

Self-assessment test #1
1TD253: Finite element methods, 5.0 hp

Præparatus supervivet

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

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

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:** For an orthogonal basis, the mass-matrix is tri-diagonal.
4. **True/False:** Let $f(x) = (1 - x)(1 + x)$. Then according to the trapezoidal rule,

$$\int_{-1}^1 f(x) dx \approx 0.$$

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

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

6. **True/False:** Simpson's rule is exact for cubic polynomials.

7. **True/False:** For an orthonormal basis, the mass-matrix is the identity.

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

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

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

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

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

is well-posed.

11. **True/False:** The orthogonal projection P_h onto the space V_h can be shown to minimize the absolute error $\max_x |f(x) - P_h f(x)|$.

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

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