ME2 Computing- Tutorial 9: 2D interpolation with unstructured grids

Learning outcomes:

- Being able to interpolate over a triangle with various methods
- Being able to interpolate over triangulated grids
- Being able to refine triangulated mesh

Before you start

In your H drive create a folder *H:\ME2CPT\Tutorial9* and work within it.

Introduction

You need to refer to the slides and the video to be able to interpret what requested in these tasks.

Task A: Interpolation over a triangle: nearest neighbour method

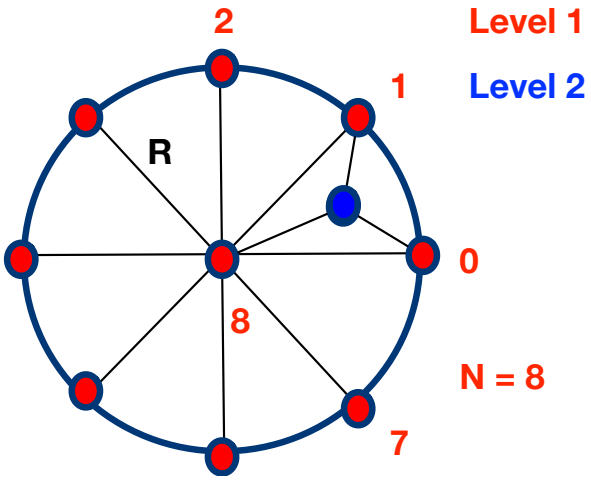
Write a function *TrNN*, to interpolate three points on a plane with the nearest neighbour methods. The function receives the coordinates of three points (r_1, r_2, r_3) and the values of the mathematical function at these three points (f_1, f_2, f_3), and the coordinates of a fourth point r_p, coplanar with the first three ones, and returns the interpolated value $f(r_p)$.

Task B: Interpolation over a triangle: barycentric coordinates

Write a function *TrBaryc*, to interpolate three points on a plane with the barycentric coordinates method. The function has same input and output arguments as in Task A.

Task C: Interpolation over a triangulated mesh and mesh refinement

1. Preparatory work, to generate a mesh with multiple triangles:
   Consider a circle of radius *R* and subdivide its perimeter in *N* points. Generate a triangulated mesh grid with *N+1* nodes, as depicted in the figure (red nodes):



   Assign at each node i the numerical values:

$$f[i] = i\frac{360}{N} \qquad i = 0,1,2,\dots,N$$

   (You can assign any value that you prefer, this is only a suggestion, as we need to assign some values at nodal points).

2. For each triangle:

   i) establish a new node at the centroid of the triangle.
   Given three vertices, r_0, r_1, r_2, the centroid of a triangle is defined as a node r_p, with coordinates:

$$x_p = \frac{x_0 + x_1 + x_2}{3} \qquad y_p = \frac{y_0 + y_1 + y_2}{3}$$

   (you can choose to create any node you prefer inside the triangle, i.e., take the incenter or the circumcenter or the orthocentre, etc.)

   ii) interpolate the value of f at this new node r_p.

   Repeat the processes i) and ii) for a number of levels *L*.