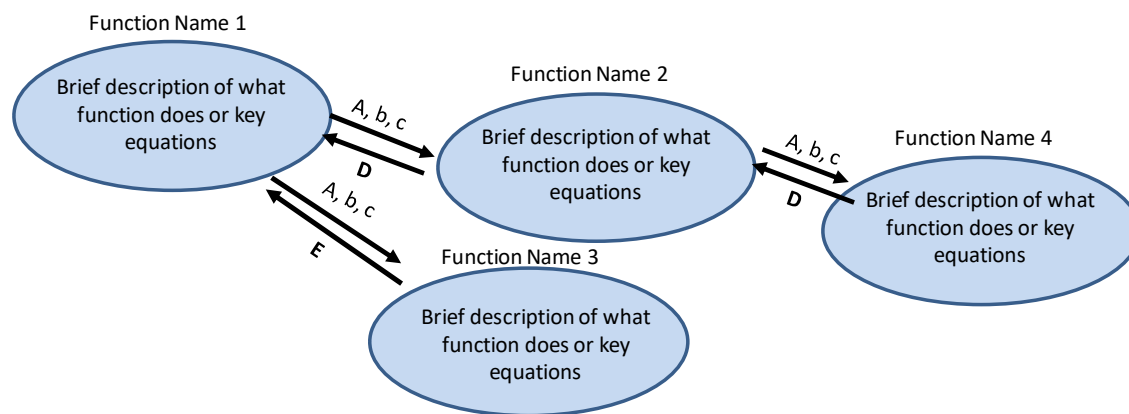


Homework 3: Stress and Strain

Write code to calculate the stress and the strain of a 4-noded linear 2-D and 8-noded quadratic 2-D element as a function of location within the element. Break up the code into a different function for each intermediate quantity. **Complete (1), (2) and (3) for pre-homework submission.**

- (1) For each intermediate quantity, write one unit test for at least one of the elements, and make sure you have at least one test for each element. Show where the “right answer” came from and what your code calculated. Label which element type each test belongs to.
- (2) Create a “bubble diagram” of the functions needed for (4) and (5). Make sure to find the most abstract tasks and create one bubble chart that works for both elements. Show the interdependency of the functions, using arrows connecting functions as shown below, where an incoming arrow should be labelled with the inputs for the function and an outgoing arrow labeled with the outputs. Indicate in RED the functions which will need to be customized for each element.



- (3) Write pseudo-code for each of the new functions in the bubble chart. Get to enough detail that you have worked out all the indices and dimensions of any arrays needed. Look up key functions needed and show that the arrays you give to the functions are in the right form.
- (4) Write a unit test for checking the stress and strain of all 3 elements using nodal locations and displacements from Homework 2 and properties of aluminum. Assume plane stress. Show where the “right answer” came from and what your code calculated.
- (5) Create an 8-noded quadratic 2-D element which has a Jacobian that cannot be inverted. Plot the element’s shape in natural coordinates and global coordinates.