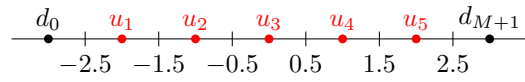unknowns $(M = 5)$

vertices

neumann

$$
\begin{pmatrix}
-1 & 1 & & & & & \\
1 & -2 & 1 & & & & \\
& & \ddots & & & & \\
& & 1 & -2 & 1 & & \\
& & & \ddots & & & \\
& & & & 1 & -2 & 1 \\
& & & & & 1 & -1
\end{pmatrix}
\begin{pmatrix}
u_1 \\
u_2 \\
\vdots \\
u_i \\
\vdots \\
u_{M-1} \\
u_M
\end{pmatrix}
=
\begin{pmatrix}
f_1 + g(u_{1/2}) \\
f_2 \\
\vdots \\
f_i \\
\vdots \\
f_{M-1} \\
f_M - g(u_{M+1/2})
\end{pmatrix}
$$

dirichlet

$$
\begin{pmatrix}
-2 & 1 & & & & & \\
1 & -2 & 1 & & & & \\
& & \ddots & & & & \\
& & 1 & -2 & 1 & & \\
& & & \ddots & & & \\
& & & & 1 & -2 & 1 \\
& & & & & 1 & -2
\end{pmatrix}
\begin{pmatrix}
u_1 \\
u_2 \\
\vdots \\
u_i \\
\vdots \\
u_{M-1} \\
u_M
\end{pmatrix}
=
\begin{pmatrix}
f_1 - d(u_0) \\
f_2 \\
\vdots \\
f_i \\
\vdots \\
f_{M-1} \\
f_M - d(u_{M+1})
\end{pmatrix}
$$

periodic

$$
\begin{pmatrix}
-2 & 1 & & & & & 1 \\
1 & -2 & 1 & & & & \\
& & \ddots & & & & \\
& & 1 & -2 & 1 & & \\
& & & \ddots & & & \\
& & & & 1 & -2 & 1 \\
1 & & & & & 1 & -2
\end{pmatrix}
\begin{pmatrix}
u_1 \\
u_2 \\
\vdots \\
u_i \\
\vdots \\
u_{M-1} \\
u_M
\end{pmatrix}
=
\begin{pmatrix}
f_1 \\
f_2 \\
\vdots \\
f_i \\
\vdots \\
f_{M-1} \\
f_M
\end{pmatrix}
$$