Homework 6

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Problem 1

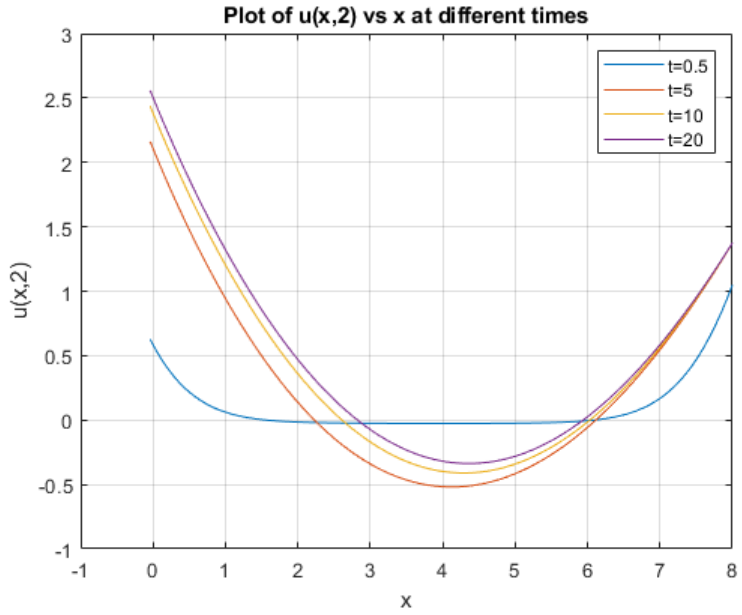
Submitted as a hand written pdf attached at the end of this report.

Problem 2

Problem 2 using the IBVP similar to problem 6 in homework 6 we had to modify the grid to properly plot the problem.

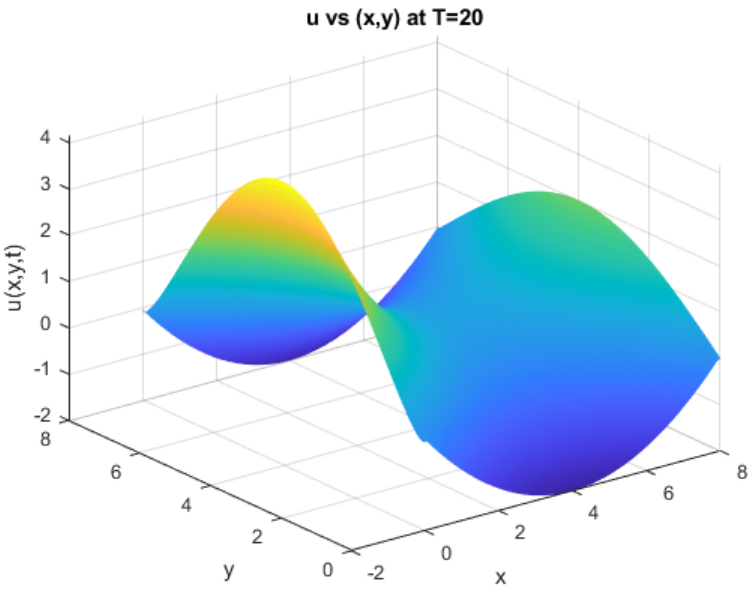
Part 1

Part 1 asked us to plot $u(x, 2)$ when $t = 0.5, 5, 10, 20$ shown below.



Part 2

Part 2 asked us to plot $u(x, y)$ when $t = 20$ as a surface pictured below.

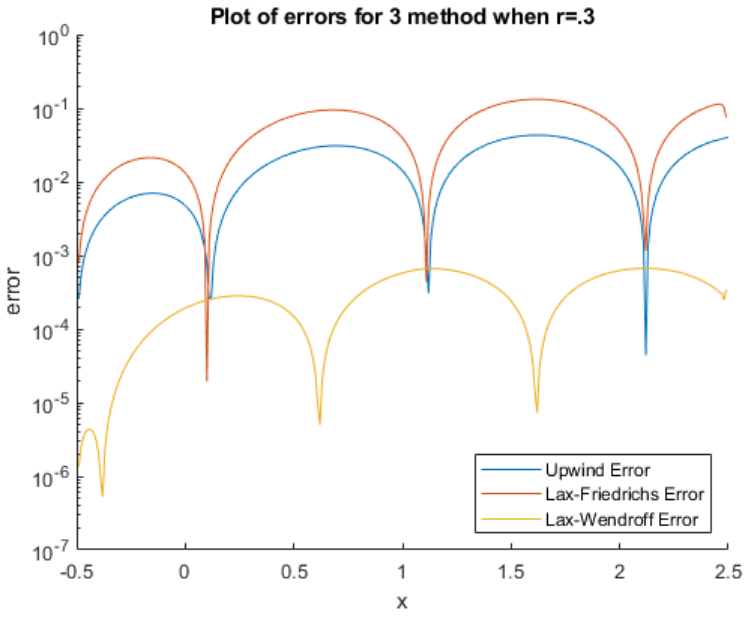


Problem 3

Problem 3 we solve an IBVP using three different methods Upwind, Lax-Friedrichs, and Lax-Wendroff.

