

Poisson's equation

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1 Statement of the problem

Solve Poisson's equation

$$\nabla^2 V = \frac{\rho_s}{\epsilon}, \quad 0 \leq x, y \leq 1 \quad (1)$$

with

$$\rho_s = x(y - 1), \quad \epsilon = 1 \quad (2)$$

and obtain the potential at the grid points indicated in Figure (1). Use the method of successive over-relaxation. The table in Figure (2)

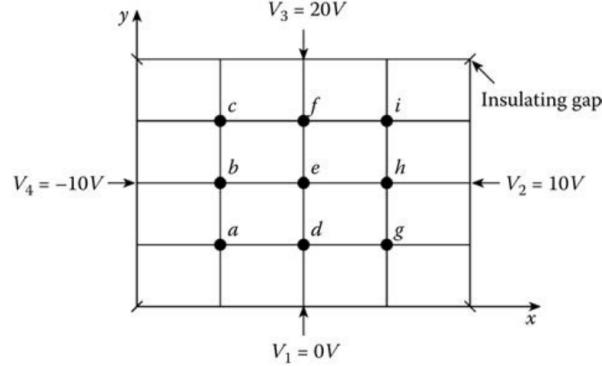


Figure 1: Solution region

Node	$h = 1/4$ $\omega_{\text{opt}} = 1.171$ 8 iterations	$h = 1/12$ $\omega_{\text{opt}} = 1.729$ 26 iterations	$h = 1/20$ $\omega_{\text{opt}} = 1.729$ 43 iterations	Exact Solution
a	-3.247	-3.409	-3.424	-3.429
b	-1.703	-1.982	-2.012	-2.029
c	4.305	4.279	4.277	4.277
d	-0.0393	-0.0961	-0.1087	-0.1182
e	3.012	2.928	2.921	2.913
f	9.368	9.556	9.578	9.593
g	3.044	2.921	2.909	2.902
h	6.111	6.072	6.069	6.065
i	11.04	11.12	11.23	11.13

Figure 2: Numerical V values vs Analytical V values