Exercises 19 and 24 INF5620

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19

In this exercise we consider an approximation to some function $f(x)$ using LSM or Galerkin methods using P1 elements and the point is to derive the element matrix and vector using the Trapezoidal rule for calculating integrals on the reference element.Assembling contributions and finally showing it results to a linear system $c_i = f(x_i)$ for $i \in I_s$

For the Trapezoidal rule we have

$$\int_{-1}^{1} g(X)dX \approx g(-1) + g(1), \bar{X}_0 = -1, \bar{X}_1 = 1, w_0 = w_1 = 1$$

I did not quite get my head around this one though I have an idea how to proceed: Use the equations on page 47: $\varphi_0(X) = 0.5(1-X)$ $\varphi_1(X) = 0.5(1+X)$ and the example on page 48 where we integrate over a reference element.

$$A^{(e)}_{r,s} = \int_{-1}^{1} \varphi_r(X)\varphi_s(X)detJdX$$

where for P1 $d = 1$ and thus $det[J] = h/2$ Finding the element matrix then using the scheme for the Trapezoidal, then we go on finding the corresponding element vector by:

$$b^{(e)}_{r} = \int_{-1}^{1} f(x(X))\varphi_r(X)detJdX$$

Then we can use the procedure on chapter 5.3 Making finite elements behave as finite differences, but instead we use elementwise computations. Using the above Trapezoidal rule on the reference elements.

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I did not get time for this one.