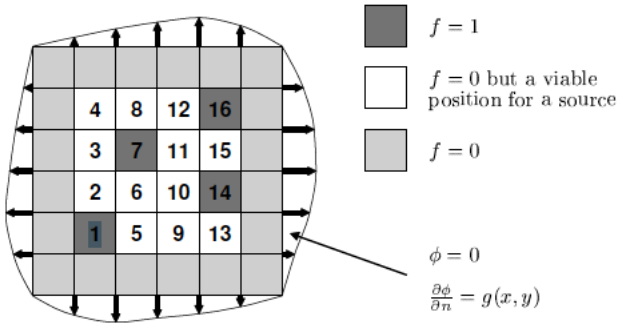
Numerical Methods Problem Set 11

Due 5/31/2011

Solve the Poisson's equation

$$-\nabla^2\phi(x,y) = f$$

with boundary condition φ(x, y) = 0, on the entire boundary. We will examine a square domain, see the following Figure. The domain is divided into 36 main blocks, or a 6 x 6 main grid. Four of the inner 16 blocks (4 x 4 interior grid) are set to be source blocks (f = 1), while for the remaining blocks f = 0. The position of the four source blocks is unknown. You are asked to determine their position given the distribution of the normal flux $\frac{\partial\phi}{\partial n} = g(x)$ on the boundary of the domain.



(1) Write down the Gauss-Siedel iteration scheme to solve the above Poison's equation and draw a flow chart outlining your proposed implementation.

(2) Use any available numerical recipes to code the G-S routine. Allow variable specification of the "fineness" of the grid (values such as, 6 x 6, 12 x 12, 24 x 24, etc). Note: For simplicity we shall assume that for the source blocks all nodes, including the block boundaries, have f = 1. Also, for two adjacent source blocks, the points on the common boundary also have f = 1.

(3) Solve the equation with f=1 for blocks 1,7,14,16.