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Example

$$\frac{dy}{dx} = y^2 = g(x, y)$$

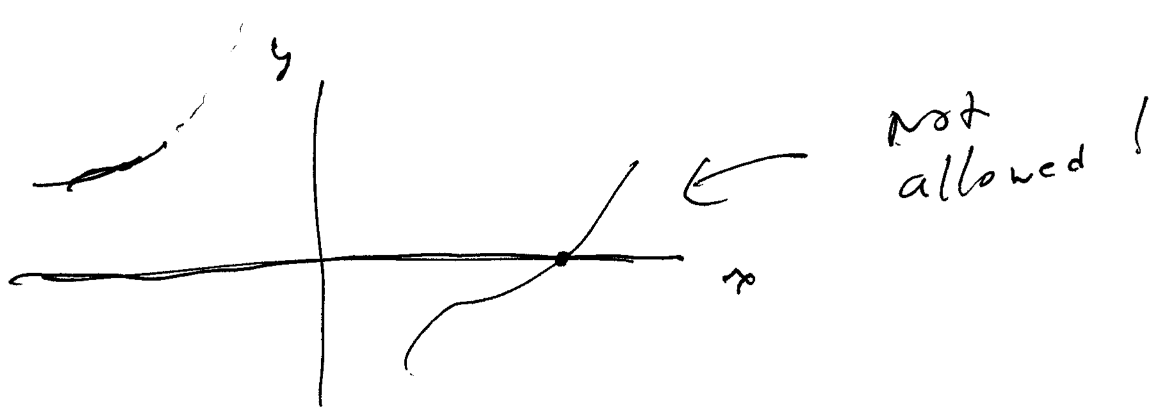
$$\frac{\partial g}{\partial y} = 2y$$

Thm applies $\Rightarrow$ local existence
uniqueness

Equilibrium solution:

$$y(x) = 0$$

No other solution can intersect the graph of 0.



If solution is positive at some x, it is always positive

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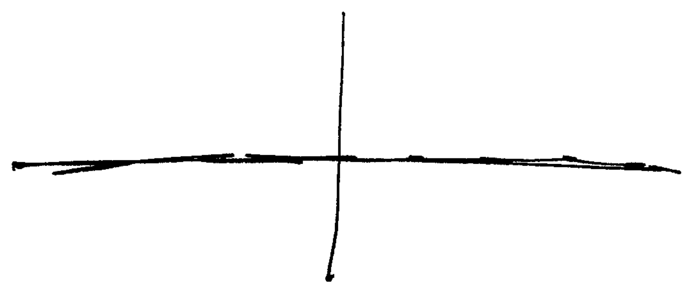
Example

$$\frac{dy}{dx} = y^{2/3} = g(x, y)$$

$$\frac{\partial g}{\partial y} = \frac{2}{3} y^{-1/3} \leftarrow$$ not defined at 0

Theorem does not apply for initial condition with $y = 0$



$$\frac{dy}{y^{2/3}} = dx \Rightarrow y^{-2/3}\, dy = dx$$

$$3y^{1/3} = x + C$$

$$y^{1/3} = \frac{x + C}{3}$$

$$y = \left(\frac{x + C}{3}\right)^3$$

Equilibrium:

0

But also solution:

$$y = \left(\frac{x}{3}\right)^3$$

Two solutions through $(0,0)$

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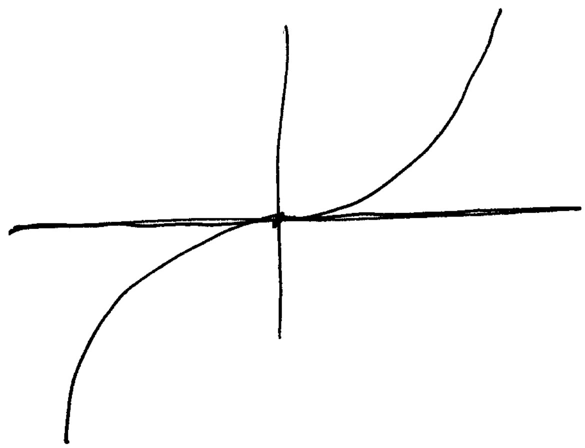
$$y(x) = 0$$

$$y(x) = \left(\frac{x}{3}\right)^3$$



no
uniqueness