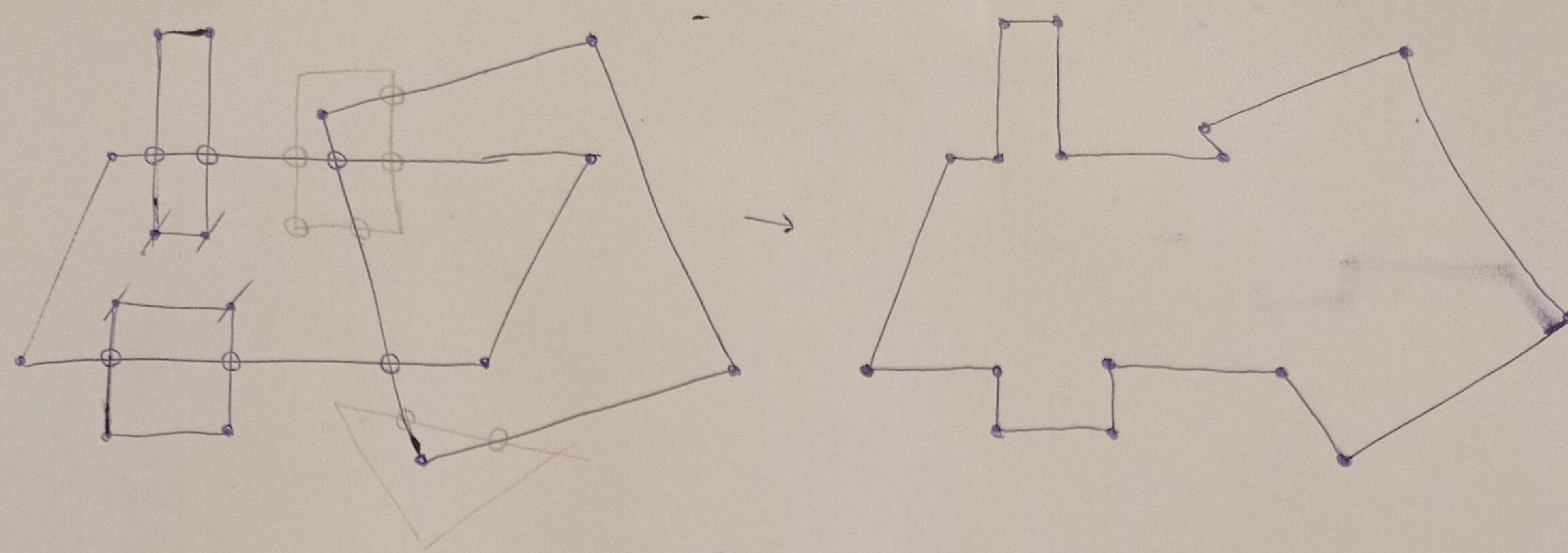
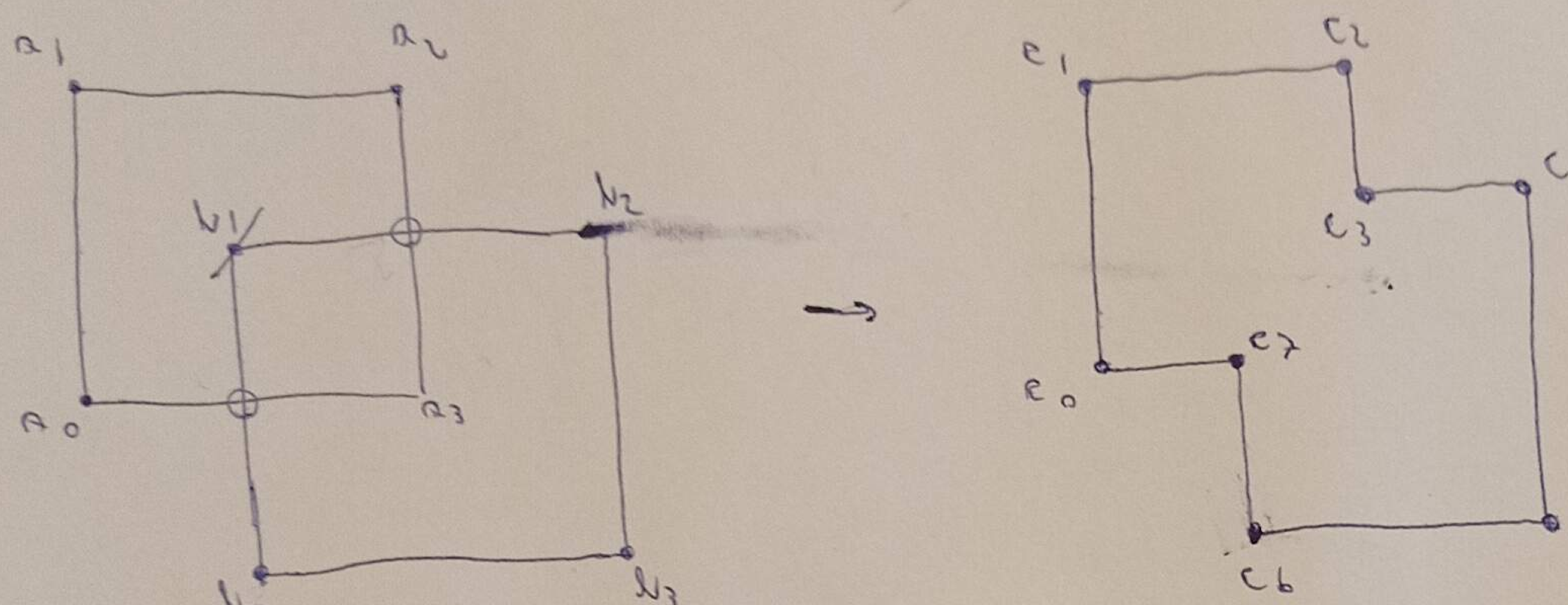
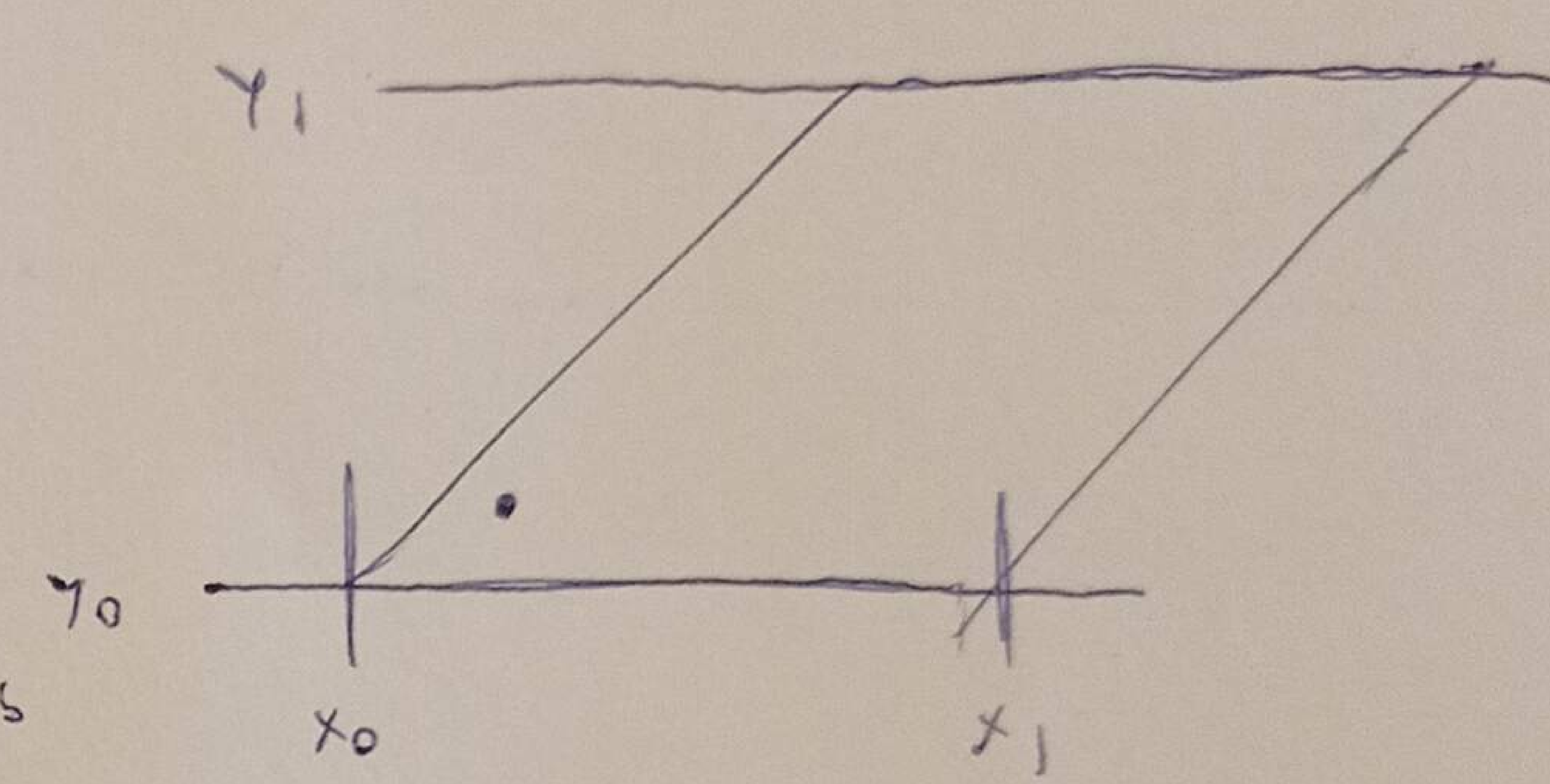
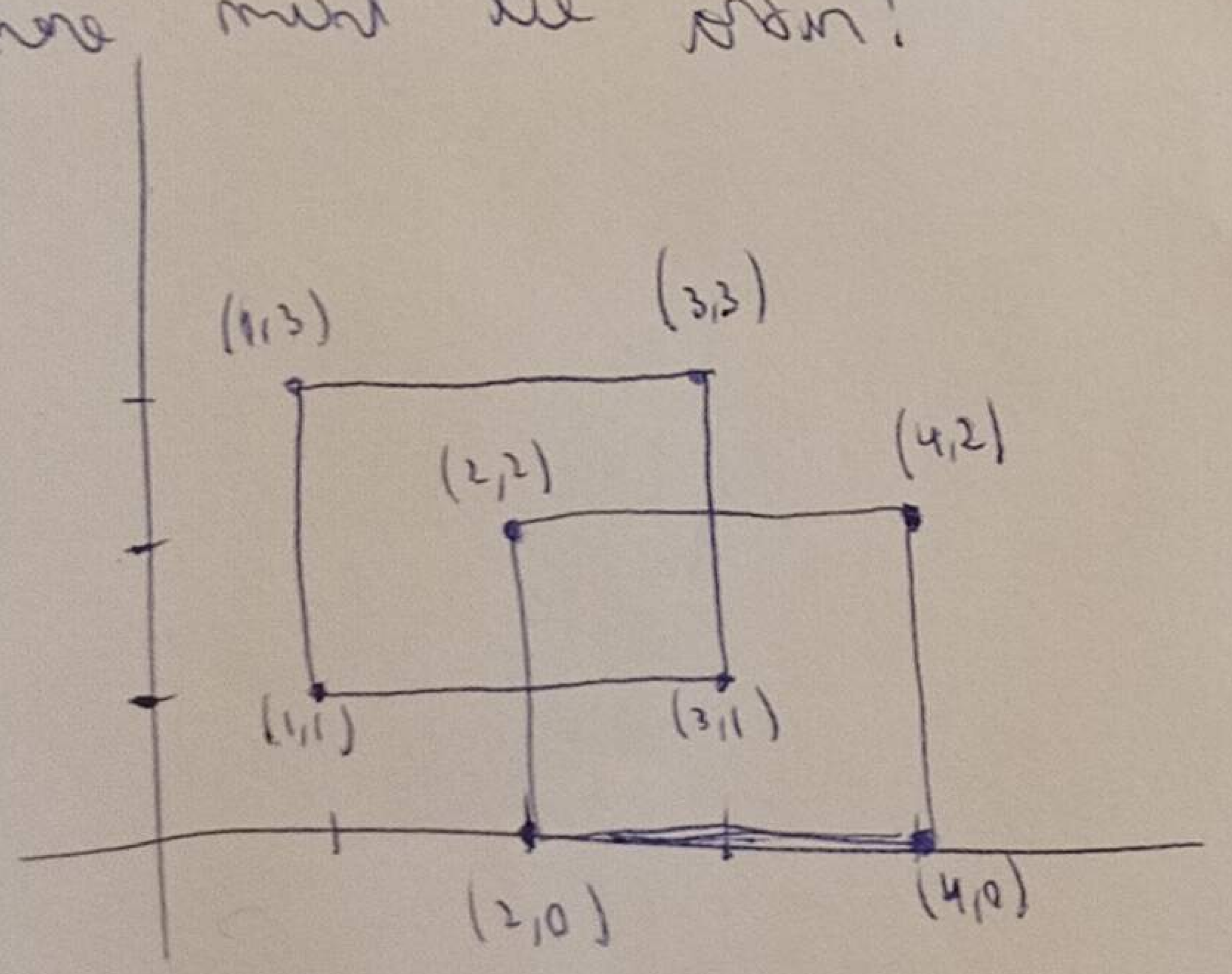






(a_0, a_1, a_2, a_3), (b_0, b_1, b_2, b_3) → $(c_0, c_1, c_2, c_3, c_4, c_5, c_6, c_7)$

- intersections become points.
- points within areas get deleted.
- there must be order!



- for each point check whether it is contained in any polygon
- make a mask (→ HashMap) with size = len(all points)
  points overlapped are to be deleted

HOW to tell that a point is contained in a polygon?

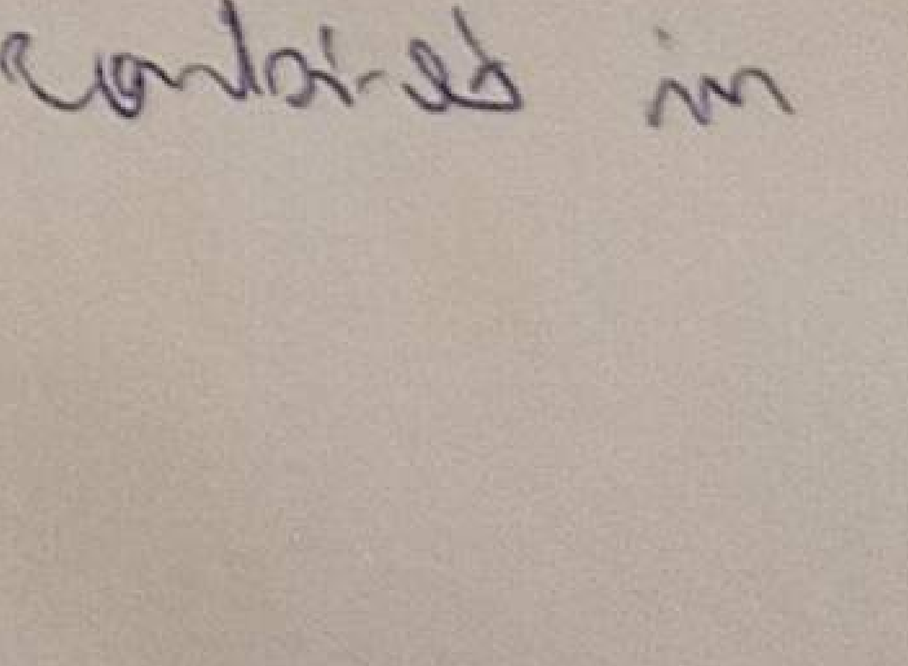
I need now to find intersections
(and we are back to n^2)

$x_0 \leq p_x \leq x_1$

OR $y_0 \leq p_y \leq y_1$

~~any only intersecting polygons~~

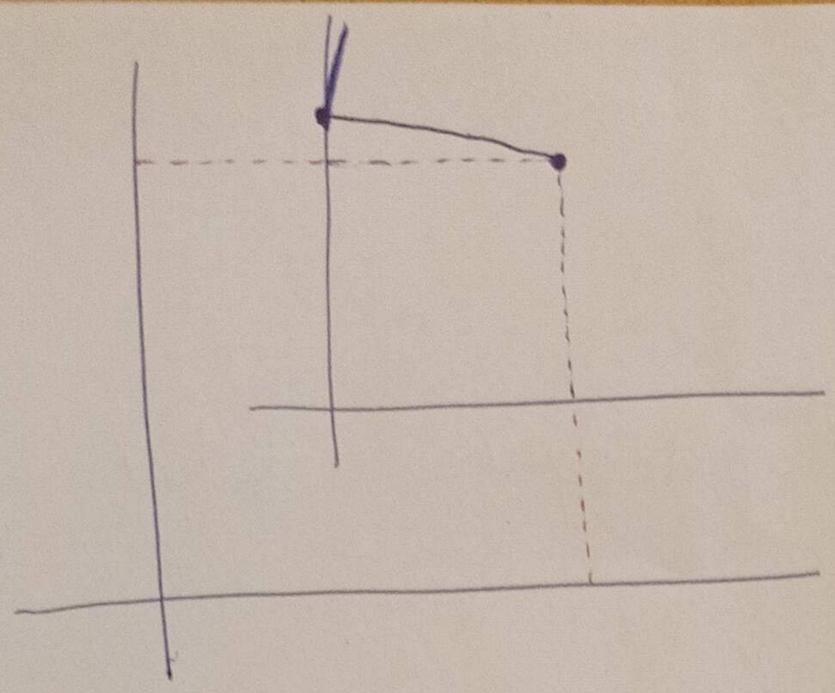
- consume one ~~test~~ polygon at a time / consume = "engulf" (gobble)
- iterate over pairs of points
- What if polygons are disjoint?

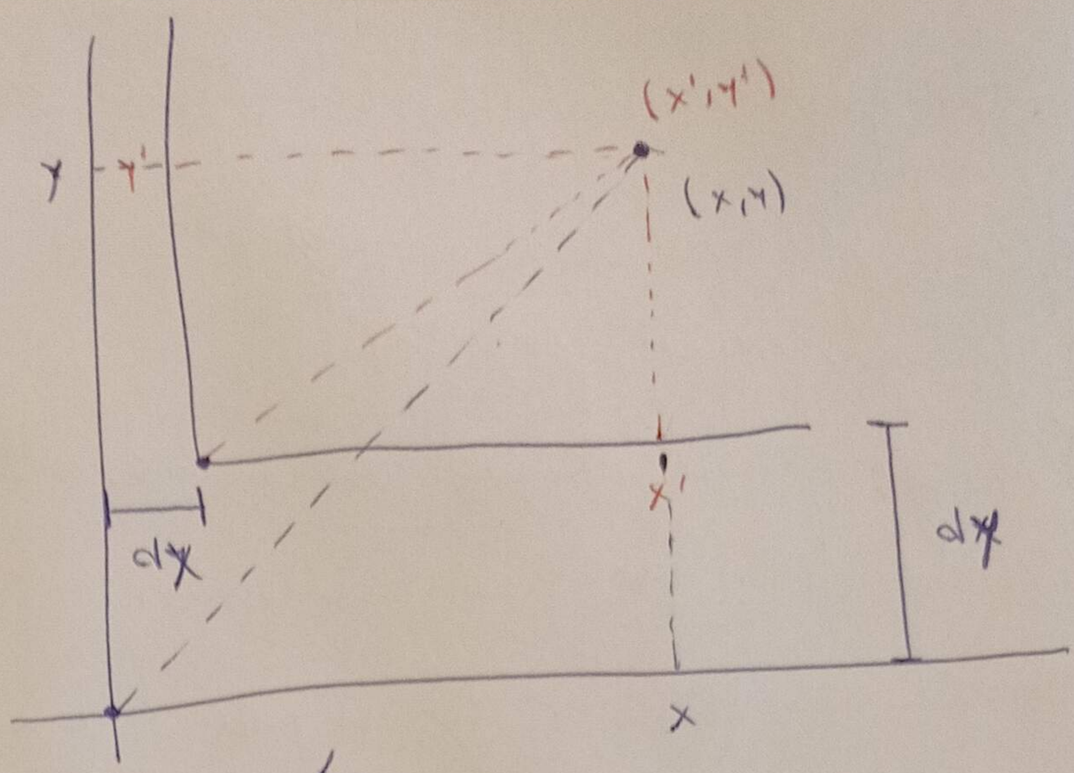


and furthermore what if they (A, C) get joined only through an intermediary (B)?
if A gobbles C first ~~then~~ B second how would it work?

