18.03 Differential Equations: Week 2

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Progress Update

Over the past week we have covered:

1. Solving basic DE's
2. Direction fields
3. Euler's Method

Solving Basic DE's

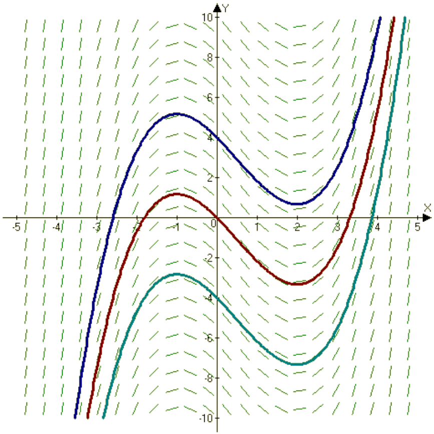
The first technique we are provided for solving first order differential equations is separation of variables; consider the case of

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

$$\int \frac{dy}{y} = \int (x-1)\,dx \tag{2}$$

$$y = e^{\frac{x^2}{2} - x + c} \tag{3}$$

Consider the following example of a slope & direction field of $\frac{dy}{dx} = x^2 - x - 2$:



Euler's Method

A numerical method of approximating a solution curve to a differential equation is Euler's method, with the equations

$$y_{n+1} = y'(x_n, y_n)h + y(x_n, y_n) \tag{4}$$
$$x_{n+1} = x_n + h \tag{5}$$

Implementing Euler's Method in Python

I made the following automation of Euler's method as part of my solutions to the textbook problems:

```python
def eulers(f, init, stop_at, step_size = 0.5):
    step = 0
    active_x = init[0]
    active_y = init[1]
    while active_x <= stop_at:
        print("At step", step, ":")
        print("x is", active_x)
        print("y is", active_y)
        print("Slope is", f(active_x,active_y))
        print("")
        active_x += step_size
        active_y = active_y  + step_size * f(active_x,active_y)
        step += 1
```