

# Differential equations. Assignment. Numerical methods

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$$y' = x^3 y^4 - \frac{y}{x}$$

$$y' + \frac{y}{x} = x^3 y^4$$

A first order Bernoulli ODE

$$y = y_1 u$$

$$y' = -\frac{y}{x}$$

$$\frac{dy}{dx} = -\frac{y}{x}$$

$$y_1 = \frac{1}{x}$$

$$\frac{u'}{u^4} = \frac{1}{(x)^3} x^3$$

$$\frac{du}{u^4} = dx$$

$$u = \sqrt[3]{\frac{1}{3x + C}} \quad \text{Where } C = \text{const}$$

Therefore, the exact solution is

$$y = \frac{1}{x} \sqrt[3]{\frac{1}{3x + C}}$$

The initial value problem:

$$y_0 = 0.5, \quad x_0 = 1$$

$$C = \frac{11}{3}$$

$$y = (11 - 3x)^{-\frac{1}{3}}$$