So ~~test~~ always generate a polygon rather than a master polygon

- "lines" (finite) segments? iterator

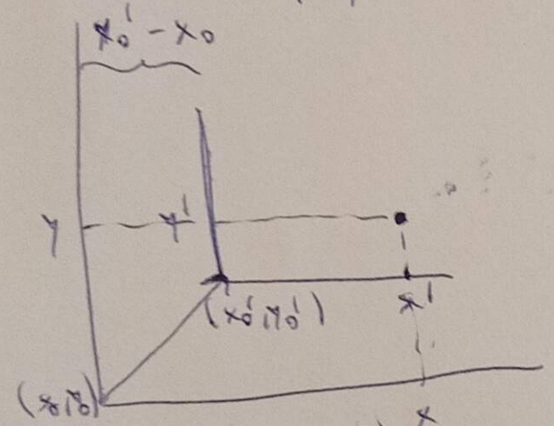




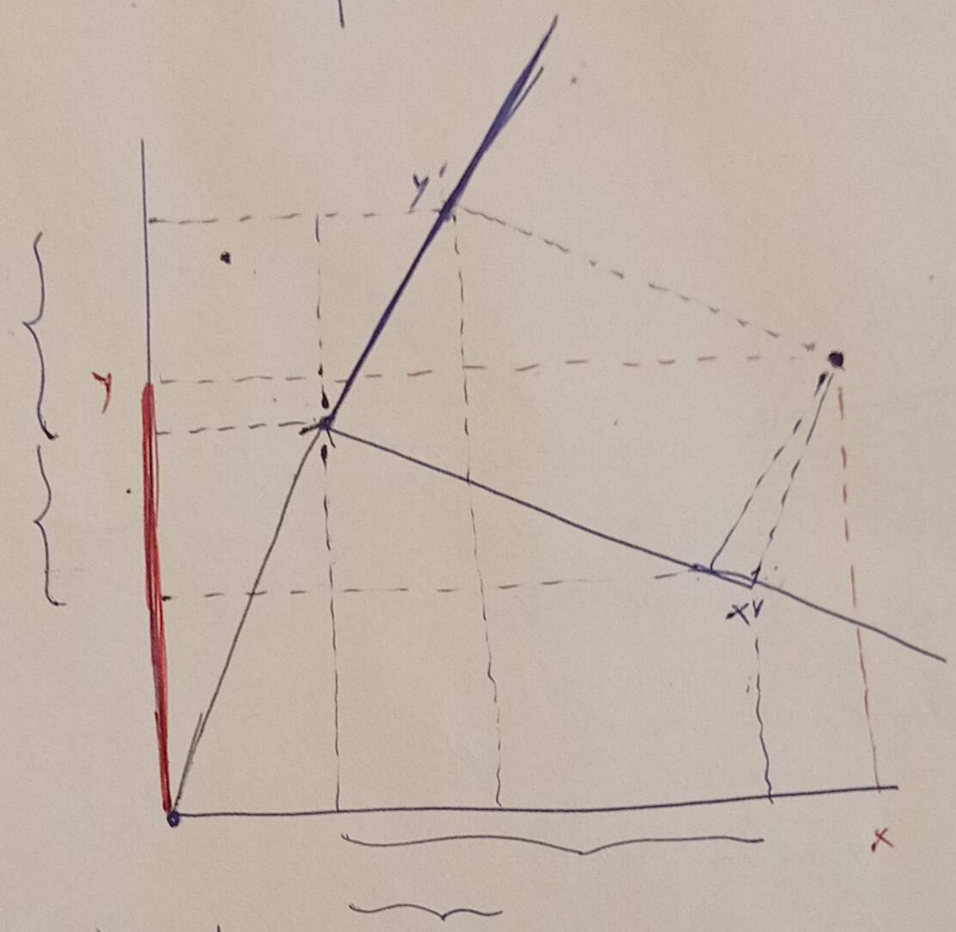
$$x = dy + y'$$

$$x = dx + x'$$

$$y = \alpha x' + \beta y'$$

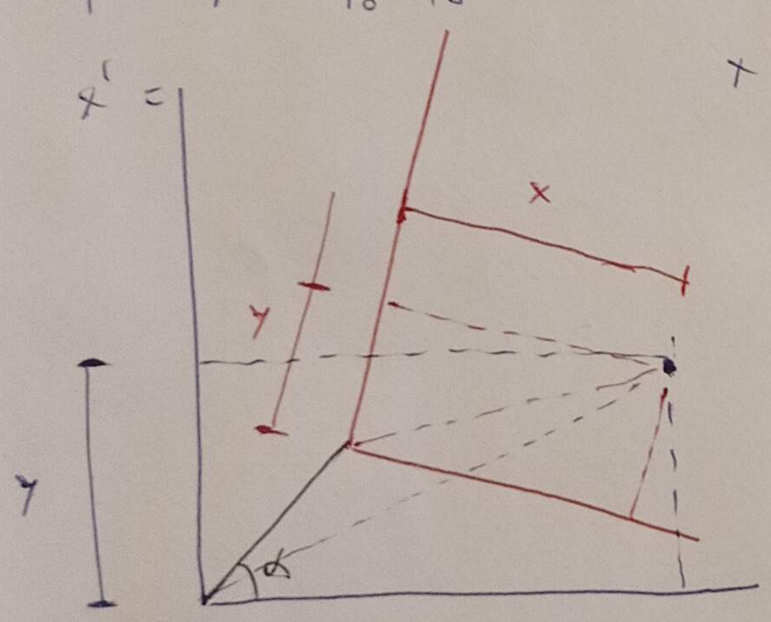


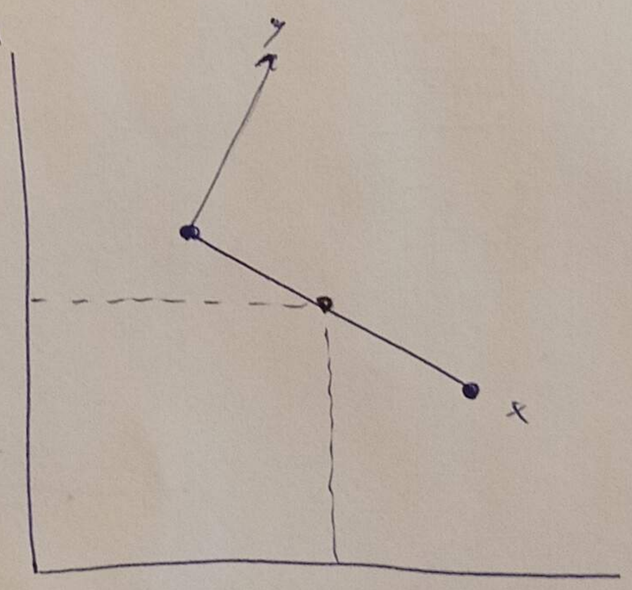
$$y' = y - (y_0' - y_0')$$

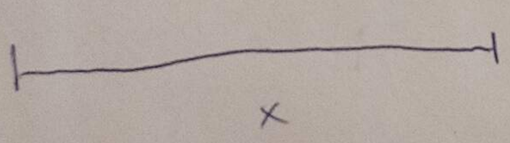


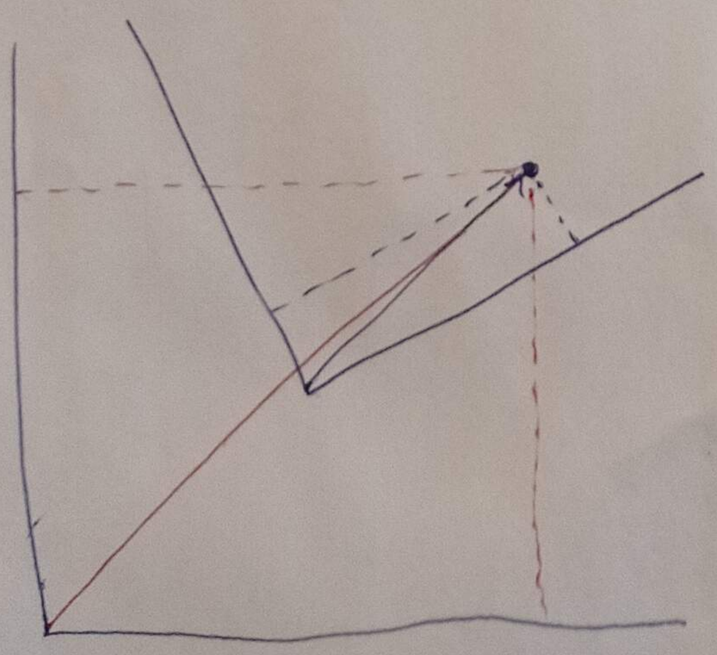
$$y = (y_0' - y_0) + y'$$

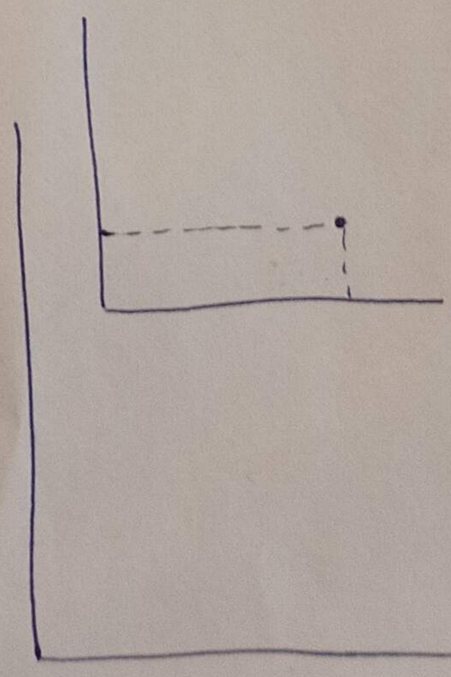
$$x = (x_0' - x_0) + x'$$

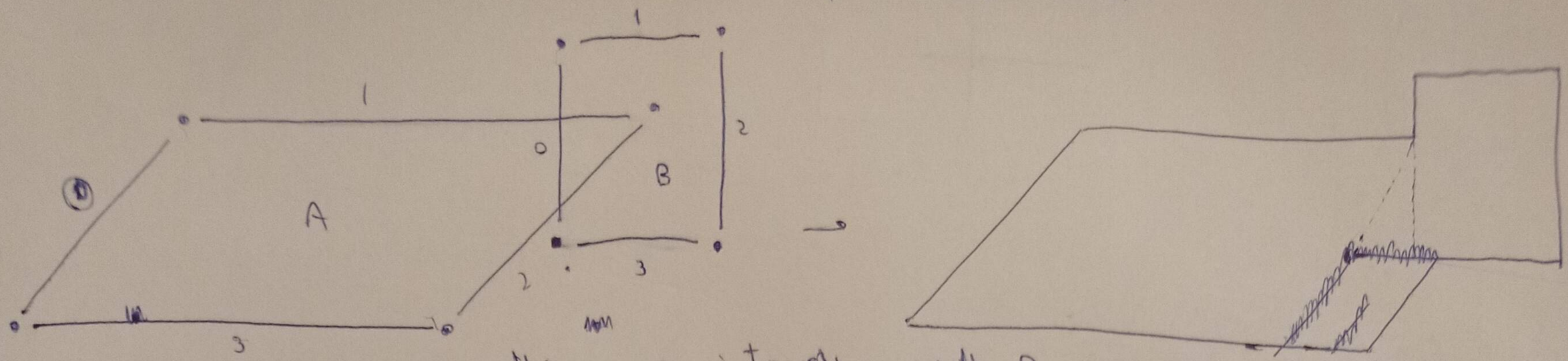








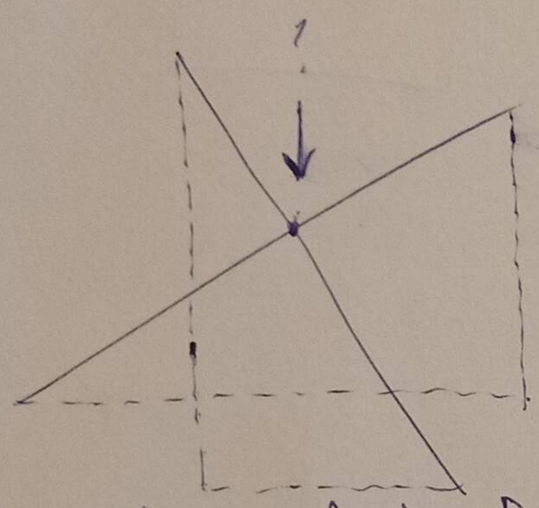


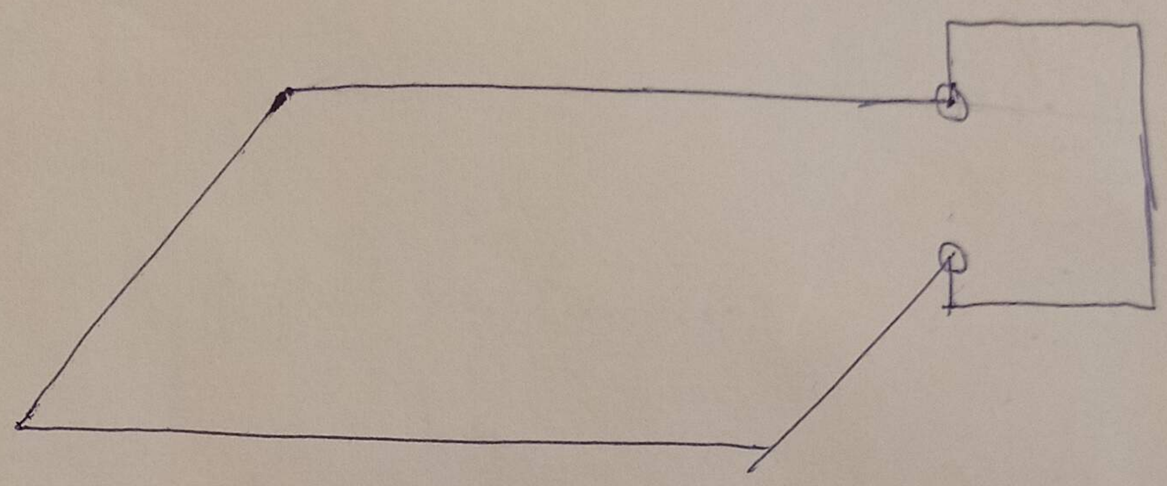


→ nothing, no intersection with B_i so move on to A_1

Start with segment A_0, loop through segments of B starting with B_0.

There is overlap. What is the moving horizon?

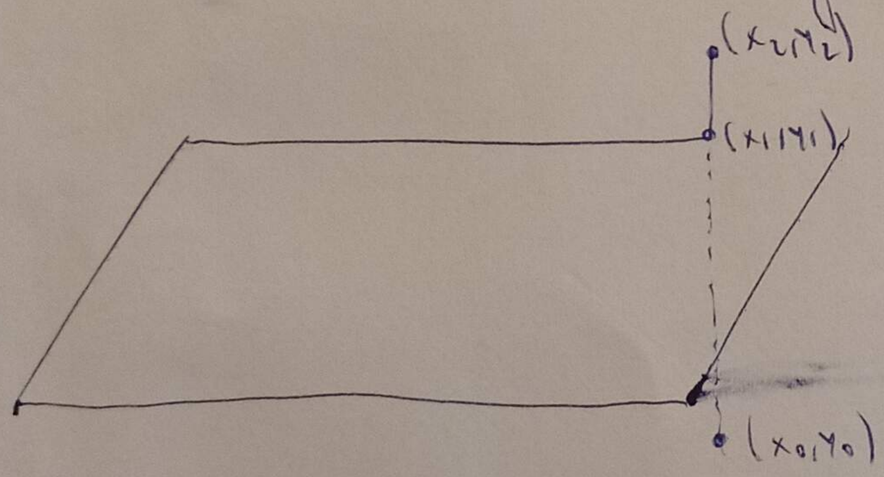




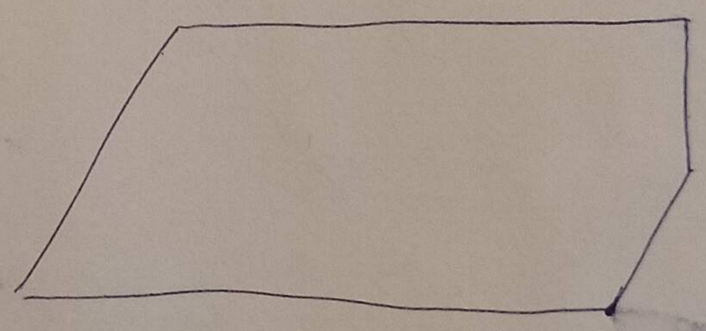
This is a Linear Algebra problem!

~~$\vec{a} \cdot \vec{b} = |a||b| \cos\theta$~~

Once I find it, how am I going on? That is how do I choose between:



and



?

Well, I choose the one that is completely outside my polygon

$y_1 = ax_1 + b$ I know a, b, c, d so

$y_1 = cx_1 + d$

$ax_1 + b = cx_1 + d$

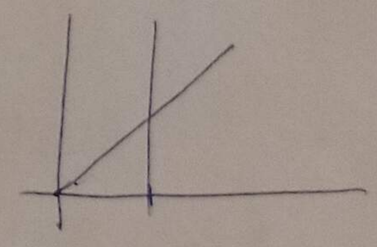
$x_1 = \frac{d - b}{a - c}$

$y_1 = a\left(\frac{d-b}{a-c}\right) + b$

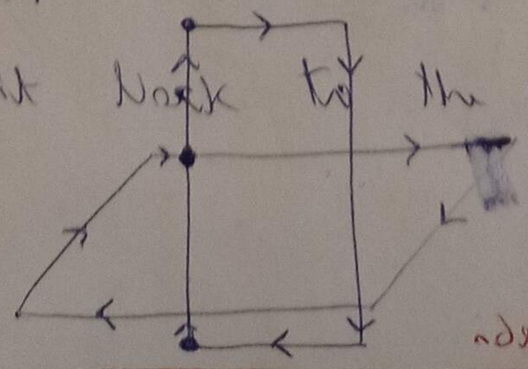
(x_1, y_1) is the point of intersection!

$y = 1 \cdot x + 0$

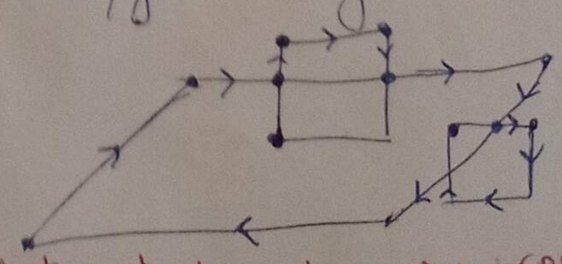
$x = 1$



The segment $(x_0, y_0) \rightarrow (x_1, y_1)$ intersects another the polygon's segments so keep the other and remove it. Back to the queue



rule: polygon is defined clockwise



rule: leftmost point IF POLYGONS EQUAL

idea: polygon is saved from leftmost DOESN'T WORK

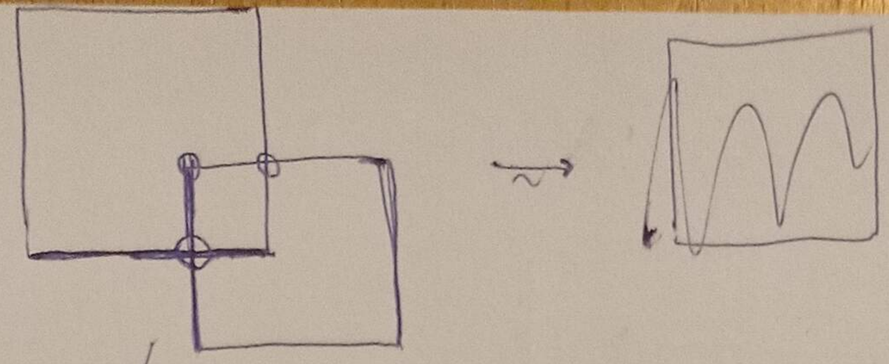
$y_0 = a x_0 + b$

$y_1 = a x_1 + b$

$y_0 - y_1 = a(x_0 - x_1)$

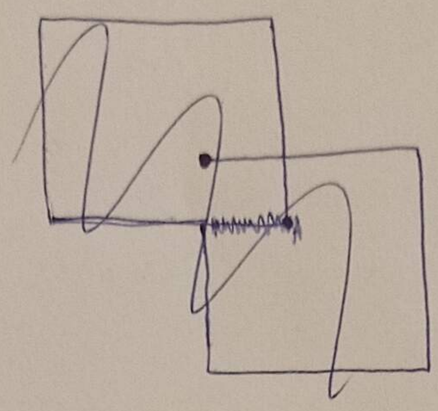
$a = \frac{y_0 - y_1}{x_0 - x_1}$

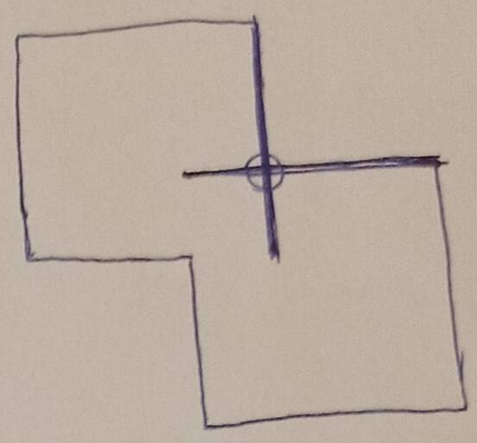
$b = y_0 - \left(\frac{y_0 - y_1}{x_0 - x_1} \right) x_0$

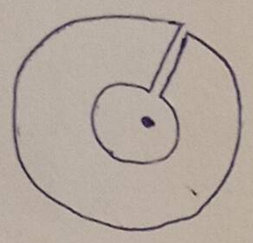


if $y_0 = y_1$ then $a = 0$

$b = y_0$ which is correct for a straight line



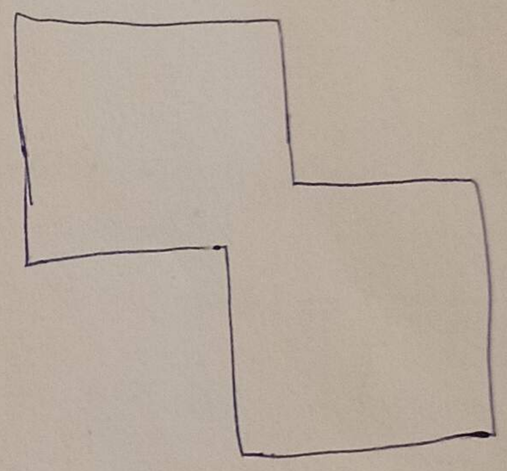




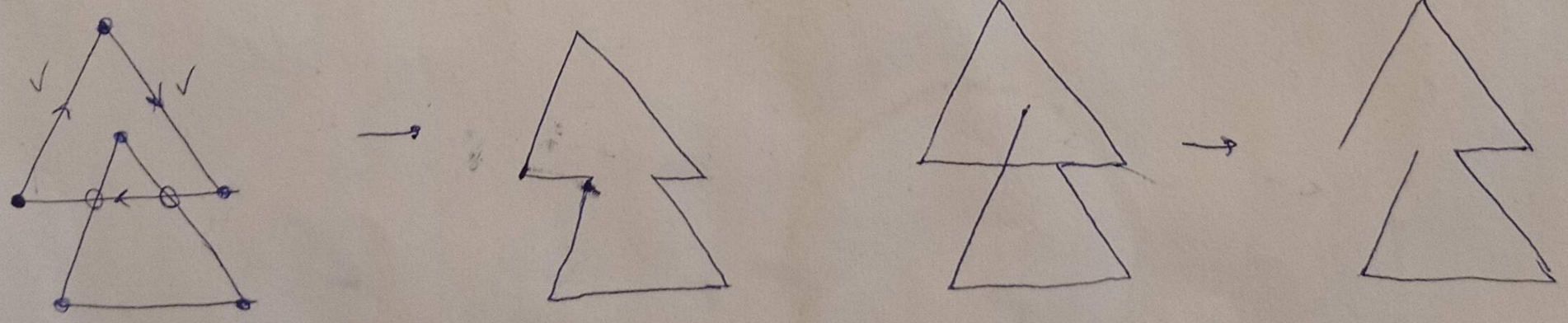
If inward segment is contained (or touching) just remove it

Otherwise it pierces the other side, so keep only that

from outside

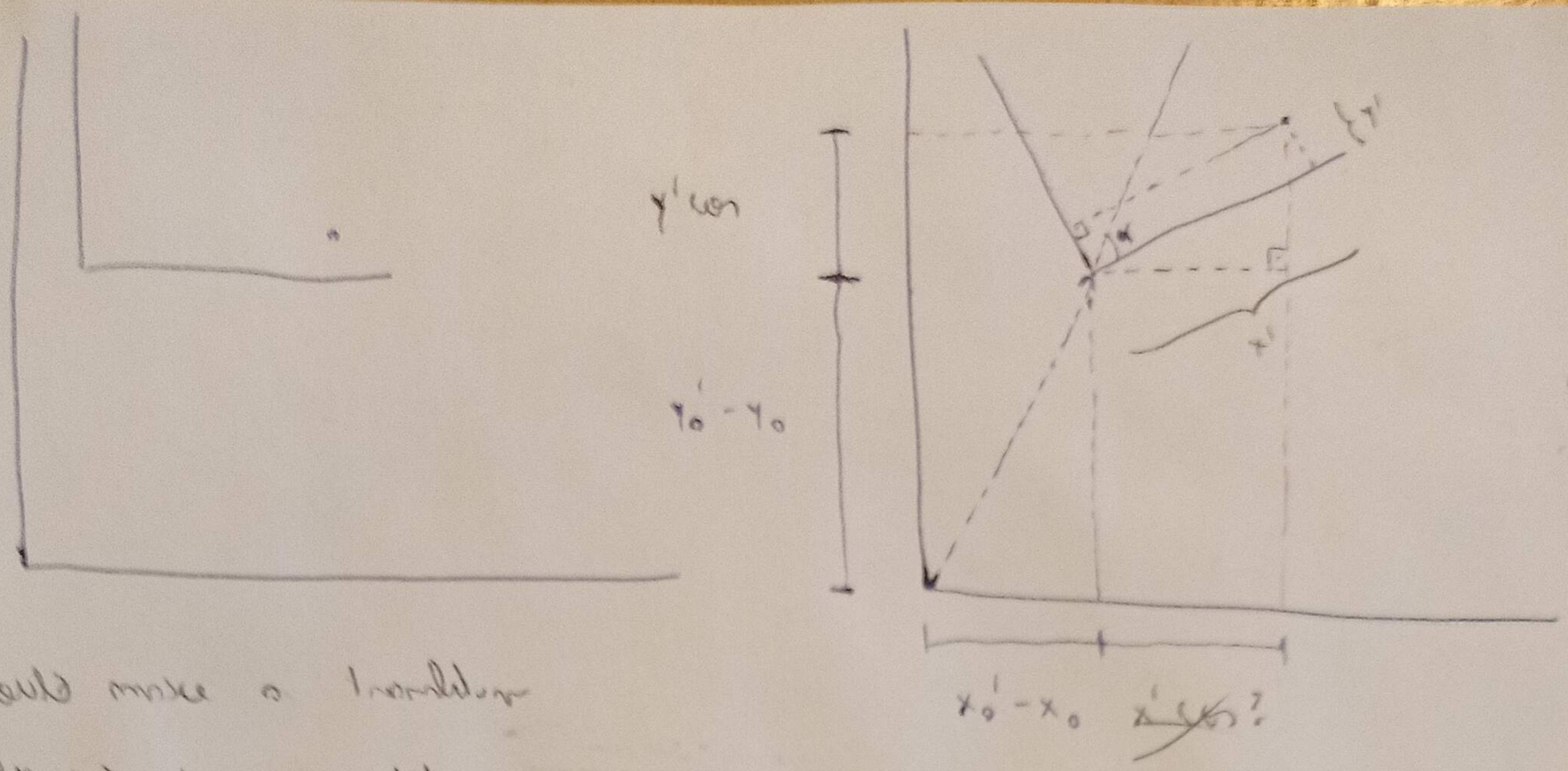


- choose two polygons that in turn to sum them into one



"anti-segments inside other polygon shouldn't be removed!

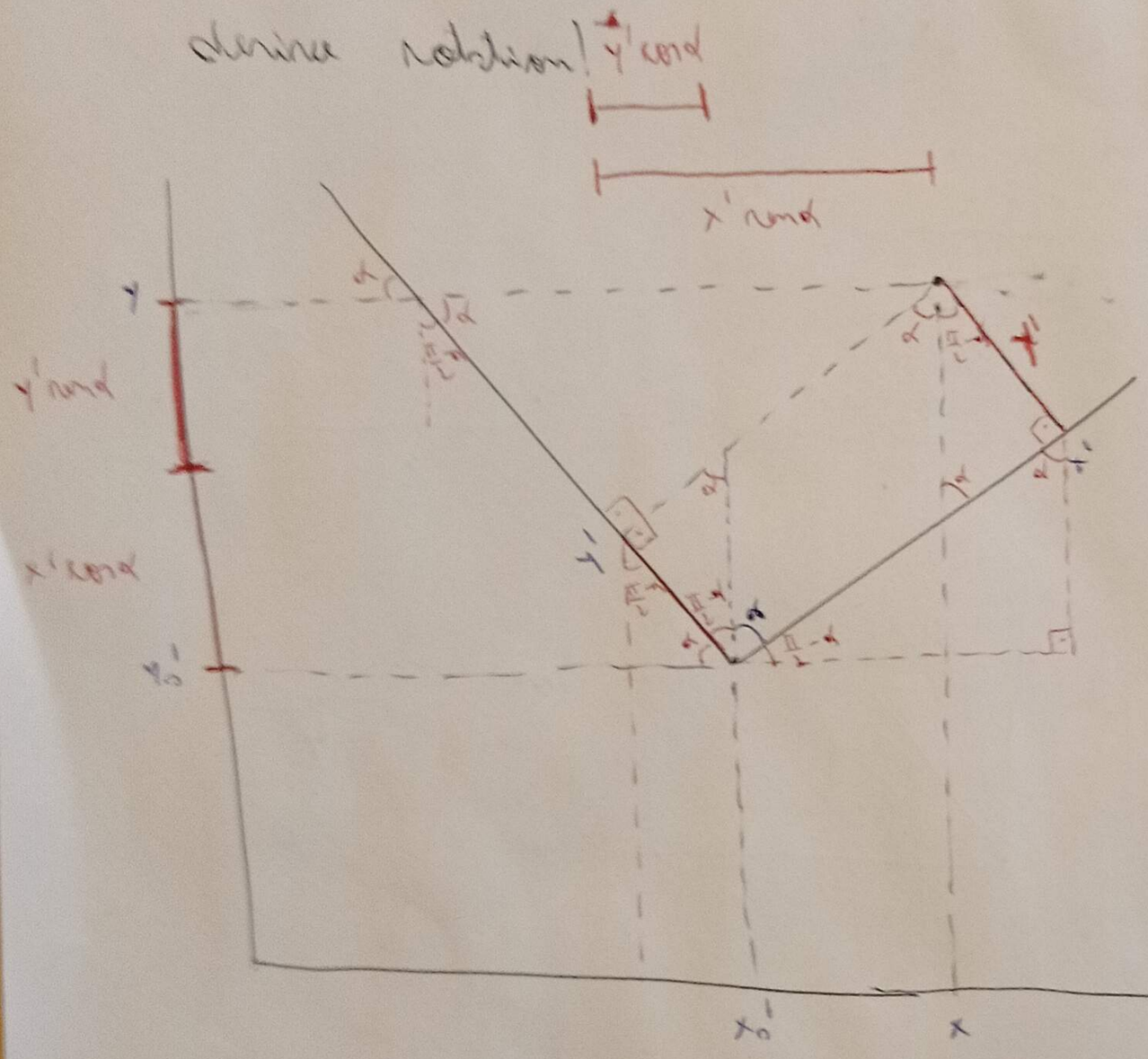
have to get segment order right!!!

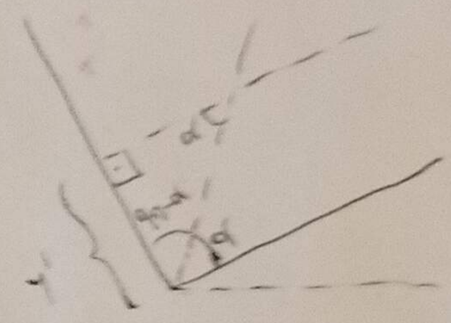


could make a translation

followed by a rotation

obvious rotation!





cosα =

$y = y_0' + x'\cos\alpha + y'\sin\alpha$

$x = x_0' + x'\sin\alpha - y'\cos\alpha$

$y\cos\alpha = y_0'\cos\alpha + x'\sin\alpha\cos\alpha + y'\sin^2\alpha$

$x\sin\alpha = x_0'\sin\alpha + x'\sin^2\alpha - y'\sin\alpha\cos\alpha$

$y\cos\alpha + x\sin\alpha = y_0'\cos\alpha + x_0'\sin\alpha + x'$

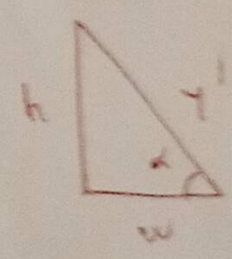
$$\boxed{x' = (y - y_0')\cos\alpha + (x - x_0')\sin\alpha}$$

$y\sin\alpha = y_0'\sin\alpha + x'\sin\alpha\cos\alpha + y'\sin^2\alpha$

$x\cos\alpha = x_0'\cos\alpha + x'\sin\alpha\cos\alpha - y'\sin^2\alpha$

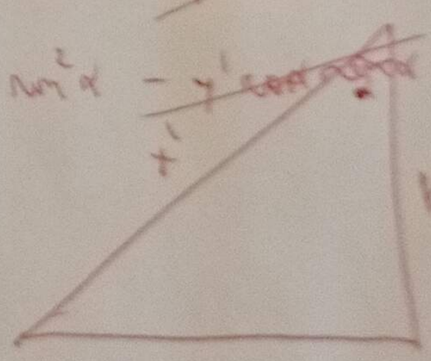
$y\sin\alpha - x\cos\alpha = y_0'\sin\alpha - x_0'\cos\alpha + y'$

$$\boxed{y' = (y - y_0')\sin\alpha - (x - x_0')\cos\alpha}$$



$\cos\alpha = \frac{w}{y'}$

$\sin\alpha = \frac{h}{y'}$



$\cos\alpha = \frac{h}{x'}$

$\cos\alpha = \frac{w}{x'}$

$\sin\alpha = \frac{w}{x'}$

$$\begin{pmatrix} x' \\ y' \end{pmatrix} = \begin{pmatrix} \sin\alpha & \cos\alpha \\ \cos\alpha & -\sin\alpha \end{pmatrix} \begin{pmatrix} x - x_0 \\ y - y_0 \end{pmatrix}$$

$$\sin\left(\frac{\pi}{2}-\alpha\right) = \frac{e^{i\left(\frac{\pi}{2}+\alpha\right)} - e^{-i\alpha\left(+\frac{\pi}{2}\right)}}{2i} =$$

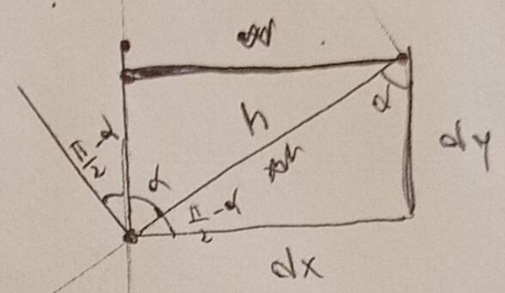
NAIT

$$e^{i\frac{\pi}{2}} = \cos\frac{\pi}{2} + i\sin\frac{\pi}{2} = i$$

$$\frac{ie^{i\alpha} + ie^{-i\alpha}}{2i} = \cos\alpha$$

$$\begin{pmatrix} \sin\alpha & \cos\alpha \\ \cos\alpha & -\sin\alpha \end{pmatrix} \xrightarrow{\frac{\pi}{2}} \begin{pmatrix} \cos\alpha & \sin\alpha \\ \sin\alpha & -\cos\alpha \end{pmatrix}$$

