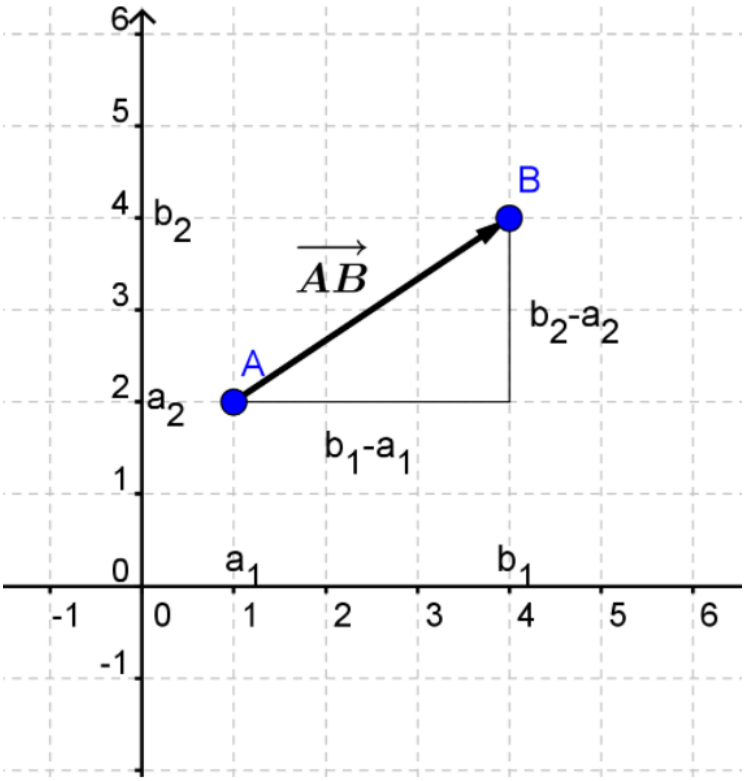
Assignment 3

Vector Basics

a) B = (7,8) does represent a vector. It has no direction because it is just a point in the coordinate system, therefore it must be a null vector.

b) We have two points: A=(4,3) and B=(7,8). The vector between the two points is defined as:
AB = (b1-a1, b2-a2) = (7-4, 8-3) = (3,5)



c) We have vector a=(3,5). The length of this is defined as:

$$|\vec{a}| = \sqrt{a_1^2 + a_2^2}$$

So the length is 5,83.

d) The formula for finding the res vector, which is the sum of the two vectors, would look like this:

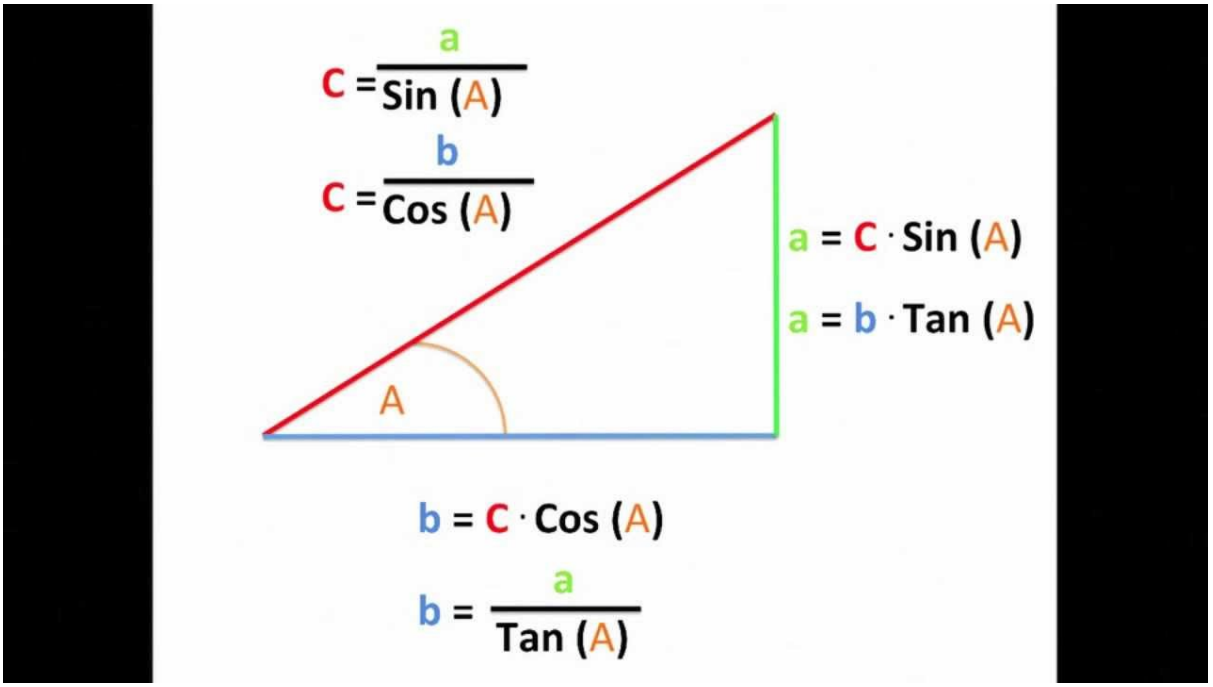
$$\vec{a} + \vec{b} = \begin{pmatrix} a_1 + b_1 \\ a_2 + b_2 \end{pmatrix}$$

