

Computer Assignment #4. Due December 4, 2018

Consider the following 2-dimensional boundary value problem in Fig. 1:

$$u_{,xx} + u_{,yy} = (x^2 + y^2)e^{xy} \quad \text{in } \Omega$$

$$u = 1 \quad \text{on } \Gamma^1$$

$$u = 1 \quad \text{on } \Gamma^2$$

$$u_{,n} = ye^y \quad \text{on } \Gamma^3$$

$$u_{,n} = xe^x \quad \text{on } \Gamma^4$$

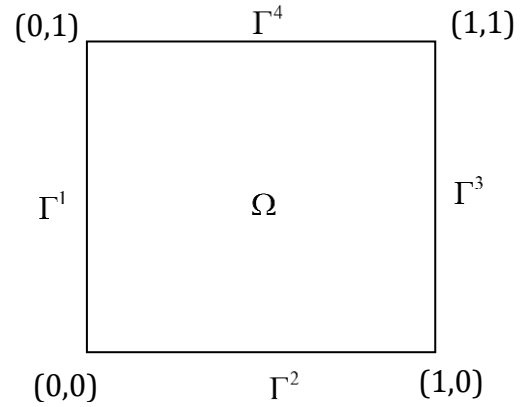


Figure 1. Problem Domain

The analytical solution of this problem is $u = e^{xy}$.

- (1) Obtain finite element solutions u^h using 6x6, 12x12, and 24x24 4-node elements, and compare the finite element solutions u^h with the analytical solution u along the line $y=0.5$ in a plot.
- (2) Compare the finite element solutions $u_{,x}^h$ obtained by using the 3 discretizations with the analytical solution $u_{,x}$ along the line $y=0.5$ in a plot.
- (3) Plot the errors of finite element solutions $e = |u - u^h|$ along the line $y=0.5$ for the 3 discretizations.
- (4) Plot the finite element solution errors $e = |u - u^h|$ at coordinate $(0.5, 0.5)$ for the three discretizations in a log-log plot and obtain the rate of convergence of this error measure.