How do I find α? Just invert

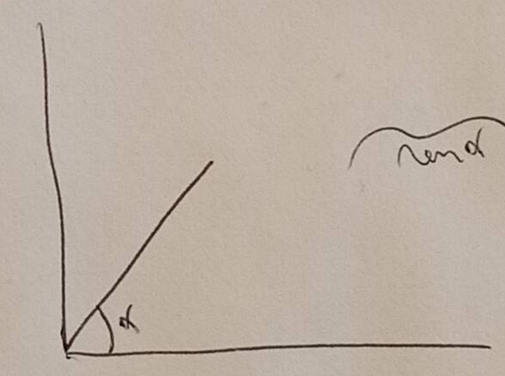


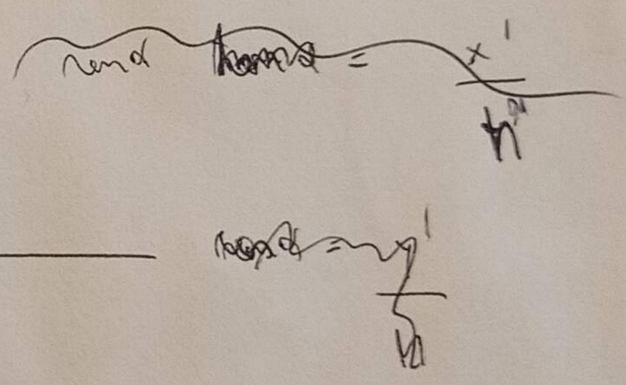
$$\sin\left(\frac{\pi}{2}-\alpha\right) = \frac{e^{i\left(\frac{\pi}{2}-\alpha\right)} - e^{-i\left(\frac{\pi}{2}-\alpha\right)}}{2i} = \frac{ie^{-i\alpha} + ie^{i\alpha}}{2i} = \cos\alpha$$

$$\cos\left(\frac{\pi}{2}-\alpha\right) = \frac{e^{i\left(\frac{\pi}{2}-\alpha\right)} + e^{-i\left(\frac{\pi}{2}-\alpha\right)}}{2} = \frac{ie^{-i\alpha} - ie^{i\alpha}}{2} = \frac{-e^{-i\alpha} + e^{i\alpha}}{2i} = \sin\alpha$$

$$|\vec{a}\cdot\vec{b}| = |a||b|\cos\alpha$$

$$\cos\alpha = \frac{|\vec{a}\cdot\vec{b}|}{|a||b|}$$





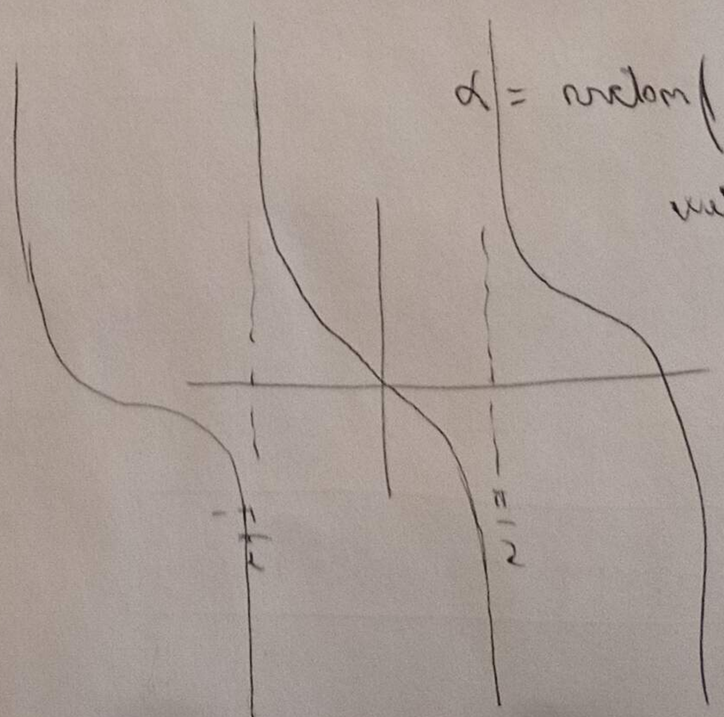
$$\cos\alpha = \frac{dx}{h}$$

$$\cos\alpha = \frac{dy}{h}$$

$$\tan\alpha = \frac{dx}{dy}$$

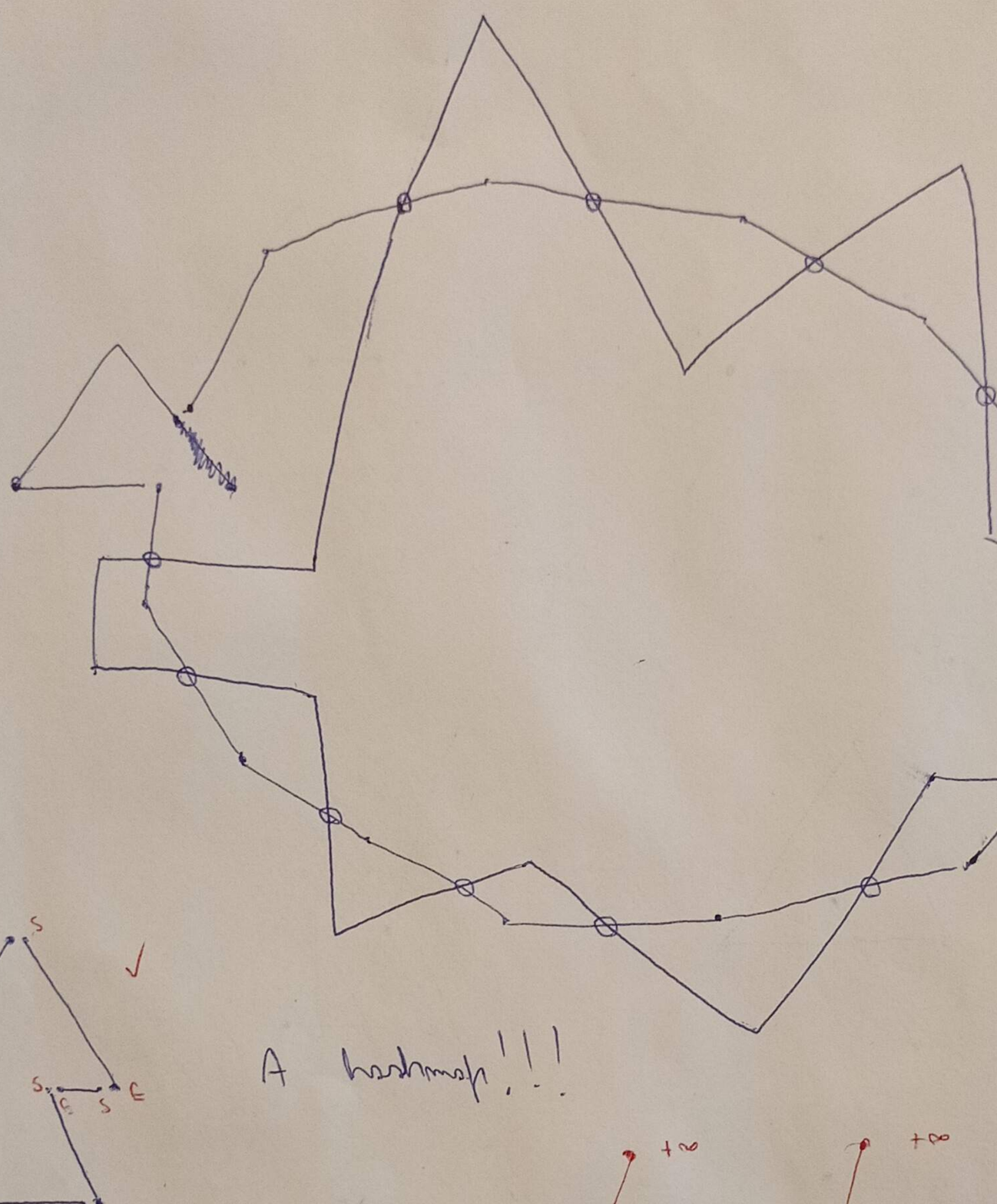
$$\alpha = \arctan\left(\frac{dx}{dy}\right)$$

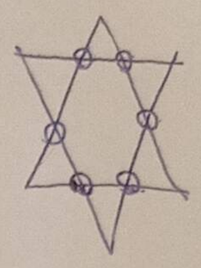
well defined for $\mathbb{R}$



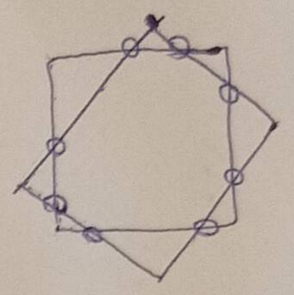
You're given a list of segments, how to order them into a polygon, efficiently?

naively: start with a segment, iterate over all other segments to find the first one ~~that~~ whose end equals this segment's start



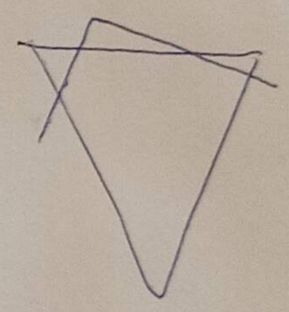


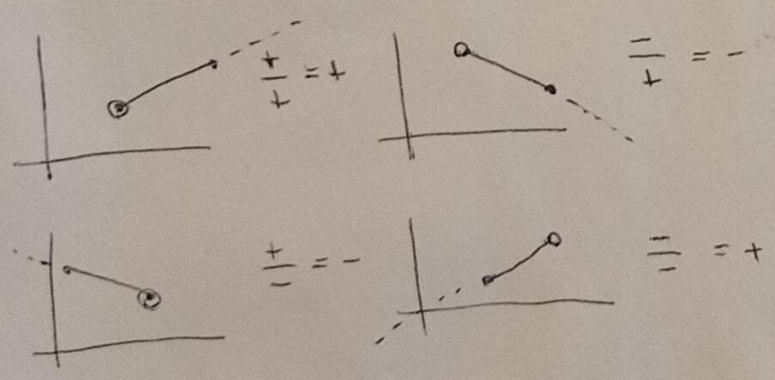
16 segments



16 segments

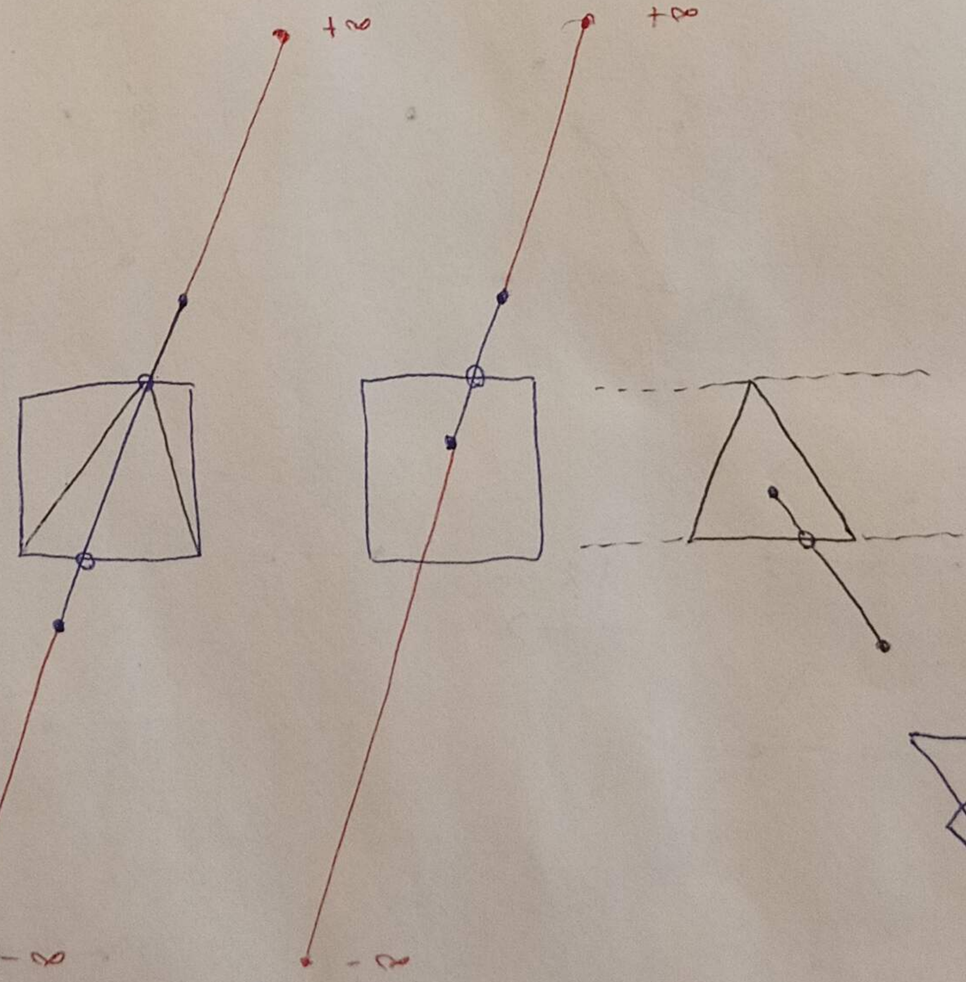
A hashmap!!!

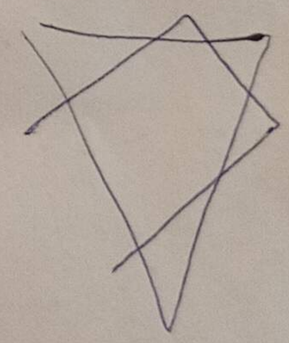


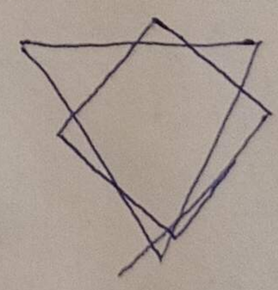


0 = start

• = end





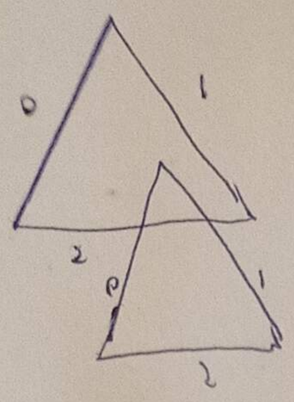


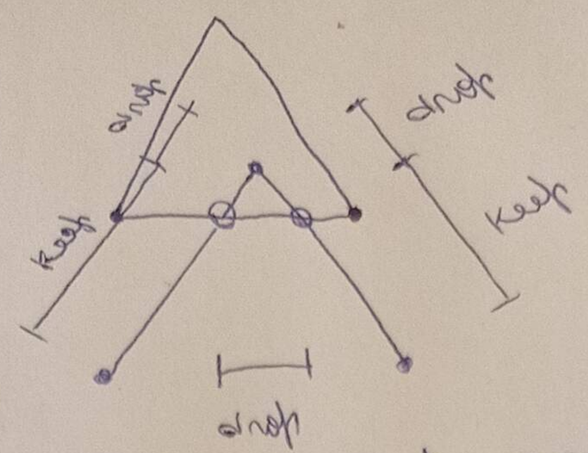
TODO: deal with ~~coincident~~ polygons

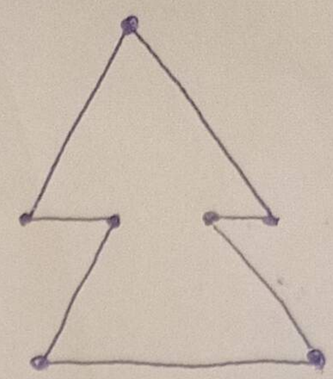
~~TODO: fix point intersects~~ no fix was needed

~~counter~~ clockwise!

TODO: handle many polygons

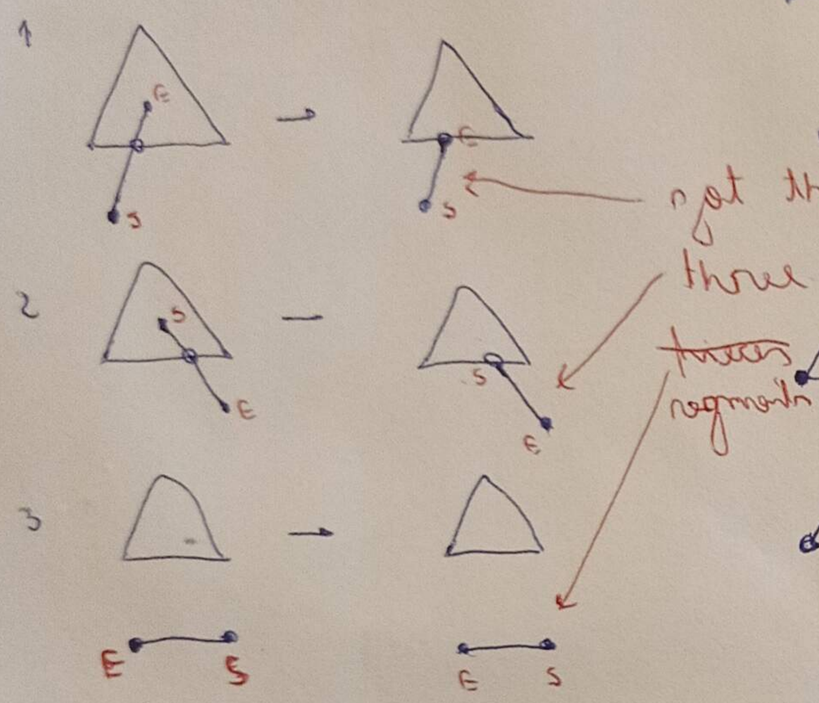


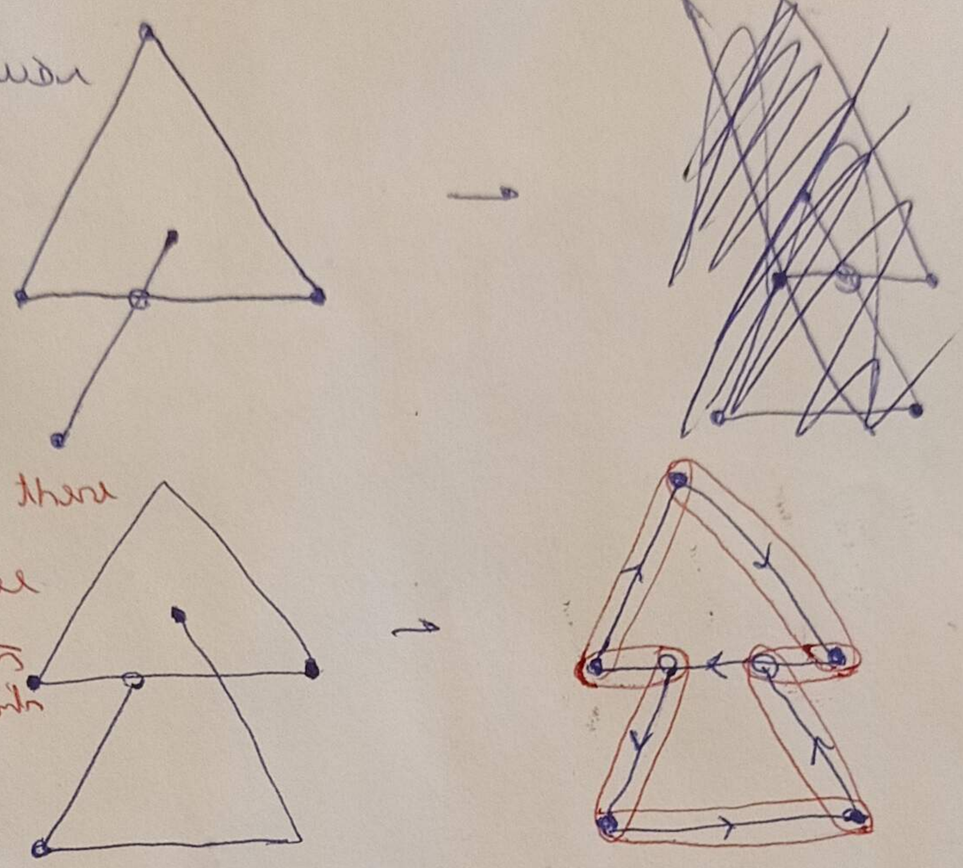


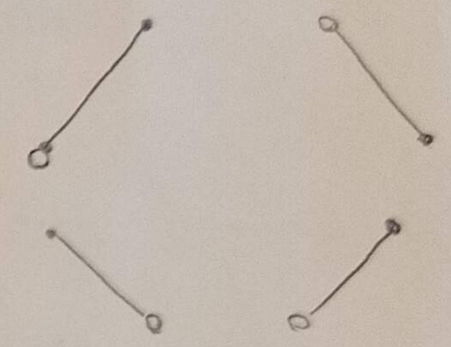


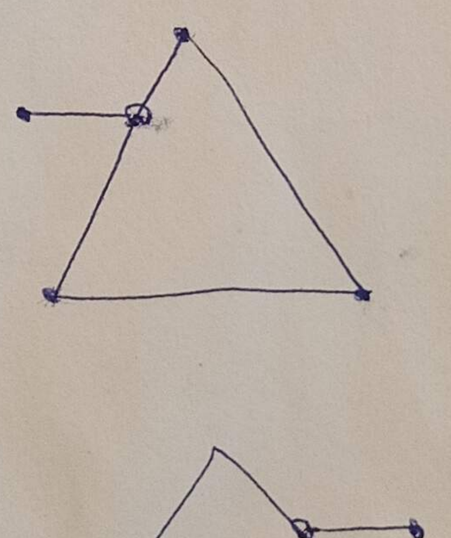
I knew how to traverse the correct segments, but I do not know how to join them after the first

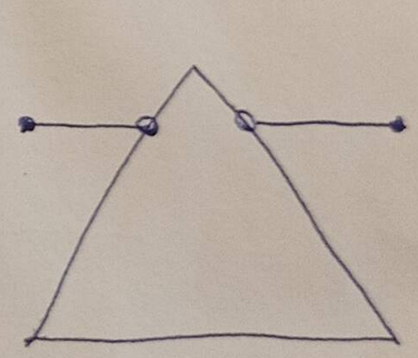
Okay, let's say I only include the clipped one and then use the other just as a mould





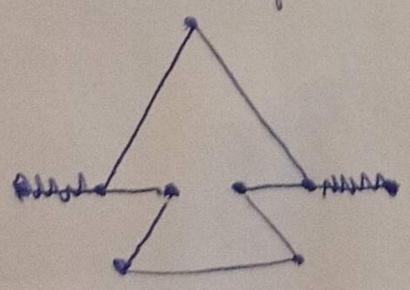






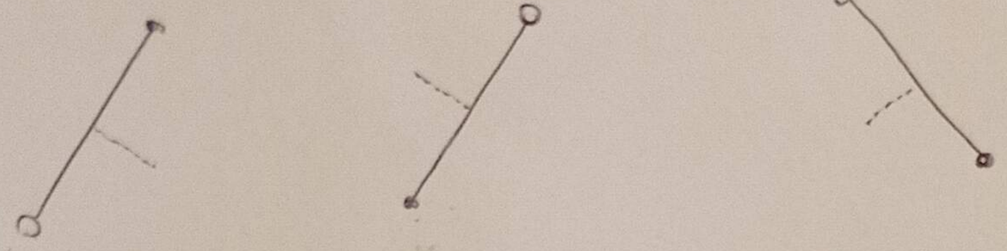
Putting it all together:

Ends of one that of the other! To determine order...



It works! And is highly intelligible!

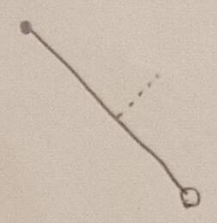
Normalvektor konstruieren

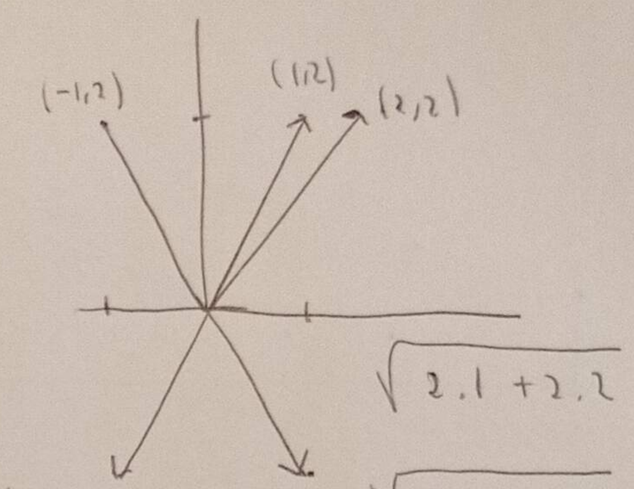


$2 \cdot -1 \quad +2 \cdot 1$

$2 \cdot 1 \quad +2 \cdot -1$

$\sqrt{-1 \cdot 2 + 2 \cdot 2} > 0$

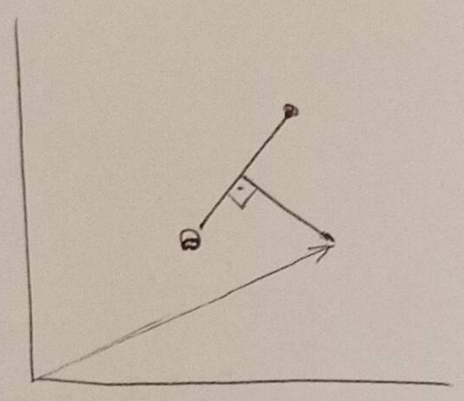


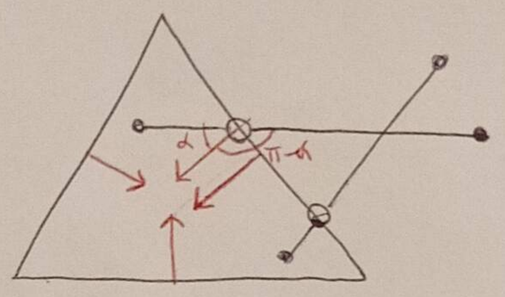


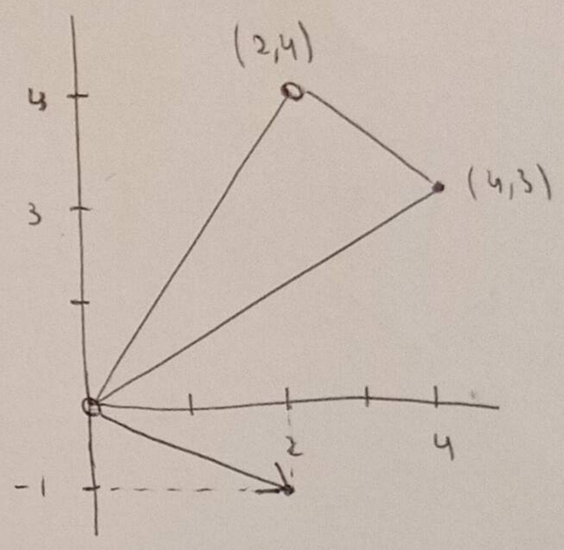
$\sqrt{2 \cdot 1 + 2 \cdot 2}$

$\sqrt{1 \cdot 2 - 2 \cdot 2} < 0$

$\sqrt{2 \cdot -1 - 2 \cdot 2}$

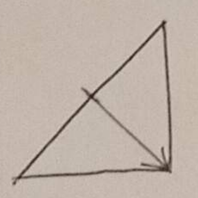


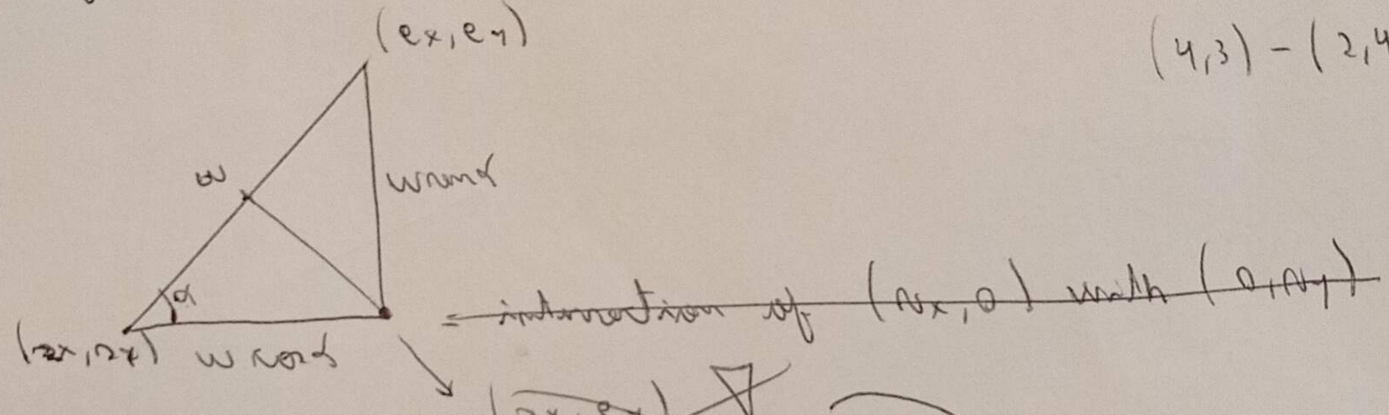




$(4,3) - (2,4) = (2,-1)$

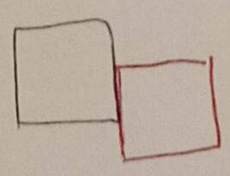
$\vec{a} \cdot \vec{N} = 0 \quad$ if $\quad \cos\theta = 0$





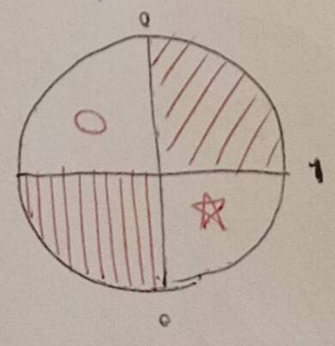
~~= Intersection of (sx,0) with (0,sy)~~

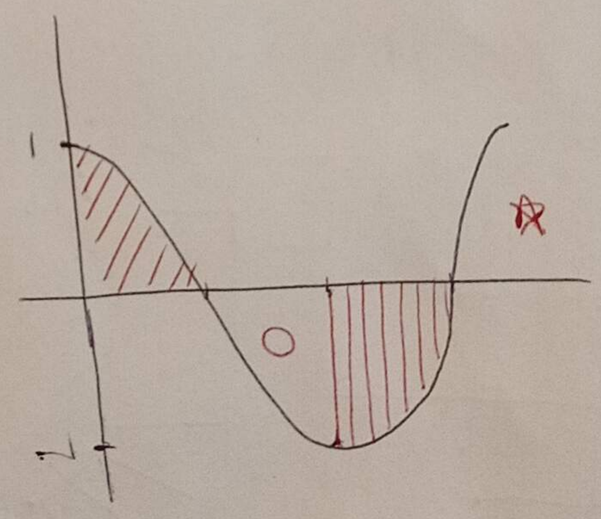
Tore:

