Computational Methods for Solving Differential Equations

- Euler's method is a numerical or computational method for solving a differential equation.
- It is called numerical, because the result is a list of numbers, not the formula for a function.
- Euler's method is simple conceptually and gets at the heart of what differential equations are.
- However, Euler's method is not very efficient, and so is not used much in practice.

Improving on Euler's Method

Two improvements:

1. **Runge-Kutta methods:** Sample the rate of change at several points along the interval Δt and average them.
2. **Adaptive step size:** Automatically adjust Δt on the fly. Make Δt small (large) when the derivative changes rapidly (slowly).

- Most numerical programming environments (matlab, octave, maple, mathematica, python with numpy, etc.) have a built-in RK, adaptive step size solver.

Looking Ahead

- Almost all of the solutions to differential equations that I will discuss in this course will be numerical solutions.
- You will not need to solve differential equations on your own.
- However, it is important that you have a sense of where numerical solutions come from and what they mean.