1 Problem Set I solving wave equation

$$\frac{\partial^2 \phi}{\partial^2 t} = c^2 \frac{\partial^2 \phi}{\partial^2 x} \tag{1}$$

1.1 fully first order formulation

$$\eta = \phi_{,t}, \quad \chi = \phi_{,x} \tag{2}$$

$$\eta(t,x)\chi(t,x)\vec{u}(\phi,\eta,\chi)$$

$$\vec{u}_{,t} + \mathbf{A}\vec{u}_{,x} = \vec{S} \tag{3}$$

1.2 initial condition

$$\phi(0,x) = e^{\sin^2\left(\frac{\pi x}{L}\right)} - 1, \quad 0 \leq x \leq L \tag{4}$$

with periodic condition:

$$\phi(t,x) = \phi(t, x \pm L) \tag{5}$$

2 Program

```
// The C++ standard version:
#include <cstdio>
#include <cmath>
#include <fstream>
#include <iostream>
using namespace std ;

void initalCondition(){
    for (int i = 0; i < 4; i++) {
                for (int j = 0; j < 4; j++) {
                        arr[i][j] = i + j;
                }
        }
}
void output(){
    // Declaring 2D array
    cout << h*(i+1)-taureal << ' ' << x[i+1] << ' ' << x[i+1-tau] << ' ' <<
    ↪  x[i+1-tau-tau] << endl;

}
void init(){
    // Declaring 2D array
        int arr[4][4];
    initalCondition();

}
double // Kommentar
    x[4][4],
    t[4][4] ,
    phi[4][4],
    dx,
    dt
    ;

```

```
int main(int argc, char** argv)
{

    init();


    // cases for solver
    //{{{solving method second order}}
    //{{{solving method forth order}}

        // Initialize 2D array using loop
        for (int i = 0; i < 4; i++) {
                for (int j = 0; j < 4; j++) {
                        arr[i][j] = i + j;
                }
        }
        return 0;
};



//example function in cpp
void pred_corr(double x[],double h,int i,double dxdt[])
{
        double
        gam=1.,
        beta=2.
        ;
        double n =7;
        //predictor step
        dxdt[i]=beta*x[i-tau]/(1+pow(x[i-tau],n))-gam*x[i];
        x[i+1]=x[i]+h/12.*(23.*dxdt[i]-16.*dxdt[i-1]+5.*dxdt[i-2]);
        //corrector step
        dxdt[i+1]=beta*x[i+1-tau]/(1+pow(x[i+1-tau],n))-gam*x[i+1];
        ↪  x[i+1]=x[i]+h/12.*(5.*dxdt[i+1]+8.*dxdt[i]-dxdt[i-1]);
};
```