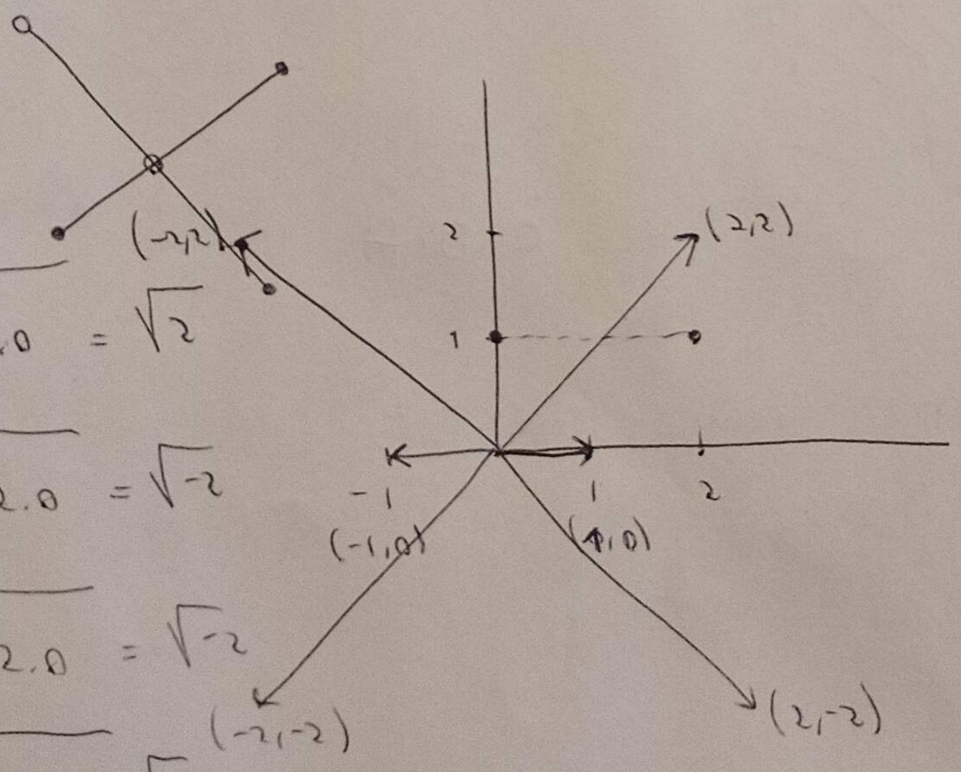


$\vec{N} \cdot \vec{N} = \sqrt{N_x N_x + N_y N_y} = |\vec{N}|$

$\cos\theta = \frac{|\vec{a} \cdot \vec{N}|}{|\vec{a}||\vec{N}|} \in [0,1]$







$\sqrt{2 \cdot 1 - 2 \cdot 0} = \sqrt{2}$

$\sqrt{2 \cdot -1 - 2 \cdot 0} = \sqrt{-2}$

$\sqrt{-2 \cdot 1 - 2 \cdot 0} = \sqrt{-2}$

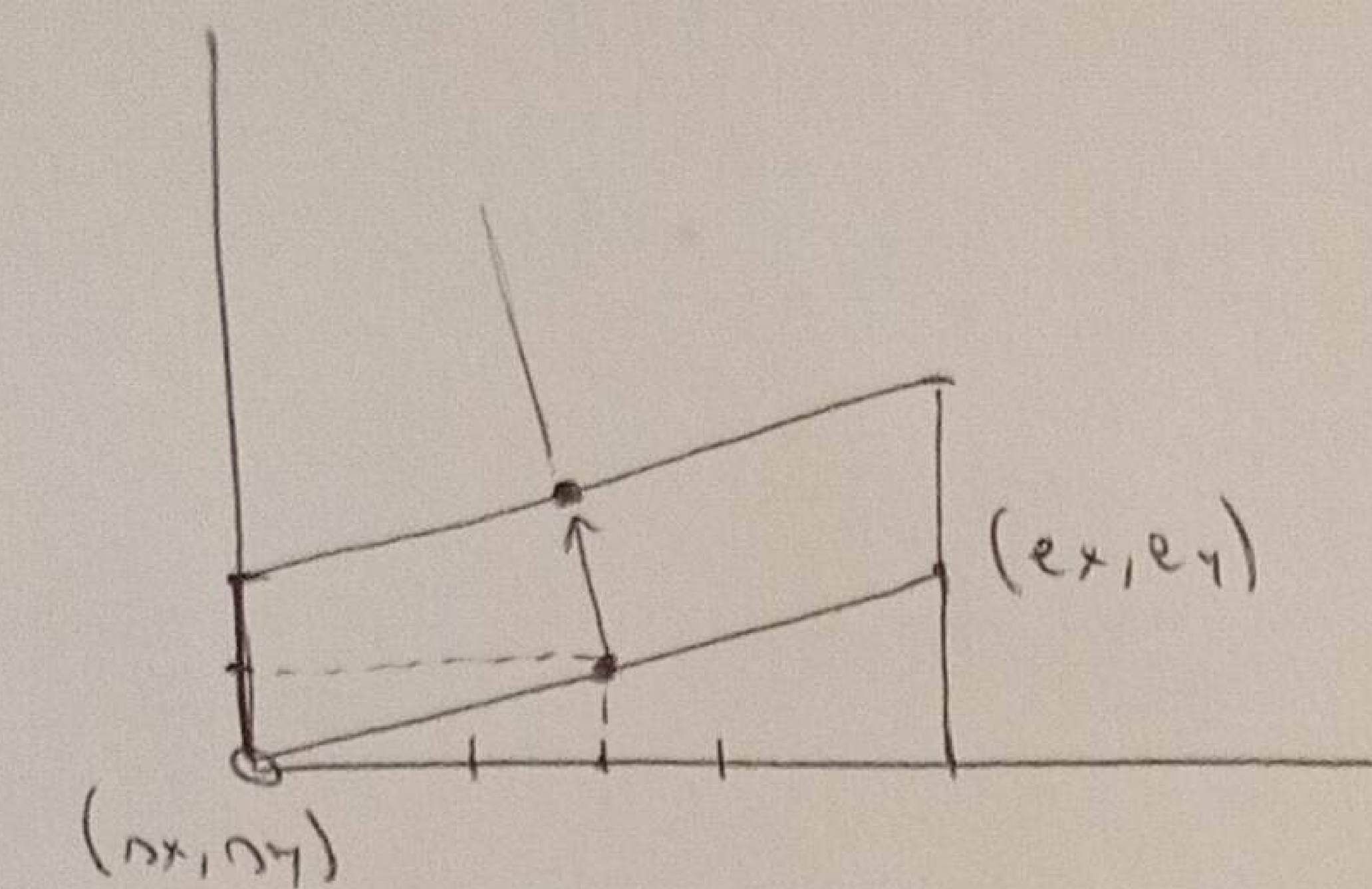
$\sqrt{-2 \cdot -1 - 2 \cdot 0} = \sqrt{2}$

$\sqrt{2 \cdot 1 + 2 \cdot 0} = \sqrt{2}$

$\sqrt{-1 \cdot 1 + 0 \cdot 0} = \sqrt{-1}$

$\sqrt{-2 \cdot 1 + 2 \cdot 0} = \sqrt{-2}$

$\sqrt{-2 \cdot -1 + 2 \cdot 0} = \sqrt{2}$

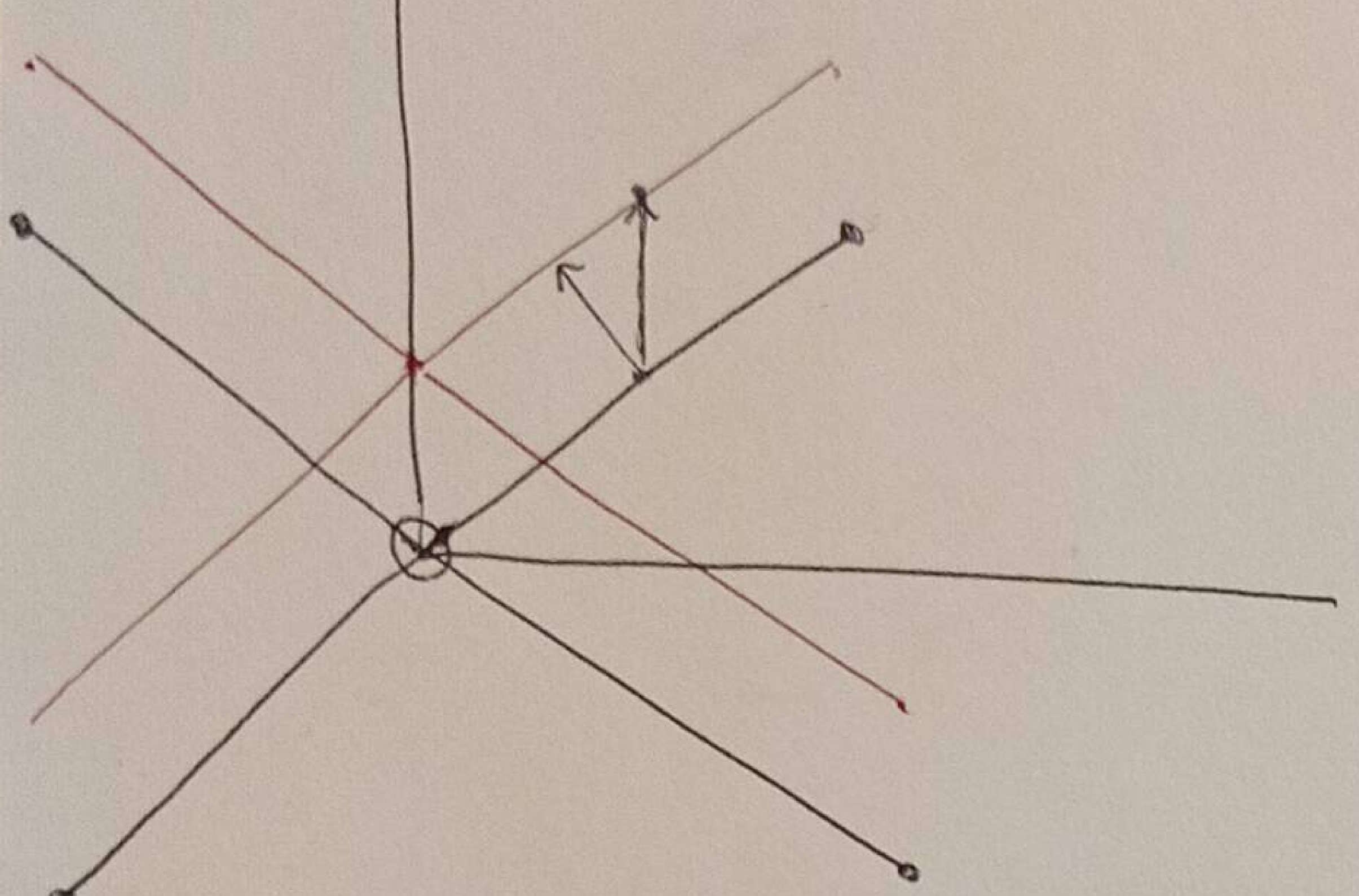


~~$s_n = \left(\frac{e_x - s_x}{2}, \frac{e_y - s_y}{2}\right)$~~

~~e_x~~

$$s_n = \left(\frac{2s_x}{2} + \frac{e_x - s_x}{2}, \frac{2s_y}{2} + \frac{e_y - s_y}{2}\right)$$

$$s_n = \left(\frac{s_x + e_x}{2}, \frac{s_y + e_y}{2}\right)$$

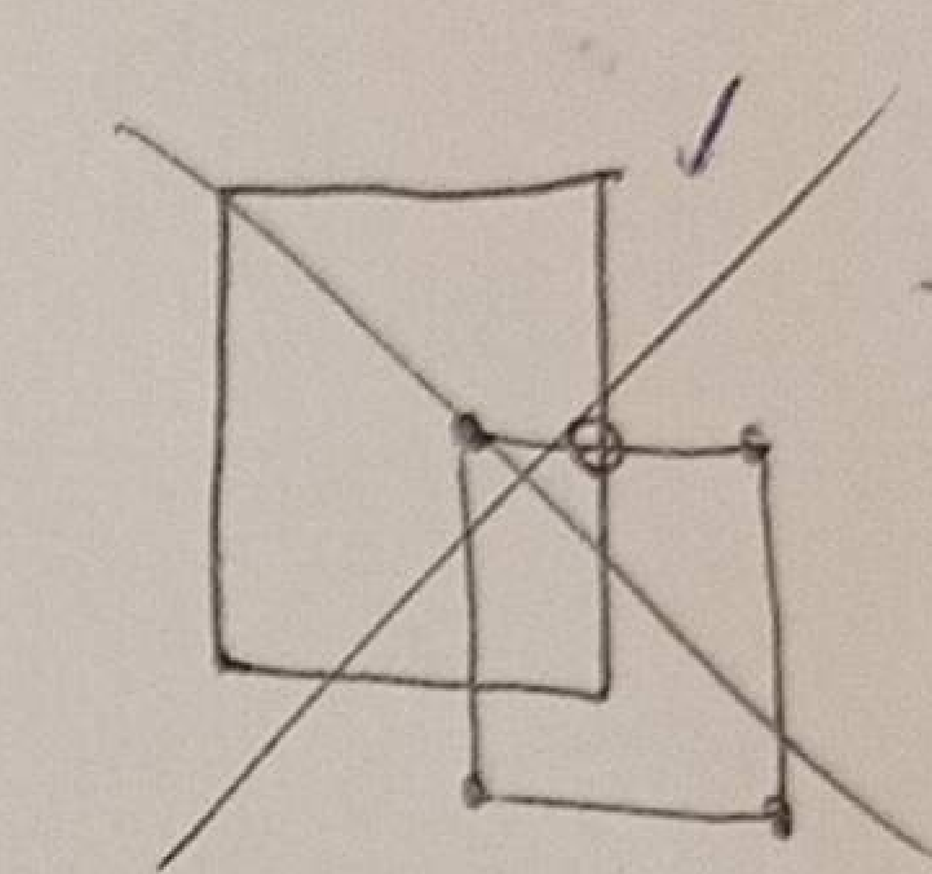


How do I find s_e?

$\vec{a} \times \vec{b}$ or $\vec{b} \times \vec{a}$

$\vec{a} = (s_{nx}, s_{ny}, 0)$

$\vec{b} = (s_{nx}, s_{ny}, 1)$

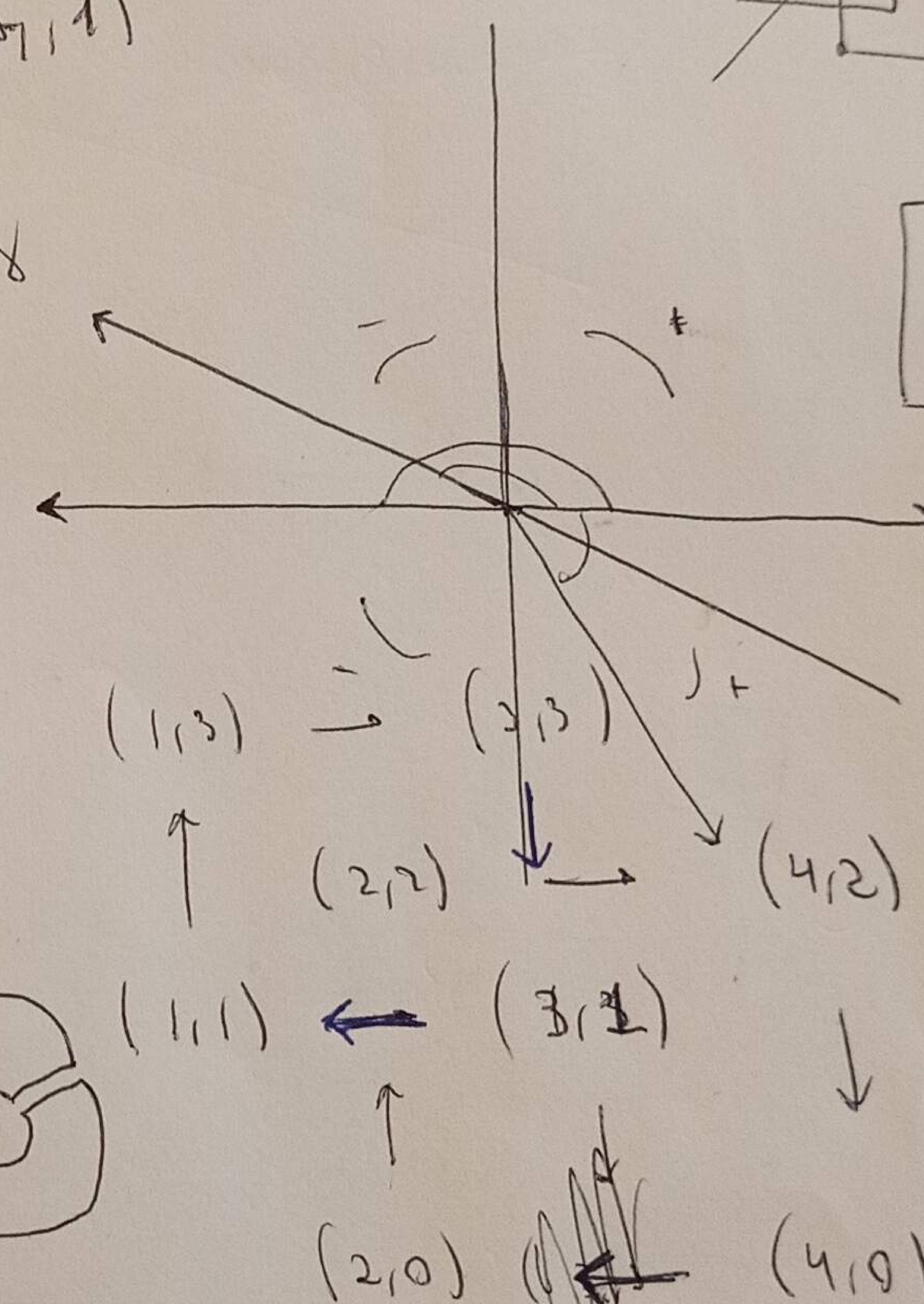


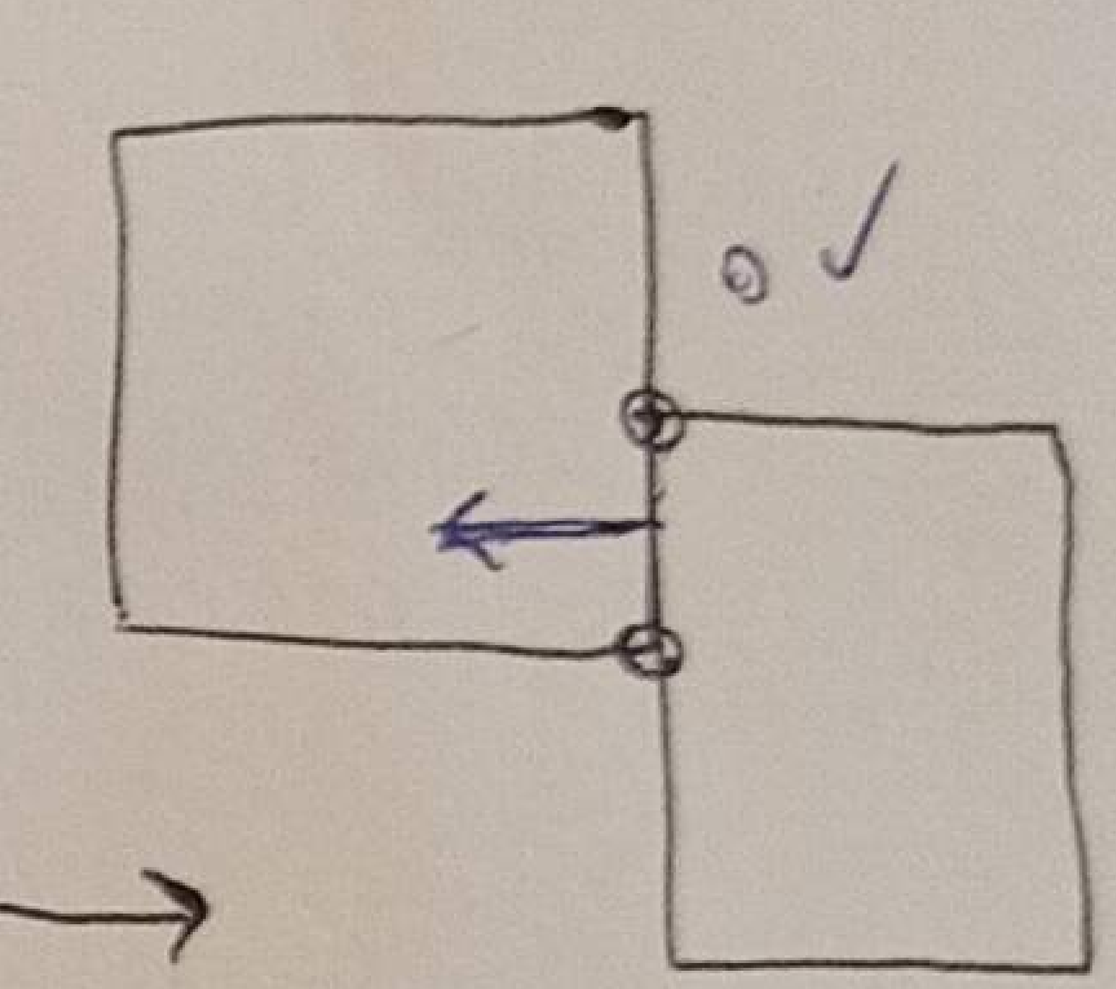
~~indeterminate~~

~~if $\cos\theta = 0$~~

$\vec{a} \cdot \vec{b} = a_x b_x + a_y b_y + a_z b_z$, little meaning

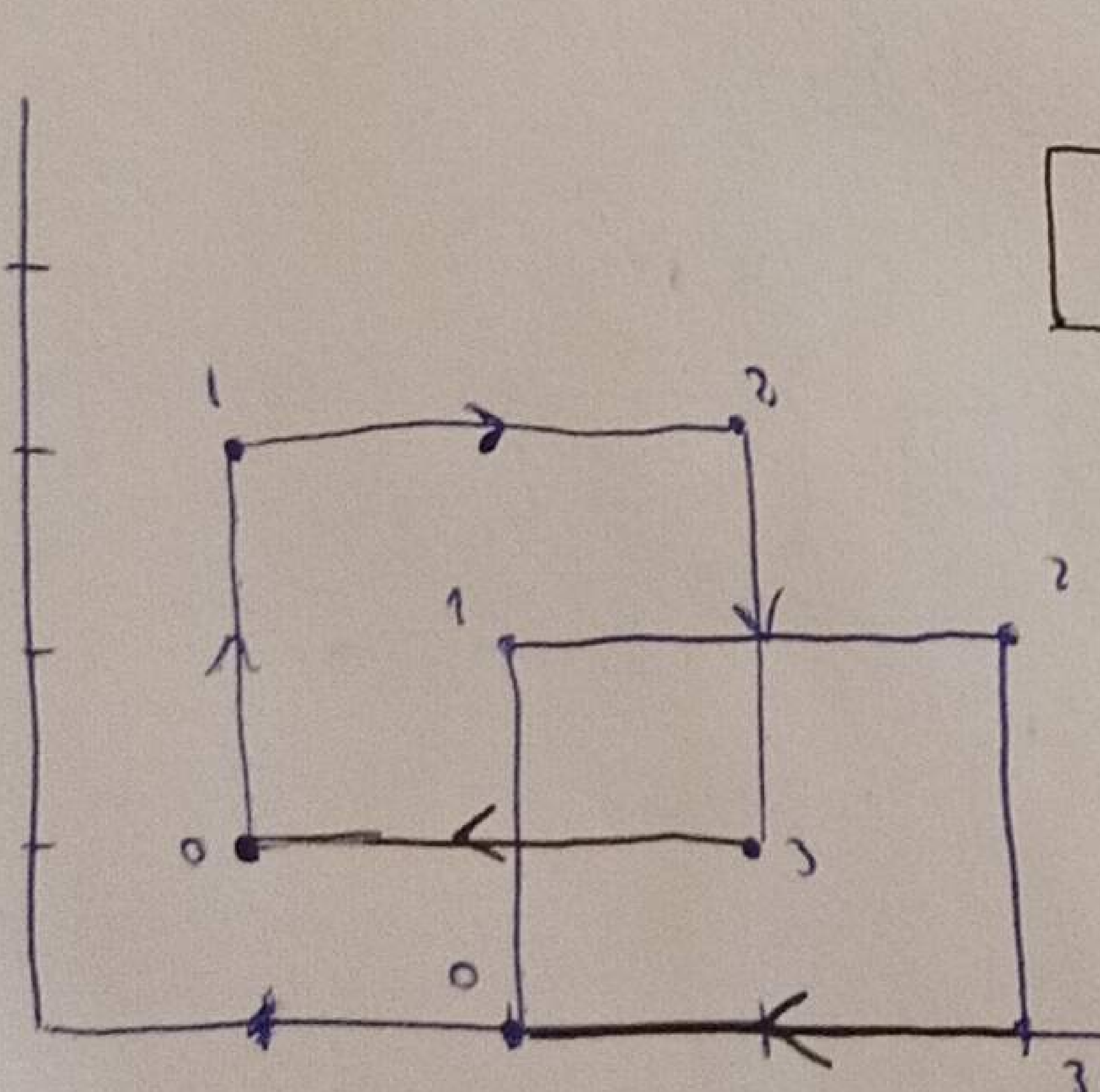
$\vec{a} \cdot \vec{b} = |\vec{a}||\vec{b}| \cos\theta$

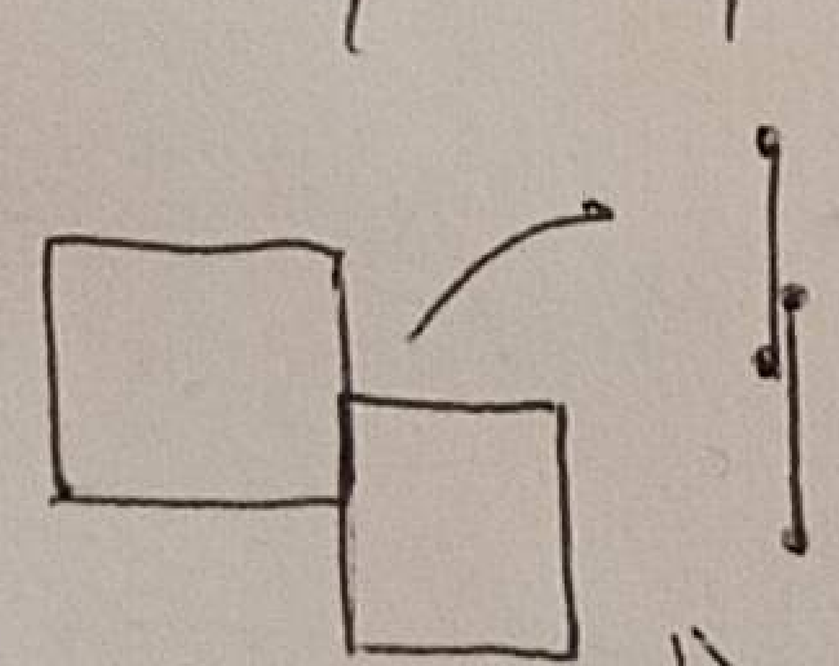


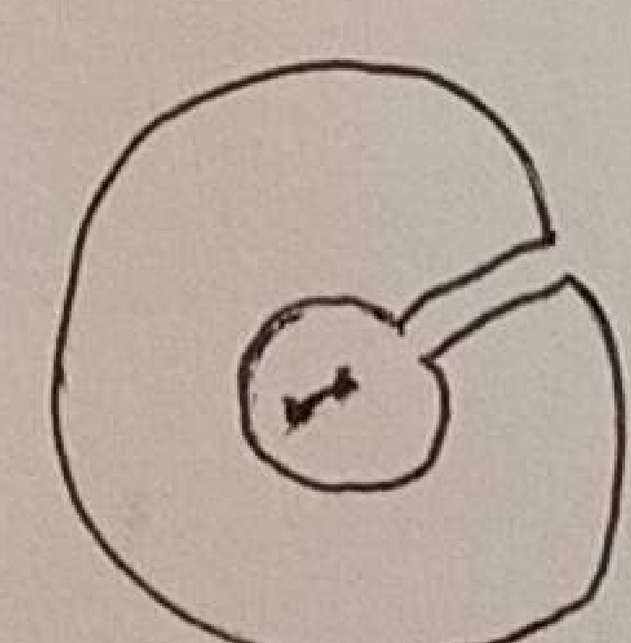


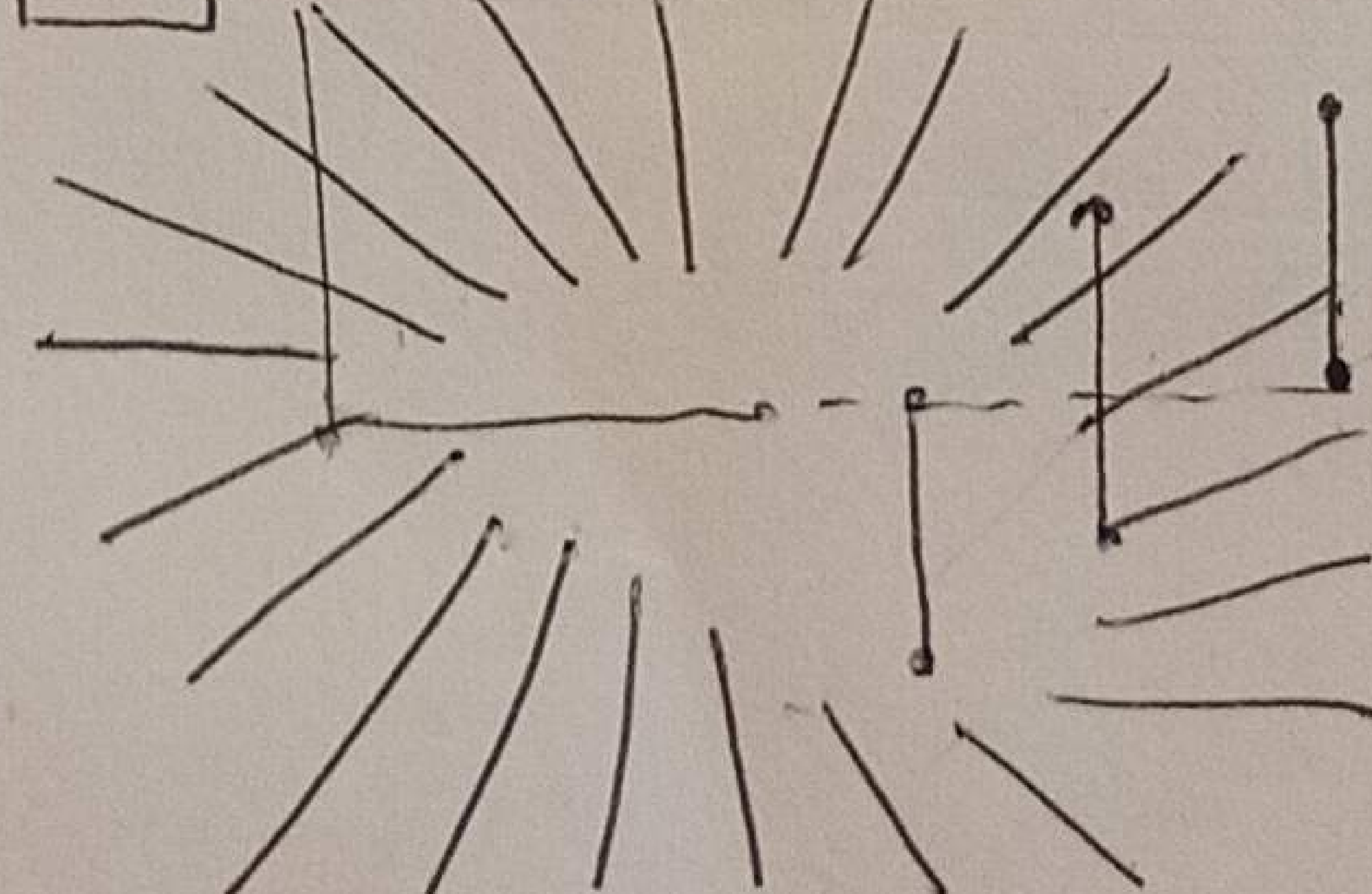
$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ a_x & a_y & a_z \\ b_x & b_y & b_z \end{vmatrix}$$

