

Numerical Methods for Partial Differential Equations

Homework 1

Problem 1

Classify the following three linear second-order PDEs:

- a) Laplace-Equation: $\partial_x z(x, y) + \partial_y z(x, y) = 0$
- b) Heat-Equation: $\partial_t z(x, t) - \partial_x^2 z(x, t) = 0$
- c) Wave-Equation: $\partial_t^2 z(x, t) - \partial_x^2 z(x, t) = 0$

(4 P)

Problem 2

Show that the one-dimensional shallow-water equation

$$\partial_t \mathbf{u} + \partial_x \mathbf{f}(\mathbf{u}) = \mathbf{0}$$

with

$$\mathbf{u} = \begin{bmatrix} \phi \\ \phi v \end{bmatrix}, \quad \mathbf{f}(\mathbf{u}) = \begin{bmatrix} \phi v \\ \phi v^2 + \frac{1}{2} \phi^2 \end{bmatrix},$$

constitute a strictly hyperbolic system. (4 P)

Due on Friday, April 13, 2012. The homework will be collected during the open programming exercise in the computer lab.