Lab 7

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ODE 2

Experiment goals:

- Expand on previous methods of solving differential equations
- Compare each method and understand when they are useful
- Understand their implications in dynamical system analysis

Introduction

Why is this important?

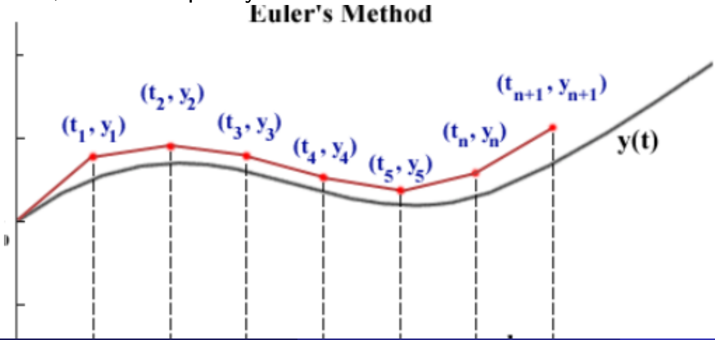
- Dynamical systems that arise from real world scenarios are never simple
- Understanding multiple methods will lead to better intuition when it comes to analysing systems
- Building technique repertoire will allow for deeper analysis

Euler's Method

The method approximates the solution to the differential equation rather than finding an analytical one, which is much more applicable to more complicated systems. The algorithm is defined by the function

$$x_{k+1} = x_k + hf(t_k, x_k)$$

Since we are working with an first order iterative function, the error is proportional to the square of the iteration step. Therefore for small values of n, it can be pretty accurate for a lot of iterations.



Modified Euler's Method

One could improve the accuracy of the previous method by reducing the step size, which would be achieved by reducing the parameter h. However, this would increase computational power by a lot. Another way to increase accuracy would be to average and midpoint method in combination with the Euler method, achieved by the formula

$$x_0 = \alpha$$
$$x_{i+1} = x_i + \frac{h}{2}\left[f(t_i, x_i) + f\Big(t_{i+1}, x_i + hf(t_i, x_i)\Big)\right]$$