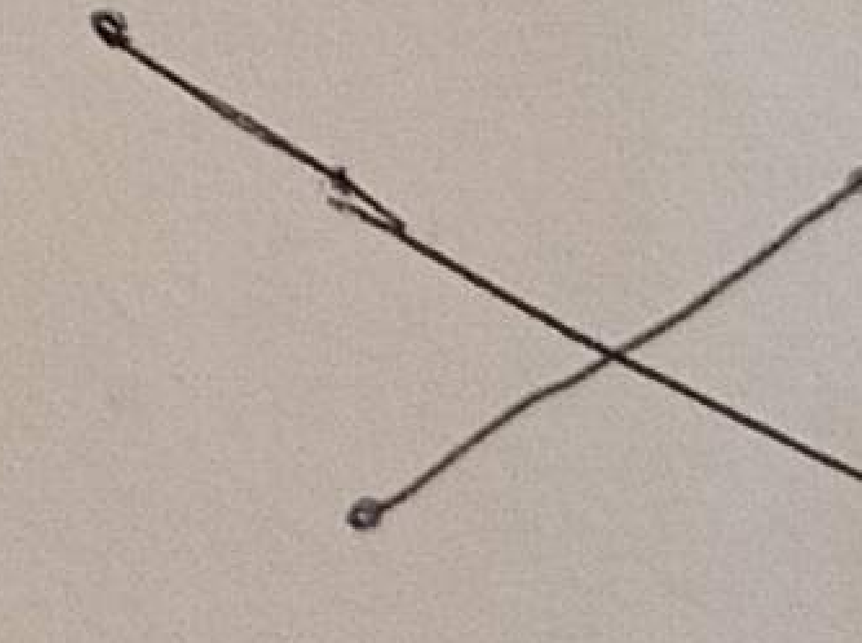
$(a_y b_z - a_z b_y)\,\hat{i}$
$-(a_x b_z - a_z b_x)\,\hat{j}$
$(a_x b_y - a_y b_x)\,\hat{k}$











A, B, C, D
↓ ↓ ↓ ↓
A, B, ~~C~~, D + ~~A~~

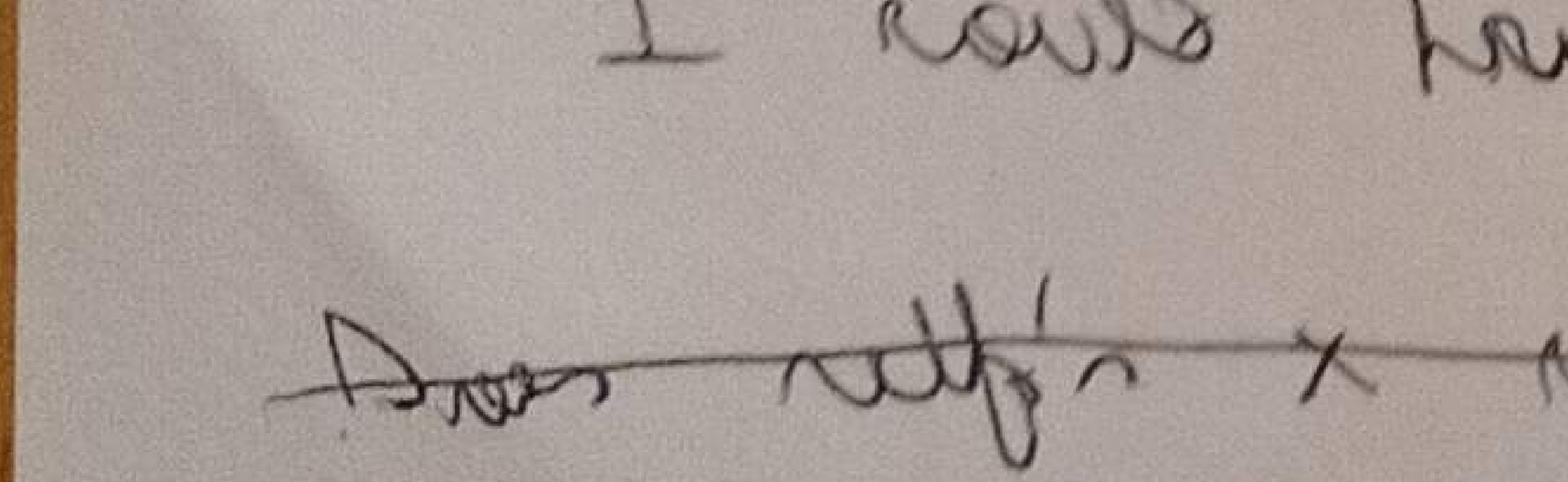
$y = ax + b$

$y = cx + d$

slope is used on intersection with, problem is that slope is $\pm\infty$ here
is there another way to detect intersection between two segments?
I could project one segment on the other's basis

~~$a = \frac{(y - b)}{x}$~~

~~Does self's x contains other's x~~



(start within (x_s, x_e)
and end not (x_s, x_e)) OR VICE-VERSA

$0 = (a - c)\,x\,b - d$

TODO: complete overlap

Hard to know in advance which polygons will make up disjoint final polygon

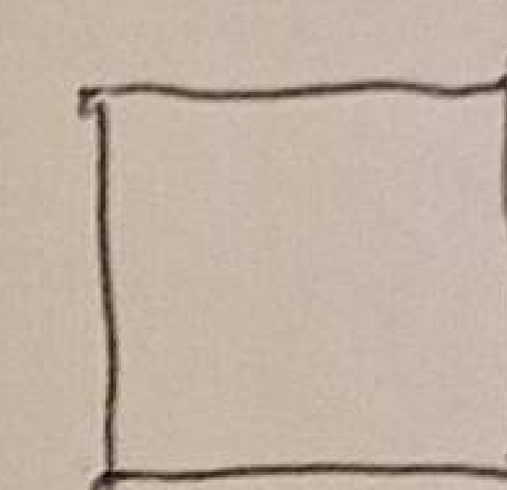
Why I cannot construct a "polygon" or a list of polygons?
- ~~it'me~~ where would it fail?

As polygon side count grows it becomes more expensive to clip
- it would fail in drawing but there I could split them in (before splitting)

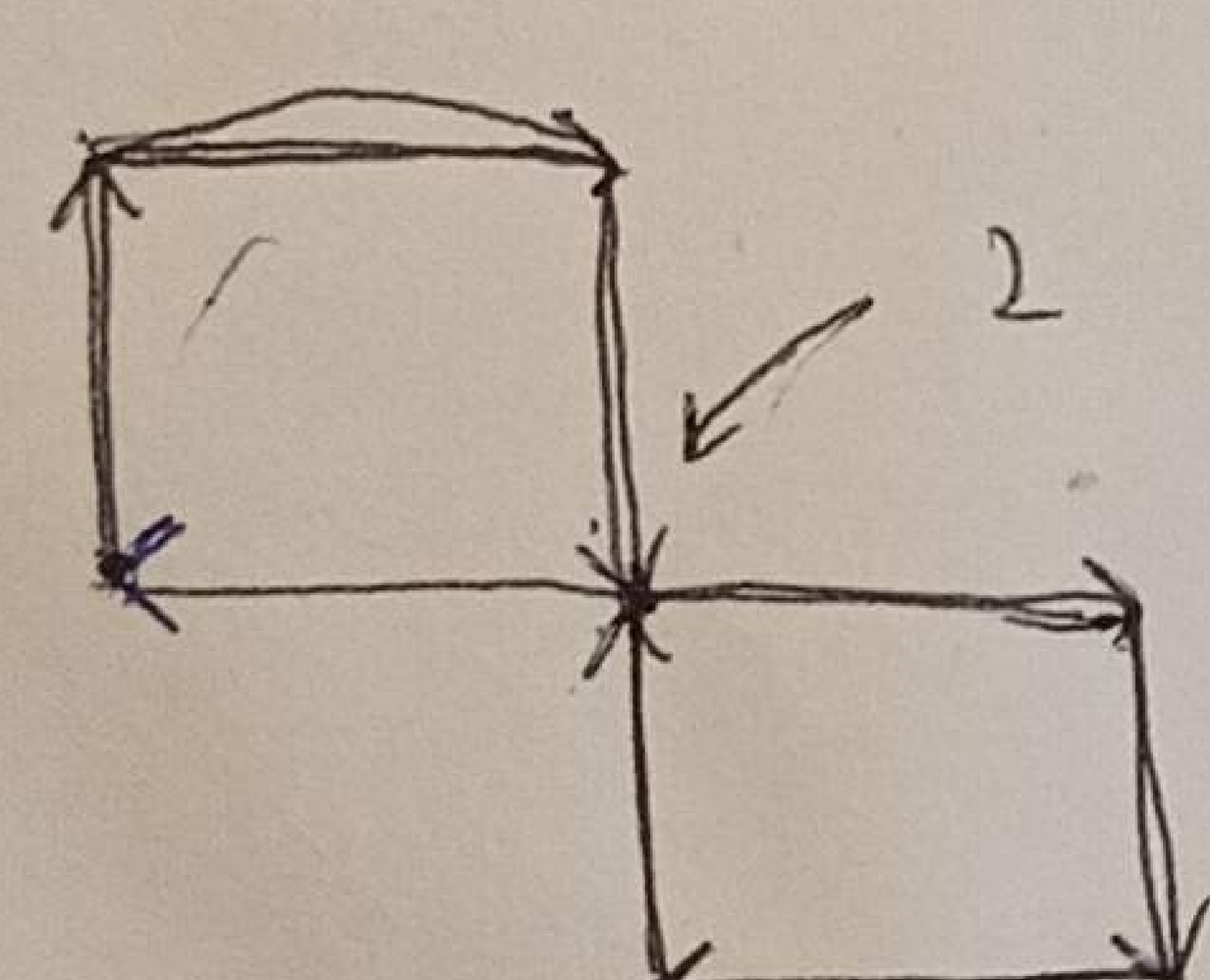
Polygon :: from_unordered_segments(...) → Vec<Polygon>

clip should take and return segments

~~final step~~ also
sum returns list of polygons



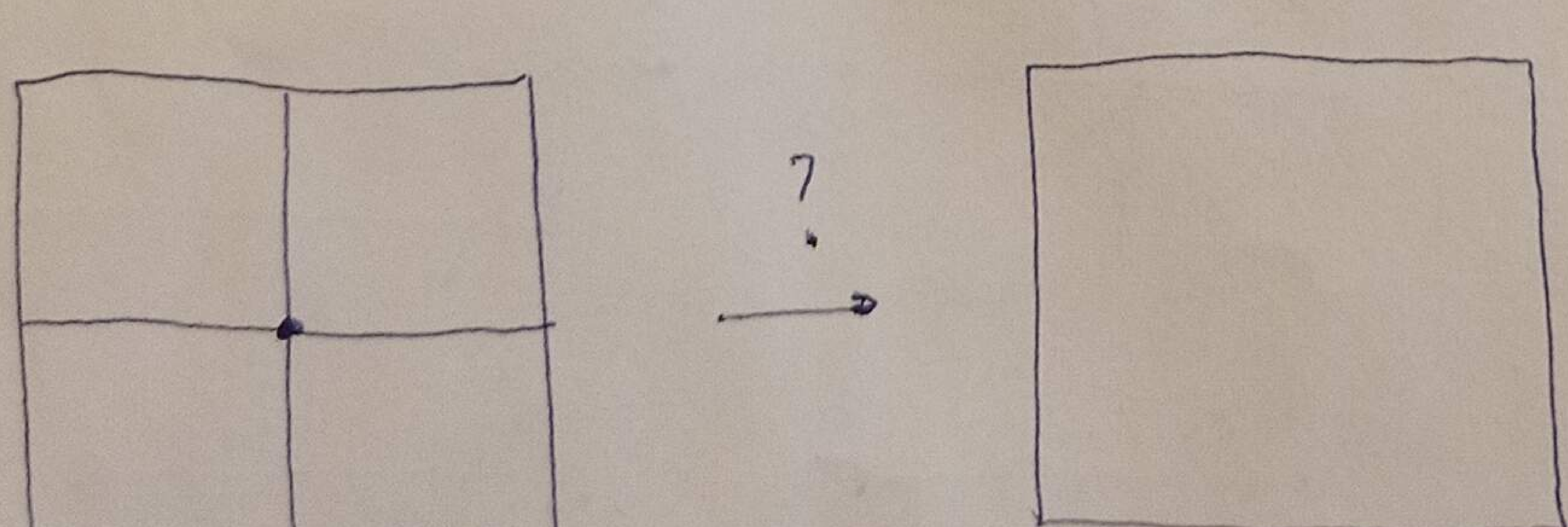
Edge case:

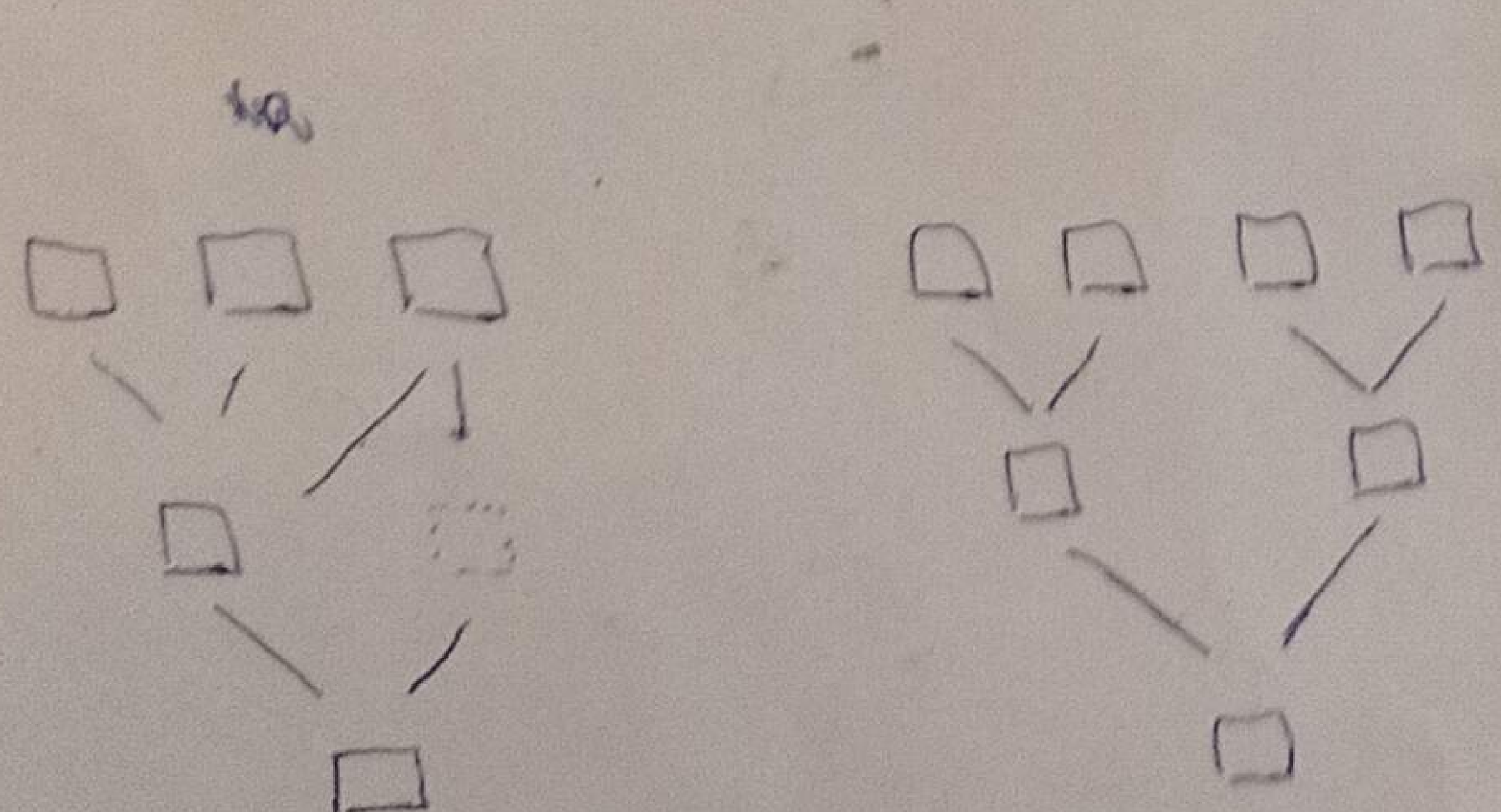


~~I need to~~
remove won't work because I need to mutate for this edge case

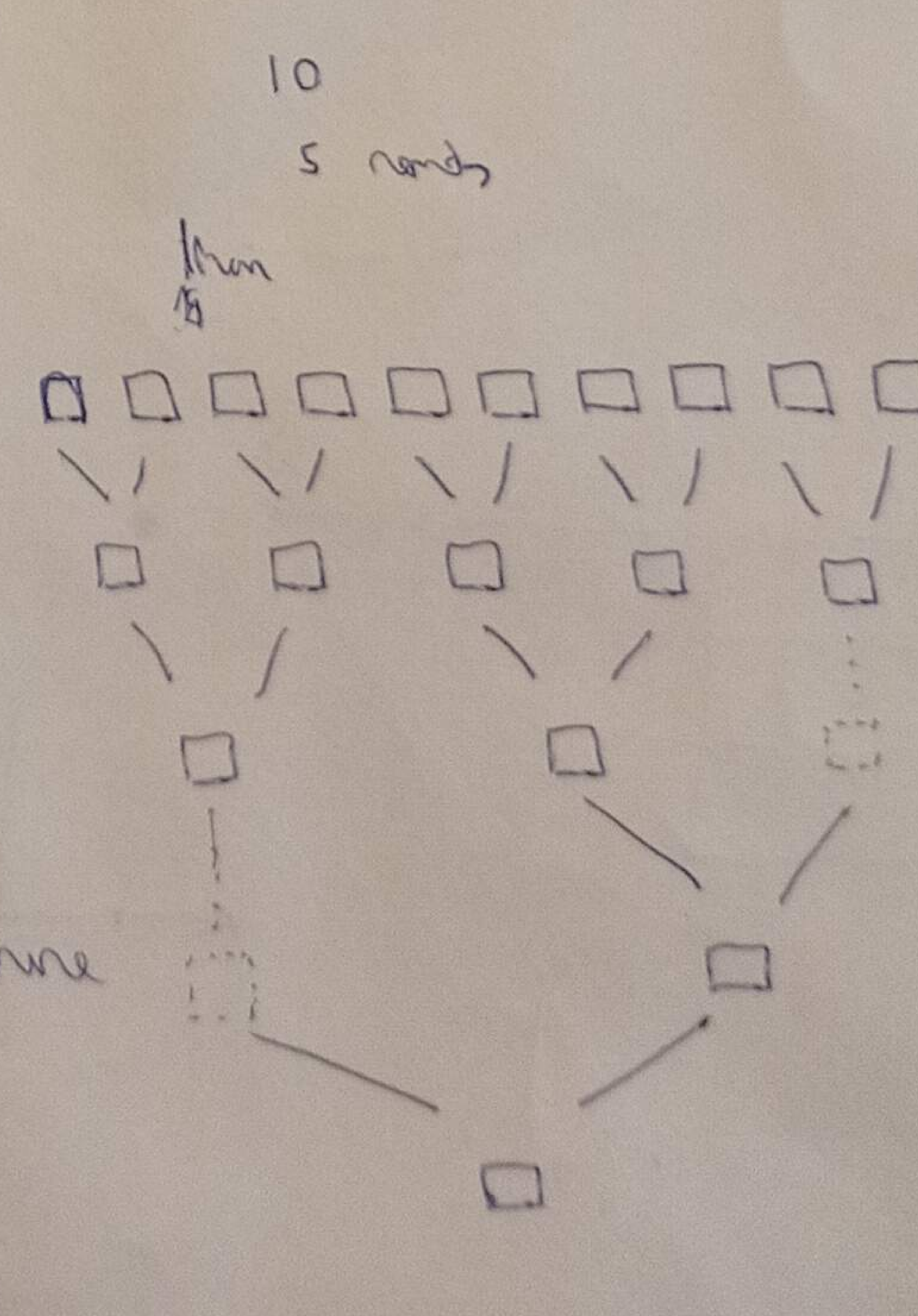
a channel blocks as long as there's a sender alive

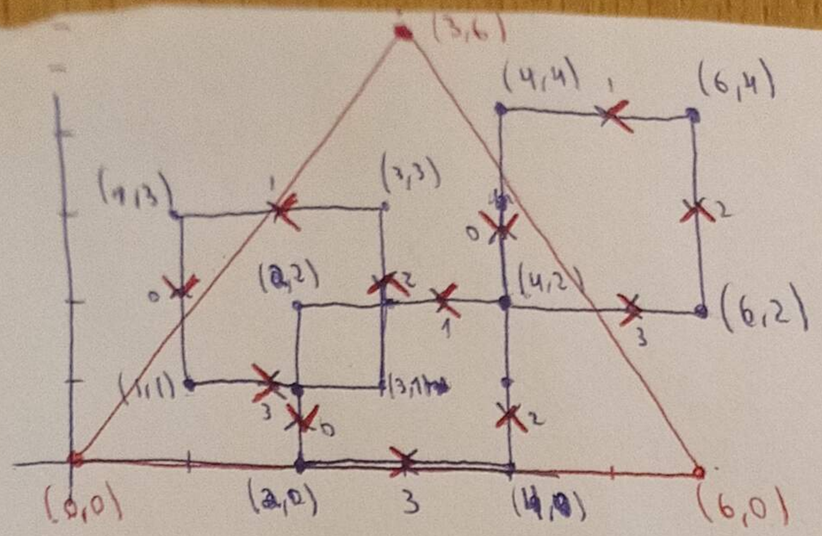
I'd like to take 2 entries from the channel and send it off to a threadpool for processing. At the end of processing a Vec<Segment> is sent back to the channel

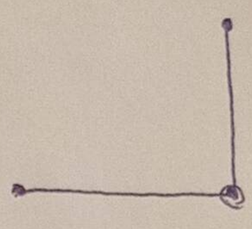




remainder is not there

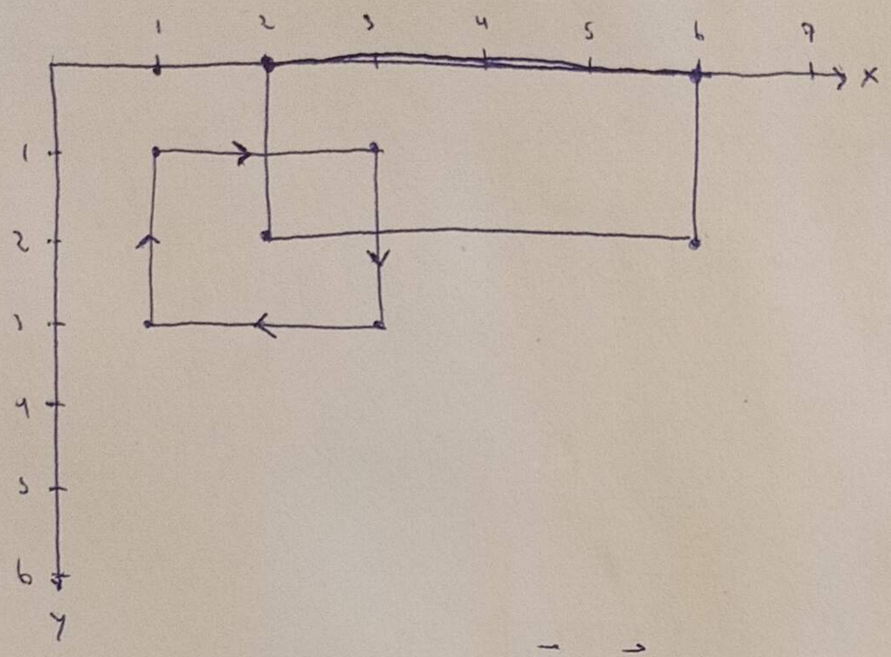


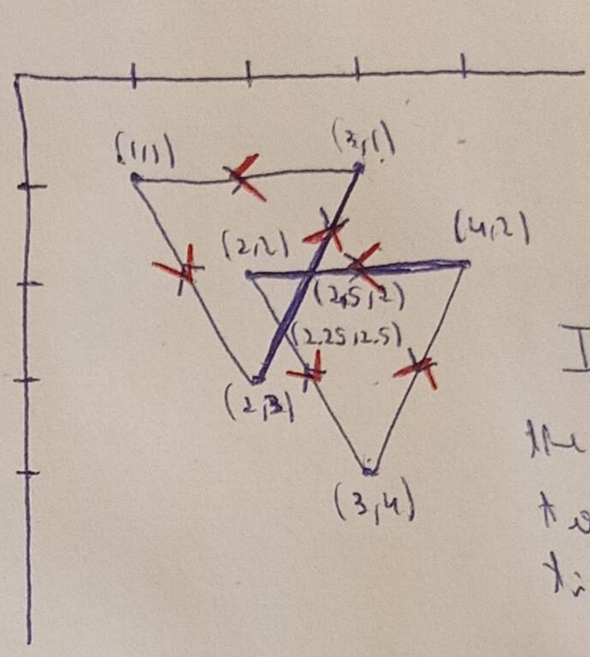




What to do here?

Edge case:



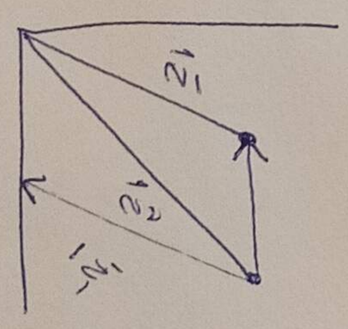


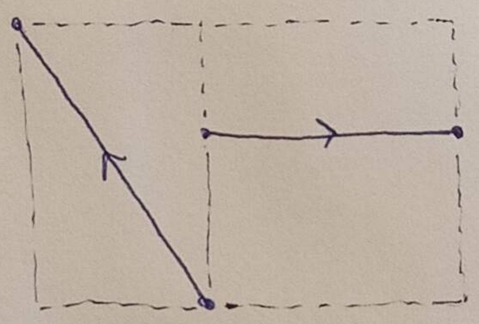
I think I should correct the creation of subsegments to keep the correct orientation. It already is

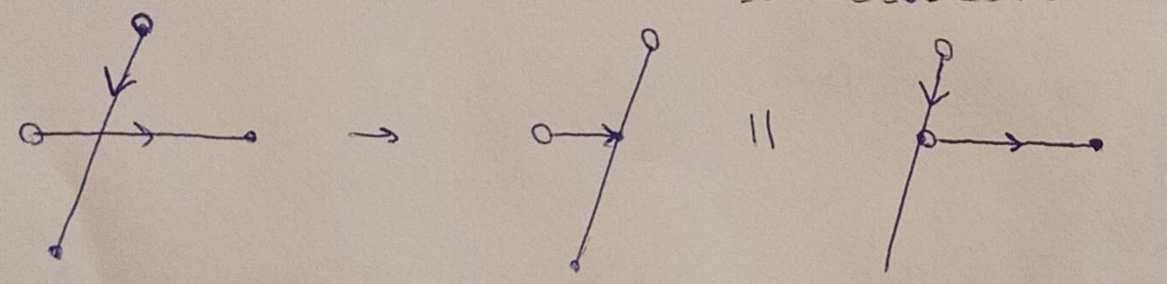
- getting no clipping, why?
- many wrong segments were kept

wow 6 different results

$\vec{v}_2 - \vec{v}_1$

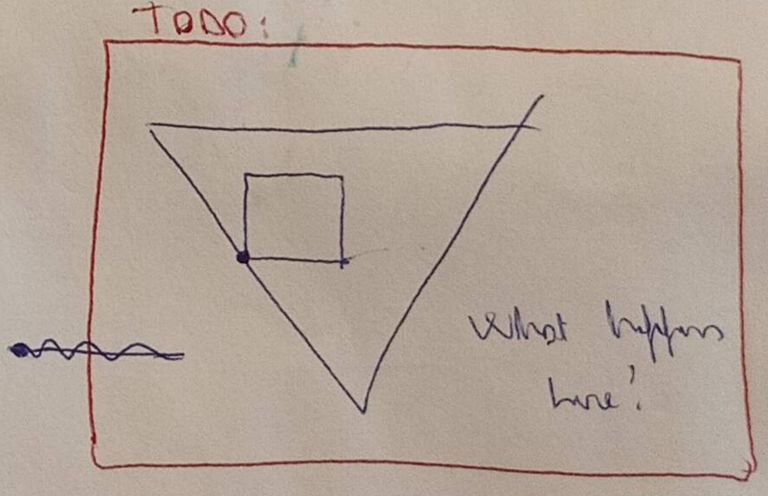


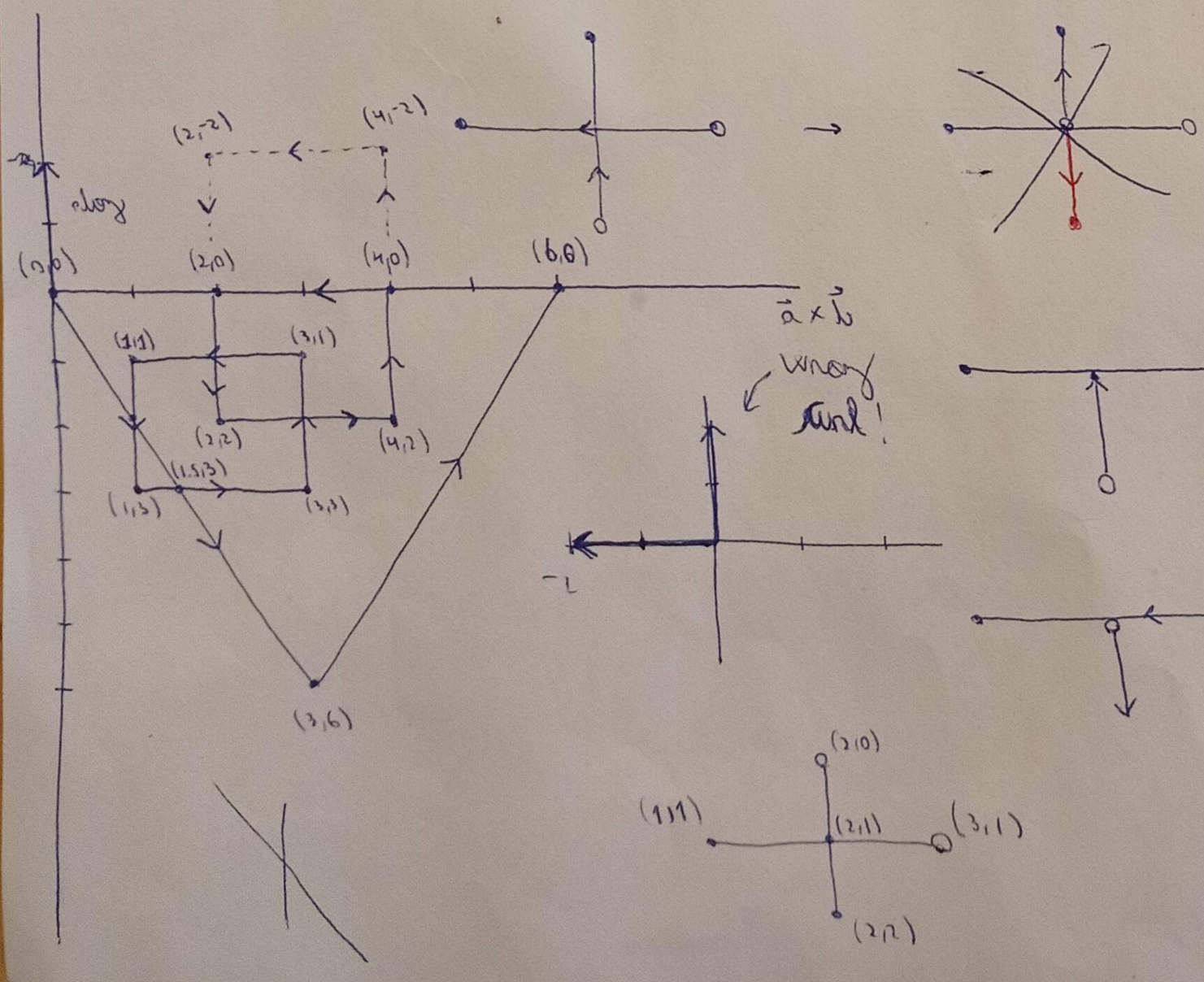


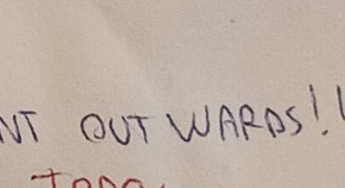


BOTH POINT OUTWARDS!!!

