Example 1

$$-\frac{d}{dx}\left(k\,\frac{du}{dx}\right) = \ f \qquad \text{in } 1 \le x \le 2 \qquad \text{with } u(1) = 3 \text{ and } u'(2) = 4$$

Solve the problem with $k(x) = x$ and $f(x) = -4x$ using 3 linear finite elements with nodes in $x_1 = 1$, $x_2 = 1.3$, $x_3 = 1.5$ and $x_4 = 2$.

********* No answer written yet **********

(On the exercise we solved it using two different approches:
1) the theoretical way, calculation all involved integrals over the entire domain.
2) the practical FEM way, calculating elementwise using matrix-notation.)

Example 2

$$-\nabla\cdot(k\,\nabla u) = \ f \qquad \text{in } \Omega = \left\{\begin{matrix} 2 < x < 4 \\ 3 < y < 5 \end{matrix}\right\} \qquad \text{with } u = g \text{ on } \Gamma$$

Solve the problem with 2D FEM and bilinear standard quad functions. Start with dividing each side in two, giving 4 quad elements. The refine by dividing each side by 2 again.. Use a 1-point (mid-point) quadrature formula.

a) Calculate the stiffness matrix and load vector assuming $k = 1$, $f = 1$ and $g = -0.3x^2 - 0.2y^2$.

b) Calculate the stiffness matrix and load vector assuming $k = x$, $f = -(y^2 + 2x^2)$ and $g = xy^2$.

********* No answer written yet **********

(On the exercise we solved part **b** using the practical FEM way, calculating elementwise using matrix-notation.)

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