PHYS:5905 Semester Project

Proposed Topic and Project Description is due on Thursday, April 4, 2019.
Completed Report on Semester Project is due on Thursday May 2, 2019.

Purpose

The project is an opportunity for each student to propose and execute a more detailed project than a typical homework assignment on a problem relevant to his or her own research, or any other topic of interest. An appropriate topic and scope will be chosen, possibly in consultation with the instructor.

Example Codes that can be used

If you have a code that is used for your own research (or related to your research), you are welcome to devise a project involving that code. Otherwise, you can choose to write a code of your own (or extend a code from the homework), or modify one of the example codes provided for this class:

1. `HYDRO`: 2D Parallel Hydrodynamics Code

2. `VP`: 1D-1V Nonlinear Vlasov-Poisson Simulation Code

3. `Gandalf`: Kinetic Reduced MHD Code (CUDA GPU Code)

Possible Projects

1. Write a new code:
   e.g., (i) Write an MHD code

2. Optimize an existing code:
   e.g., (i) Determine parallel weak/strong scaling for a parallel code, (ii) Re-organize data arrays and loops for faster performance, (iii) Test performance and plot results, (iv) Use profiling to characterize code performance

3. Make a serial code parallel:
   e.g., (i) Use OpenMP or MPI to parallelize a serial code, (ii) Use CUDA to employ GPU computing for compute intensive parts of a code

4. Make a significant change to an existing code:
   e.g., (i) Implement an input file for a code, (ii) Increase the dimensionality of domain decomposition in `HYDRO` or other code, (iii) Implement an implicit timestepping scheme, (iv) Re-write `HYDRO` in dimensionless variables (v) Write a nonlinear hydrodynamics using a shock-capturing algorithm

5. Increase the dimensionality of a code:
   e.g., (i) 1D to 2D, (ii) 2D to 3D

6. Perform Detailed Code Validation:
   e.g., (i) Validate code results vs. Dispersion relation

7. Improve a code by implementing a library:
   e.g., (i) FFTW, (ii) BLAS, (iii) LAPACK

8. Improve a code by using compressed, self-describing output:
   e.g., (i) NetCDF, (ii) HDF

9. Port a code to a new platform:
   e.g., (i) Port existing code to work on Argon or other HPC platform

10. Create a code package for distribution:
    e.g., (i) Put together Makefile, documentation, and test input files with sample output

Final Project Report

A key part of the project is a final report describing the motivation and proposed scope of work, work completed, and quantitative or visual demonstration of the result.

Due Dates

Project Proposal: Due on Thursday, April 4, 2019.

Final Project Report: Due on Thursday May 2, 2019.