TODO:





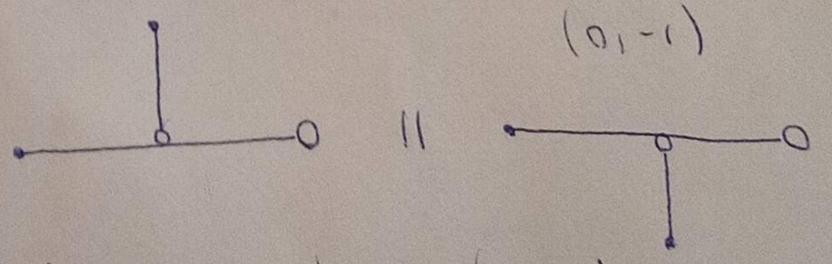


BOTH POINT INWARDS!!!

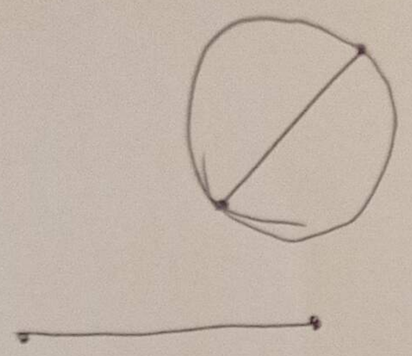
$(2,1) \rightarrow (2,0)$

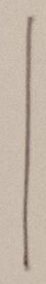
$(2-2), (0-1)$

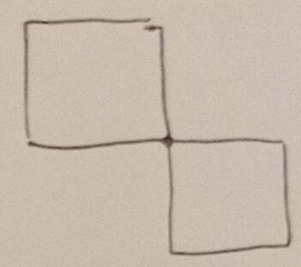
$(0,-1)$

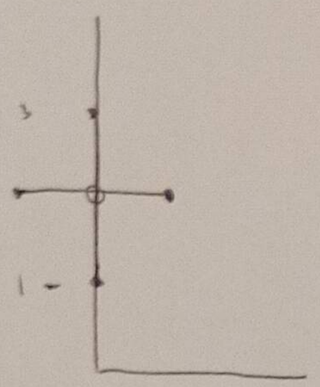


$(2,0) - (2,1) = (0,-1)$







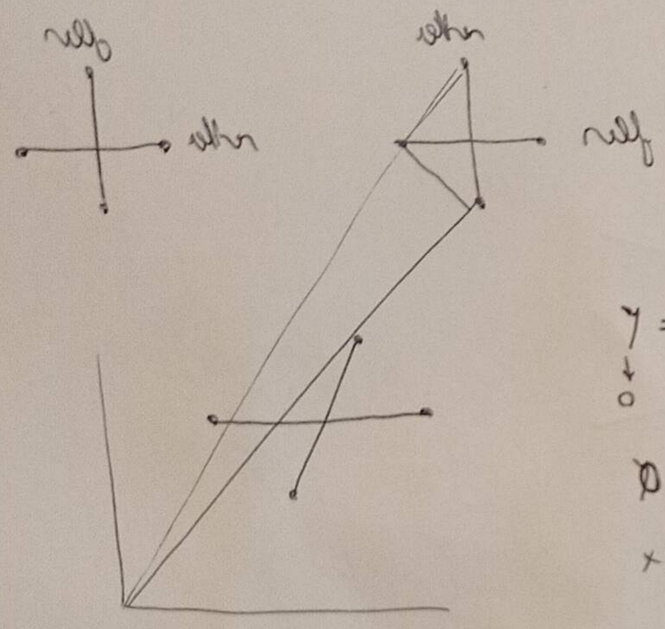


$$y_k = a x_k + b$$

$$y_k = 0 \cdot x_k + b$$

$$0 = (a-c)x_k + (b-d)$$

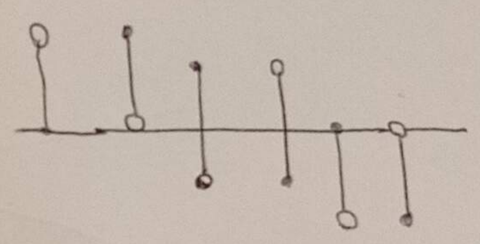
$$x_k = \frac{b-d}{a-c} = \frac{-\infty + 2}{+\infty + 0}$$

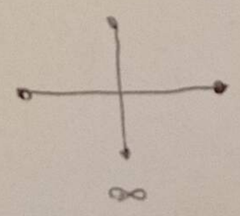


$$y = ax + b$$

$$0 = ax + b$$

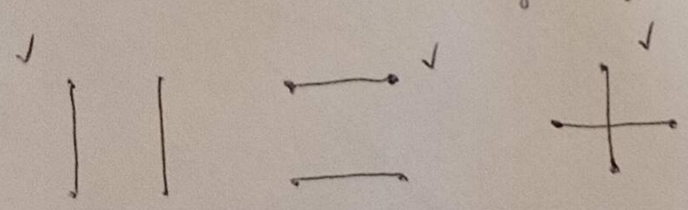
$$x = -\frac{b}{a}$$





intersections cannot be one from two different places be if 64 will mon the histomp

I think my theory of brain is not correct!

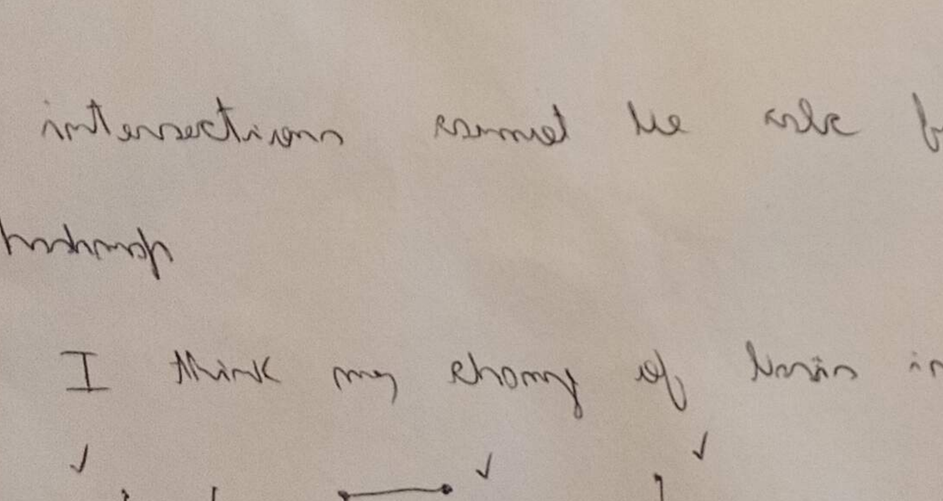


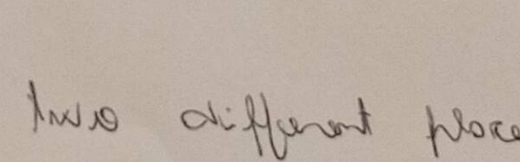
$$y = ax + b$$

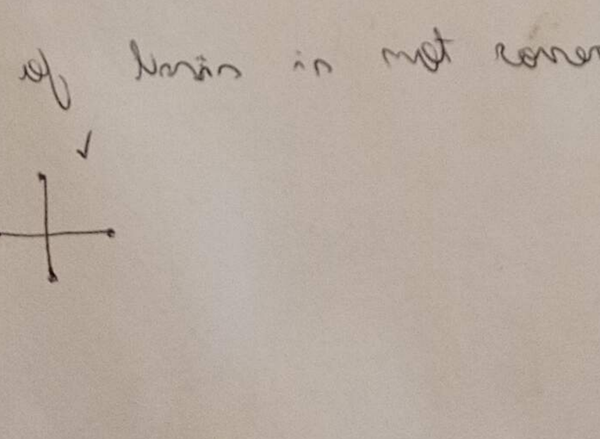
$$y = ax + d$$

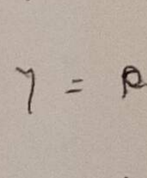
$$0 = b - d$$

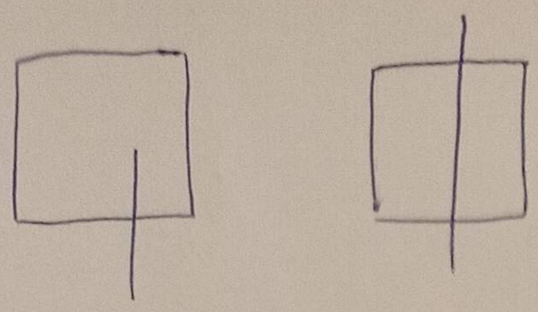
if they are parallel

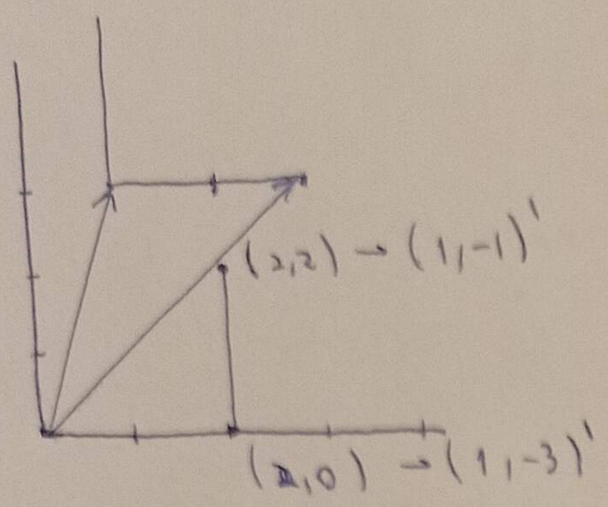


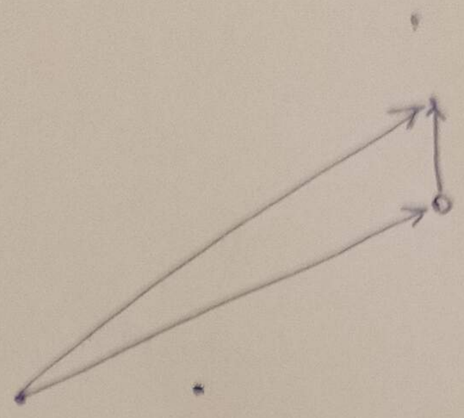


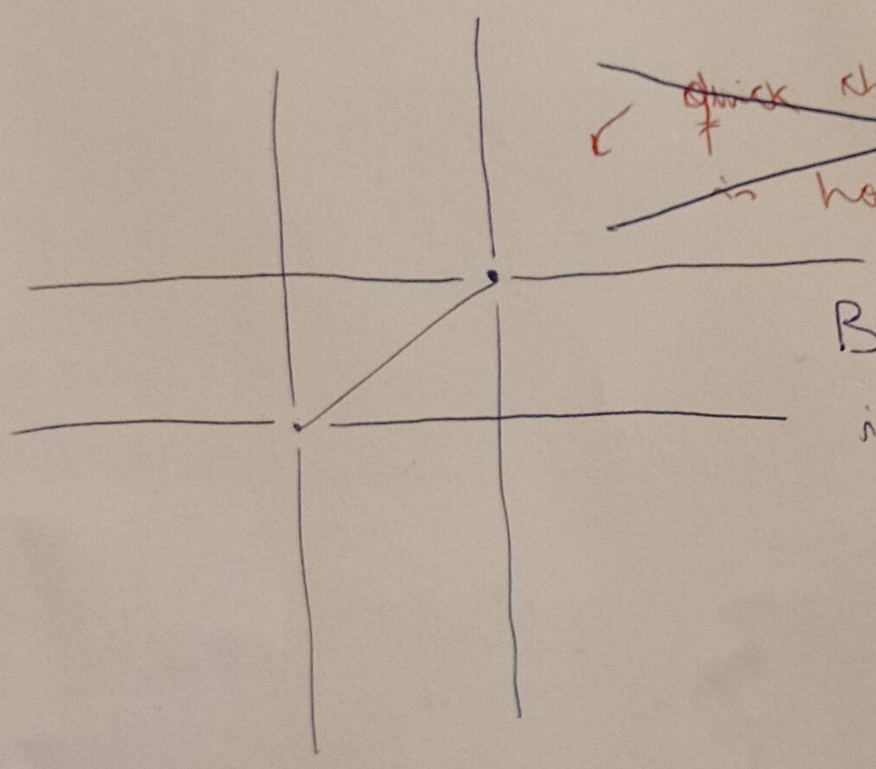








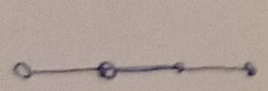




quick check whether intersection ≠ is horrible

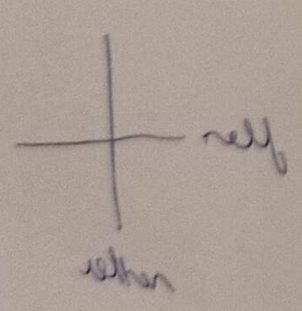
But the point of intersection is there!!!

they are either parallel, perpendicular or neither



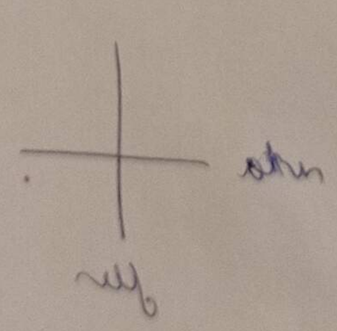
$y = ax + b$

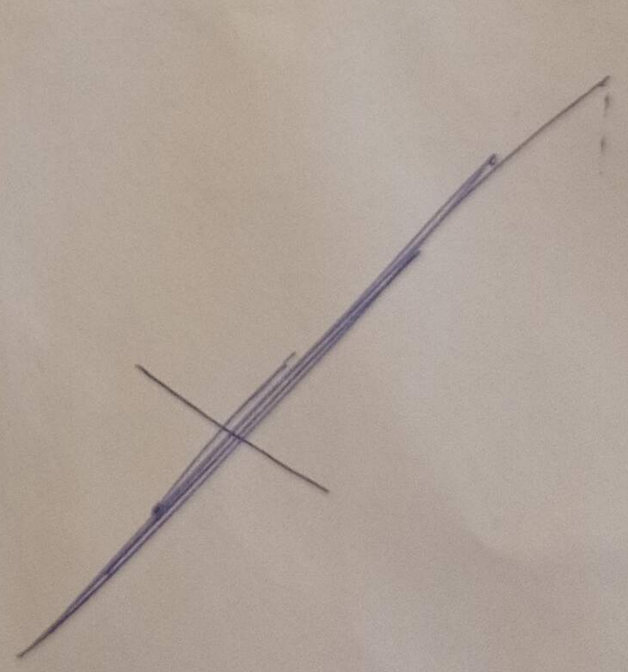
$y = ax + b$



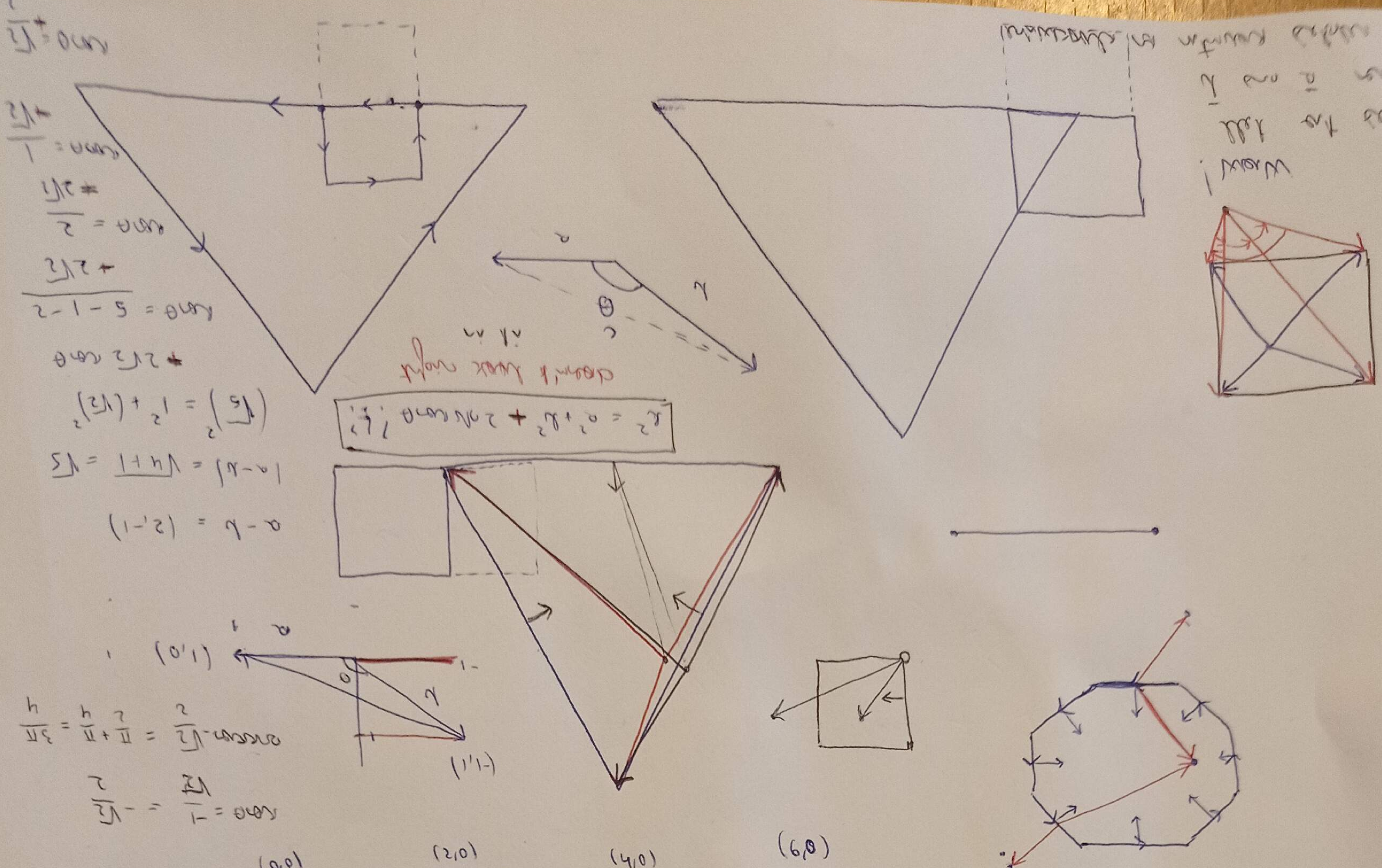
$y = \infty x + b$

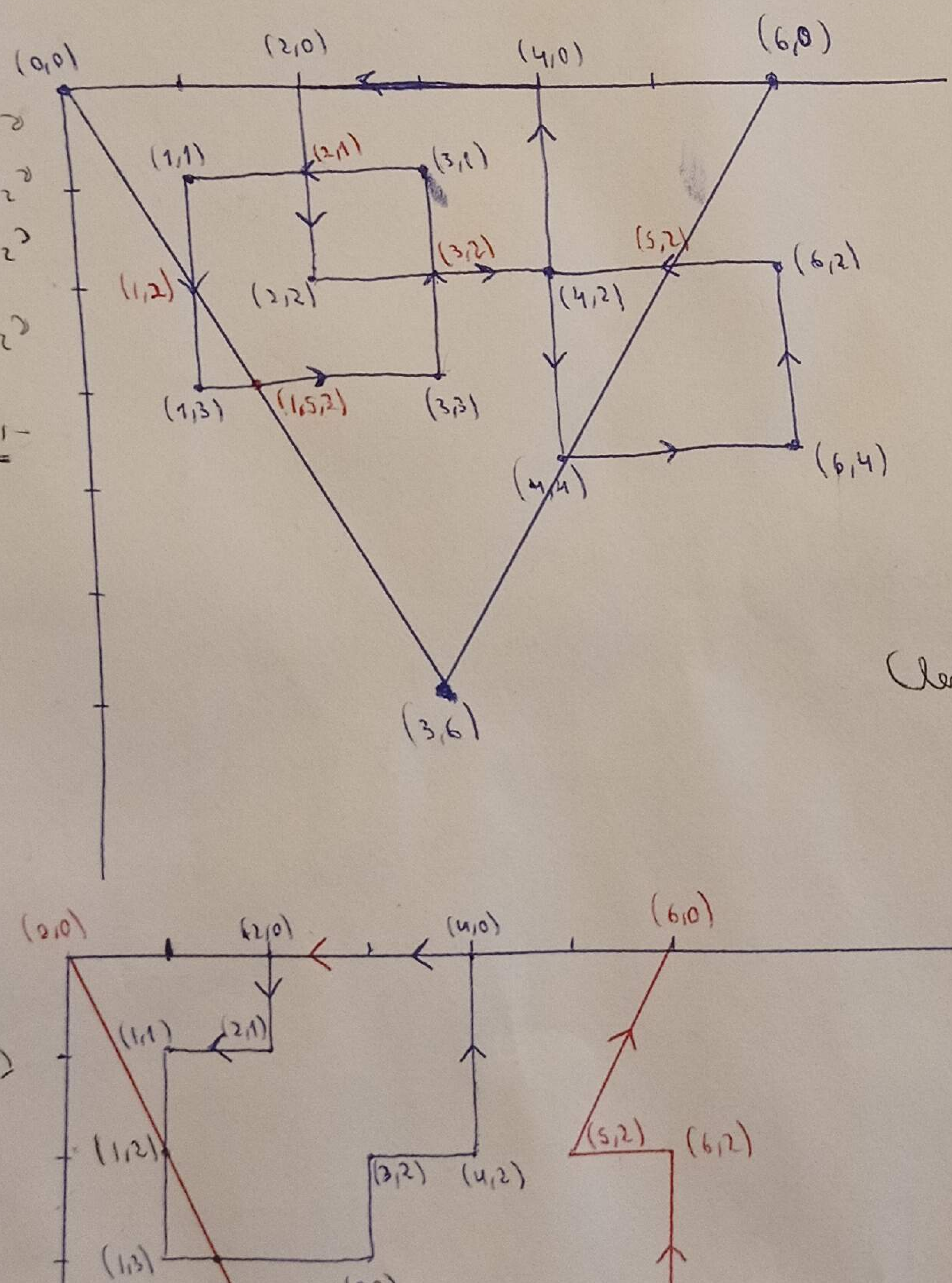
$y = 0x + c$

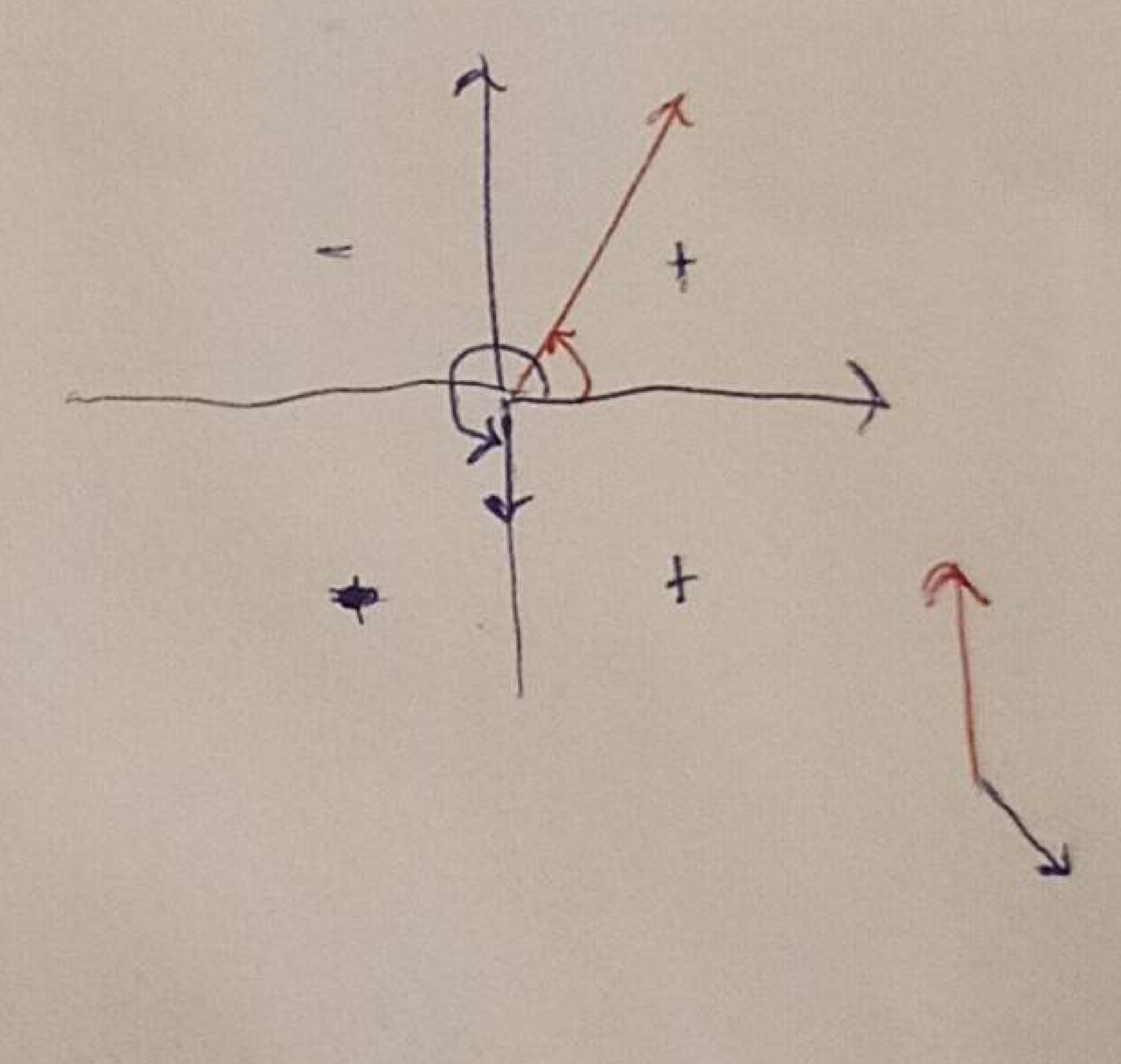




A story of how roads like to cross with parallelism and perpendicularity







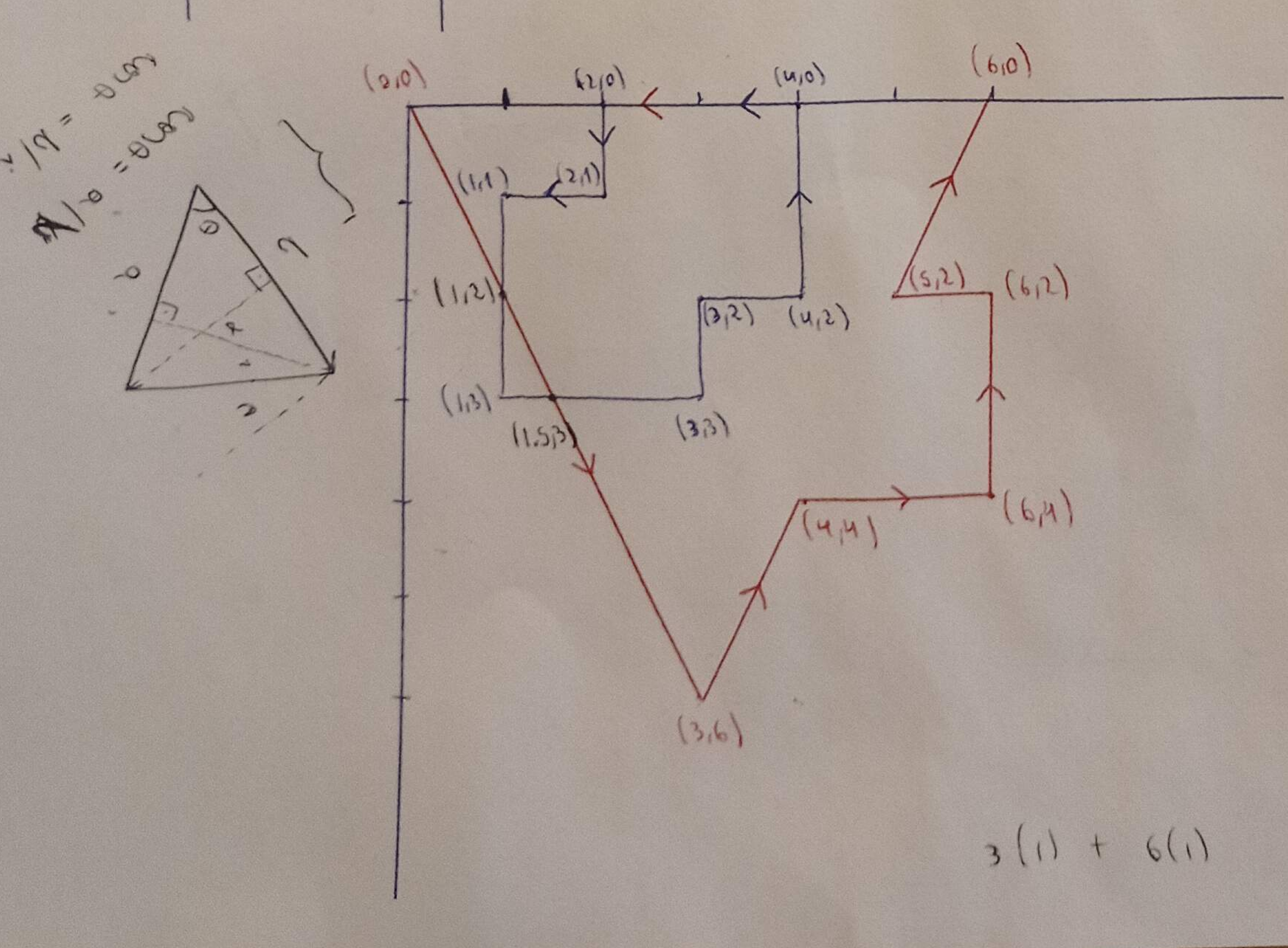
Clearly I'm still not getting the concept of "inside" right

