T U T O R I A L

"Numerical Methods for the Solution of Elliptic Partial Differential Equations"

to the lecture

"Numerics of Elliptic Problems"

Tutorial 06 Tuesday, 28 April 2020, Time: $10^{\underline{15}}$ – $11^{\underline{45}}$, Room: KEP3.

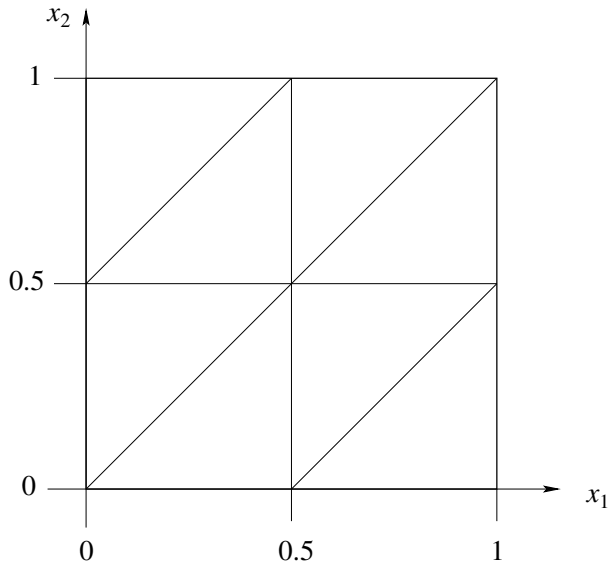
27 In the lectures, we used the input file `*.net` (see Slide 10) for the input of the mesh data. Design and implement a new Algorithm, which inputs the file `coarse.net` containing a coarse triangulation and outputs the file `fine.net` containing the refinement of the coarse triangulation by dividing every triangle of the coarse mesh into 4 triangles (red refinement) !

28* How would you modify the algorithm from Exercise 27 in order to refine selected elements only ? Note that you have to ensure conformity of the triangulation by using the green refinement dividing a triangle into two triangles by bisection.

29 Generate the system of finite element equations for the mixed boundary value problem

$$
\begin{aligned}
-\Delta u(x_1,x_2) &= 0 \quad \forall (x_1,x_2) \in \Omega := (0,1)\times(0,1), && (17)\\
u(x_1,1) &= 0 \quad \forall x_1 \in [0,1], && (18)\\
u(1,x_2) &= 0 \quad \forall x_2 \in [0,1], && (19)\\
u_{x_1}(0,x_2) &= 1-x_2 \quad \forall x_2 \in (0,1), && (20)\\
u_{x_2}(x_1,0) &= 1-x_1 \quad \forall x_1 \in (0,1), && (21)
\end{aligned}
$$

and for the triangulation shown in the attached figure. Solve this linear system of algebraic equations ! Note that u_{x_1} and u_{x_2} denote the partial derivatives with respect to x_1 and x_2.


x_2
1
0.5
0
x_1
0
0.5
1