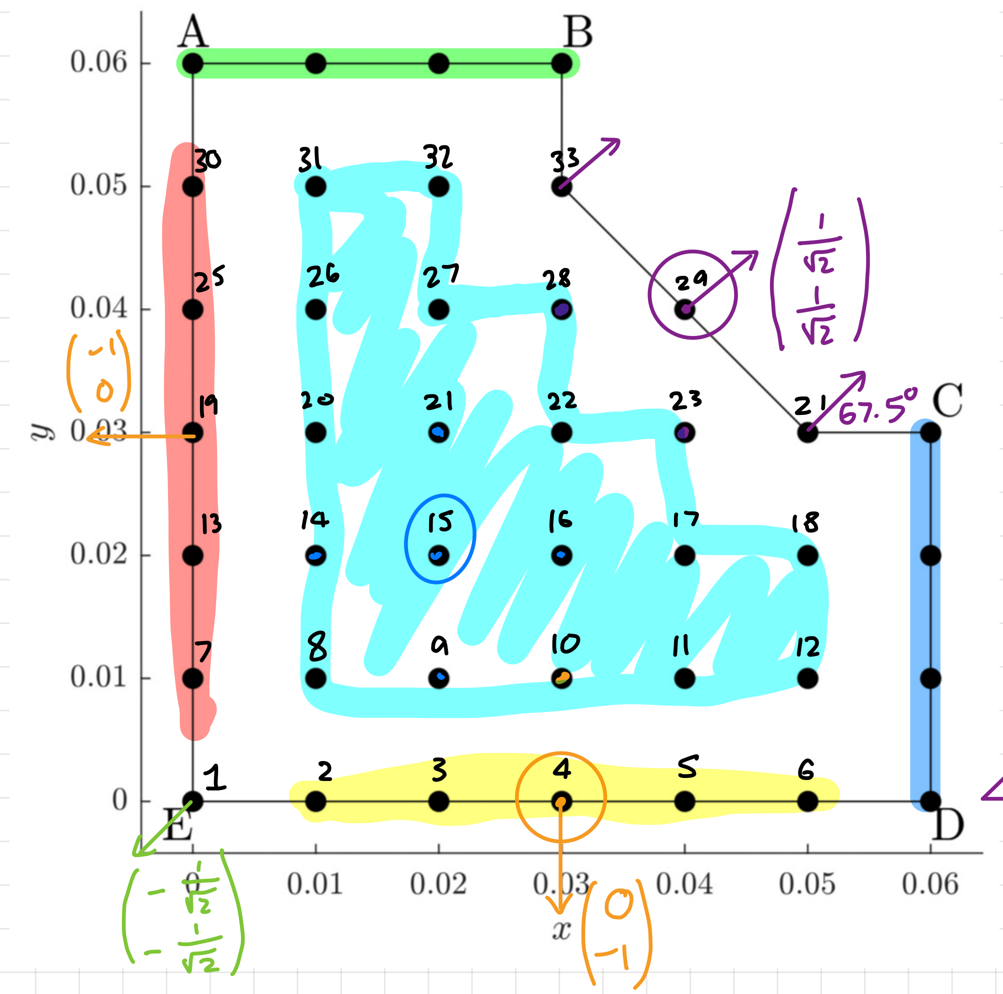
# Notes from Prac

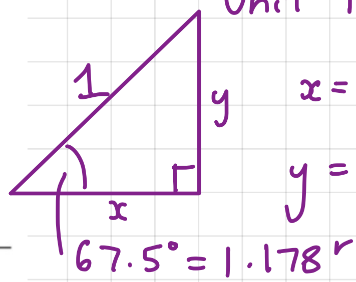



Separate equations for report:
- 1
- 29
- 33/21
- red
- blue
- yellow

all equal to 40

all equal to 70

Unit Normal




$x = \cos(1.178)$

$y = \sin(1.178)$

## How to solve for Node 4
(2, 3, 5, 6)

$$\nabla T \cdot \hat{n} = 0$$

$$\left(\frac{\partial T}{\partial x}, \frac{\partial T}{\partial y}\right) \cdot (0, -1) = 0$$

$$0 \cdot \frac{\partial T}{\partial x} + -1 \cdot \frac{\partial T}{\partial y} = 0$$

