

Problem Set 4

(Out Mon 02/24/2020, Due Mon 03/16/2020)

Problem 5

Download the Matlab file `temple8024_godunov_shallow_water.m` from the course website.

- a) Run the code, and explain what you see (which problem is solved, what scheme is used, etc.).
- b) Modify the code to solve *Moses' first problem*:

$$h(x, 0) = 1 \quad \text{and} \quad u(x, 0) = \begin{cases} -0.88 & \text{for } x < 0 \\ 0.88 & \text{for } x \geq 0 \end{cases}$$

on the domain $x \in [-5, 5]$. Plot the height and velocity field at $t = 2$. Explain what physically should happen, how the numerical solution looks like, any where any discrepancies stem from.

- c) Now change the code to solve *Moses' second problem*:

$$h(x, 0) = \begin{cases} 1 & \text{for } x \leq -2 \\ 0.01 & \text{for } -2 < x < 2 \\ 1 & \text{for } x \geq 2 \end{cases} \quad \text{and} \quad u(x, 0) = 0$$

on the domain $x \in [-5, 5]$. Plot the height and velocity field at $t = 2.5$. Again, explain the physical behavior of the true solution, the shape of the numerical solution, and the reason for any discrepancies.

- d) Add an entropy fix to the Matlab code, and re-run the three examples above.