- (4,0) → (2,0)
- (2,0) → (2,1)
- (4,2) → (4,0)

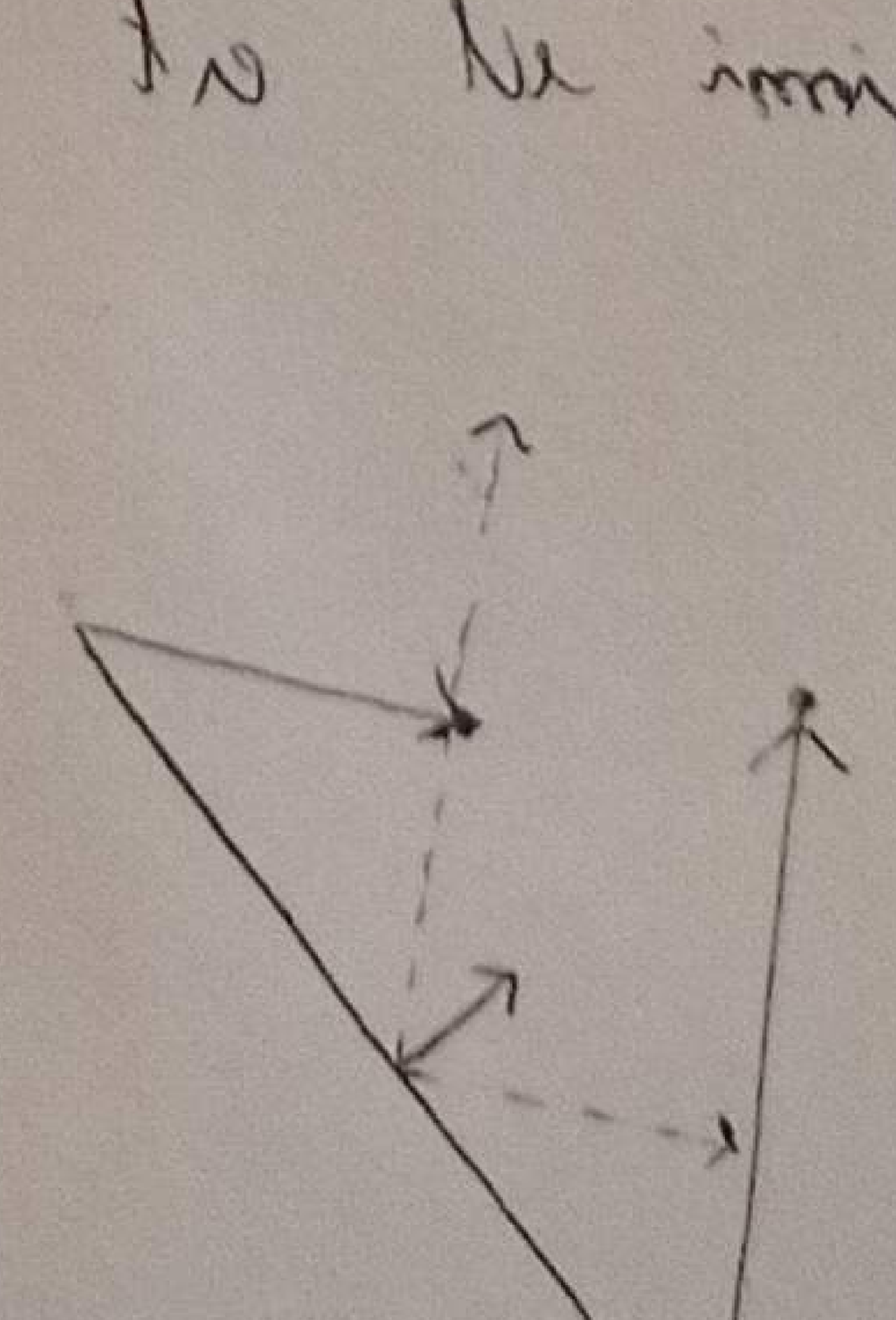
AND very strangely also:

- (2,1) → (1,1)

are all not being considered to be inside!



$$\cos\theta = \frac{\vec{a} \cdot \vec{b}}{|\vec{a}||\vec{b}|}$$



3(1) + 6(1)

Clearly I'm still not explaining the concept of "inside" right

- (4,0) → (2,0)
- (2,0) → (2,1)
- (4,2) → (4,0)

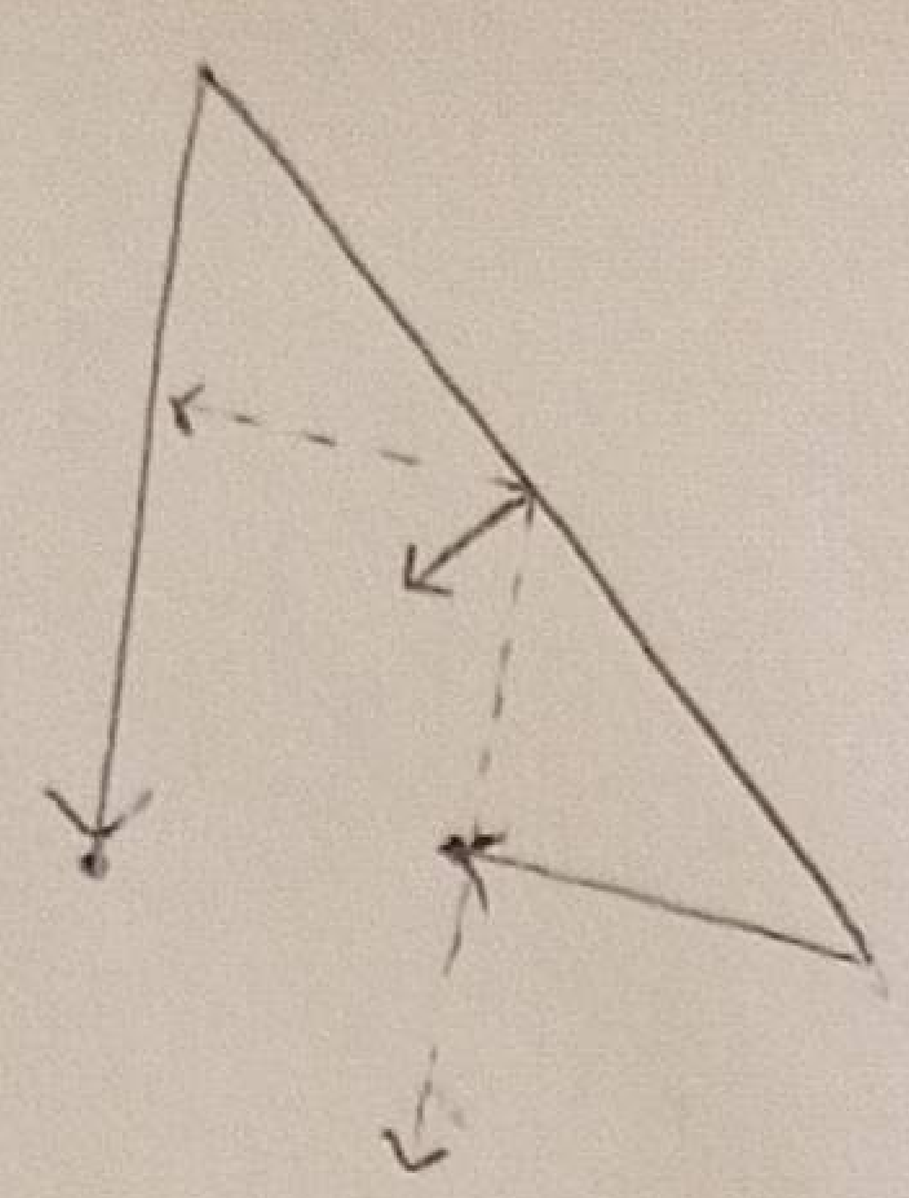
AND these triangles also:

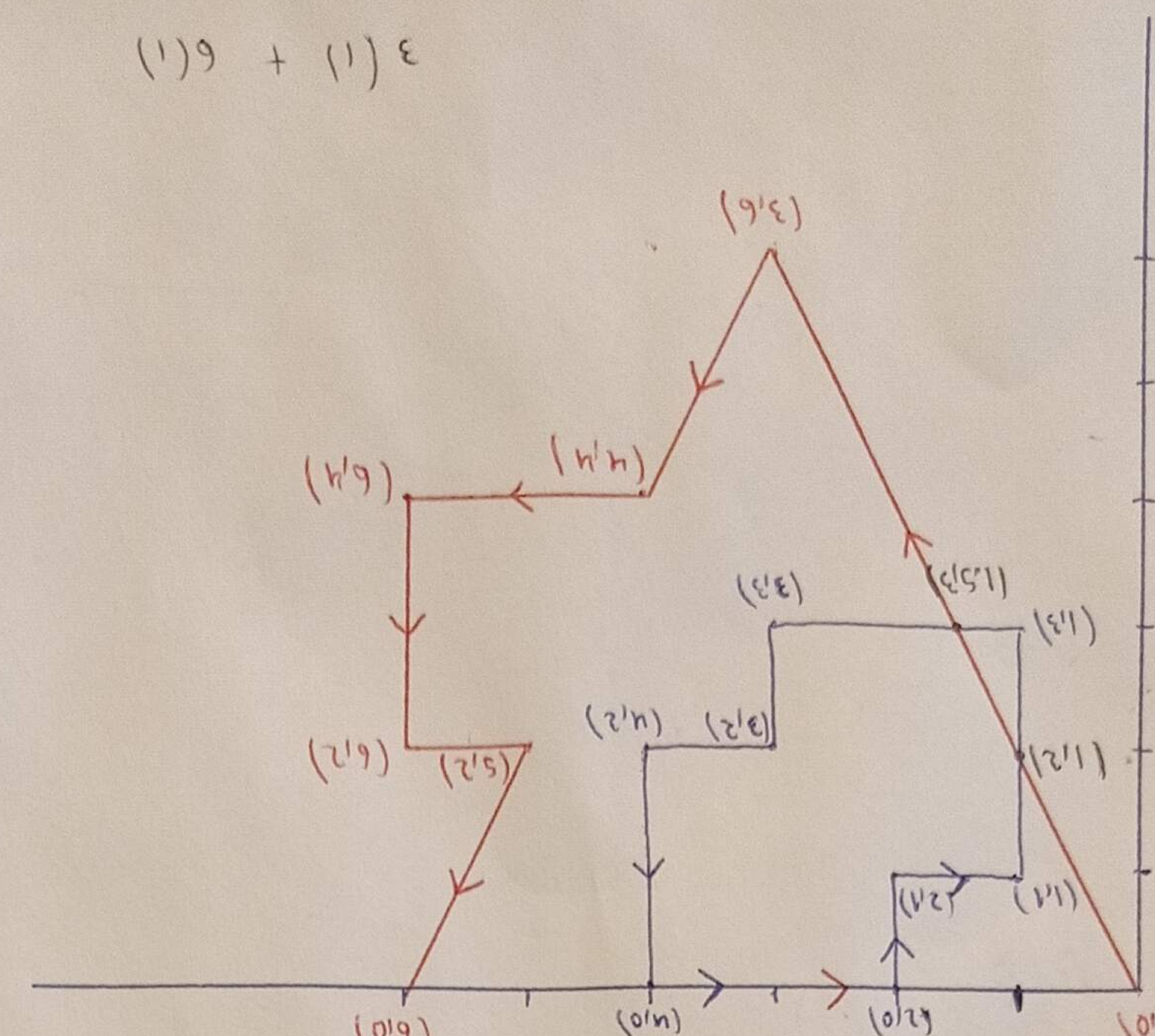
- (2,1) → (1,1)

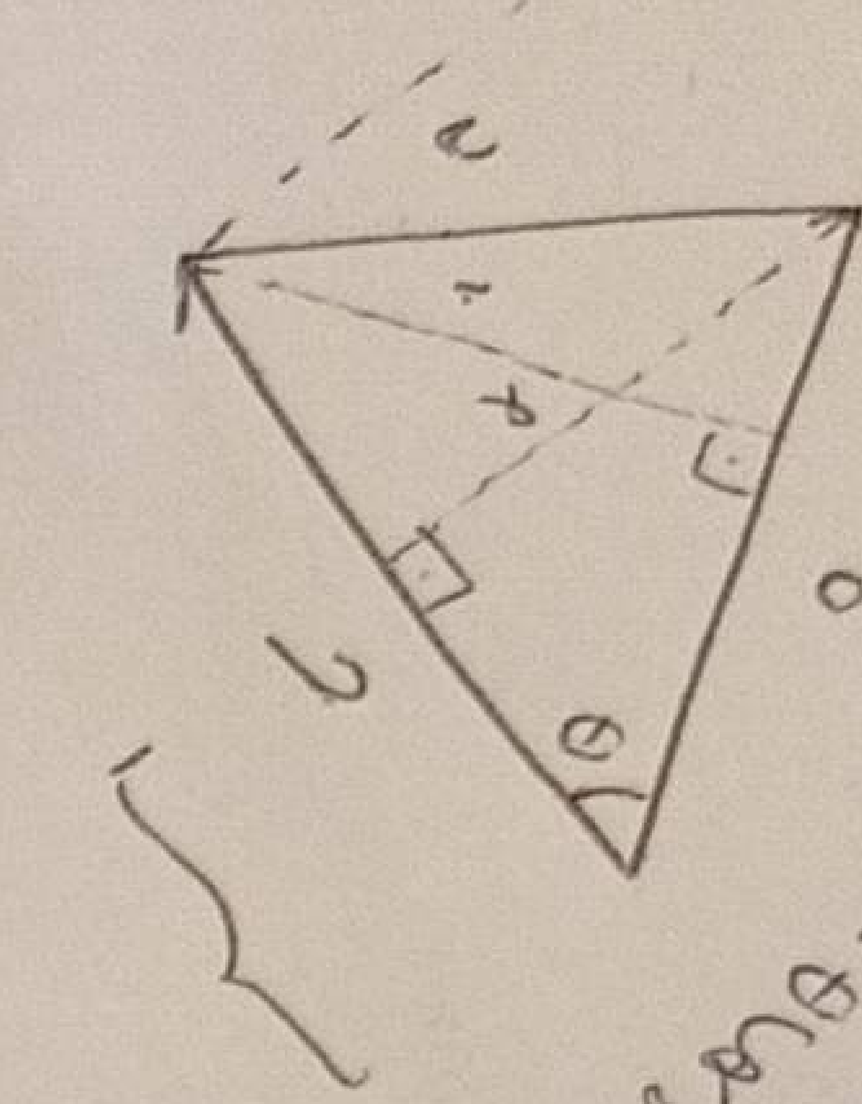
are all not being considered to be inside!

$\cos\theta = \frac{\vec{a}\cdot\vec{b}}{|\vec{a}||\vec{b}|}$

$3(1) + 6(1)$

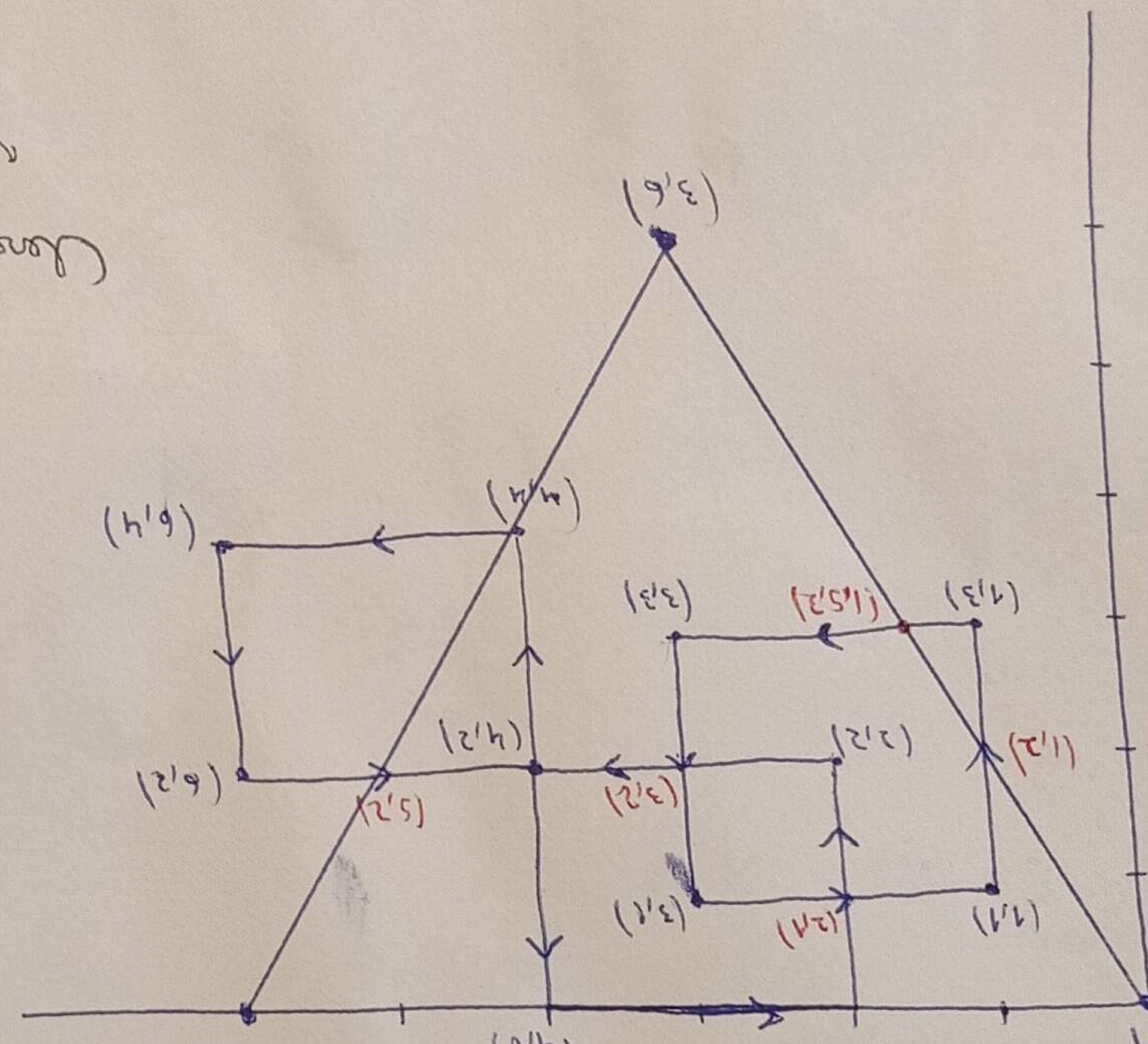


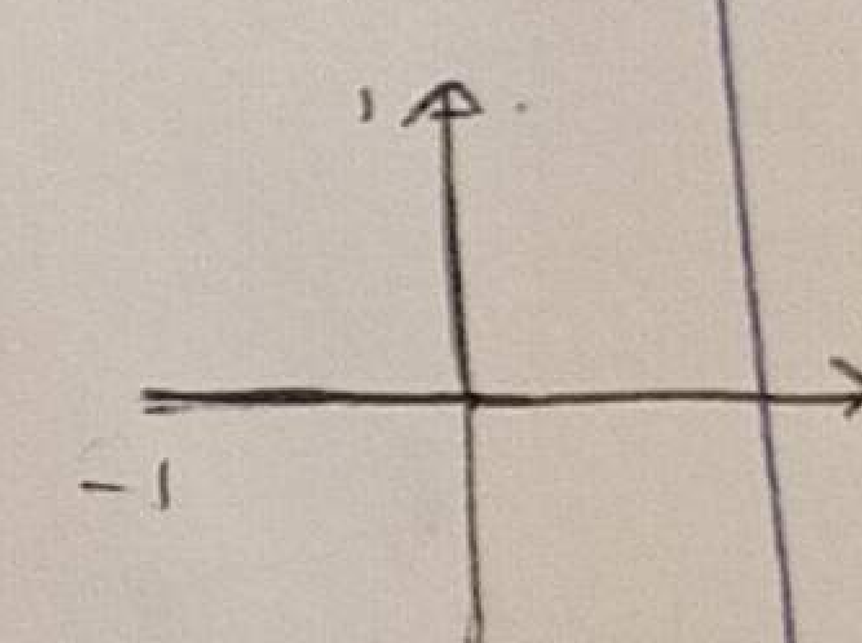


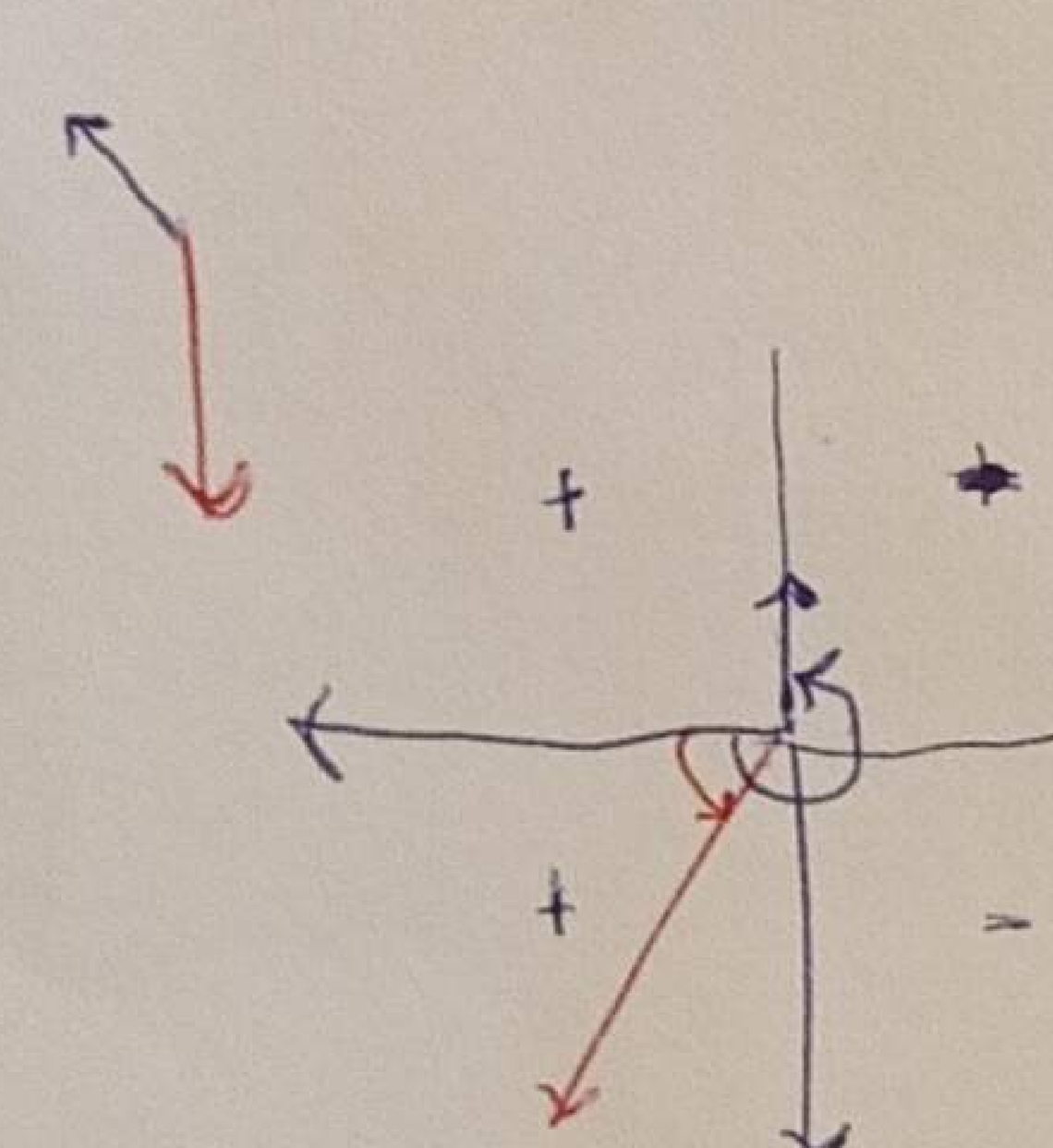


$\cos\theta = b/a$

$\cos\theta = x/b$





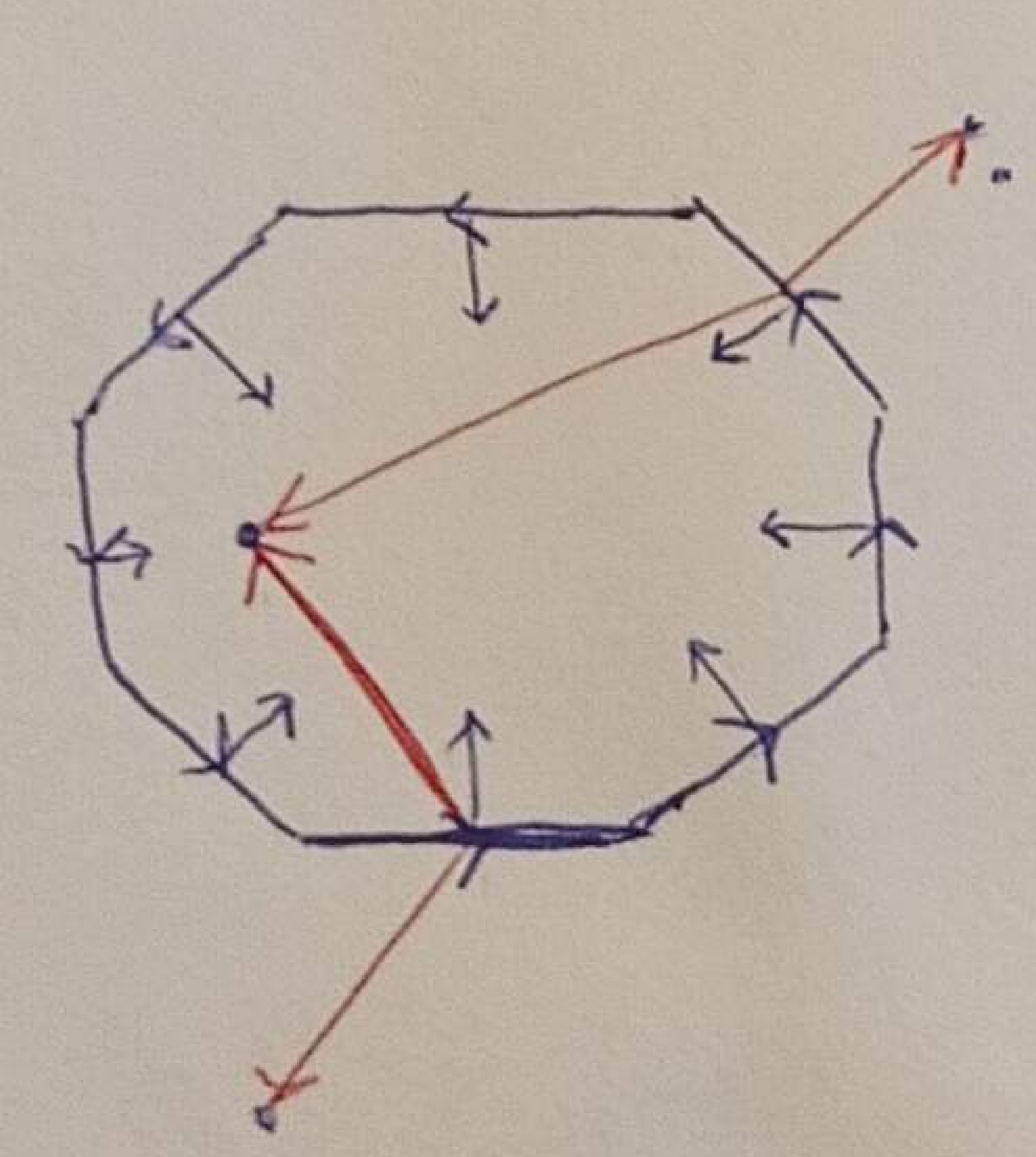


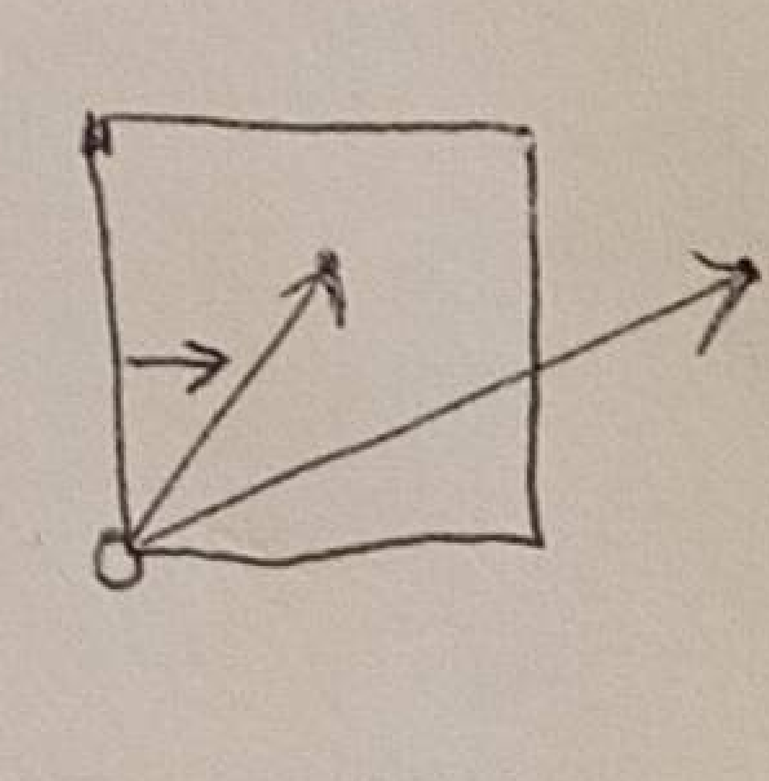
$c^2 = a^2 + b^2 + 2ab\underbrace{\cos\theta}_{0}$

