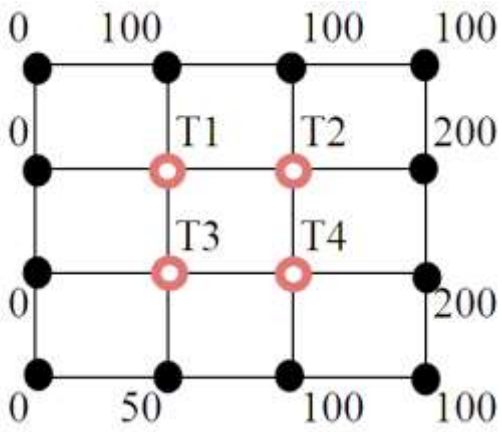
Assignment#9

Numerical Sol^n. of Partial Differential Equations

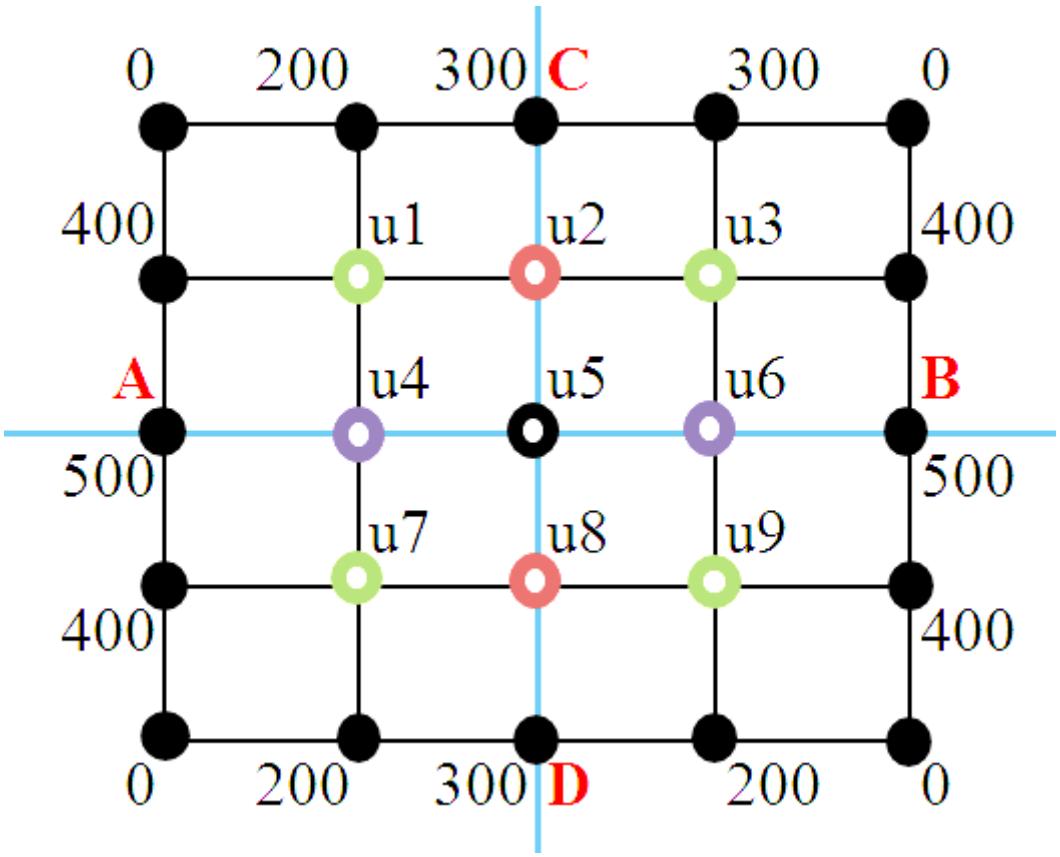
1. The steady state two dimensions heat-flow in a metallic plate is given by

   $$\frac{\partial^2 T}{\partial^2 x} + \frac{\partial^2 T}{\partial^2 y} = 0$$

   Given the boundary conditions as shown in the figure below, find the temperatures T1, T2, T3 & T4. Solve the equations using Gauss-Seidel method.

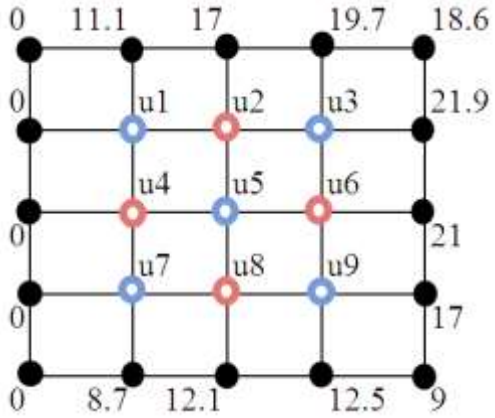


2. Torsion on a rectangular bar subject to twisting in governed by $\nabla^2 T = -4$. Given conditions: T = 0 on boundary, find T over a cross section of a bar of size **9cm x 9cm,** use the small grid size of **3cm x 3cm**.
3. Solve the Laplace equation Uxx + Uyy = 0 given that



4. Solve for the steady-state temperature in rectangular plate **8cm x 10cm**, if one 10cm side is held at 50C, and the other 10cm side held at 30C and the other sides are held at 10C. Assume square grids of **2cm x 2cm**. [Hint: 4x5 data grid]

5. Solve the Laplace equation Uxx + Uyy = 0 given that



6. Solve the equation $\nabla^2 f = F(x, y)$ with F(x, y) = xy and f = 0 on boundary. The domain is a square with corners at (0, 0) & (3, 3). Use h=1
7. Estimate the values at grid points of the following equations, assume h = 1:
   a. $f_{xx} - 0.5f_t = 0$

      Given: f(0, t) = 0; f(5, t) = 0; f(x, 0) = x(5-x);

   b. $9f_{xx} = f_t$

      Given: f(0, t) = -5; f(5, t) = 5;

      $$f(x,0) = \begin{cases} -5 \; for \; 0 \le x \le 2.5 \\ 5 \; for \; 2.5 \le x \le 5 \end{cases}$$

8. Solve the following hyperbolic equations:
   a. $f_{tt} = uf_{xx}$

      Given: f(0, t) = 0; f(5, t) = 0; f(x, 0) = $100x^2(5-x)$; $f_t(x, 0) = 0$

   b. $f_{tt} = uf_{xx}$

      Given: f(0, t) = 0; f(1, t) = 0; f(x, 0) = f(x) = sin(πx) + sin(2πx); $f_t(x, 0) = 0$

9. Solve by relaxation method, the equation $\nabla^2 u = 0$ in the square region with square meshes starting with the initial values u1 = u2 = u3 = u4 = 1.

[Ans: u1 = 1, u2 = 1.3, u3 = 0.7, u4 = 1]