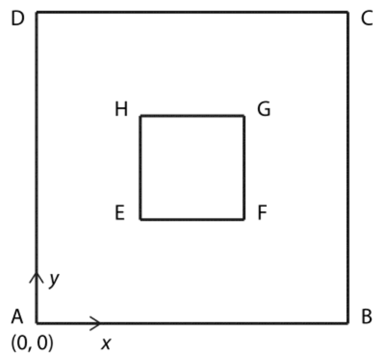
Qn3 (10 marks)

Deadline 27 Sep (Wed), 2359 hrs

The steady state heat conduction problem is given by

$$\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} = 0$$

where T is the temperature field.



Consider the above plate *ABCD* with a central opening *EFGH*. The dimensions are $AB = BC = CD = AD = 3m$ and $EF = FG = GH = EH = 1m$. The location of the central opening is such that node *E* is positioned at (1, 1).

Boundary *AB* is maintained at $T = 100^{\circ}\mathrm{C}$, and boundary *CD* at $T = 0^{\circ}\mathrm{C}$. A zero flux is maintained at *BC, AD, EF, FG, GH and EH*.

Note: a zero flux is defined as zero gradient in the normal direction of a surface, i.e. $\frac{\partial T}{\partial x} = 0$ at a vertical boundary and $\frac{\partial T}{\partial y} = 0$ at a horizontal boundary.

Determine the temperature at the following points:

a	(0.5, 0.5)
b	(0.5, 1.5)
c	(0.5, 2)
d	(1, 0.5)
e	(1.5, 0.5)
f	(2, 0.5)
h	(2.5, 2.5)

CE5377 students:

- Solve the problem as it is to determine the temperature at points *a* – *h* using the finite difference method. (Don’t need to think too much…)
- Discuss on the accuracy of method and solution.

CE6077 students:

- Discuss on how the problem can be solved more efficiently. Then, solve it accordingly to determine the temperature at points *a* – *h* using the finite difference method.
- Discuss on the accuracy of method and solution.

Note to all: for this problem, you are free to decide whether you need to use MATLAB. Write down clearly your steps/derivations and how you solve the problem.