# Global Exercise - 15

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## 1 Monotone $\to$ $L_1$-Contracting $\to$ TVD $\to$ Mon.Pre.

**Example 1.** *abc*

Roe'solver:
P.L.Roe [1981], Approximate Riemann solvers, parameter vectors, and difference schemes.

## 2 Total variation diminishing (TVD)

**Example 2.** *abc*

# 3 Limiter

**Example 3.** *Examine the $1^{st}$-order-converged LF and the $2^{nd}$-order-converged LW.*

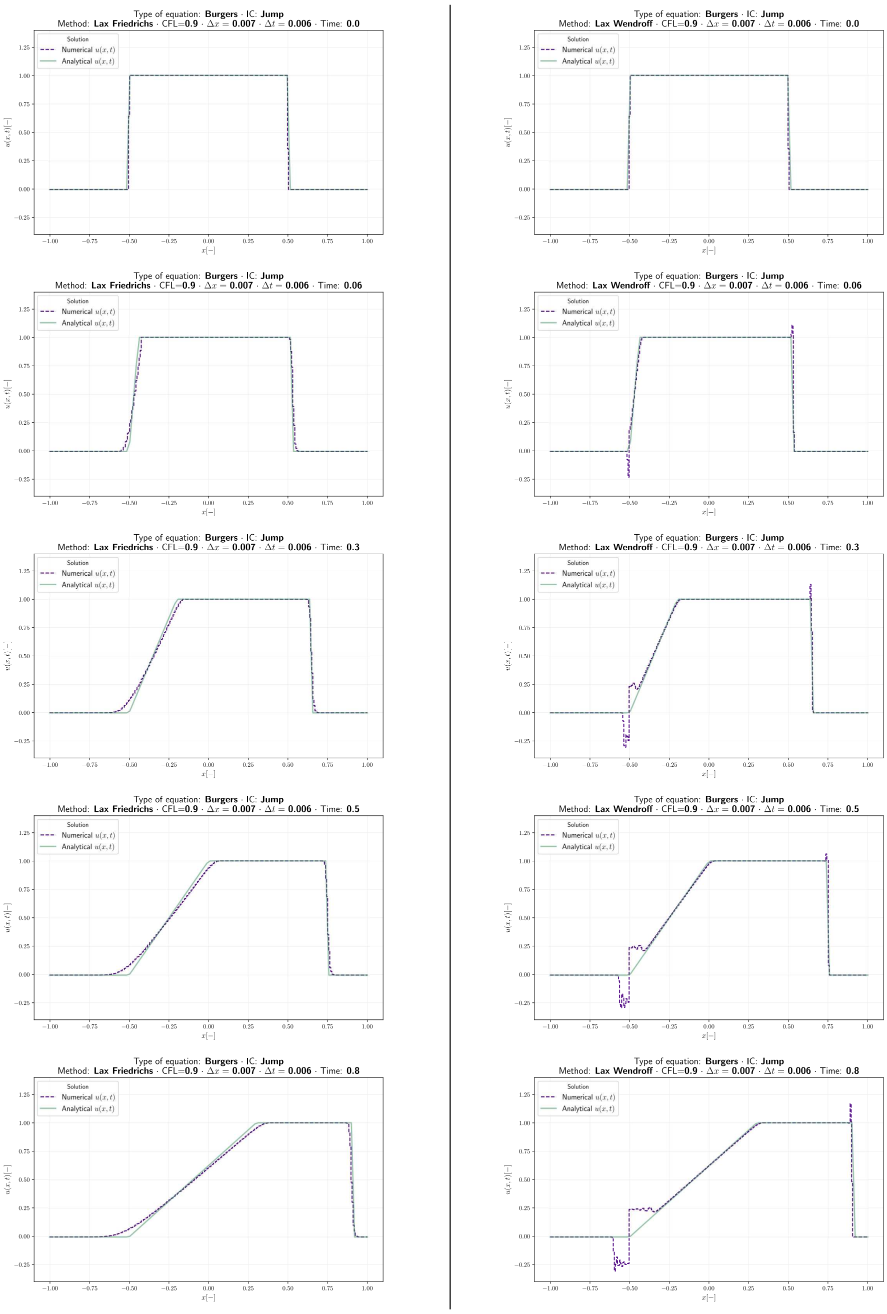


Figure 1: Oscillatory phenomena around discontinuity: (left) none oscillation founded in *Lax-Friedrichs*; (right) oscillation observed in *Lax-Wendroff*.

