

Physics 514 – Homework II

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Due 10:00 AM, Thursday September 21, 2017

1 Poisson's Equation

Solve the poisson's equation

$$\nabla^2 \Phi(x, y) = -4\pi\rho(x, y)$$
$$\text{with } \rho(x, y) = e^{-16[(x - \frac{1}{2})^2 + (y - \frac{1}{2})^2]}$$

in a square area ($0 \leq x \leq 1, 0 \leq y \leq 1$).

The boundary condition is,

$$\begin{aligned}\phi(x = 0) &= 1 \\ \phi(x = 1) &= 0 \\ \phi(x, y = 0) &= 1 - x \\ \phi(x, y = 1) &= 1 - x\end{aligned}$$

Use different methods to solve the poisson's equation:

1. The relaxation method
2. Gauss-Seidel method

Show $\Phi(x, y)$ in 2-D plots and send the code.

2 Heat Equation

Solve the heat equation in the interval of -1 to 1 , assuming an initial temperature distribution $T(x, t = 0) = 1, |x| < 0.1$ and 0 otherwise, in the absence heat sources and with $T(-1) = T(1) = 0$.

Use the forward Euler algorithm to integrate the equations. Plot the time evolution and send the code.

3 Poisson's Equation with Multi-Grid Method

Solve Problem1 with Multi-Grid method, show $\Phi(x, y)$ in 2-D plots and send the code.

Homework Submission

Summarize your results and plots into one PDF file and also submit your codes to Canvas.