**Problem 1.1 – Streamlines.** Consider the flow given by

$$\mathbf{u} = [x, x(x-1)(y+1), 0].$$

Find an equation for the streamlines of the flow and plot them.

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**Solution by Mohammed Muddassir**

We start by parameterizing the streamline curve and comparing the velocity equations such that:

$$\frac{dx/d\xi}{u} = \frac{dy/d\xi}{v} \qquad (Eq\ 1.7)$$

Since $\mathbf{u}$ describes two dimensional flow, we can ignore the w and z components.

We can simplify by multiplying by $d\xi$ on both sides. And after substituting the corresponding equations for $u$ and $v$, we have:

$$\frac{dx}{x} = \frac{dy}{x(x-1)(y+1)}.$$

After separating variables and simplifying,

$$(x-1)dx = \frac{dy}{y+1}.$$

Now we integrate both sides:

$$\int (x-1)\, dx = \int \frac{dy}{y+1},$$
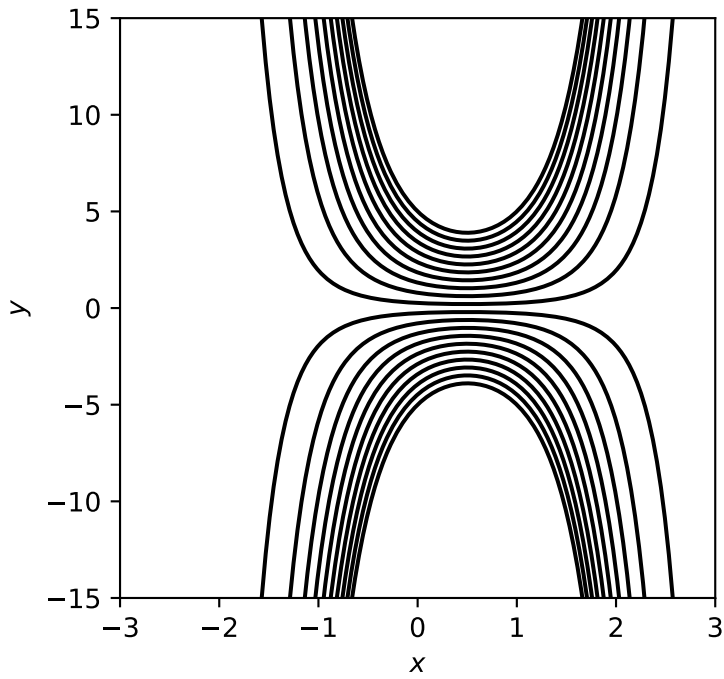
$$x^2 - x + c = ln(y+1),$$

with $c$ as the integration constant, and solve for $y$,

$$y = Ae^{x^2-x} - 1$$

where A = $e^c$.

You can use python or any other method to produce the plot.



**Figure 0.1:** Streamline Plot for Problem 1.1