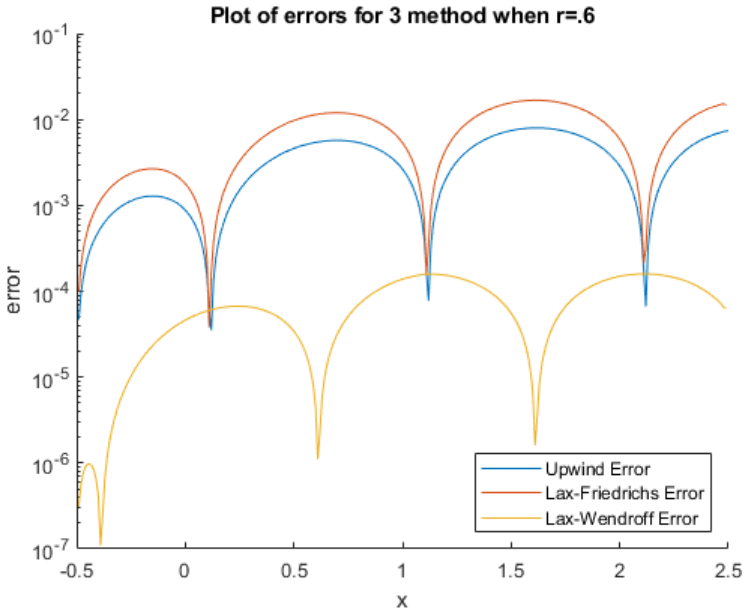
Part 1

Part 1 asks us to plot the error vs x for the 3 methods at $t = 1.08$ in one graph. One when $r = 0.3$ and one when $r = 0.6$ shown below.



Part 2

Part 2 asks us which r value and method has the smallest error. From the graphs we see that when $r = 0.6$ the Lax-Wendroff gives smallest error.

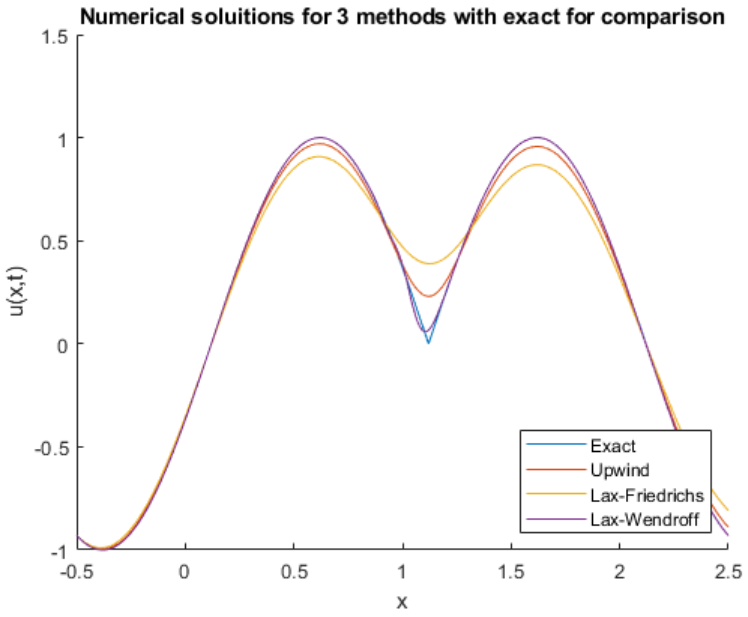


Problem 4

Using the same IBVP from problem we modify the initial value.