$$\therefore \; -\frac{\partial T}{\partial y} = 0$$

$$\frac{-(u_{10} - u_4)}{\Delta x} = 0$$

$$-u_{10} + u_4 = 0$$

$$u_4 = u_{10}$$

## How to solve for Node 7
(13, 19, 25, 30)

$$\nabla T \cdot \hat{n} = 0$$

$$\left(\frac{\partial T}{\partial x}, \frac{\partial T}{\partial y}\right) \cdot \begin{pmatrix} -1 \\ 0 \end{pmatrix} = 0$$

$$-1 \cdot \frac{\partial T}{\partial x} + 0 \cdot \frac{\partial T}{\partial y} = 0$$

$$\therefore \; -\frac{\partial T}{\partial x} = 0$$

$$-\frac{(u_7 - u_8)}{\Delta x} = 0$$

$$-u_7 + u_8 = 0$$

$$u_7 = u_8$$

How to solve for Node 15 (all interior)

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

Lecture notes for steps

$$-4u_{15} + u_{14} + u_{16} + u_{21} + u_9 = 0$$

How to solve for Node 29 (33, 24)

$$k \, \underset{\sim}{\nabla} T \cdot \underset{\sim}{\hat{n}} = h(T_\infty - T)$$

$$k\left(\frac{\partial T}{\partial x}, \frac{\partial T}{\partial y}\right) \cdot \left(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right) = h(T_\infty - u_{29})$$

$$k\left(\frac{1}{\sqrt{2}} \frac{u_{29} - u_{28}}{\Delta x} + \frac{1}{\sqrt{2}} \frac{u_{29} - u_{23}}{\Delta x}\right) = h(T_\infty - u_{29})$$

$$\frac{1}{\sqrt{2}} k \left(\frac{u_{29} - u_{28}}{\Delta x} + \frac{u_{29} - u_{23}}{\Delta x}\right) = h(T_\infty - u_{29})$$

$$\frac{1}{\sqrt{2}} k \left(\frac{u_{29} - u_{28} + u_{29} - u_{23}}{\Delta x}\right) = h(T_\infty - u_{29})$$

$$\frac{\frac{1}{\sqrt{2}} k}{\Delta x} \left(2u_{29} - u_{28} - u_{23}\right) = hT_\infty - hu_{29}$$

$$\frac{k\Delta x}{\sqrt{2}}(2u_{29}) - h(u_{29}) - \frac{k\Delta x}{\sqrt{2}}(u_{28}) - \frac{k\Delta x}{\sqrt{2}}(u_{23}) = hT_\infty$$

$$\left(\frac{2k\Delta x}{\sqrt{2}} - h\right) u_{29} - \left(\frac{k\Delta x}{\sqrt{2}}\right) u_{28} - \left(\frac{k\Delta x}{\sqrt{2}}\right) u_{23} = hT_\infty$$

How to solve for Node 1

$$\nabla T \cdot \hat{n} = 0$$

$$\left(\frac{\partial T}{\partial x}, \frac{\partial T}{\partial y}\right) \cdot \left(-\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}\right) = 0$$

$$-\frac{1}{\sqrt{2}} \cdot \frac{\partial T}{\partial x} + -\frac{1}{\sqrt{2}} \cdot \frac{\partial T}{\partial y} = 0$$

$$-\frac{1}{\sqrt{2}}\left(\frac{u_1 - u_2}{\Delta x}\right) - \frac{1}{\sqrt{2}}\left(\frac{u_1 - u_7}{\Delta x}\right) = 0$$

$$\frac{-\frac{1}{\sqrt{2}}}{\Delta x}(u_1 - u_2) + \frac{-\frac{1}{\sqrt{2}}}{\Delta x}(u_1 - u_7) = 0$$

let $a = \dfrac{-\frac{1}{\sqrt{2}}}{\Delta x} = \dfrac{-\Delta x}{\sqrt{2}}$

$$a u_1 - a u_2 + a u_1 - a u_7 = 0$$

$$2 a u_1 - a u_2 - a u_7 = 0$$

$$\therefore \frac{-2\Delta x}{\sqrt{2}} u_1 + \frac{\Delta x}{\sqrt{2}} u_2 + \frac{\Delta x}{\sqrt{2}} u_7 = 0$$

to make matrix symmetric all nodes need to depend on eachother

e.g. 15 depends on 14, 16, 21, 9 so 14, 16, 21, 9 need to depend on 15.