Exercise #1

21. August 2023

Exercises marked with a (J) should be handed in as a Jupyter notebook.

Problems marked with 4N or 4D must be submitted only by the respective course, while unmarked problems must be submitted by both courses.

Optional exercises will not be corrected.

Problem 1. (Partial Derivatives - 4D only)

Given the functions $u(x, y, t)$ below, dependent on the independent variables x, y, t, find $u_y, u_t, u_{xx}, u_{xy}, u_{yx}$.

$$u = t^5 + \sin(xy), \qquad u = \cos(txy), \qquad u = e^{-t}\sin(x)\ln(y),$$
$$u = e^{-x}\sqrt{x^2 + y}, \qquad u = (t^2 e^t)\cos(x), \qquad u = \sin(t)e^{-y} + \cos(t)e^{-x}.$$

Problem 2. (PDE verification - 4D only)

Verify that the following functions u all solve the PDE $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$.

$$u = -x^2 + y^2, \qquad u = \sin x \cosh y,$$
$$u = \frac{y}{x^2 + y^2}, \qquad u = \arctan\frac{y}{x}.$$

See attached Jupyter notebook for the numerical problems (J)