Computational Physics

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Project 1, due October 5, 2022 at 11:59 p.m.
to be uploaded to https://elearning.jacobs-university.de

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1. Falling body [100 points]

a) Write a computer program in Python using the Euler algorithm which includes a height-dependent gravitational field of the earth and a velocity-dependent damping as well. Provide the documented source code as well as the command how to run it. Please make sure that you are not using libraries specific for individual operating systems!
b) Which checks did you perform to validate the code? Please state the results you got.
c) Give the results for a drag force of the form kv^2 with k=2*10^{-4}kg/m and for a body of mass $m = 1$ kg falling from a height of 50 000 m. Plot the results.
d) Implement the Euler-Richardson algorithm for the case of constant acceleration (g=9.81 m/s) and without friction. For the other parameters as above. How many iterations do you have to perform using the Euler and the Euler-Richardson algorithms, respectively, to get stable results. Is there a difference in the possible time step using these different integration schemes?

General remarks for all Projects

You will have to (i) analyze the problem, (ii) select an algorithm (if not specified), (iii) write a Python program, (iv) run the program, (v) visualize the data numerical data, and (vi) extract an answer to the physics question from the data.
Which checks did you perform to validate the code? State the results you got for these tests.
For each project you will submit a short report describing the physics problem, your way of attacking it, and the results you obtained. Provide the documented Python code in such a form that we can run the code. A Jupyter Notebook including the code and report is fine but not necessary.