

## Project 5 Proposal

**Idea**

The goal of this project is to implement a finite difference solver for diffusion equation for both the 1D and 2D systems that can be described by partial differential equations.

**Design Strategy**

To show code evolution, the program will inherit forward Euler, backward Euler, trapezoidal Euler (Crank-Nicholson), Gauss-Seidel algorithm from the previous program.

1. Implement the 1D diffusion equation.

$$\frac{\partial u}{\partial t} = \alpha \frac{\partial^2 u}{\partial x^2},$$

2. Integrate the solver with sparse matrix data structure.
3. Develop testing units.
4. Evaluate performance, stability and accuracy.
5. Parallelize the program for the matrix operation and compare the performance.
6. Implement the 2D diffusion equation.