Tutorial 1 - 3

Various Equations

pure convection

Wave equation: 1D, 2D

Diffusion equation: 1D, 2D

Laplace equation: 1D, 2D

Inviscid burger equation: 1D, 2D

Viscous Burger equation: 2D

Laplace's Equation 1D and 2D

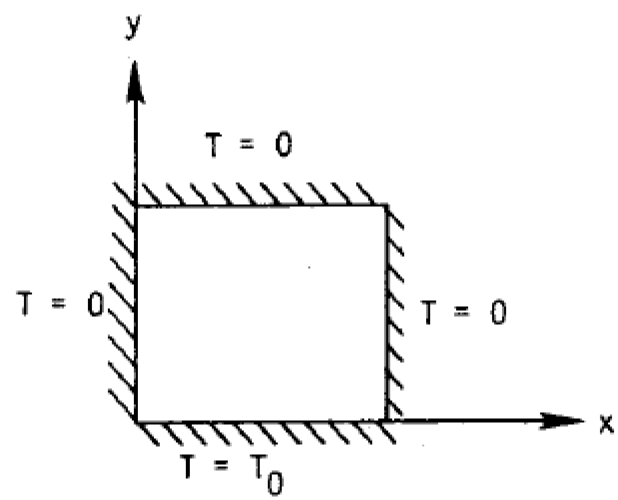
1D

$$\frac{\partial^2 T}{\partial x^2} = 0$$

2D

$$\nabla^2 T = \frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} = 0$$

$$0 \le x \le 1 \quad 0 \le y \le 1$$



1D Wave Equation

$$\frac{\partial^2 T}{\partial t^2} = c^2 \frac{\partial^2 T}{\partial x^2}$$

It is pure IV Problem

C = wave speed

Ex1: c = 0.75 and in x direction periodic BC

$$IC: \quad T(x,0) = \sin(6\pi x), \quad 0 \le x \le 1$$

$$\Delta x = 0.01, \quad \Delta t = 0.01$$

Ex2: c = 0.65 and in x direction periodic BC

$$IC: \quad T(x,0) = 2\sin(2\pi x - 0.4\pi), \quad 0 \le x \le 2$$

$$\Delta x = 0.01, \quad \Delta t = 0.01$$

1D Heat Equation

$$\frac{\partial T}{\partial t} = \alpha \left[\frac{\partial^2 T}{\partial x^2} \right]$$

$$IC: \quad T(x,0) = \sin(\pi x), \quad 0 \le x \le 3$$

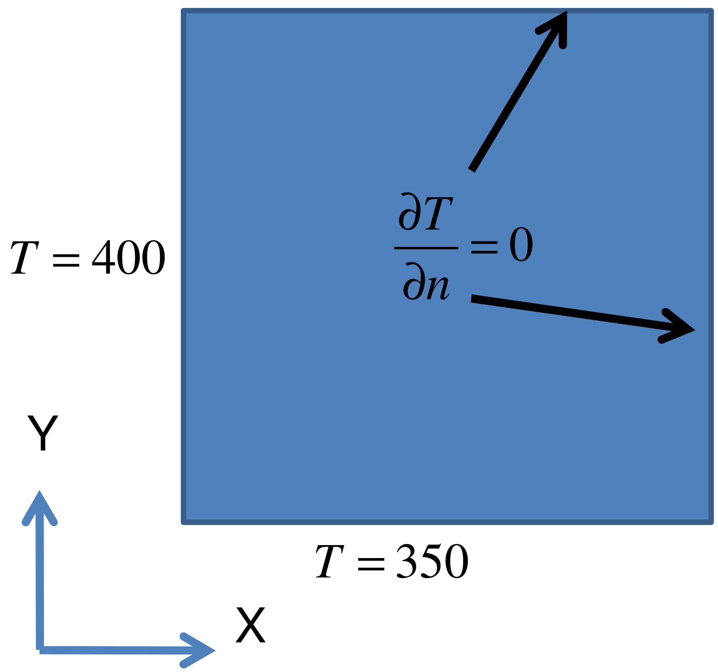
$\Delta x = 0.01, \quad \Delta t = 0.01$ $\qquad \alpha = 0.02\ m^2 / h$

$T = 0$  $T = 0$

$\longrightarrow$ x

2D Heat Equation

$$\frac{\partial T}{\partial t} = \alpha\left[\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2}\right]$$