# 4 Review Riemann's problem and Godunov's solver

**Example 4.** *abc*

**Example 5.** *Examine $u_L > u_R$.*

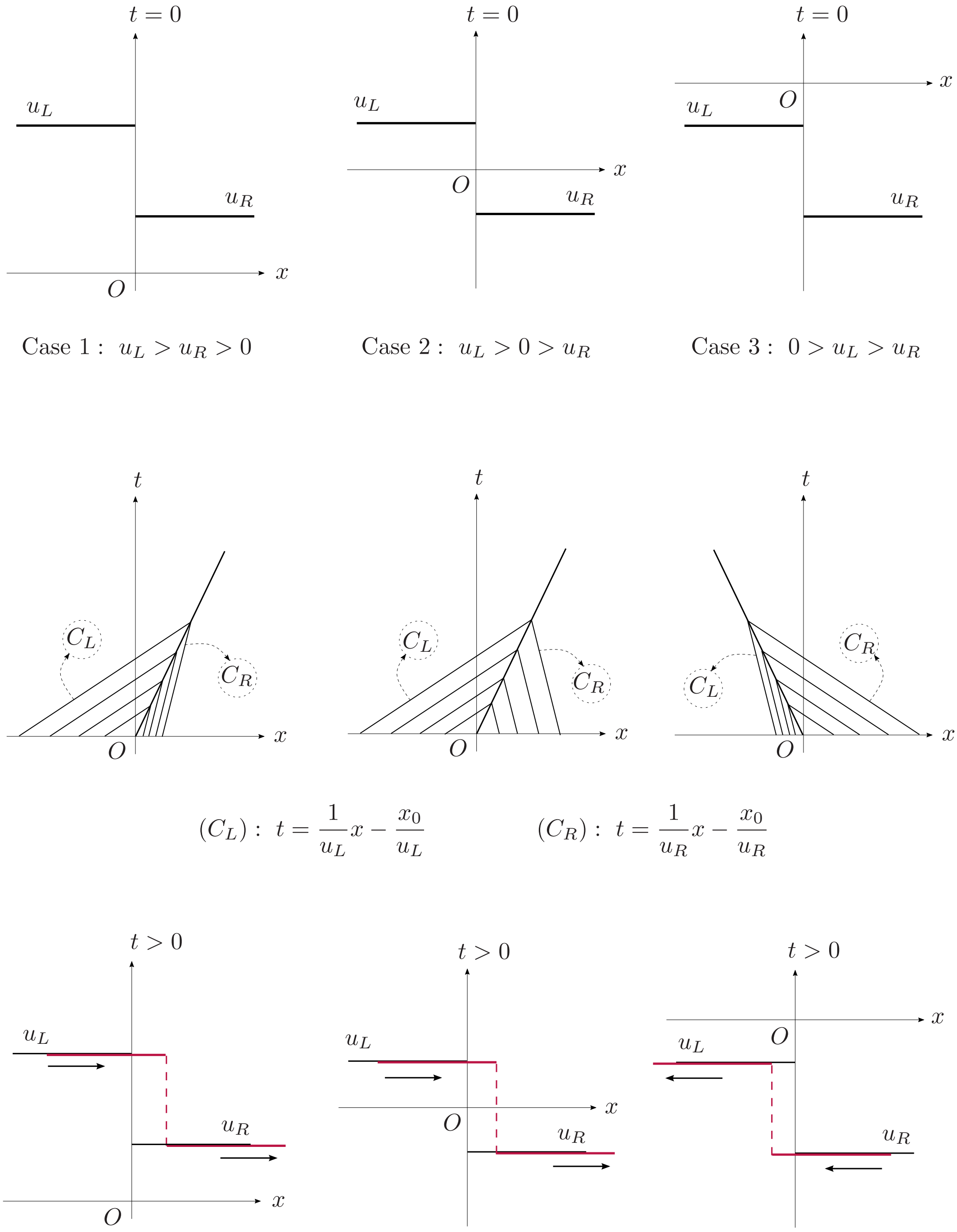


Figure 2: Riemann problem with $u_L > u_R$: IC, Characteristics, Solution.

