coursera

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Runge-Kutta Methods

The Euler method for solving the differential equation $dy/dx = f(x, y)$ can be rewritten in the form

$$k_1 = \Delta x f(x_n, y_n), \quad y_{n+1} = y_n + k_1,$$

and is called a first-order Runge-Kutta method. More accurate second-order Runge-Kutta methods have the form

$$k_1 = \Delta x f(x_n, y_n), \quad k_2 = \Delta x f(x_n + \alpha\Delta x, y_n + \beta k_1), \quad y_{n+1} = y_n + a k_1 + b k_2.$$

Some analysis (not shown here) on the second-order Runge Kutta methods results in the constraints

$$a + b = 1, \qquad \alpha b = \beta b = 1/2.$$

Write down the second-order Runge-Kutta methods corresponding to (i) $a = b$, and (ii) $a = 0$. These specific second-order Runge-Kutta methods are called the modified Euler method and the midpoint method, respectively.

Note: Remember, you may check the solutions in the lecture notes.

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