

# Differential Equations Week 2

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January 26, 2025

## **Problem 1** (Problem 1a)

Consider the differential equation  $y' = 3x^2y^2$ .

- I. Prove that there is a unique solution on some interval around all initial values.
- II. Draw at least 5 level curves of  $y'(x, y)$ .
- III. Solve the differential equation.
- IV. Draw a direction field for the differential equation.
- V. For the initial value problem  $y(0) = 1$ :
  1. Draw the solutions of the differential equation with this initial value onto the direction field.
  2. Approximate the solutions of the differential equation with Euler's Method, with a delta-value of  $\Delta$ .
  3. Graph the solutions in 1aV2 for
    - (a)  $\Delta = 0.4$
    - (b)  $\Delta = 0.2$
    - (c)  $\Delta = 0.01$ .
- VI. For the initial value problem  $y(0) = 0$ :
  1. Draw the solutions of the differential equation with this initial value onto the direction field.
  2. Approximate the solutions of the differential equation with Euler's Method, with a delta-value of  $\Delta$ .
  3. Graph the solutions in 1aVI2 for
    - (a)  $\Delta = 0.4$
    - (b)  $\Delta = 0.2$
    - (c)  $\Delta = 0.01$ .