# PHYS 511: Computational Modeling and Simulation - Fall 2016
Assignment #3, due Friday November 11, before class

Solving stationary heat equation in 3D

1. Write a Fortran (or C) program that solves the stationary heat equation for a rectangular block that is placed between two media, say air and water, that are kept at constant (yet different) temperatures. The density of the material the block is made of is twice lower than that of water, i.e. the block is half-immersed in water. The temperature of the water is 0° C, while the temperature of the air is 10° C. The size of the block is $3 \times 2 \times 1$ meters. Use $h = 0.01$ m grid spacing in your simulations. This gives you the number of grid points in each direction (n_x=301, n_y=201, n_z=101). Use three-point approximation for second derivatives and and iterative approach that was discussed in class/lecture. How many iterations did you need to converge the results to about 0.00001° C?
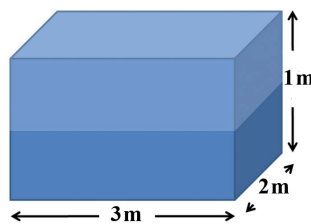
Hint: Depending on how fast your computer is, it may take a few minutes to complete the calculations. Make sure you generate an optimized binary code when compiling your program. To do so you need to include an optimization flag, -O3, as follows:
```
gfortran -O3 myprog.f90 -o myprog
```

2. Make your program output the temperature profile in the center of the block in a file called `temperature.dat`. Essentially this temperature profile is a 100×300 matrix.

3. Use GNUPLOT or any other relevant plotting software to generate a plot of that temperature profile (2D density plot). Make sure everything is labelled and properly scaled on the plot and the temperature profile looks sensible.

4. Put the source file of your program, the data file with your numerical solution (2D slice only), and the plot in subdirectory `as03` in your google-drive directory that is shared with the instructor. Any comments about your solution should be written in file `report.txt`.