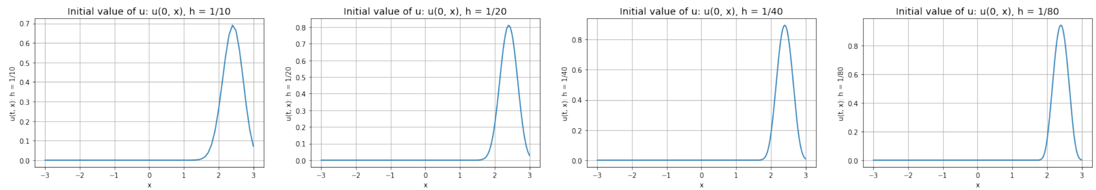
ADVECTION EQUATION

Forward Time Backward Space (lambda = 0.8) : USEFUL

In this scheme we observe that all the values of U for all values of m and n are less than 5 hence this scheme is useful.

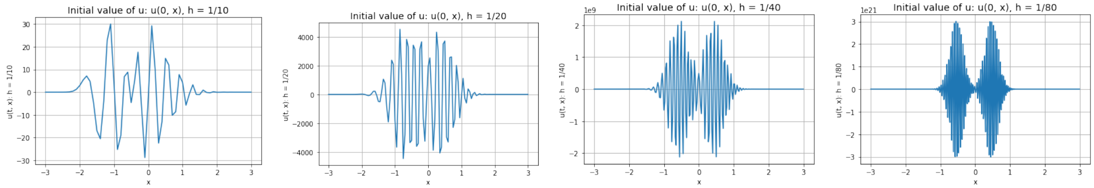


(a) h = 0.1 (b) h = 0.05 (c) h = 0.025 (d) h = 0.0125

Figure 1: FTBS plots

Forward Time Central Space (lambda = 0.8) : USELESS

In this scheme we observe that all the values of U for all values of m and n are greater than 5 hence this scheme is ueless.

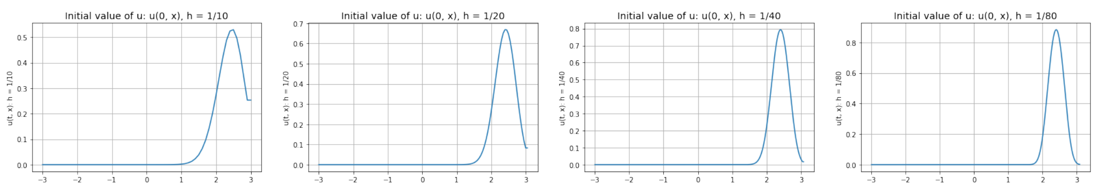


(a) h = 0.1 (b) h = 0.05 (c) h = 0.025 (d) h = 0.0125

Figure 2: FTCS plots

Lax-Friedrichs (lambda = 0.8) : USEFUL

In this scheme we observe that all the values of U for all values of m and n are less than 5 hence this scheme is useful.

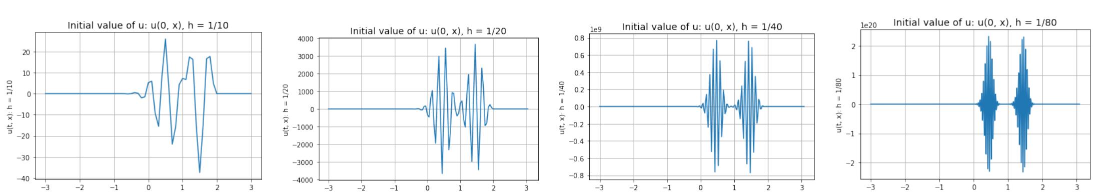


(a) h = 0.1 (b) h = 0.05 (c) h = 0.025 (d) h = 0.0125

Figure 3: Lax-Friedrichs (lambda = 0.8) plots Forward

Lax-Friedrichs (lambda = 1.6) : USELESS

In this scheme we observe that all the values of U for all values of m and n are greater than 5 hence this scheme is ueless for this value of lambda.

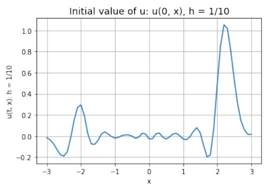


(a) h = 0.1 (b) h = 0.05 (c) h = 0.025 (d) h = 0.0125

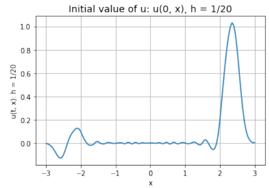
Figure 4: Lax-Friedrichs (lambda = 1.6) plots

Leap-Frog (lambda = 0.8) : USEFUL

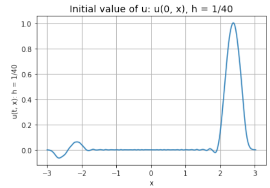
In this scheme we observe that all the values of U for all values of m and n are less than 5 hence this scheme is useful.



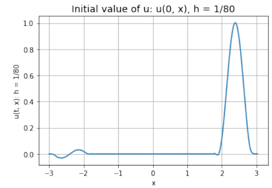
(a) h = 0.1



(b) h = 0.05



(c) h = 0.025



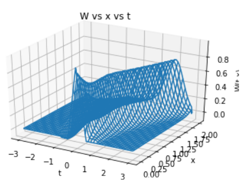
(d) h = 0.0125

Figure 5: Leap-Frog plots

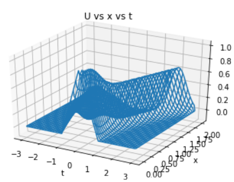
SYSTEM OF EQUATIONS

We first resolve the given equations to separate out the variables in them and form a general advection equation of the form au_t + bu_x + u = 0 and then solve it using lax-friedrichs scheme. Thus we have our matrix B, and A which is time dependent as given in the code. We use the initial conditions and then plug in all the given values to come to a solution.

Lastly, we create a 3D plot, in which we show the plot of U and W respectively. showing its changing nature with changing values of x and t.



(a)



(b)

Figure 6: U and W plots as a function of t and x 3D plots