Computational Science 2

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Seminar
Exercises

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Exercise 3 (11.4.2019):

Random walk solution of Laplace's equation

from ***An Introduction to Computer Simulation Methods***,
Chapter 10, Problem 10.17-18

a) Implement the random walk solution of Laplace's equation. Consider a 6×6 square lattice. Set the potential on the border to $V = 10$ for upper and lower side and to $V = 5$ for left and right side. Try $n = 100$ and $n = 1000$ walkers, and choose a point near the center of the square.

b) Repeat part (a) for other points within the square. Do you need more or less walkers when the potential near the surface is desired? How quickly do your answers converge as a function of n?

c) Compute the Green's function $G(x, y, x_b, y_b)$ for the same geometry. Use at least 200 walkers at each interior site to estimate G. Because of the symmetry of the geometry, you can determine some of the values of G from other values without doing an additional calculation. Store your results for G in a file.

d) Use your results for G found in part (c) to determine the potential at each interior site when the boundary potential is the same as in part (a), except for five boundary sites which are held at $V = 20$. Find the locations of the five boundary sites that maximize the potential at the interior site located at $(3, 5)$. Repeat the calculation to maximize the potential at $(5, 3)$. Use trial and error guided by your physical intuition.