# Project description:

Lid-Driven Cavity flow with energy term and temperature B-C was solved - $\psi$ - $\Omega$ formulation

We want to show the effect of different Reynolds and Richardson numbers on the flow velocity and temperature distribution. (Prandtl number (Pr) is constant)

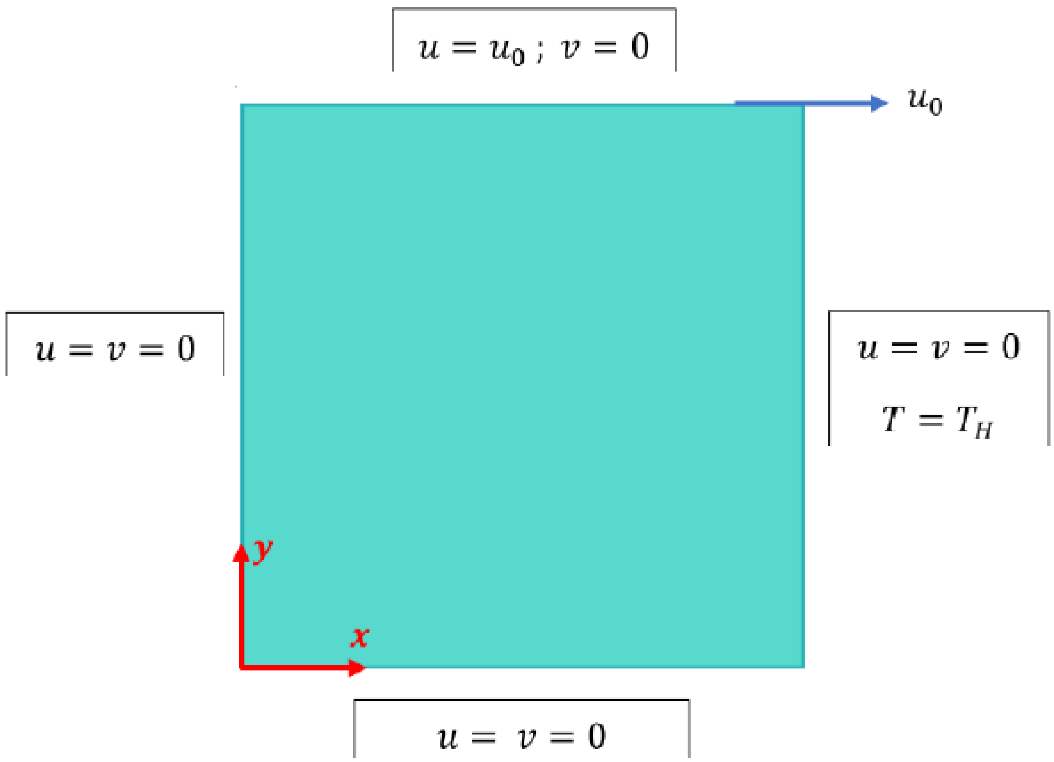



Figure 1: Geometry model and B.C. of the project.

Governing N-S equations:

$$\frac{\partial U}{\partial \tau}+U\frac{\partial U}{\partial X}+V\frac{\partial U}{\partial Y}=-\frac{\partial P}{\partial X}+\frac{1}{Re}\left(\frac{\partial^2 U}{\partial X^2}+\frac{\partial^2 U}{\partial Y^2}\right)$$

$$\frac{\partial V}{\partial \tau}+U\frac{\partial V}{\partial X}+V\frac{\partial V}{\partial Y}=\frac{\partial P}{\partial y}+\frac{1}{Re}\left(\frac{\partial^2 V}{\partial X^2}+\frac{\partial^2 V}{\partial Y^2}\right)+Ri\theta$$

$$\frac{\partial \theta}{\partial \tau}+U\frac{\partial \theta}{\partial X}+V\frac{\partial \theta}{\partial Y}=\frac{1}{Pe}\left(\frac{\partial^2 \theta}{\partial X^2}+\frac{\partial^2 V}{\partial Y^2}\right)$$

