clear all;

clc;

%numerical grid

xlength=6\*pi; %grid length

n=50; %number of grid points

h=xlength/(n-1);%gap between grid points

% set numerical & physical parameters

cfl = 0.9; % Ak/h

a = 1d0;

dt = h \* cfl / a;

tout = 1;

time = 1;

x = zeros (1,n);

fn = zeros (1,n);

fnlw = zeros (1,n);

f = zeros (1,n);

flw = zeros (1,n);

x(1)= 0D0;

% assigning values to array x(i)

for i=2:n

x(i)=x(i-1)+h;

end

for i = 1:n

f(i) = sin(x(i)); %

flw(i) = sin(x(i));

end

nt = 20;

for k = 1:nt

for i = 2:n %first order upwind

flux = a \* (f(i)-f(i-1));

fn(i) = f(i)-(dt/h)\*flux;

end

fn(1) = fn(n);

f = fn;

for i = 2:n-1%Lax-Wendroff

l0 = (dt/(2\*h))\* a \* (flw(i+1)-flw(i-1));

h0 = (dt^2/(2\*h^2))\* a^2 \* (flw(i+1)-(2\*flw(i))+flw(i-1));

fnlw(i) = flw(i) - l0 + h0;

end

fnlw(1) = fn(n);

fnlw(n) = fn(1);

flw = fnlw;

end

time = nt\*dt

for i = 1:n

freal(i) = sin(x(i)- a\*time);

end

freal(1)=freal(n);

freal(n)=freal(1);

plot(x(5:n-5),f(5:n-5),'-o')

hold on

plot(x(5:n-5),flw(5:n-5),'-\*')

hold on

plot(x(5:n-5),freal(5:n-5))

grid on

legend('upwind','LWendroff','realsolution')