Schock solution

**Example 6.** *Examine* $u_L < u_R$.

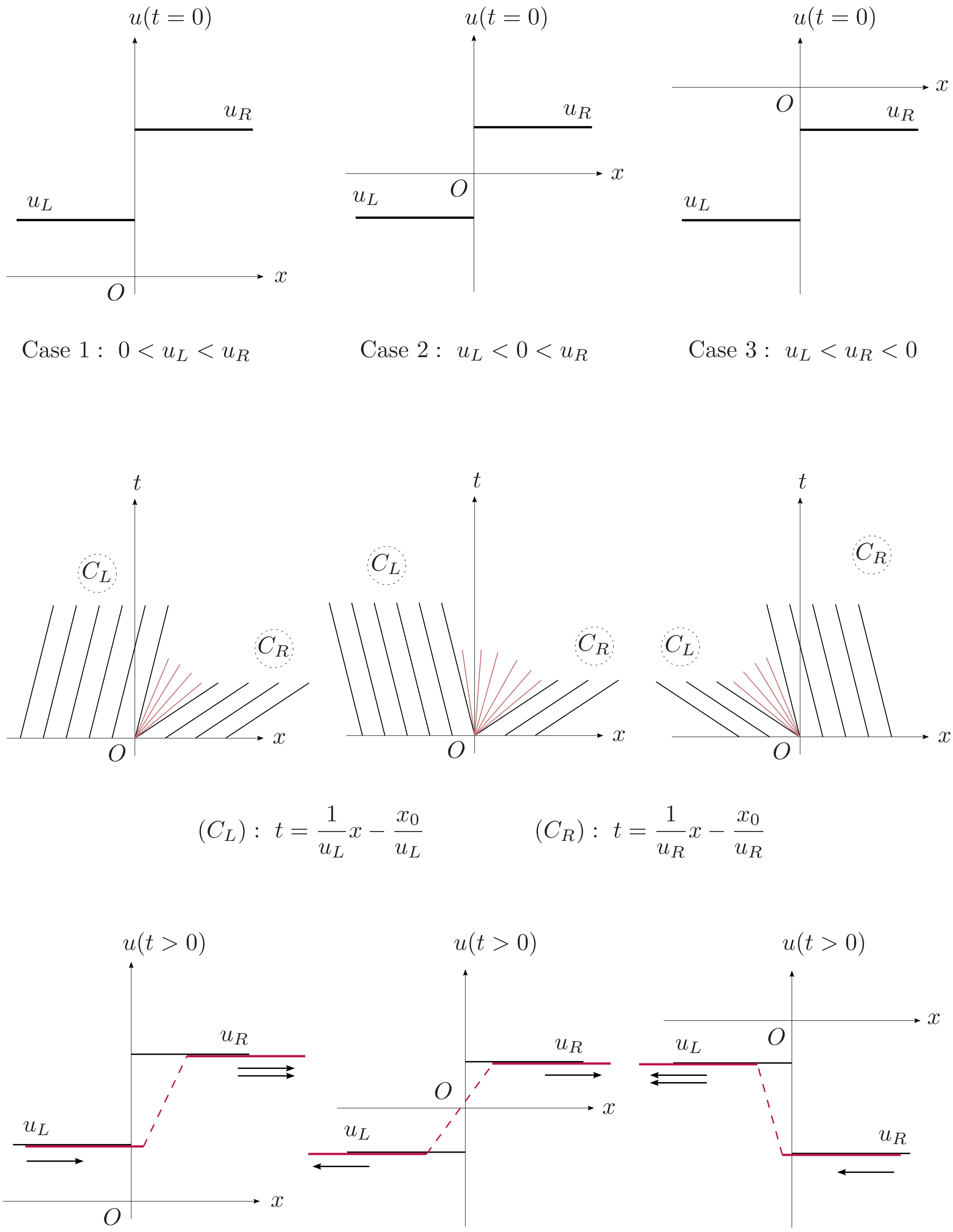


Figure 3: Riemann problem with $u_L < u_R$: IC, Characteristics, Solution.

Rarefaction solution