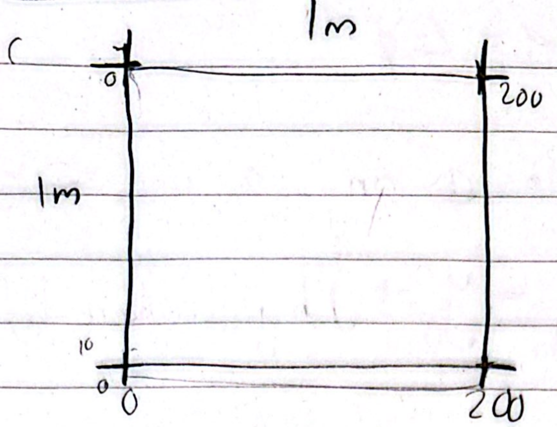
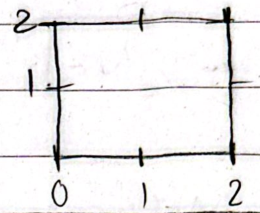
Lab3



lets say N-1 $\longrightarrow$ N=3 $\longrightarrow h = \frac{1}{N-1} = \frac{1}{2}$

$\frac{x_i}{h} \in \{0, 1, 2\}$



Example:

$h = \frac{1}{200}$

round : $\frac{2/100}{1/200} = 4$

$\text{rect}(0, N-1, 0, \text{wall}-1, 0) = \text{rect}(\text{minx}, \text{maxx}, \text{miny}, \text{maxy}, \text{val})$

$\boxed{\text{rect}(0, 200, 0, 3, 0)}$

$\text{rect}(0, 200, 200-4, 200-1, 0)$ (top wall)

$\hookrightarrow \text{rect}(0, 200, 196, 199, 0)$

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Countour plot VS quiver plot

Lab 3.2

$E = grad(\phi)$ & $\rho = \Delta\phi$

Explanation: We sample ϕ on a uniform grid:

$x_i = x_0 + ih_x$, $y_j = y_0 + jh_y$ where h_x & h_y are mesh-sized:

Note: We compute derivites only at interior pts:

$i = 2, 3, \dots, N-1$, $j = 2, 3, \dots, N-1$

Thus the output matrices have size $(N-2)\times(N-2)$

$$E = grad(\phi) = \begin{cases} \text{in } \underline{x} \text{ direction} : E_x(i,j) = \dfrac{\phi_{i+1,j} - \phi_{i-1,j}}{2h_x} \\ \text{in } \underline{y} \text{ dir.:} \ E_y(i,j) = \dfrac{\phi_{i,j+1} - \phi_{i,j-1}}{2h_y} \end{cases}$$

1 These formulas are truncation errors of second order accurate:

$$O(h_x^2) , O(h_y^2)$$

2 Laplacian: $\rho = \Delta\phi$ (second derivitive)

$$\begin{cases} \dfrac{\partial^2\phi}{\partial x^2}(x_i, y_j) \simeq \dfrac{\phi_{i+1,j} - 2\phi_{i,j} + \phi_{i-1,j}}{h_x^2} \\ \dfrac{\partial\phi}{\partial y^2}(x_i, y_j) \simeq \dfrac{\phi_{i,j+1} - 2\phi_{i,j} + \phi_{i,j-1}}{h_y^2} \end{cases}$$

$$\Rightarrow \rho(i,j) = \Delta\phi(i,j) = \frac{\phi_{i+1,j} - 2\phi_{i,j} + \phi_{i-1,j}}{h_x^2} + \frac{\phi_{i,j+1} - 2\phi_{i,j} + \phi_{i}}{h_y^2}$$