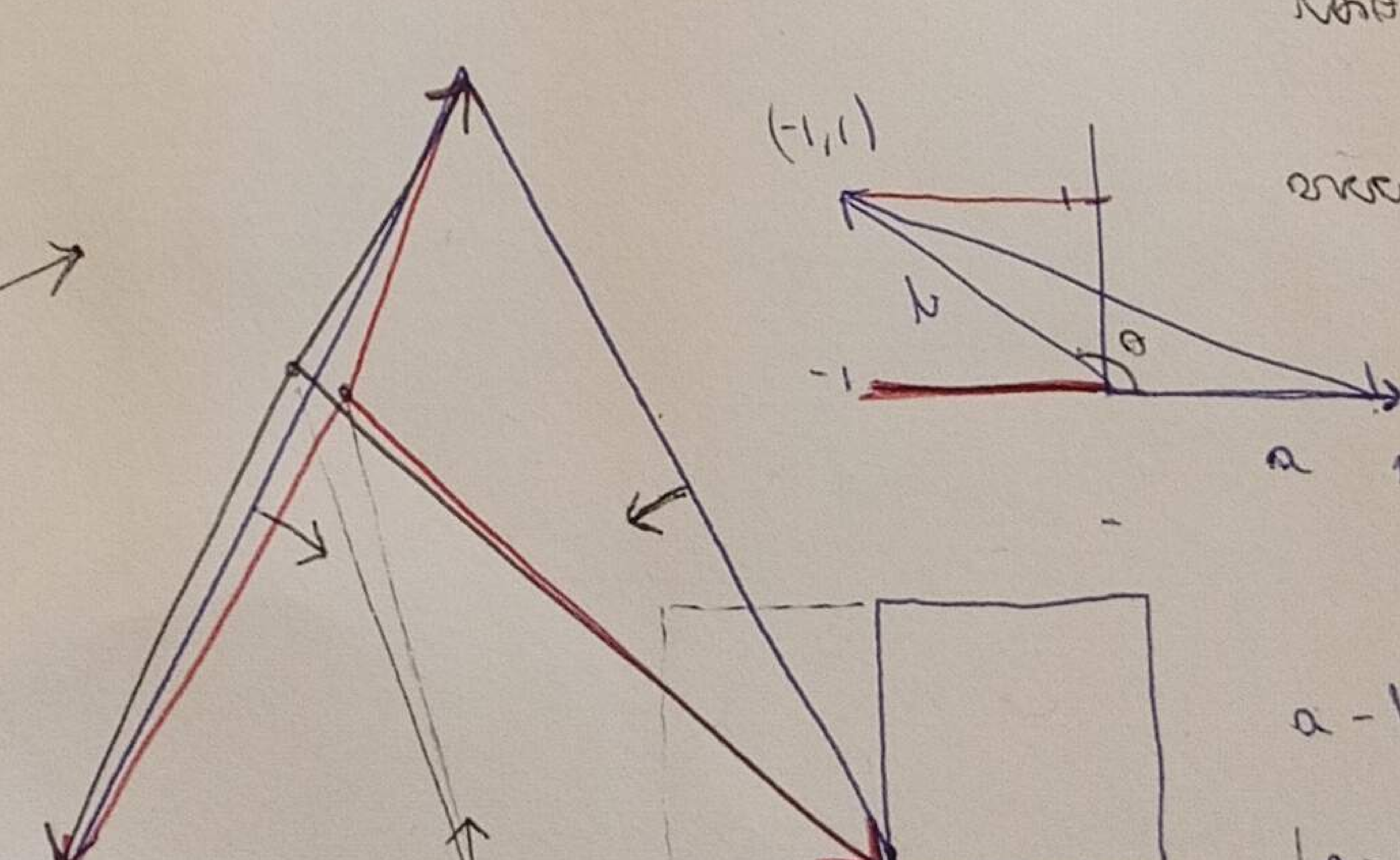
$c^2 = a^2 + b^2 + 2ab(-1)$

$a^2 = 1^2 + 1^2 - 2.1.1$

$a = 0$







$\cos\theta = \frac{-1}{\sqrt{2}} = -\frac{\sqrt{2}}{2}$

$\arccos -\frac{\sqrt{2}}{2} = \frac{\pi}{2} + \frac{\pi}{4} = \frac{3\pi}{4}$

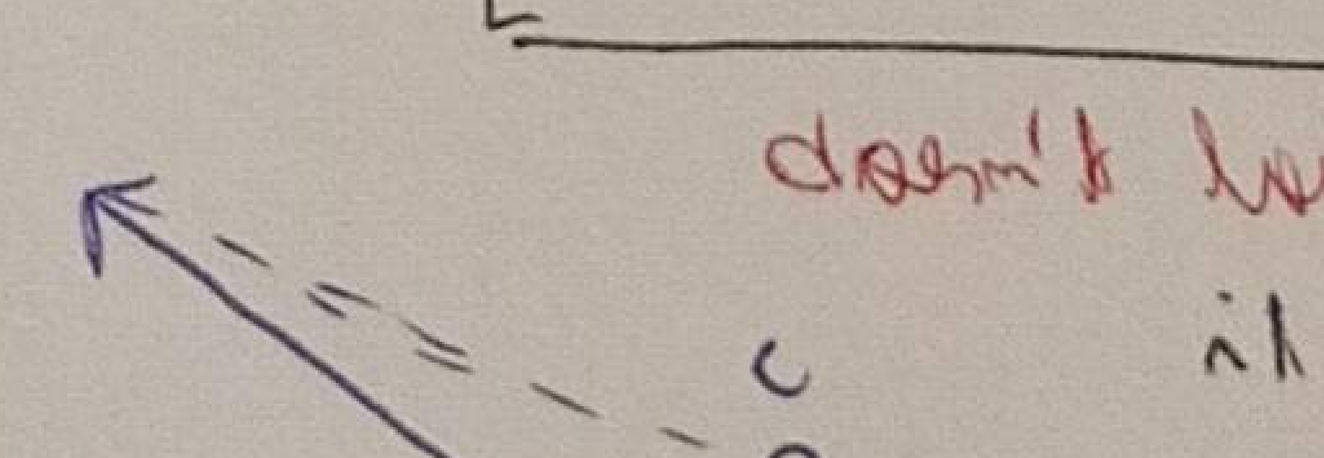
$a - b = (2,-1)$

$|a-b| = \sqrt{4+1} = \sqrt{5}$

$c^2 = a^2 + b^2 + 2ab\cos\theta$?!?

doesn't look right

it is



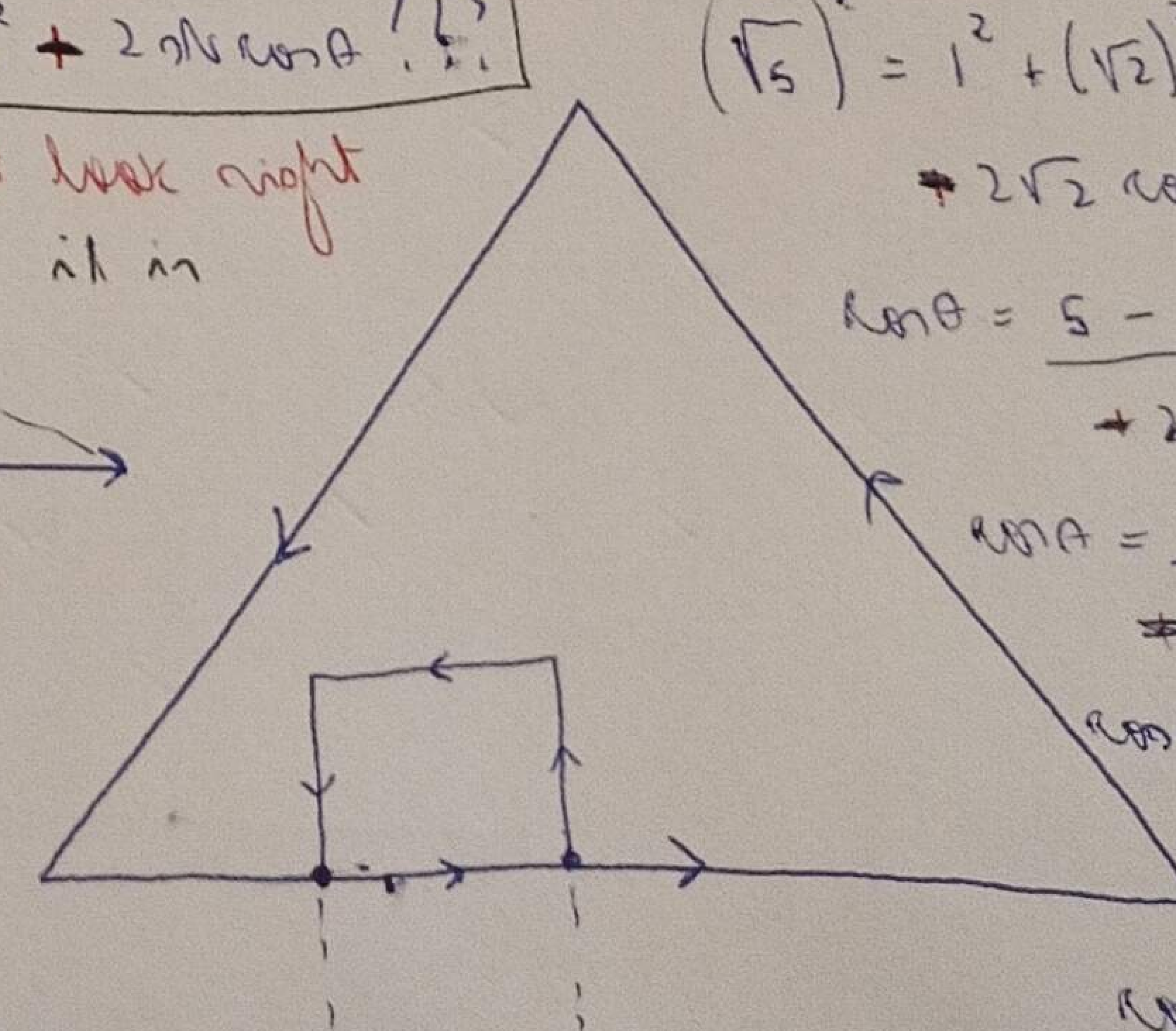
$(\sqrt{5})^2 = 1^2 + (\sqrt{2})^2 + 2\sqrt{2}\cos\theta$

$\cos\theta = \frac{5-1-2}{+2\sqrt{2}}$

$\cos\theta = \frac{2}{+2\sqrt{2}}$

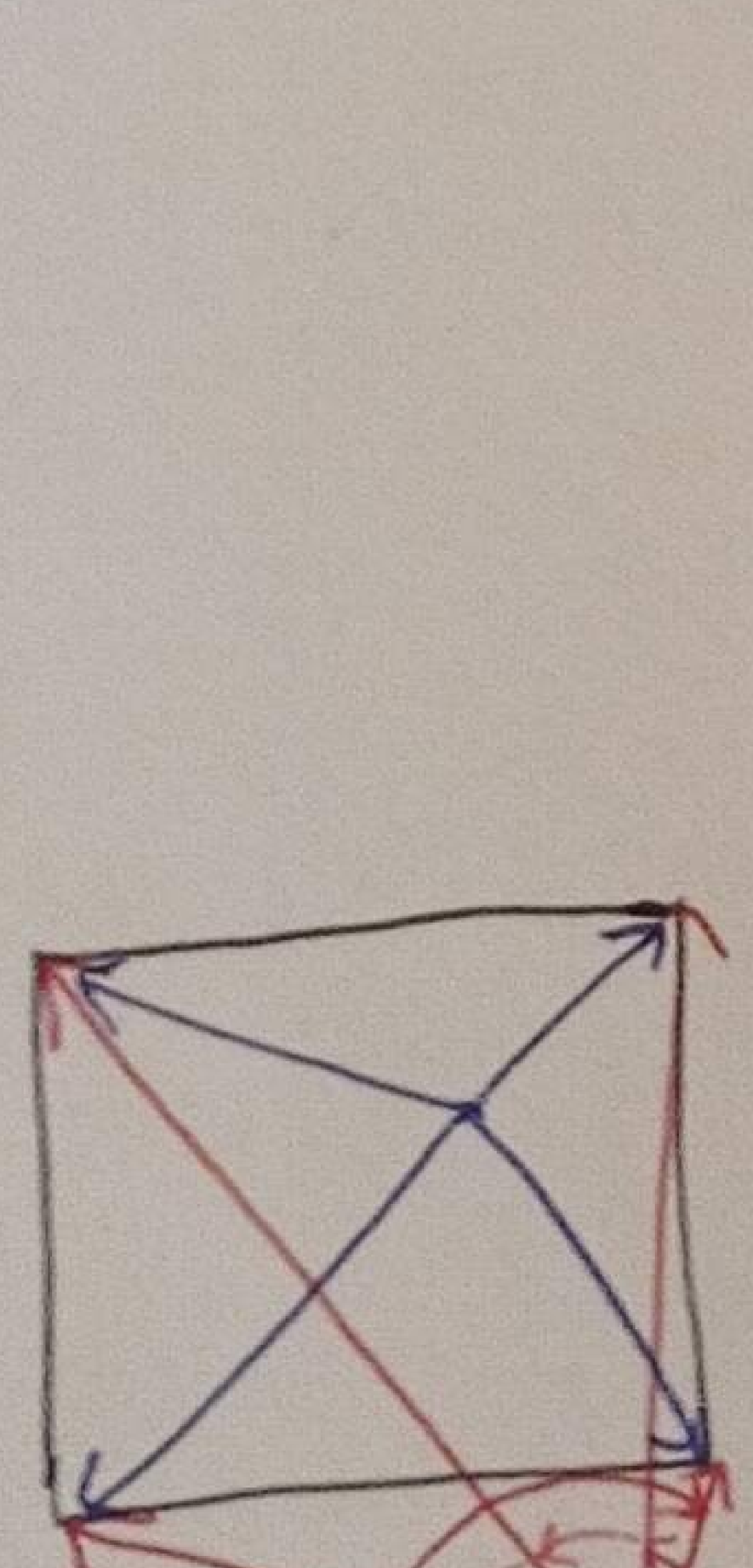
$\cos\theta = \frac{1}{+\sqrt{2}}$

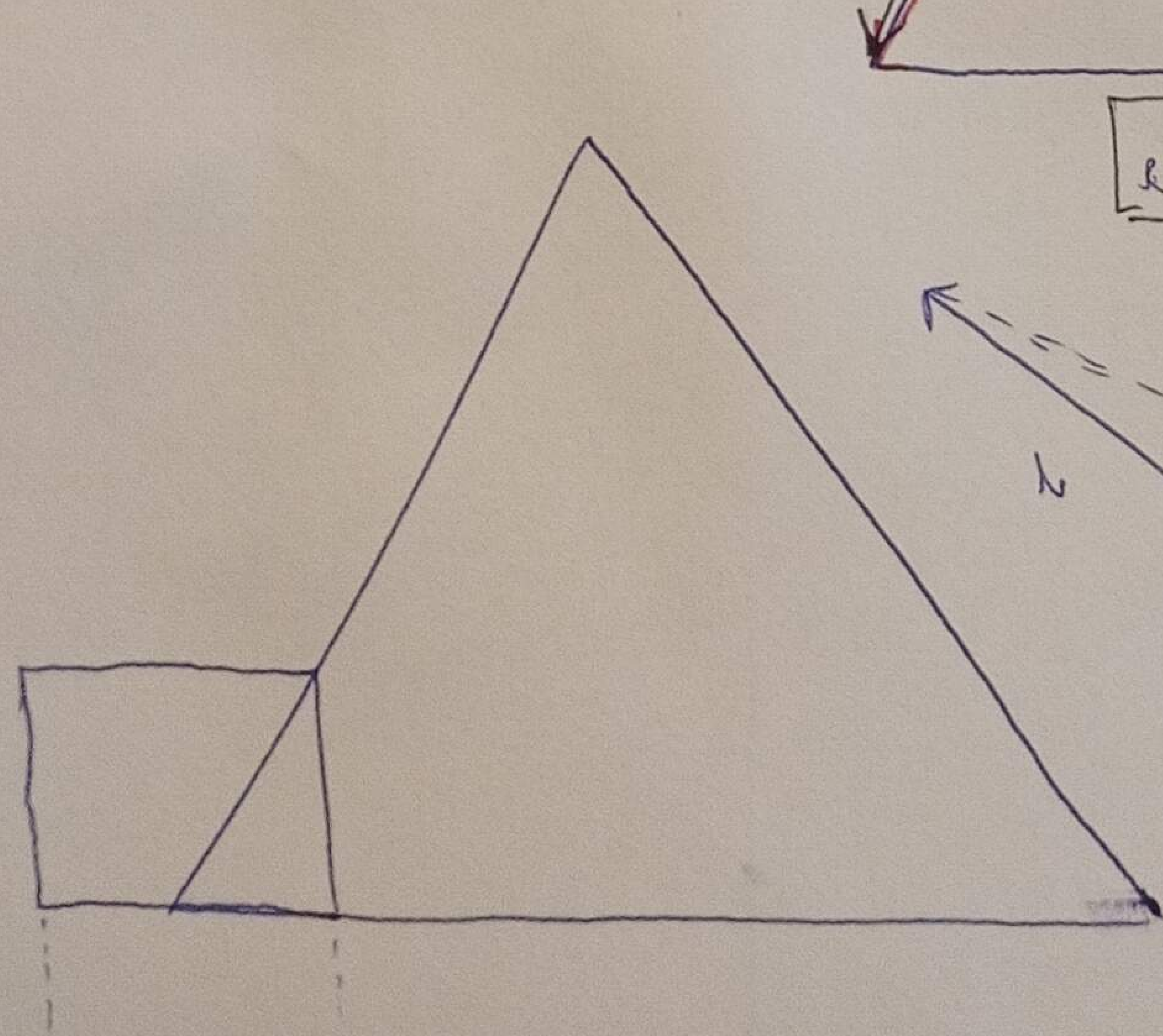
$\cos\theta = +\frac{\sqrt{2}}{2}$



Wow!

must tell whether $\vec{a}$ and $\vec{b}$ are rotated counter or clockwise



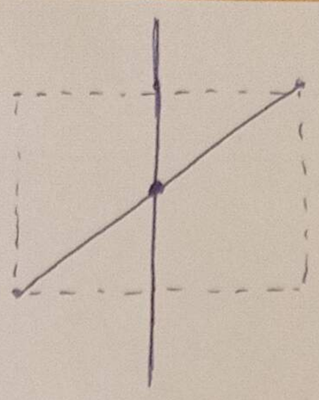


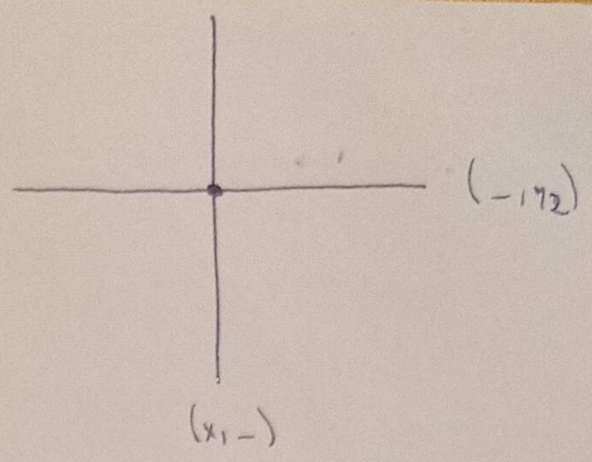
$y = \infty x + b$

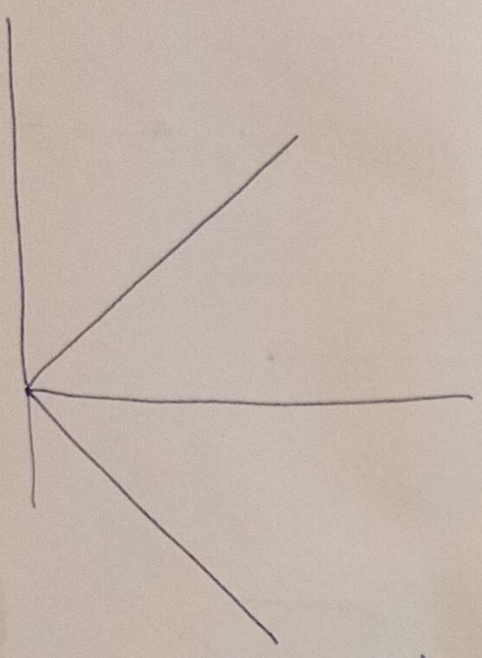
$y = a x + b$

$0 = (\infty - a) x + (b - c)$

undefined



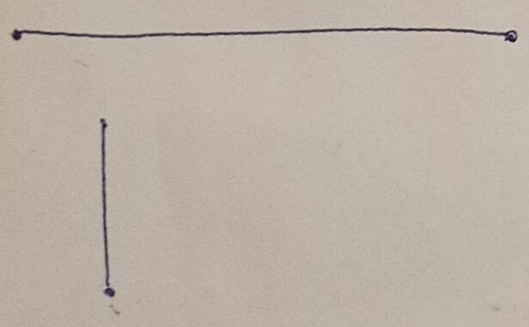




let $y = \quad 0 x + y_2$

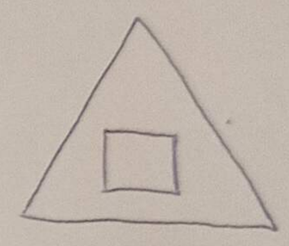
intersection $= (x_1, y_2)$

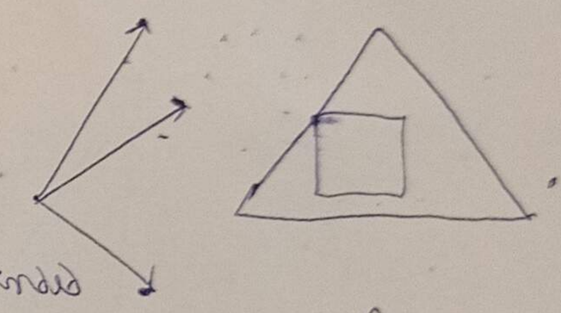
Okay now let's deal with a polygon completely containing a segment

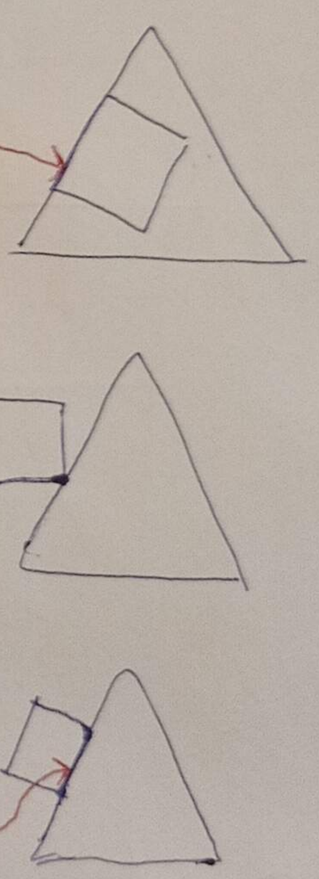


Next issue:

a poly might be inside another poly and be divided, but that doesn't necessarily hold for a third poly







also does not distinguish

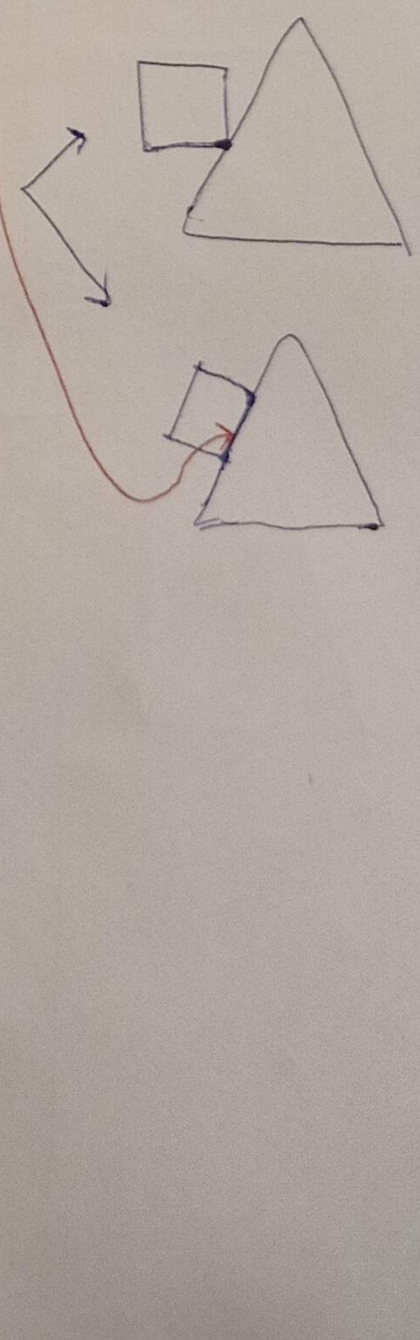
between this segment

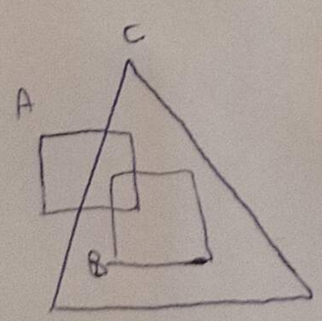
and this segment

but these don't

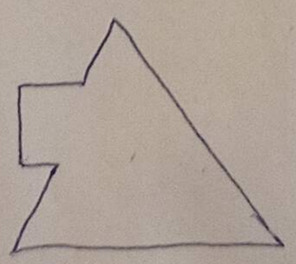
and the bottom must

be cut

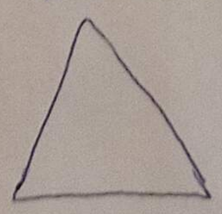




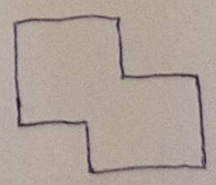
A ∩ C =

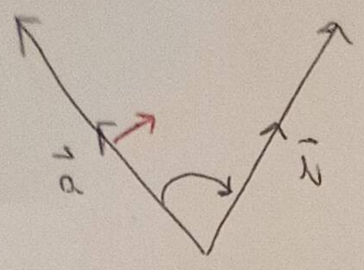


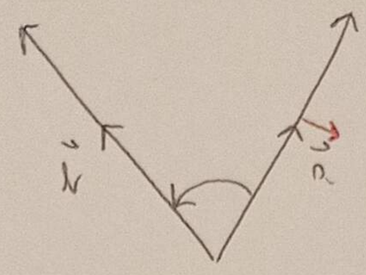
B ∩ C =

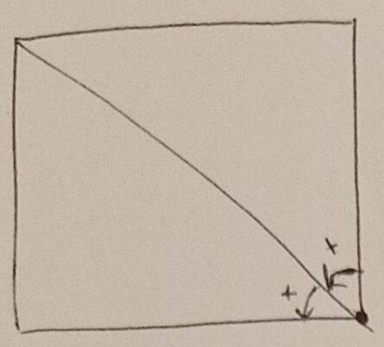


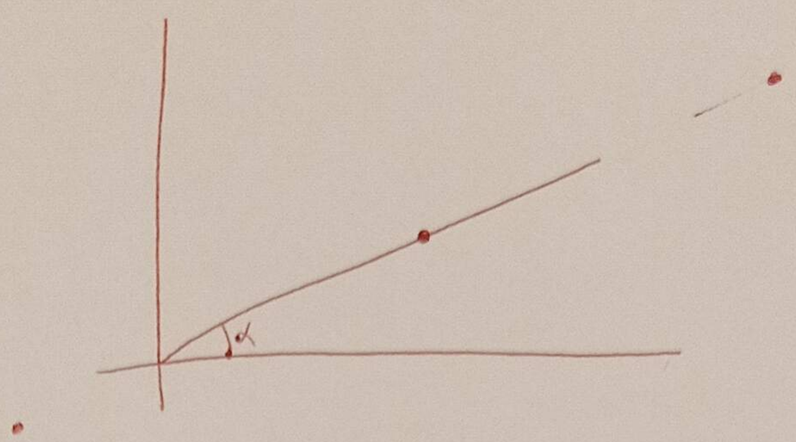
A ∪ B =











A B C D E from C

E D C B A

written: [A, B]

C
D
E
× B
× A

```
pub trait IntoIterator {
    type Item;
    type IntoIter: Iterator<Item = Self::Item>;
    fn into_iter(self) -> Self::IntoIter;
}

impl<'a, T> IntoIterator for &'a Vec<T> {
    type Item = &'a T;
    type IntoIter: slice::Iter<'a, T>;
    fn into_iter(self) -> Self::IntoIter {
        self.iter()
    }
}
```

```
impl<I: Iterator> IntoIterator for I {
    type Item = I::Item;
    type IntoIter = I;
    fn into_iter(self) -> I
        self
    }
}
```

ABC → CAB → BCA → ABC

A BC
↑ ↑↑

CAB
↑ ↑ ↑