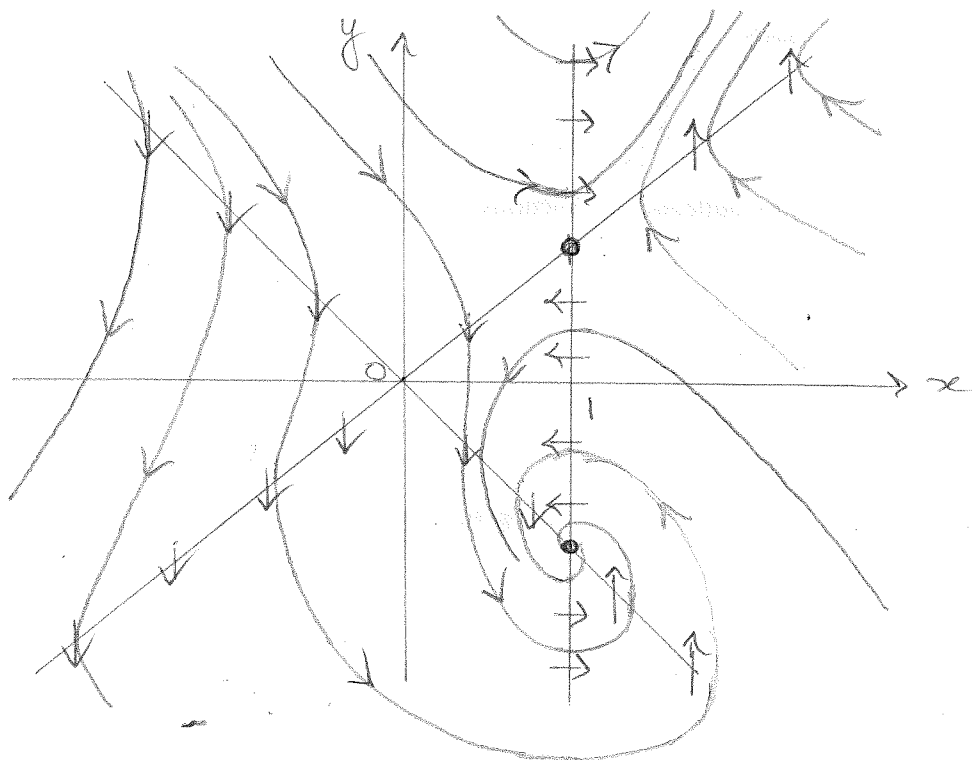


QUESTION 2

$$\begin{aligned}\dot{x} &= y^2 - x^2 \\ \dot{y} &= x - 1.\end{aligned}$$

- (i). x-nullcline: $\dot{x} = 0 \Rightarrow y = \pm x$ } Equilibria at
y-nullcline: $\dot{y} = 0 \Rightarrow x = 1$ } $(x_1, y_1) = (1, 1)$ and $(x_2, y_2) = (1, -1)$.



- (ii). Along $y = \pm x$ $\dot{x} = 0$
 $\dot{y} = x - 1$ $\begin{cases} > 0 \text{ for } x > 1 \\ < 0 \text{ for } x < 1. \end{cases}$

Along $x = 1$ $\dot{x} = y^2 - 1$ $\begin{cases} > 0 \text{ for } |y| > 1 \\ < 0 \text{ for } |y| < 1. \end{cases}$
 $\dot{y} = 0$

- (iii). Jacobian: $Df(x, y) = \begin{pmatrix} -2x & 2y \\ 1 & 0 \end{pmatrix}$

linear approximation about (1, 1)

$$\underline{\dot{u}} = \begin{pmatrix} -2 & 2 \\ 1 & 0 \end{pmatrix} \underline{u}$$

linear approximation about (1, -1)

$$\underline{\dot{u}} = \begin{pmatrix} -2 & -2 \\ 1 & 0 \end{pmatrix} \underline{u}$$