ψ - Ω formulation:

$$\nabla^2\psi=\frac{\partial^2\psi}{\partial x^2}+\frac{\partial^2\psi}{\partial y^2}=-\omega$$

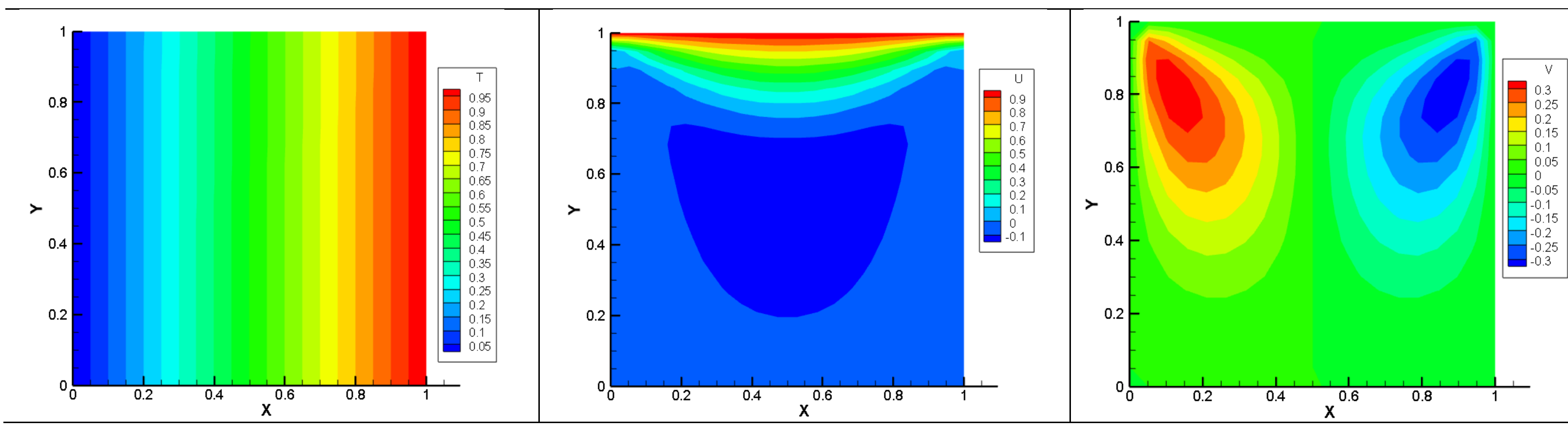
$$u\frac{\partial \omega}{\partial x}+v\frac{\partial \omega}{\partial y}=\nu\left(\frac{\partial^2 \omega}{\partial x^2}+\frac{\partial^2 \omega}{\partial y^2}\right)$$

Pressure equation derived from N-S equations:

