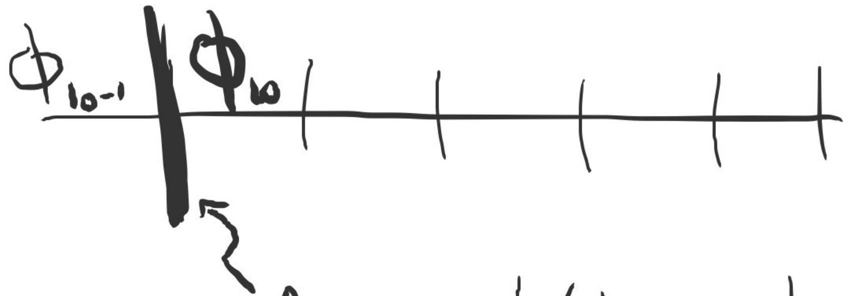
$$\underbrace{\frac{\phi_i^{n+1}-\phi_i^n}{\Delta t}}_{\phi_t} = \underbrace{\frac{k}{\Delta x^2}\left(\phi_{i+1}^{n+1}-2\phi_i^{n+1}+\phi_{i-1}^{n+1}\right)}_{\nabla^2\phi}$$

$$\alpha \equiv k\frac{\Delta t}{\Delta x^2}$$

$$\boxed{\underline{-\alpha}\,\phi_{i+1}^{n+1} + \underline{(1+2\alpha)}\,\phi_i^{n+1} \underline{-\alpha}\,\phi_{i-1}^{n+1} = \phi_i^n}$$

$$\begin{pmatrix} (1+2\alpha) & -\alpha & 0 & \cdots & \\ -\alpha & (1+2\alpha) & -\alpha & 0 & \cdots \\ & & & & \end{pmatrix}$$

LHS: value of A



Finite volume: A $\qquad \frac{1}{2}(\phi_{10-1} + \phi_{10}) = A$

$$\phi_{10-1} = 2A - \phi_{10}$$

$$\underbrace{-\alpha\phi^{n+1}_{10-1}} + (1+2\alpha)\phi^{n+1}_{10} - \alpha\phi^{n+1}_{10+1}$$

$$\underbrace{-\alpha(2A - \phi_{10})}$$

$$-2\alpha A + \boxed{\alpha\phi^{n+1}_{10}} + \underbrace{(1+2\alpha)\phi^{n+1}_{10}} - \alpha\phi^{n+1}_{10+1}$$

$$\boxed{-2\alpha A} + (1+3\alpha)\phi^{n+1}_{10} - \alpha\phi^{n+1}_{10+1} \leftarrow \phi_{10}$$

$$
\begin{bmatrix}
\boxed{(1+3\alpha)} & -\alpha & 0 & \cdots & \\
-\alpha & (1+2\alpha) & -\alpha & & \\
 & \ddots & \ddots & \ddots & \\
 & \cdots & 0 & -\alpha & \boxed{(1+3\alpha)}
\end{bmatrix}
\begin{bmatrix}
\phi^{n+1}_{lo} \\
\phi^{n+1}_{lo+1} \\
\vdots \\
\phi^{n+1}_{hi}
\end{bmatrix}
=
\begin{bmatrix}
\phi^{n}_{lo} + \underbrace{\alpha 2A} \\
\phi_{lo+1} \\
\vdots \\
\phi_{hi-1} \\
\phi^{n}_{hi} + \underbrace{\alpha 2A}
\end{bmatrix}
$$

$$A x = \underbrace{b}$$