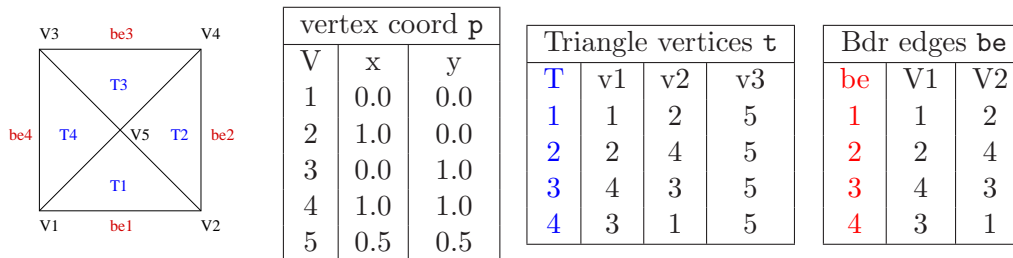


## 2D triangular mesh

To write a 2D finite element program using continuous piecewise  $P_1$  elements on triangular meshes, we need the following minimum set of mesh data:



Usually, we would like to have the triangles be positively oriented, that is, the three vertices of a triangle is given in the counter-clockwise order. Notice that a triangle's orientation can easily be checked by computing the Jacobian from the reference triangle to this triangle. If the Jacobian is negative (negatively orientated triangle), the orientation can be easily fixed by swapping the second and the third vertices.

Boundary edges need to be specified in order to apply boundary conditions later. We would also like the boundary edges to be given in the positive orientation, that is, the domain lies on the left-hand side of a boundary edge when looking from its starting vertex to its ending vertex.

There are many different methods to get a 2D triangular mesh in Matlab. To name a few:

1. Write a uniform mesh by hand, when the domain  $\Omega$  is a rectangle or combination of rectangles. For example, uniform meshes as shown in the following can be written by hand.



2. Use the Matlab PDE Toolbox, if you have access to it. This Toolbox is not free. It has a 2D mesh generator. Details can be found on <http://www.mathworks.com/products/pde/>
3. Use Distmesh, which is an open-source Matlab package generating 2D and 3D meshes. Distmesh can be downloaded from
  - (a) Old version : <http://www-math.mit.edu/~persson/mesh/>
  - (b) New verison : [http://people.sc.fsu.edu/~burkardt/m\\_src/distmesh/distmesh.html](http://people.sc.fsu.edu/~burkardt/m_src/distmesh/distmesh.html)
4. You can also read a mesh from a given mesh file generated by other programs. For example,
 

Triangle : <http://www.cs.cmu.edu/~quake/triangle.html>

Here's a list of many mesh generators:

<http://www-users.informatik.rwth-aachen.de/~roberts/software.html>

Be careful that in mesh files generated by a c/c++ program, array indices starts from 0, while in Matlab, array indices starts from 1. You need to make necessary changes in order to read the mesh correctly.