Computational physics mini-course

Part I. 10/9 – 11/10

- Interpolation and Finite difference
- Numerical integration.
- Integration of ordinary differential equations.
- Symplectic integrator.
- (Tow-point boundary value problem, Spectral method or Fourier series: optional.)

Part II. 11/13 – 12/11

1. Finite difference scheme for the hyperboric equation.
2. Finite difference scheme for the elliptic equation.
3. Introduction for numerical relativity.
4. Formulation of the Einstein’s equations in 3+1 form.

0. Introduction

References: ‘A Friendly Introduction to Numerical Analysis’,
Brian Bradie, (Pearson Prentice Hall)
‘Numerical Recipe’, Press et al. (Cambridge)
‘Numerical computation’, C.W. Ueberhuber, (Springer)

Computer aided researches in physics.

- Experiments / Observations – Data processing and data analysis including statistical analysis, data modeling (e.g. χ^2 –fit)….
  e.g. SDSS, LIGO
- Tool for theoretical study – Numerical approximations, Simulations, Quantitative predictions. Symbolic calculations (manipulation for long equations).

This course is an introduction for numerical analysis. So, what do we use?

Hardware check list – CPU power enough?
Memory ?
Storage (HD space)?

Example for the softwares for computational physics on PC or a server.

Numerical computing – Fortran, C++, and other computer languages.
Symbolic Computation – Mathematica, Maple, Maxima.
Graphics software and
plotter – Gnuplot, xmgrace, supermongo
visualization – OpenDX, IDL, AVS
Unified environment – Octave, MATLAB