

HW 3: Due Thursday Feb. 18

1. JNR 4.13
2. JNR 4.21
3. Consider a single 1-D 4 node Lagrangian element with nodes located at $x_1^e, x_2^e, x_3^e, x_4^e$.
 - (a) What is the order of the element? i.e. what is the degree of completeness?
 - (b) Write expressions for the shape functions of this element.
 - (c) Plot your shape functions.
 - (d) Consider a 1-D bar, discretized by 3 of these elements. Create a global numbering scheme for the mesh and write out the LM matrix.
4. The 1-D 4 node *isoparametric* element has nodes in the parent domain located at $-1, -1/3, 1/3, 1$.
 - (a) Write out the isoparametric shape functions $\psi_i^e(\xi)$.
 - (b) Assuming an element with physical nodes located at $0, 1, 1.5, 2$. Write out the isoparametric mapping.
 - (c) Compute the isoparametric Jacobian $J_e = \partial x_e / \partial \xi$ and plot. Is the Jacobian positive everywhere?
5. Explain the best approximation property of the finite element method.