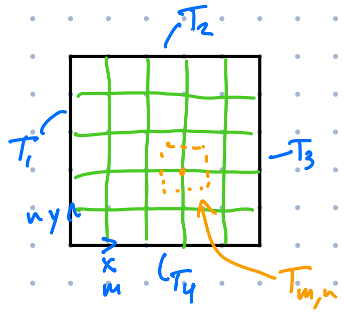
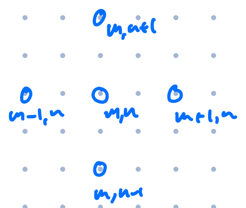
5C - FINITE DIFFERENCE CONTINUED



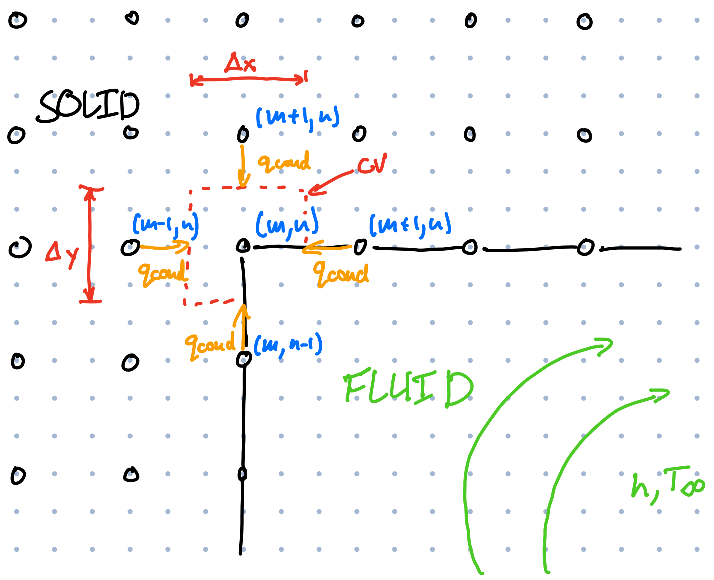
$T(x,y) \to \boxed{T_{m,n}}$

$$T_{m-1,n} + T_{m+1,n} + T_{m,n-1} + T_{m,n+1} - 4T_{m,n} = 0$$



$T_{m,n}$ is nothing but the average of its neighbors

* Think of diffusion as an averaging process



$$\cancel{\dot{E}_{st}}^{\,0} = \dot{E}_{in} - \cancel{\dot{E}_{out}}^{\,0} + \cancel{\dot{E}_g}^{\,0}$$

$$\dot{E}_{in} = 0$$

"unit depth" → to get area

$$k\Delta y(1)\left(\frac{T_{m-1,n} - T_{m,n}}{\Delta x}\right) + k\Delta x(1)\left(\frac{T_{m,n+1} - T_{m,n}}{\Delta y}\right) + k\frac{\Delta y}{2}(1)\left(\frac{T_{m+1,n} - T_{m,n}}{\Delta x}\right)$$

$$+ k\frac{\Delta x}{2}(1)\left(\frac{T_{m,n-1} - T_{m,n}}{\Delta x}\right) + h\frac{\Delta x}{2}(1)(T_\infty - T_{m,n}) + h\frac{\Delta y}{2}(1)(T_\infty - T_{m,n}) = 0$$

conduction | convection

Assume, $\Delta x = \Delta y$, simplify:

$$T_{m-1,n} + T_{m,n+1} + \frac{1}{2}(T_{m+1,n} + T_{m,n-1}) + \frac{h\Delta x}{k}T_\infty - \left(3 + \frac{h\Delta x}{k}\right)T_{m,n} = 0$$

Finite Difference Eq. for an interior corner node with convection.

See Table 4.2