Exercises in computer-oriented physics

1 system of charges

Complete a program for a two-dimensional (variabledim=2)System of charges calculates and outputs the potential for different positions in the x,y plane.

Download thischarge_main_fragment.cfrom StudIP. The program contains:

1. Arrays for charge (values   of charge and locations),

2. the main program, which creates the necessary data structures and (here) places two loads.

Look at the existing program and make sure you understand everything. It is compiled with

cc -o charge charge_main_fragment.c -g -Wall -lm

- Complete the main program part so that the potential

$$V(\vec{x}) = \sum_i \frac{q_i}{|\vec{r} - \vec{x}|} \tag{1}$$

  calculated and in the variablepotentialis saved (constants are set to 1). The sum runs over all charges,$q_i$is the value of the$i$-th load
  and $\vec{r}_i$your position.
  Note 1: Use $|\vec{r}| = \sqrt{r_1^2 + r_2^2 + \ldots + r_{dim}^2}$.

  Note 2: You should use the case $\vec{r}_i = \vec{x}$intercept and there set the potential contribution of the amount large but finite.

- Complete the main programMain(),so that in the xy plane the area $\vec{x} = (x_0, x_1) \in [-2, 2] \times [-2, 2]$ is scanned with a step size of 0.05 in each direction and the potential in each case$V(\vec{x})$is calculated. It should be a three-column output in format$x_0 x_1 V(\vec{x})$ output to standard output.

- Test the program with the debuggergdb.

- Let the program run. Pipe the output to the filepotential.dat around:

  batch > potential.dat

- Set the potential landscape gnuplot as "3d plot" using the commands plot Please read the help help splot. Note: it looks pretty nice if you use the option with lines take.

- Additional task 1: Vary the number, charge value and positions of the charges to achieve more "interesting" potential landscapes.

- Additional task 2 (advanced): Design and program a heuristic that searches for a local minimum of the charge distribution, e.g. for the case of 4 charges $q_i=1$ at the corners of a square with edge length 2 (very open task).