Computational Methods and Modelling

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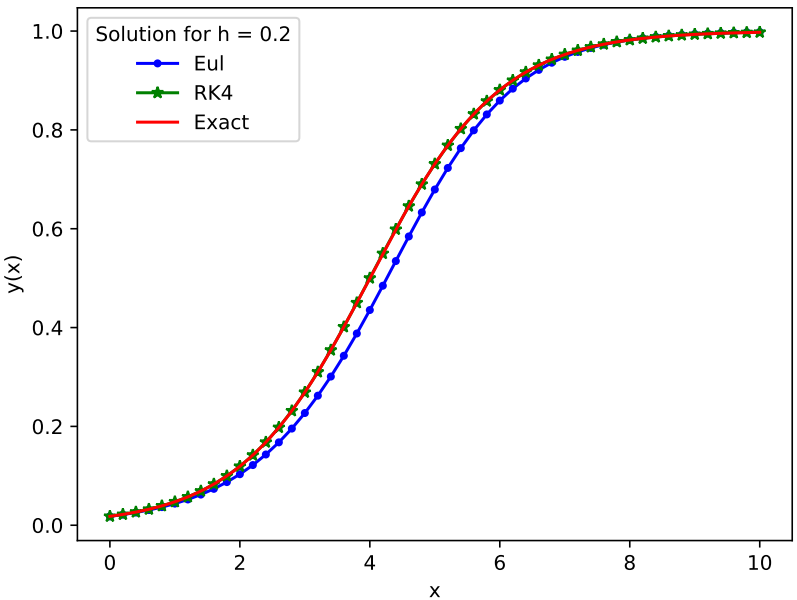
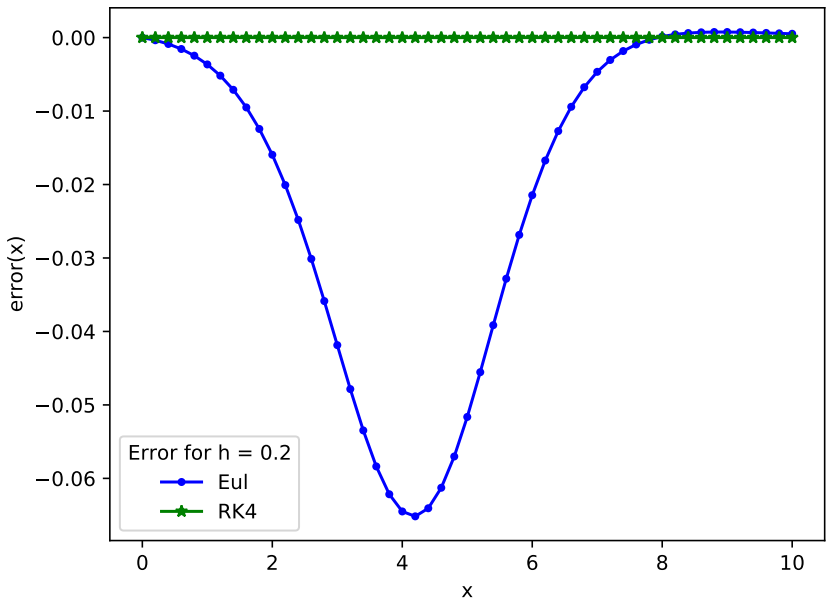
Solution tutorial 7
Differential Equations

Exercise 1: Euler and Runge-Kutta methods for the Logistic equation

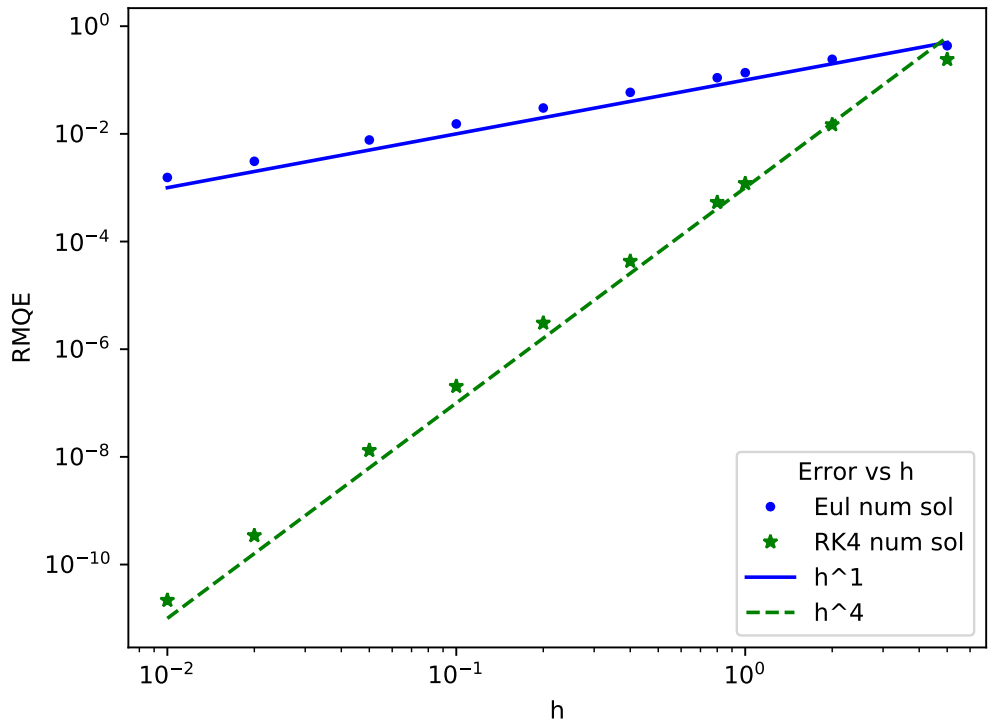
- The python file with the full solution is available on Learn in the course material. The file name is: logistic.py
- The solution with Euler and RK4 for $h = 0.02$ is shown in the figures:





Exercise 2: Order of accuracy of Euler and Runge-Kutta methods

- We compute several solutions with different steps h, both for Euler and RK4.
- For each solution, we evaluate the Root Mean Square Error RMSE and collect the results.
- This can be done with a for loop in python. The RMSE for the various solutions are collected in arrays and then plotted (Note that the plot is in log-scale.).



- The dots in the figure indicate the RMSE for different values of h.
- The lines are the theoretical "scaling" of the error:
  - $RMSE \propto h^1$ for the Euler method.
  - $RMSE \propto h^4$ for the fourth order RK method.