Self-assessment test #1
1TD254: Finite element methods II, 5.0 hp

Præparatus supervivet

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1. **True/False:** The following problem

$$\begin{aligned} -u_{xx} &= f, \qquad x \in I = (0,1), \\ u(0) &= u(1) = 0, \end{aligned}$$

   is well-posed.

2. **True/False:** The orthogonal projection P_h onto the space V_h, is the minimizer f^* of $\|f - f^*\|_{L^2}$.

3. **True/False:** Let $f(x) = (x-1)(x+1)$. Then according to the midpoint rule,

$$\int_{-1}^{1} f(x)\,dx \approx -1.$$

4. **True/False:** Let $I = (0,1)$. Then

$$\int_I uv + u_x v_x\,dx \le \left(\|u\|^2_{L^2(I)} + \|u_x\|^2_{L^2(I)}\right)^{1/2} \left(\|v\|^2_{L^2(I)} + \|v_x\|^2_{L^2(I)}\right)^{1/2}.$$

5. **True/False:** For the orthogonal projection P_h onto the space V_h, $P_h^2 f = P_h f$.

6. **True/False:** Let $u,\ u_x \in L^2(I),\ I = (0,1)$. Suppose that $u(0) = 0$. Then

$$\|u\|_{L^2(I)} \leq \|u_x\|_{L^2(I)}.$$

7. **True/False:** The following problem

$$\begin{aligned} u_t &= -u_{xx} + f, \qquad x \in I = (0,1), \\ u(t=0,x) &= u_0(x), \\ u(t,0) &= u(t,1) = 0, \end{aligned}$$

is well-posed.

8. **True/False:**

$$\|u+v\|^2 \leq \|u\|^2 + \|v\|^2.$$

9. **True/False:** *A priori* error estimates are difficult to use for mesh adaptivity.

10. **True/False:** The bilinear form

$$a(u,v) := \int_\Omega \nabla u \cdot \nabla v \, \mathrm{d}x$$

defines a scalar product on $V = \{v;\ \|v\|_{L^2(\Omega)} + \|\nabla v\|_{L^2(\Omega)} < \infty\}$.