GL
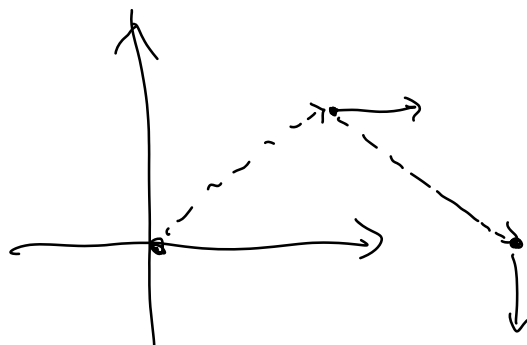
$$V = (0, +1)$$

Proof:

Let $\vec{v} = (x, y)$ be the displacement

and dir = north or
south or   be the final
west or   direction
east
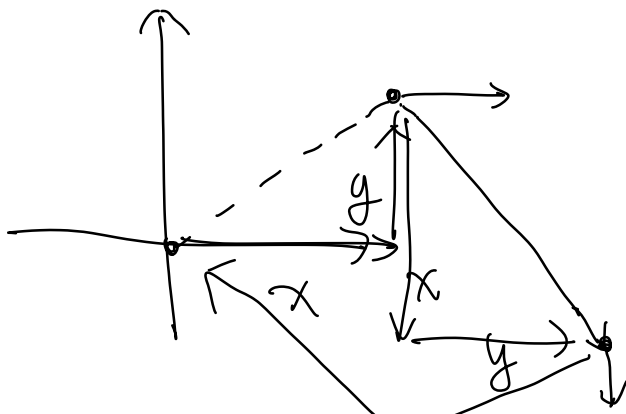
Claim:

if $\vec{v} = 0$ or   dir != north

$\Longleftrightarrow$ in a circle

① if $\vec{N} = 0$ $\Rightarrow$ trival, it will
stay at $(0,0)$

$(\Rightarrow)$ ②

Assume dir = east

First time $(0,0) \longrightarrow (x,y)$

second time $(x,y) \xrightarrow{(+y,-x)} (x+y, y-x)$

third time $(x+y, y-x) \xrightarrow{(-x,-y)} (y, -x)$

fourth time $(y, -x) \xrightarrow{(-y,+x)} (0, 0)$ #

$(\Leftarrow)$ $\vec{v}=0$ or dir!=north $\Leftarrow$ in a circle

$\equiv$ $V\neq 0$ and dir = north $\Rightarrow$ diverge

if $v \neq 0$ and dir=north

$\Rightarrow$ trivally, it will keep going
north ! #