Computational Physics 2019

PPROJECT

In the project students are expected to solve larger and more complicated problems. They are also expected to find relevant readings themselves. Students can design project themselves or select one from the list. A report for the project should be submitted and a **15-minute** oral presentation will be held for the assessment of the course. The report should consist of problem, physics, algorithm, results, and references. The computer programs should be attached. The due date of the project is **November 25, 2019**

A list of possible projects

(1). Gaussian Quadrature. Write a note on how to generate Gauss-Chebyshev quadrature and then implement it by writing a code. To demonstrate the correctness of your code, evaluate an integral using Gaussian quadrature method. Please note that this is not Gauss-Legendre quadrature that we discussed in the class.

(2). Calculate numerically the transmission coefficient as a function of energy for a periodic potential of the form: (a) $V(x) = V$ for $0 < x < a$ and $V(x) = 0$ for $a < x < L$; (b) $V(x) = Vx$ for $0 < x < a$ and $V(x) = 0$ for $a < x < L$ where L is the periodicity of the potential.

(3). Calculate the time evolution of an electron wave packet in a one-dimensional potential barrier by solving the time-dependent Schrodinger equation.

(4). Two dimensional percolation Problem.

(5). Simulation of two-dimensional Ising model using Monte-Carlo method.

Your Report
The report should consist of problem, physics, algorithm, results, and references.

1. Write your own code whenever it is necessary, **don't** just use the existing subroutine.
2. If you have another project in mind that is different from the list, you should ask for my permission.
3. In your report you should first state the problem that you want to solve. You should think about the physics of the problem and try to identify the physically interesting parameter combinations. In particular you should ask yourself whether there is a qualitative change of behaviour at some value of the parameters or whether there is a value at which some special behaviours might be observed.
4. You should describe how you have chosen the algorithm and the value of the parameters and show that the method you have chosen is stable for this problem and for the range of parameters you have chosen. Let your physical intuition guide your choice of parameters. If you can't identify the physically interesting values, then start by doing a broad sweep of the meaningful parameters to try to identify any interesting features.
5. Once you have found the interesting parameter ranges you can look at them more closely. Try not to make meaningless changes. If the results can only depend on a particular combination of parameters it is pointless to vary them individually.
6. Your report should contain a representative selection of results and a discussion of the physics which they illustrate.