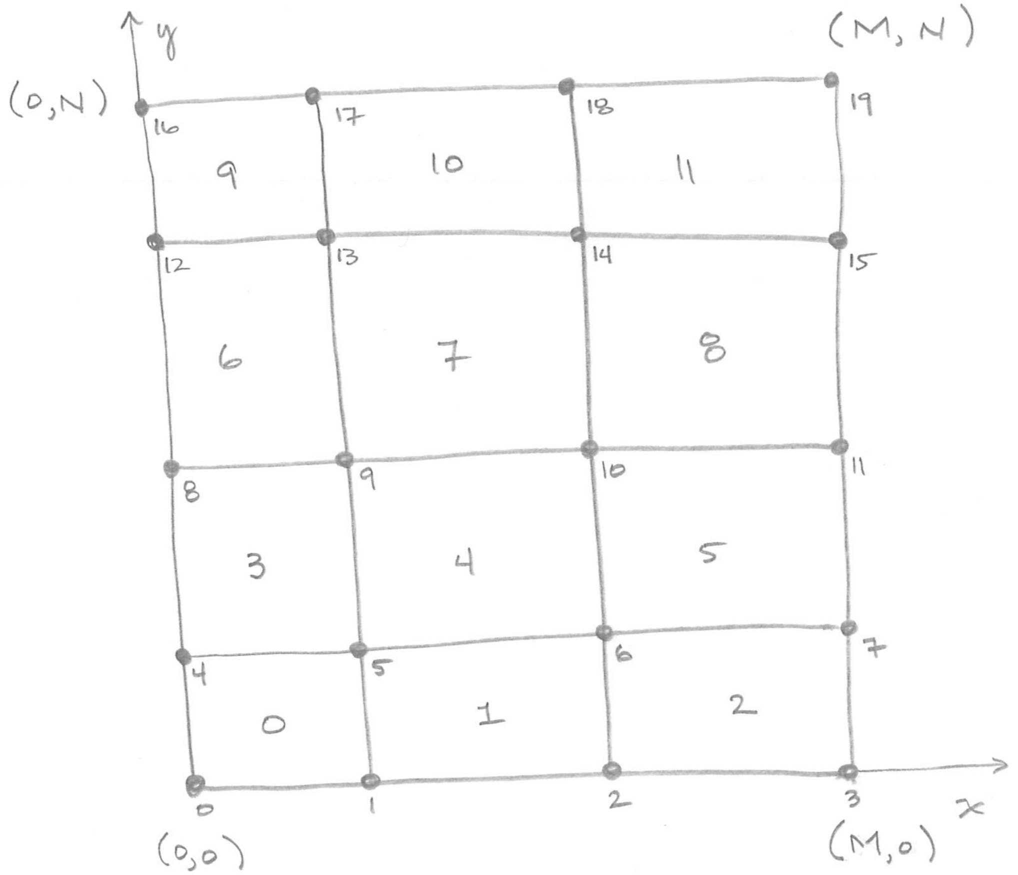
Pre-processing

The process of preparing all required input for a finite element program. This usually consists of building a mesh, assigning loads and boundary conditions, building connectivity arrays, etc.

Tensor product linear meshes

Consider the following mesh



M - width in x direction

N - height in y direction

m - number of elements in x direction

n - number of elements in y direction

In this case, $m = 3$, $n = 5$

We now want to devise algorithms to construct algorithms to build the nodes and IEN connectivity array.

Constructing nodal positions

The input are the 4 parameters (M, N, m, n) needed to specify a tensor product mesh and the output will be an array of nodal positions.

2d algorithm

```
$x_i = 0$
$y_j = 0$
$step_i = M/m$
$step_j = N/n$
for $j = 0;\ j < n+1;\ ++j$
    $y_j = j * step_j$
    for $i = 0;\ i < m+1;\ ++i$
        $x_i = i * step_i$
        $Node(j*(m+1)+i) = \{x_i, y_j\}$
```

Constructing element connectivity array IEN

The input is the element index e and the number of elements m in the x direction. The output is the nodal connectivity array for that element.

2d algorithm

```
$i_{ee} = e \% m$
$j_{ee} = e / m$
$n_{en} = 4$
$size = \sqrt{n_{en}}$
for $j=0$; $j < size$; $++j$
    $j_c = j_{ee} + j$
    for $i=0$; $i < size$; $++i$
        $i_c = i_{ee} + i$
        $A = j_c * (m+1) + i_c$
        $a = j * size + i$
        $IEN(e, a) = A$
```

Note that this algorithm can be wrapped up in a loop over elements to populate the IEN array for every element in the mesh.