

### PH3105 Problem Set 9

**Q 1)** Modify the `heat.py` program to solve the IBVP

$$\begin{aligned}u_t &= u_{xx} \\ u(x, 0) &= \begin{cases} 0.1x & \text{for } 0 \leq x < 5 \\ 1 - 0.1x & \text{for } 5 \leq x \leq 10 \end{cases} \\ u(0, t) &= 0.0 \\ u(10, t) &= 0.1\end{aligned}$$

**Q 2)** Solve the previous problem using the implicit euler algorithm.

**Q 3)** Write a program to solve this problem using the Crank-Nicolson algorithm

**Q 4)** Solve

$$\begin{aligned}u_t &= u_{xx} \\ u(x, 0) &= \begin{cases} 0.1x & \text{for } 0 \leq x < 5 \\ 1 - 0.1x & \text{for } 5 \leq x \leq 10 \end{cases} \\ u_x(0, t) &= 0.0 \\ u_x(10, t) &= 0.1\end{aligned}$$

using the implicit algorithm.

**Q 5)** Solve

$$\begin{aligned}u_t &= u_{xx} + 0.1 \sin t \\ u(x, 0) &= \begin{cases} 0.1x & \text{for } 0 \leq x < 5 \\ 1 - 0.1x & \text{for } 5 \leq x \leq 10 \end{cases} \\ u(0, t) &= 0.0 \\ u(10, t) &= 0.1\end{aligned}$$

using the Crank-Nicolson algorithm.

**Q 6)** Modify the `schroEuler.py` program so that it uses the Numerov algorithm.