We need to solve $\underline{\underline{M}} \cdot \underline{u}^{n+1} = \underline{u}^n$, where

$$\underline{\underline{M}} = \begin{bmatrix} 1+2\alpha & -\alpha & 0 & 0 & 0 & \cdots \\ -\alpha & 1+2\alpha & -\alpha & 0 & 0 & \cdots \\ 0 & -\alpha & 1+2\alpha & -\alpha & 0 & \cdots \\ 0 & 0 & -\alpha & 1+2\alpha & \alpha & \cdots \\ & 0 & & \ddots & \ddots & \ddots \end{bmatrix}, \quad \underline{u}^n = \begin{bmatrix} u_0^n \\ u_1^n \\ \vdots \\ u_{N-1}^n \end{bmatrix}$$

The goal of forward substitution is to manipulate the system into the form

$$\begin{bmatrix} d_0 & -\alpha & 0 & 0 & 0 & \cdots \\ 0 & d_1 & -\alpha & 0 & 0 & \cdots \\ 0 & 0 & d_2 & -\alpha & 0 & \cdots \\ 0 & 0 & 0 & d_3 & -\alpha & \cdots \\ & & & & \ddots & \ddots \end{bmatrix} \cdot \underline{u}^{n+1} = \underline{\tilde{u}}^n .$$

1. What is d_0 ?
2. What is d_1 ?

3. What is $\tilde{u}_1^n$?

4. What is d_j ? What is $\tilde{u}_j^n$?

Once all d_j and $\tilde{u}_j^n$ are known, we find via backsubstitution u_{N-1}^{n+1}, u_{N-2}^{n+1}, ...

What is u_{N-1}^{n+1} ?

What is u_{N-2}^{n+1} ?

What is u_j^{n+1} ?