Homework #9 (NQe311, Spring, 2020)

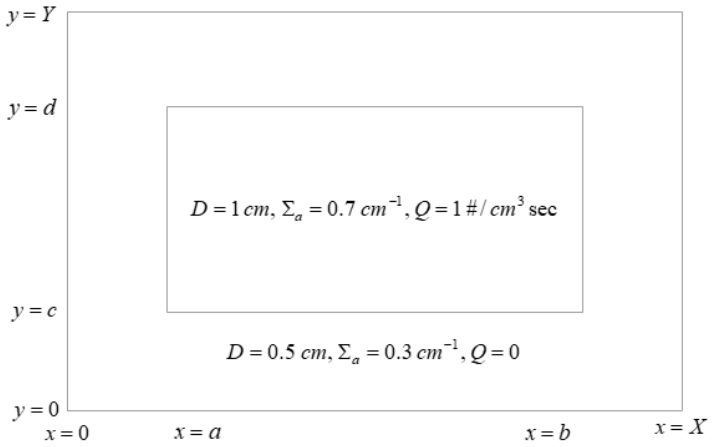
KAIST

(Due June 12, 6:00 pm)

1. The one-group neutron diffusion equation can be written as

$$-\nabla D(r)\nabla\phi(r)+\Sigma_a(r)\phi(r)=Q(r),\quad \phi(r)\,|_{boundary}=0.$$

Let's assume that the domain is two dimensional ($0\le x\le$X, $0\le y\le$Y) and it is comprised of two materials as shown below. Based on the **box-scheme** FDM (finite difference method) and a natural line-scheme indexing (indexing begins from bottom-left corner and ends at top-right corner),



i) Develop the matrix system of the following form

$$\mathbf{A\Phi = q}$$

ii) Write a computer program to solve the resulting matrix system by the SOR and SLOR iterative methods (you may choose an over-relaxation parameter),

iii) Obtain the solution for X=Y=100 cm, a=c=10 cm, b=d=90 cm for two mesh sizes, Δx=Δy= 1cm, or Δx=Δy=0.5 cm Plot the neutron flux for x=50 cm and discuss computing times for the SOR and SLOR methods.

Note. *If the SOR and SLOR methods are compared with the CG (Conjugate Gradient) method, extra point will be given*