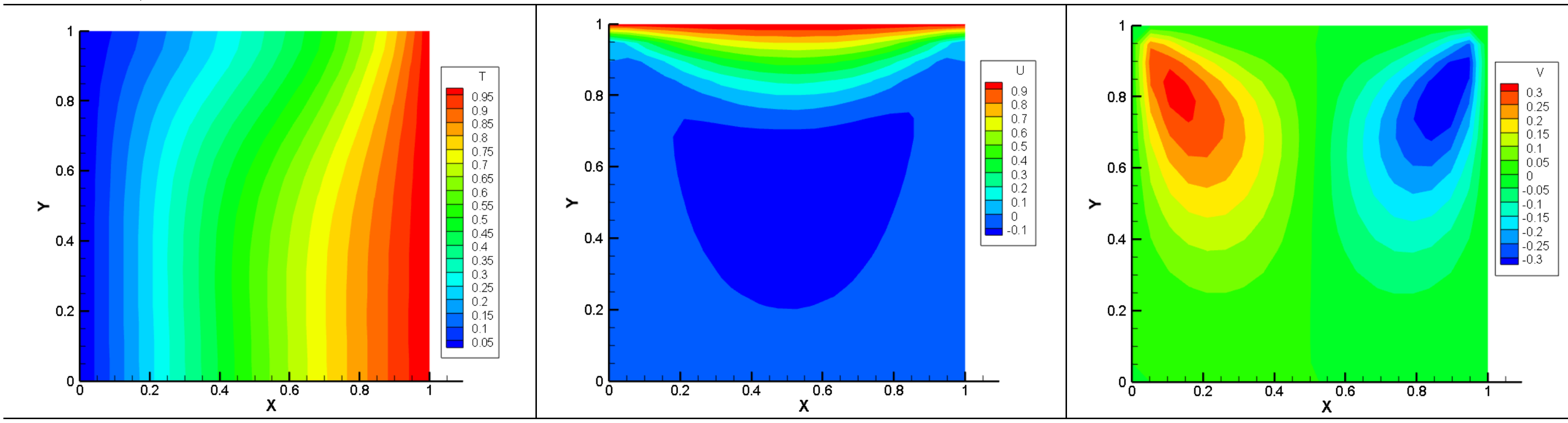
$$\nabla^2 P=\frac{\partial^2 P}{\partial X^2}+\frac{\partial^2 P}{\partial Y^2}=2\left(\frac{\partial U}{\partial X}\frac{\partial V}{\partial Y}-\frac{\partial U}{\partial Y}\frac{\partial V}{\partial X}\right)-Ri\,\frac{\partial \theta}{\partial Y}$$

# Results:

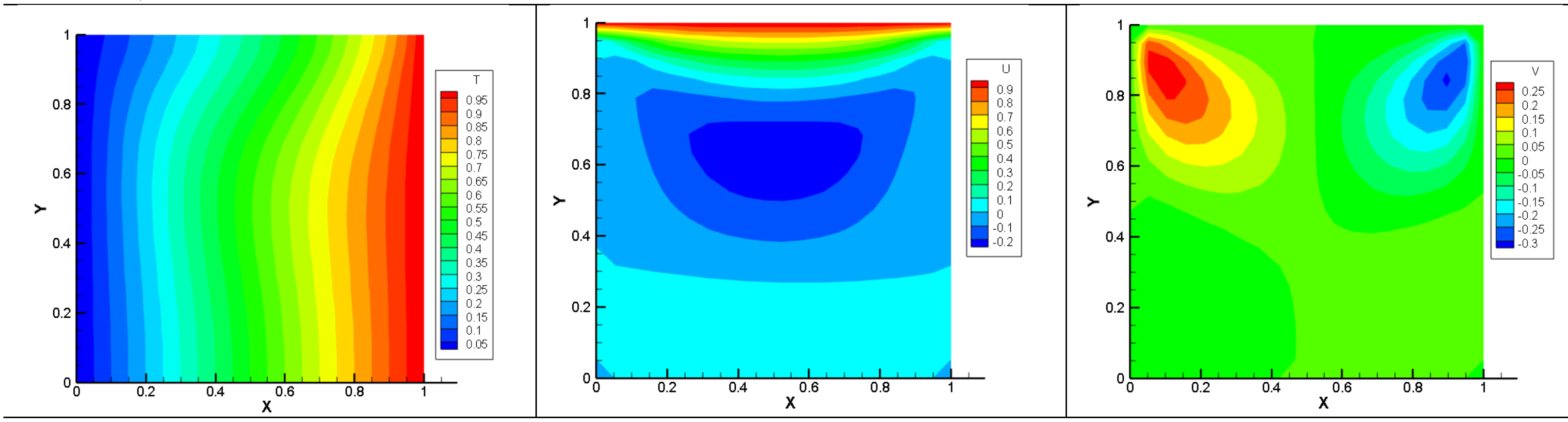
Re=0.1 , Ri=0.1



Re=10 , Ri=0.1




Re=10 , Ri=5




Re=25 , Ri=5