理 學 院
108 學年度第二學期模組化課程

計算物理習題演練
Exercise in Computational Physics

授課教師：

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課程類別	學分數	選必修	開課人數	開課日期及上課時間
講義+演習	1	選修	12	2020 年 02 月 03 日至 2020 年 02 月 06 日 14:00-17:35 2020 年 02 月 07 日 14:00-17:40

先修課程或先備能力：

A freshmen level, basic knowledge of calculus.

建議修課年級：

不設限

建議修課學生背景：

適合各領域學生修習

教學方法：

講授 75%，其他 25%：In class exercise with hands on training.

評量方式：

問題考試 20%；
科學報告 80%：Three“programming + physics interpretation”based reports. Two of them (20% + 30%) due Wednesday and Friday in the week of the course, and one of them (30%) due next Tuesday after the course.

學習規範：

課程概述：

Numerical modeling and resultantly solving (differential) equations numerically are becoming crucial skills for students and researchers in physical sciences and engineering. However, many students tend to have an image of difficulty in getting into “programming” or “numerical computation” (it is not difficult at all). This course will lower the threshold at the entrance level of computing by providing students with simple but paradigmatic examples. The course will start by adding “1 to 10 (which is 55)” by setting up the loop. Once one gets through this simple stage, the rest becomes quite straightforward. This time, the course will focus on numerical integration and solving ordinary differential equations. Mont-Carlo and molecular dynamics approaches are also referred to. The course will take an interactive style to give the students hands on training. Opened for all levels, even for those who do not have any experiences in programming language at all (or those who has missed chances to learn high level programming language up to senior or graduate level).

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課程進度：

Period	Hours	Syllabus
2020/2/3(一)	14:00-17:35	Introduction to programming. “Add one to ten” by using the loop. Numerical derivative and numerical integration.
2020/2/4(二)	14:00-17:35	ODE solve by Euler (1st order) and improved Euler (2nd order) methods.
2020/2/5(三)	14:00-17:35	Computation of planetary motion (Kepler's problem).
2020/2/6(四)	14:00-17:35	Computation of charged particle motion. A sixty minutes quiz on numerical algorithm.
2020/2/7(五)	14:00-17:40	Simple exercise in parallel computing employing MPI and OpenMP.

課程學習目標：

1. **Understand and become familiar with high-level computational language (C and F95, for example) to the extent students can apply the acquired programming knowledge to their theoretical and/or experimental research.**
2. **Understand how to model dynamical system and how to solve ordinary differential equations by numerical methods.**
3. **Become familiar with parallel computing employing simple examples in Message Passing Interface (MPI) and Open Multi-Processing (OpenMP) on a Linux platform.**

課程的重要性、跨域性與時代性：

[Importance of the course contents]

Numerical modeling and solving (differential) equations by numerical methods are becoming increasingly crucial skills for students and researchers in physical sciences and engineering. Life sciences and social sciences are not exceptions. This is because most of the problem we deal with in a real life are not solvable by a pure analytical approach. Numerical modeling is also an intellectual practice. During students’ learning process, numerical computation also acts as a touchstone to examine the accuracy of their knowledge (unless the mathematical formulation and implementation is 100% correct, numerical solutions will provide us with erroneous results).

[Interdisciplinary nature of the course]

Numerical computing is applicable to all the field of natural science, engineering, and social sciences. The specific physics problems dealt in the class are quite common ones for all the majors (for example orbital motion of the earth around the sun which can be found in high school level science).

其他備註:

Slides. Computer terminal will be provided to each student. Hands on training will be given by the instructor during the class.

http://myweb.ncku.edu.tw/~yasutaro/LA80600