

# Heat Equation

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## 1 Problem

$$\frac{\partial u(x, y, z, t)}{\partial t} = D \cdot \Delta u(x, y, z, t)$$

### 1.1 Finite differences and forward Euler

$$\begin{aligned}\Delta u(i, j, k) &= f(i, j, k) = \\ &\frac{1}{\Delta x^2} (-6u(i, j, k) + u(i+1, j, k) + u(i-1, j, k) \\ &\quad + u(i, j+1, k) + u(i, j-1, k) + u(i, j, k+1) + u(i, j, k-1)) \\ u^{n+1}(i, j, k) &= u^n(i, j, k) + \Delta t \cdot f(i, j, k)\end{aligned}$$