$$\frac{d^2u}{dx^2} - k^2u(x) = f(x) \qquad u(x=0) = U_0,\ u(x=L) = 0 \quad f(x) = A$$

$$\frac{u_{j-1} - 2u_j + u_{j+1}}{h^2} - k^2u_j = f_j$$

$$\begin{bmatrix} -(2+k^2h^2) & 1 & 0 \\ 1 & -(2+k^2h^2) & 1 \\ 0 & 1 & -(2+k^2h^2) \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \\ u_3 \end{bmatrix} = \begin{bmatrix} h^2f_1 - U_0 \\ h^2f_2 \\ h^2f_3 \end{bmatrix}$$

$$u_{j-1} - (2+k^2h^2)u_j + u_{j+1} = h^2f_j$$

$\underline{j=1}$ $$-(2+k^2h^2)u_1 + u_2 = h^2f_1 - u_0$$

$\underline{j=N}$ $$u_{N-1} - (2+k^2h^2)u_N = h^2f_N - \cancel{u_L}^{\,0}$$

Neumann $$\left.\frac{du}{dx}\right|_{x=0} = V,\ u(x=L) = 0 \quad f(x) = A$$

$$\frac{u_1 - u_0}{\Delta x} = V \qquad u_1 - u_{-1} = 2hu_0$$

$j=0$ $$u_{-1} - (2+k^2h^2)u_0 + u_1 = h^2f_0$$

$$-(2+k^2h^2)u_0 + 2u_1 = h^2f_0 - u_1 + 2hV + O(h^3)$$