

ASSIGNMENT 2

2D Heat Diffusion Equation Using Python and Temperature Contour Animation Using Matplotlib

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2D Heat Diffusion Equation:

$$\frac{1}{\alpha} \frac{\partial T}{\partial t} = \frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2}$$

$$\text{Time derivative: } \frac{\partial T}{\partial t} = \frac{T_{xy}^{k+1} - T_{xy}^k}{\Delta t}$$

$$\text{Space derivative: } \frac{\partial^2 T}{\partial x^2} = \frac{T_{x+1,y}^k + T_{x-1,y}^k - 2T_{xy}^k}{(\Delta x)^2}$$

$$\frac{\partial^2 T}{\partial y^2} = \frac{T_{xy+1}^k + T_{xy-1}^k - 2T_{xy}^k}{(\Delta y)^2}$$

$$\frac{1}{\alpha} \left(\frac{T_{xy}^{k+1} - T_{xy}^k}{\Delta t} \right) = \left(\frac{T_{x+1,y}^k + T_{x-1,y}^k - 2T_{xy}^k}{(\Delta x)^2} \right)$$

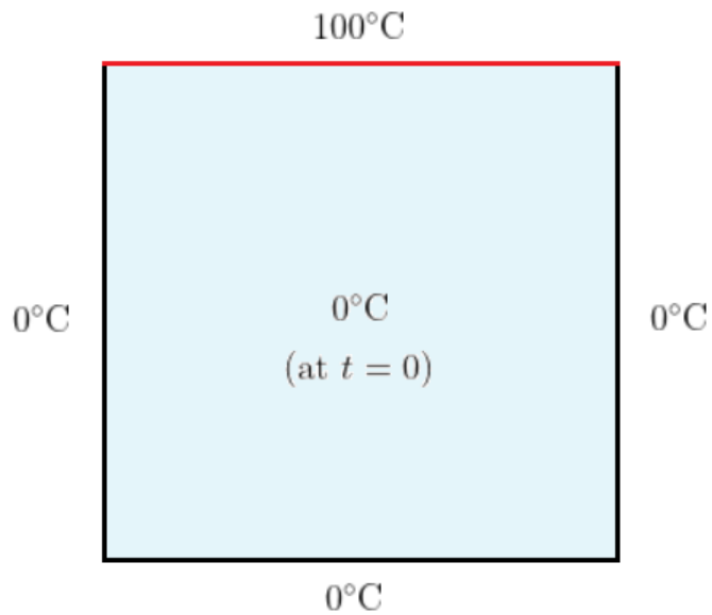
$$+ \left(\frac{T_{xy+1}^k + T_{xy-1}^k - 2T_{xy}^k}{(\Delta y)^2} \right)$$

$$\text{Assume } \Delta x = \Delta y$$

$$r = \frac{\alpha \Delta t}{\Delta x^2}$$

$$T_{xy}^{k+1} = r \left(T_{x+1,y}^k + T_{x-1,y}^k + T_{xy+1}^k + T_{xy-1}^k - 4T_{xy}^k \right) + T_{xy}^k$$

The 2D Plate:



Final Temperature Contour in the Grid:

