Programming assignment #10

Write a MATLAB function that integrates the nodal flux vector on the top edge of a semi-circular plate given a mesh and a function that describes the nodal heat flux. The mesh is composed of 8-node quadratic elements that has curved edges at the boundary. The nodal heat flux should be integrated with at least a 2-point Gaussian quadrature rule and is defined as

$$\mathbf{f}^e = -\int_{\Gamma_q} \mathbf{N}^e \bar{q} d\Gamma .$$

For the example mesh file provided with this assignment, the node number is shown in the figure below. Note that the mesh that your code will be checked against will be generated with a different element size and therefore, you should not assume that the node numberings will remain constant.

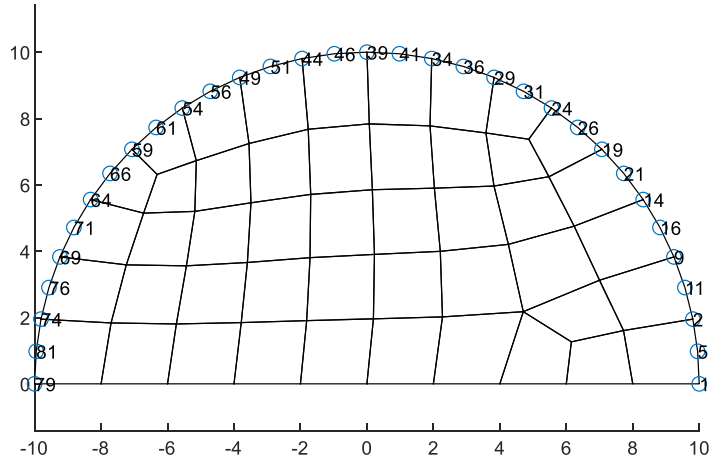

Figure 1 – Example of node numbering on the top edge of the mesh.

To determine which nodes are on the boundary and sort them in the correct ordering to generate an edge connectivity matrix, you can use the following code.

```
% Finds nodes located at radius of 10 or larger from the origin.
ns = find(sqrt(mesh.x(1,:).^2 + mesh.x(2,:).^2) > 9.999);
% Reorders the nodes so that they are sorted by their x-coordinate.
[~, order] = sort(mesh.x(1,ns));
ns = ns(order);
```

Instructions for programming and assignment submission:

- **The input variables are:**
  - **mesh**: a MATLAB structure containing a mesh.conn and mesh.x fields for the connectivity and nodal coordinates. Note that you do not need to use mesh.conn.
  - **b:** a MATLAB function that takes the global position as an input and returns the heat flux leaving the domain at the boundary at this position.
- **The output variable is:**
  - **f:** [n×1] matrix of the nodal heat fluxes

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Template code for programming assignment

```
function [f] = asurite_hw10(mesh, qbar)
    if nargin == 0
        mesh = abaqus_reader('semicircle.inp');
        qbar = @(x,y) x.^2 - y.^2;
    end
end
```

Code used to create Figure 1 (do not submit this, but it may be useful for debugging).

```
r = sqrt(mesh.x(1,:).^2 + mesh.x(2,:).^2);
ns = find(r > 9.999);
figure(1); clf; hold on;
p.facecolor = 'w';
p.vertices = mesh.x';
p.faces = mesh.conn([1 5 2 6 3 7 4 8], :)';
patch(p);
scatter(mesh.x(1,ns), mesh.x(2,ns));
for i=ns
    text(mesh.x(1,i), mesh.x(2,i), int2str(i));
end
axis equal;
```

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

Due date: April 9 at 11:59 pm.

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