We have a=(2, -2) and b=(5, 2).
The res vector is then (2+5, (-2)+2) = (7, 0).

e) We have a=(3,2), b=(5,1) and c=(-2,6).

Sum of a and b: (3+5, 2+1) = (8,3)
Sum of b and c: (5+(-2), 1+6) = (3,7)
(a+b)+c: (8+(-2), 3+6) = (6,9)
a+(b+c): (3+3, 2+7) = (6,9)
b+a: (5+3, 1+2) = (8,3)
Conclusions:
Sum of a and b is always the same. If the 3 vectors are summed then it will give the same result no matter which order you calculate it.

Vector Decomposition



f) Finding x and y:
x = c* cos(angle)
x = 5*cos(pi/5) = 4,96
y = c*sin(angle)
y = 5*sin(pi/5) = 0,05

g) The force vector is F = (4.96, 0.05) because it goes from origo.
h) Given Fx=4,96 and Fy=0,05:

$$\sqrt{F_x^2 + F_y^2}.$$

= 4,96

Multiplication of Vectors

i) Given a=(-4, 5) and b=5*a
b = (-20, 25)
j) The magnitude of a is:

$$|\overrightarrow{a}| = \sqrt{a_1^2 + a_2^2}$$

-16+25 = 9 = 3
Answer is 3.

k) The magnitude of b is:
-400+625 = 225 = 15
Answer is 15.

l) The result of (1,0)*4 is:
(4,0)

m) The result of (1,3)*½ is:
(0.5, 1.5)

n) We have two vectors a=(2,3) and b=(4,6)
We understand the assignment as this:

$$\begin{pmatrix} a_1 \\ a_2 \end{pmatrix} \cdot \begin{pmatrix} b_1 \\ b_2 \end{pmatrix} = a_1 \cdot b_1 + a_2 \cdot b_2$$

Whereof the answer is:
2*4+3*6 = 8+18 = 26

o) We have a=(2,3) and b=(-3, 2)
2*(-3)+3*2 = -6+6 = 0
Because the dot product is 0 then the vectors are perpendicular on eachother.

Unit Vectors

p) To find the unit vector you need to divide each coodinate with the magnitude of the vector:
a=(x,y), unit=(x/|a|, y/|a|)

q) We have a=(3,4).

$$|\overrightarrow{a}| = \sqrt{a_1^2 + a_2^2}$$

9+16 = sqrt(25) = 5
unit = (⅗, ⅘) = (0.6, 0.8)

r) We have a=(3,-4).
9+16 = sqrt(25) = 5
unit = (⅗, ⅘) = (0.6, -0.8)

Python

s)

```
def mag(v:Vector)-> float:
    return math.sqrt(sum(v1i*v2i for v1i, v2i in zip(v, v)))
```

t)

```
def unit(v:Vector)-> np.array:
    return np.array([vi/mag(v) for vi in v])
```

u)

```
def rot90(v:Vector) -> np.array:
    v.reverse()
    return np.array([v[0]*(-1),v[1]])
```

v)

```
def scal(c:float, v:Vector)->Vector:
    return[c*vi for vi in v]
```

```
a = [3,2]
```

```
rest = scal(2, a)
rest
```

```
[6, 4]
```

w)

```
a = [3,2]
b = [8,7]
c = [1,5]
```

```
def calvector(v1:Vector, v2:Vector, v3:Vector)-> Vector:
    return([v1i+v2i-v3i for v1i,v2i,v3i in zip(v1,v2,v3)])
```

```
rest = calvector(a,b,c)
rest
```

```
[10, 4]
```

x)

Numpy has a method called “numpy.dot(vector1, vector2)”

y)

```
rest = np.dot(a,a)
rest
```

```
13
```

```
rest1 = mag(a)*mag(a)
rest1
```

```
12.999999999999998
```

The mag methods are more precise

z)

```
rest = np.dot(a,b)
rest
```

```
38
```

aa)

```
rest = np.dot(rot90(a),a)
rest
```

```
5
```