Computational Physics **Problem Set 8** **Due 2019/12/3**

Your solutions should include your source codes (without *.exe files), results, and discussions. The discussion file as well as the derivation in the problem 1 should be prepared with a typesetting system, e.g., LaTeX, Word, etc., and it is converted to a PDF file. All files should be zipped into one gzipped tar file, with a file name containing your student number and the problem set number (e.g., r05202043_ps8.tar.gz). Please send your homework from your NTU email account to twchiu@phys.ntu.edu.tw before 24:00 of the due date.

1. **Vibrating String**
   Consider a vibrating string with tension T and mass density μ under the gravitational acceleration g . Derive the equation of motion of this vibrating string, neglecting the air resistance. Write a C or C++ program to solve the partial differential equation of this vibrating string with fixed end. Moreover, animate its motion with real time graphics, using the output directly from your solver. The initial wave function should include 3 different options: sinusoidal wave, plucked string, and Gaussian wave packet.

2. **Heat Diffusion**
   Using a Cartesian grid, solve for the temperature distribution on a circular plate. The temperature along one-quarter of the plate is held fixed at 373 K, while the reminder of the circumference is held at 273 K. Write a C or C++ program to solve the problem. Moreover, animate the heat diffusion with real time graphics, using the output directly from your solver.

3. **Poisson Equation**
   Write a C or C++ program to solve the Poisson equation in 3-dimensional space with a point source at the origin, using the following different methods:
   (a) Jacobi method
   (b) Gauss Seidel method
   (c) Successive over-relaxation
   (d) Conjugate gradient with double precision
   (e) Conjugate gradient with mixed precision
   Using the exact solution as the reference solution, compare the efficiencies of above methods.