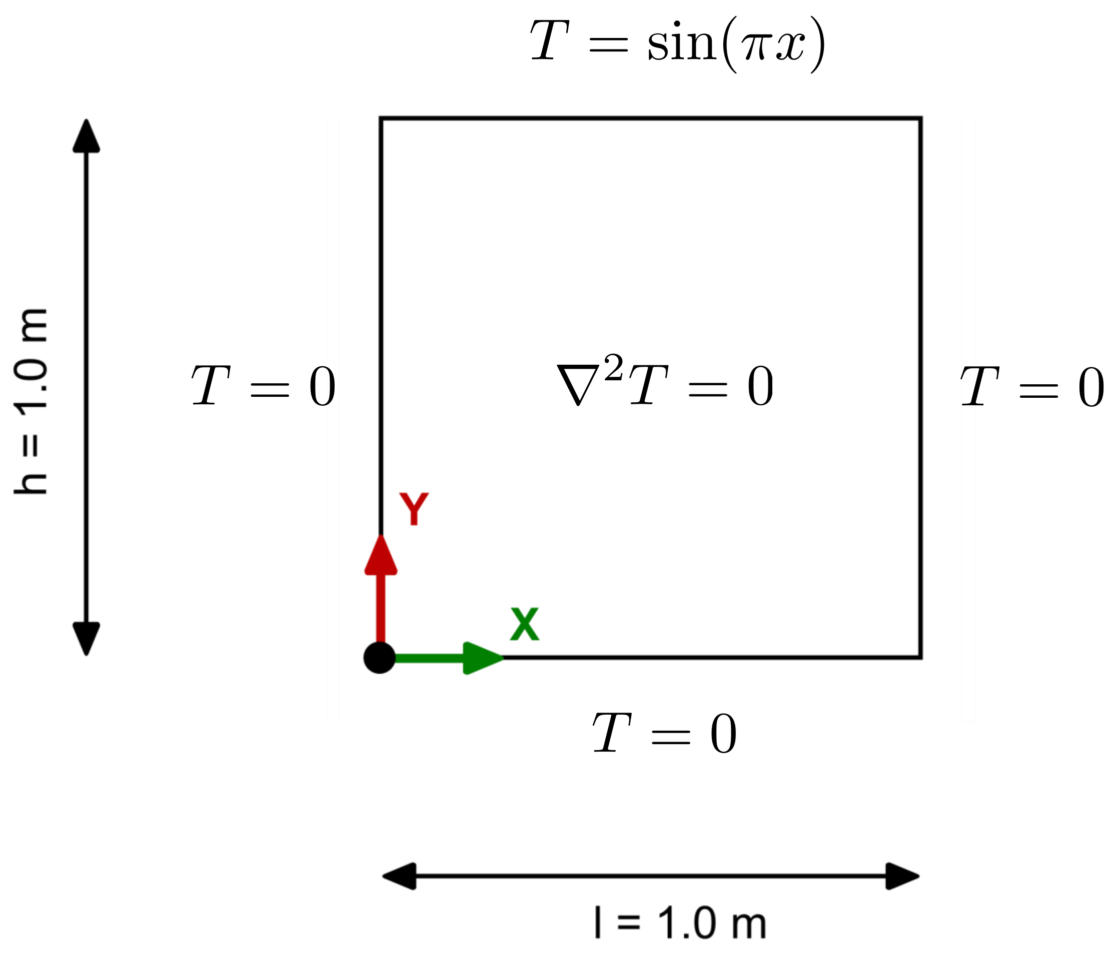
2D Laplace equation in a square domain



- In this case we are solving the following equation (general transport equation),

$$\underbrace{\frac{\partial \rho \phi}{\partial t}}_{\text{Time derivative}} + \underbrace{\nabla \cdot (\rho \mathbf{u} \phi)}_{\text{Convective term}} - \underbrace{\nabla \cdot (\rho \Gamma_\phi \nabla \phi)}_{\text{Difussion term}} = \underbrace{S_\phi}_{\text{Source term}}$$

- We will set the velocity to zero, the diffusion coefficient to one, and no source terms. Therefore, we will solve the following equation,

$$\frac{\partial \rho \phi}{\partial t} - \nabla \cdot (\rho \Gamma_\phi \nabla \phi) = 0$$

- This is the Poisson-Laplace equation, which has a smooth solution.
- With the given boundary and initial conditions, this case has an analytical solution.
- Run the case using different under-relaxation factors.
- Run the case in steady and unsteady mode.
- Run the case using different meshes.

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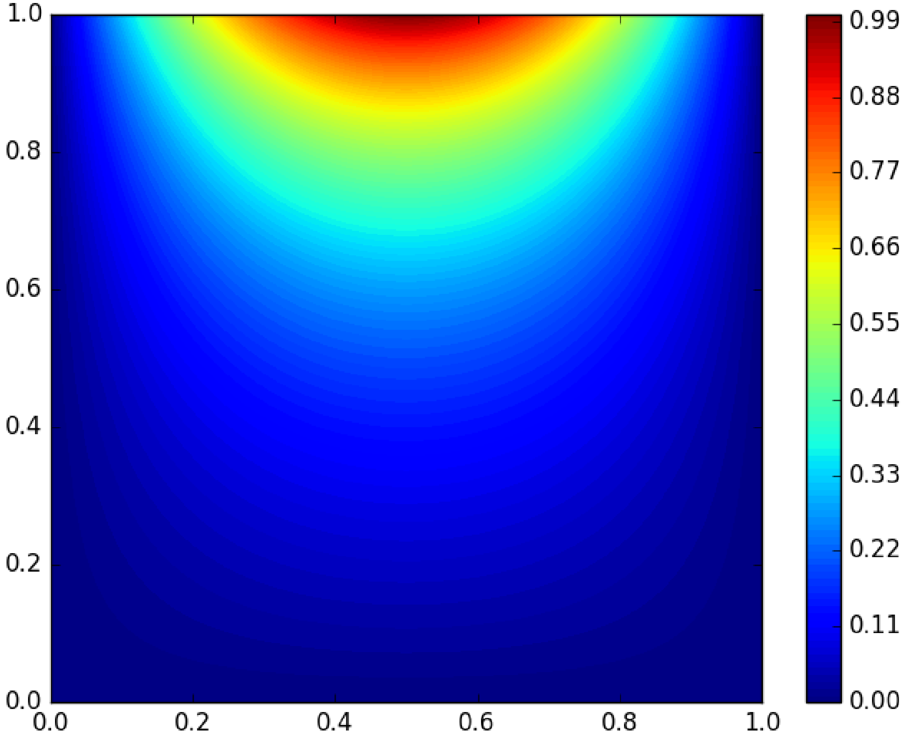
- We are solving for the Laplacian operator, which is a smooth operator.
- This operator appears in many governing equations, e.g., NS momentum equations, transport equations of the turbulent quantities, energy equations.
- This operator is especially sensitive to secondary gradients due to mesh quality issues.



- This problem has the following analytical solution:

$$T(x,y) = \frac{\sin(\pi x) \times \sinh(\pi y)}{\sinh(\pi)}$$