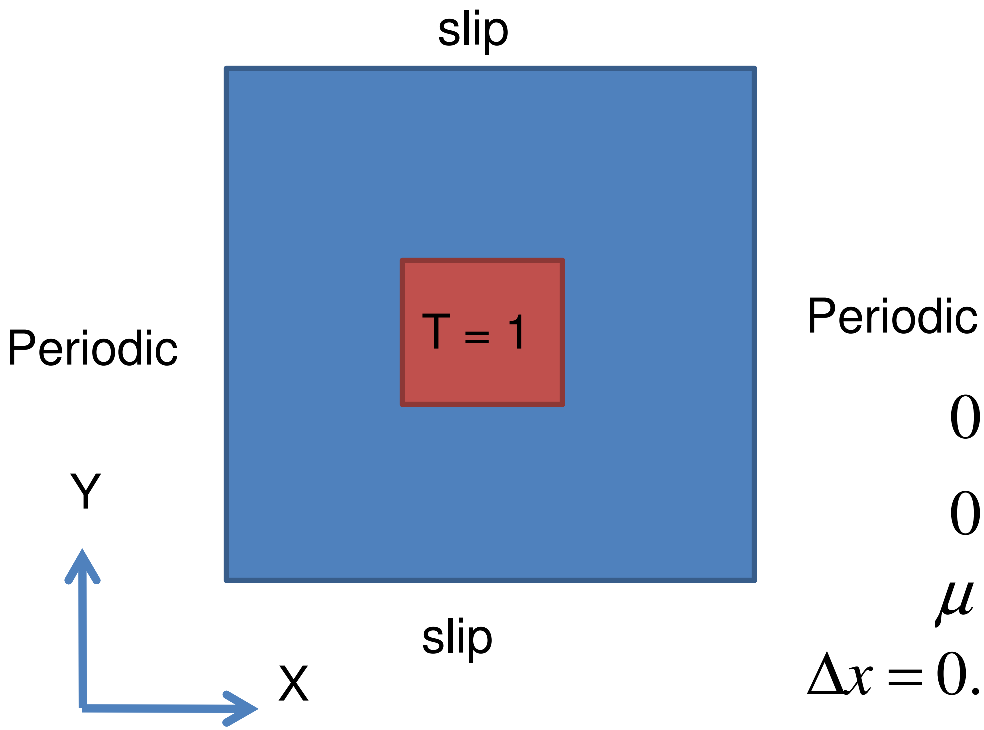
$IC: \quad T(x, y, 0) = 0$

$\Delta x = 0.01, \quad \Delta t = 0.01$

$\alpha = 0.05$

2D Convection Diffusion Equation

$$\frac{\partial T}{\partial t} + u\frac{\partial T}{\partial x} + v\frac{\partial T}{\partial y} = \mu\left[\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2}\right]$$



$$0 \le x \le 2$$

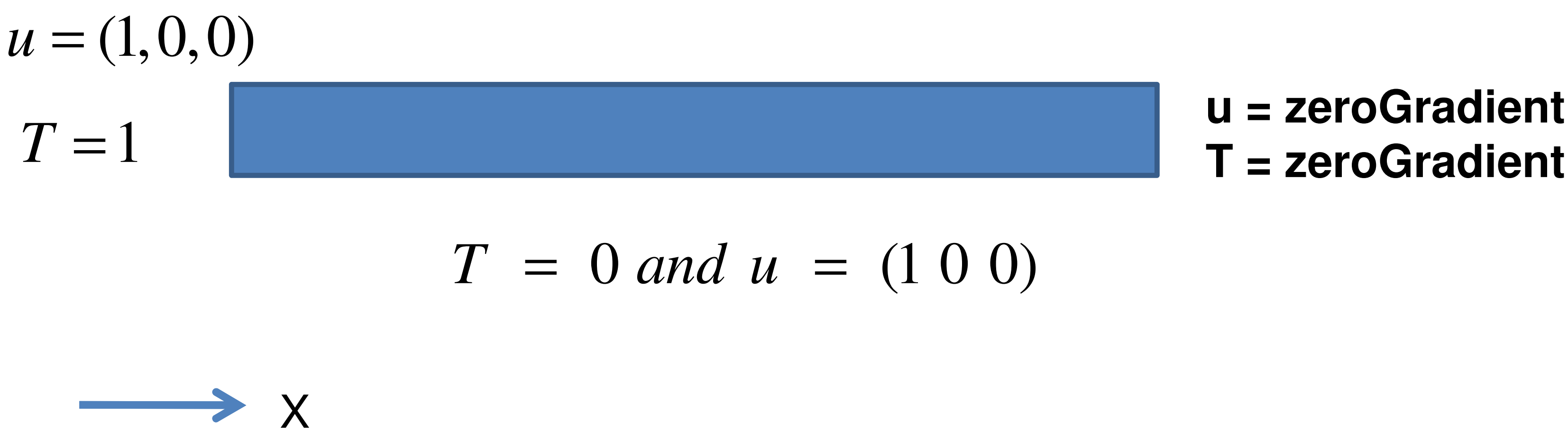
$$0 \le y \le 2$$

$$\mu = 0.05$$

$$\Delta x = 0.01, \quad \Delta t = 0.01$$

Pure Convection

$$\frac{\partial T}{\partial t} + \frac{\partial(\phi T)}{\partial x} = 0$$



Thank you