

## MAE 404/503 Finite Elements in Engineering

### Programming assignment #5

Write a MATLAB function that implements shape functions and their derivatives for 2-node, 3-node, and 4-node one-dimensional elements (linear, quadratic, cubic) in terms of the parent coordinate  $1 \leq \xi \leq 1$ . Assume element nodes are equally spaced in the parent coordinates.

#### Instructions for programming and assignment submission:

- Submit a single file (MATLAB code). The file name must be in the format “asurite\_hw5.m”. Note that the separator is an underscore and you must substitute your ASU id, e.g., jdoe123.
- The file **must** define a function of the same name as the file name (but without the “.m”), however, it is recommended to follow the following format and define 4 functions.

```
function [N, dNdp] = asurite_hw5(p, nne)
    if nne == 2
        [N, dNdp] = shape2(p);
    elseif nne == 3
        [N, dNdp] = shape3(p);
    elseif nne == 4
        [N, dNdp] = shape4(p);
    end
end

function [N, dNdp] = shape2(p)
    % Define linear shape functions and derivatives
end

function [N, dNdp] = shape3(p)
    % Define quadratic shape functions and derivatives
end

function [N, dNdp] = shape4(p)
    % Define cubic shape functions and derivatives
end
```

- The order of the input variables and output variables must not be changed.
- **The input variables are:**
  - **p**: the parent coordinate  $\xi$  to compute the shape functions at.
  - **nne**: the number of nodes per element.
- **The output variables are:**
  - **N**:  $nne \times 1$  array of element shape functions.
  - **dNdp**:  $nne \times 1$  array of element shape functions derivatives.
- If the input variable **nne = 2**, then a **linear shape** function must be used. If **nne = 3**, then a **quadratic shape** function must be used, if **nne = 4**, then a **cubic shape** function should be used.

**Your submission will be graded electronically. Failure to comply with the above instructions may result in zero credit.**

**Grading:** You will receive points for each of the functions that are correct (linear, quadratic, cubic). Both output values (N and dNdp) must be correct in order to receive a point for the function. For full credit for this assignment, those enrolled MAE 404 need only to compute the shape functions and derivatives for linear and quadratic elements, while those in MAE 503 must complete linear, quadratic and cubic.

Submit your assignment to <http://sparky.fulton.asu.edu/fem/>

Due date: Feb 12 at 11:59 pm.

You may submit as many times as you like, however only your most recent submission will count for you grade.