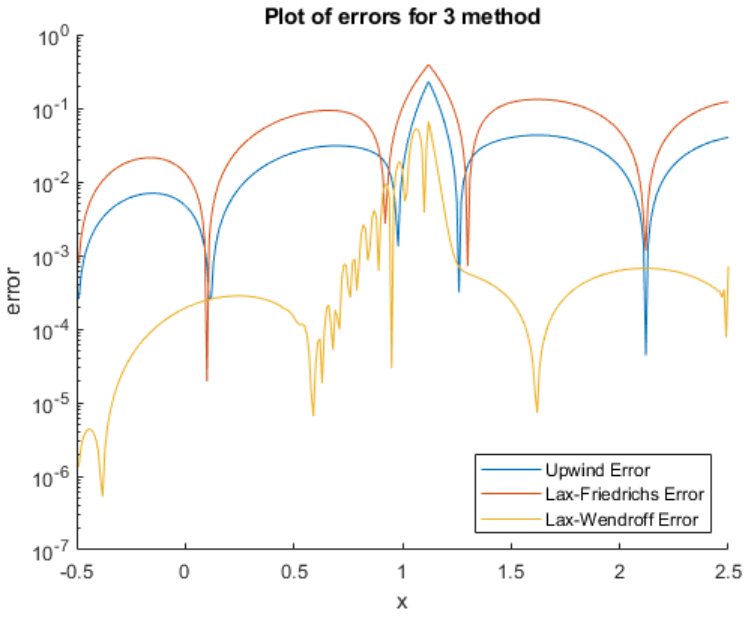
Part 1

Part 1 asks us to plot the numerical solutions of the 3 methods mentioned above vs the exact solution at $t = 1.08$.



Part 2

Next in part 2 we plot error vs x for the three methods at $t = 1.08$.



Part 3

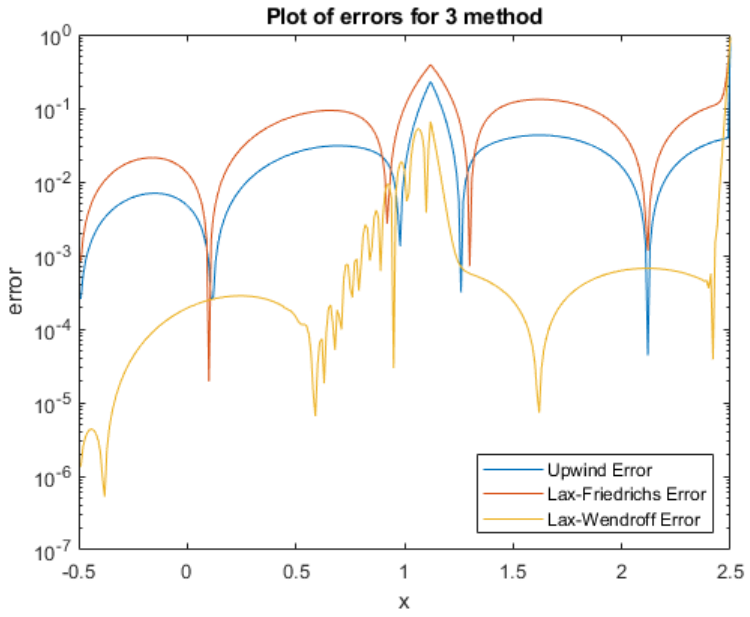
We can see that as the numerical methods approach the cusp in the exact solution that is where maximum error occurs.

Problem 5

Again we continue with the IBVP from problem 4 but this time change the ad hoc boundry condition.

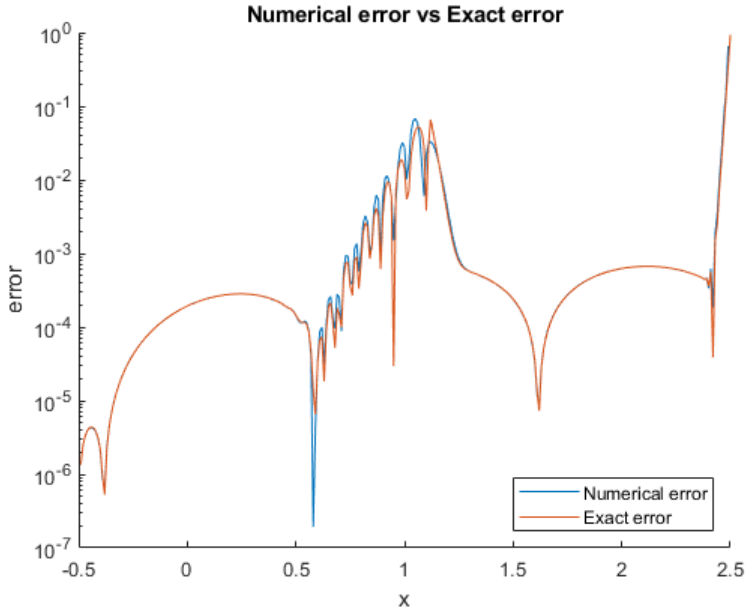
Part 1

Part 1 we plot the error of the 3 methods vs x at time $t = 1.08$ looking at the graph below we can see that the BC does not affect the deep interior of computational region far away from $x_N = 2.5$.



Part 2

Part 2 we are only looking at Lax-Wendroff and we plot the exact error vs the numerical error.



Problem 6

Problem 6 asks us to solve an IVP linear hyperbolic PDE with variable coefficients by using the method of characteristics. We calculted u(x,t) at three different time levels $t = 0.2, 0.5, 1$. We were then asked to plot $u(x,t)$ vs x for the 3 different time levels.