國立清華大學
NATIONAL TSING HUA UNIVERSITY

10920ASTR660000
Computational Astrophysics
計算天文物理

Syllabus

Instructor
Assis. Prof. Kuo-Chuan Pan (潘國全)
Office: General building II, R506
Email: kuochuan.pan@gapp.nthu.edu.tw
Phone: 03-5742563
Web: https://kuochuanpan.github.io/
Office hours: by appointment

Teaching assistant (TA)
TBA

Class Web page
https://kuochuanpan.github.io/courses/109ASTR660_CA/

Class schedule
Lectures on Thursday from 14:20 - 17:20
General building II, R521

Preface

This course does not require previous programming experience but with little knowledge on compiled languages and/or python is recommended. We will use mainly Fortran (or C/C++) with some python in the course. A Unix-like system (e.g. Linux, Mac OS X, or Windows 10 subsystem for Linux) is required. Students are required to bring a laptop to class.

Homework assignments

We will have a few homework assignments during the semester. Each assignment contains written problems and/or numerical exercises. All homework assignments are required to typed using Latex. We will use Google classroom to announce and collect homework assignments. You are encouraged to ask questions or discuss with your classmates in Google classroom as well.

國立清華大學
NATIONAL TSING HUA UNIVERSITY

Final project

Depending on students' need and interests, the final project could have several forms, including

1. Design a "new" numerical technique (tool/library/application) that is related to their own research project.
2. Attack an interesting astrophysical problem that involve numerical techniques we covered in class.
3. Reproduce scientific numerical results in existing published journals.

Evaluation

Grades will be determined by homework assignments (70%), and the final project (30%).

Tentative lecture schedule

Week	Date	Topics
1	2/25	Course overview / basic tools
2	3/4	Basic fortran programming, part 1
3	3/11	Basic fortran programming, part 2
4	3/18	Basic python programming
5	3/25	Linear systems
6	4/1	Non-linear equations
7	4/8	Initial value problems (celestial movement)
8	4/15	Boundary value problem (stellar Interior)
9	4/22	Project proposal presentation
10	4/29	PDE: hyperbolic systems
11	5/6	PDE: elliptical systems (gravity)
12	5/13	PDE: astrophysical fluids
13	5/20	PDE: magneto-hydrodynamics
14	5/27	Parallel programming with MPI
15	6/3	Parallel programming with OpenMP
16	6/10	Parallel programming with GPUs
17	6/17	Final project presentation
18	6/24	*(final exam week)* No lecture

Recommended textbooks

1. "Numerical Recipe", by Press, W.H. (http://www.nr.com)
2. "Numerical Methods in Astrophysics", by Bodenheimer, P. et al.
3. "Scientific Computing: An introductory survey", by Michael Heath

4. “Introduction to Computational Astrophysical Hydrodynamics”, by Zingale, M. (https://github.com/python-hydro/hydro_examples)
5. “The C Programming Language”, by Kernigan, B.W.
6. “Finite Volume Methods for Hyperbolic Problems”, by Leveque, R. J.
7. “Parallel Programming with MPI”, by Pacheco P.