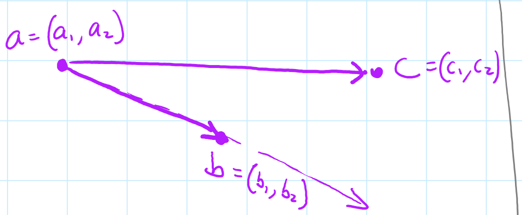
Downsides of using slope in calculations

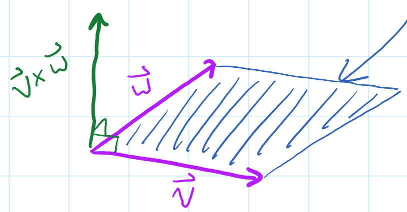
- slope is not defined for vertical lines
- numerical (in) stability
- speed (?)

LEFT OF QUERIES

Decide whether point c is left of a directed segment ab.



Recall: cross product $\vec{v}\times\vec{w}$ gives the (signed) area of a parallelogram



Vectors in the plane

$$\vec{ab} = \langle b_1 - a_1,\ b_2 - a_2,\ 0\rangle$$

$$\vec{ac} = \langle c_1 - a_1,\ c_2 - a_2,\ 0\rangle$$

Cross product: $$\vec{ab}\times\vec{ac} = \langle b_1-a_1,\ b_2-a_2,\ 0\rangle \times \langle c_1-a_1,\ c_2-a_2,\ 0\rangle = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ b_1-a_1 & b_2-a_2 & 0 \\ c_1-a_1 & c_2-a_2 & 0 \end{vmatrix}$$

$$= \langle 0,\ 0,\ \underbrace{(b_1-a_1)(c_2-a_2)-(b_2-a_2)(c_1-a_1)}_{\text{signed area of parallelogram}}\rangle$$

+ if c is left of $\vec{ab}$

− if c is right of $\vec{ab}$

0 if c is collinear with $\vec{ab}$