Practice Sessions
Astrophysical Simulations

Part 2: Introduction

GHENT
UNIVERSITY

Master of Science in Physics and Astronomy
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Structure of this course

Theory classes

- Modeling the physical processes that influence the structure and evolution of objects in the Universe
  - » Gravity
  - » Hydrodynamics

Practice sessions

- Introduction to C++
- Introductory programming exercises
- Programming project
  - » Presentation of the assignment
  - » Assistance with implementation

Grading structure

- Theory exam, closed book: 10 out of 20 points
- Programming project: 10 out of 20 points

Practice sessions

Differential equation

- Data types, flow-control, functions, input/output streams
- Assignment: compare various finite difference methods

Two-body problem

- Classes: data members, instance methods, operator overloading
  - » Construct class to hold x,y components of 2D vector
- Assignment: evaluate leapfrog integrator for two-body problem

Project

- Sequences and aggregation: array, vector, pointers
- Project assignment and follow-up

Programming project

Objectives

- Write your own simulation code in C++
- Learn to interpret and present the results

Practicalities

- Project teams of four, selected randomly (by us, not you)
- Source code written in C++11/14 (to be handed in)
- Visualization tools are your own choice (e.g. Python, PowerPoint)
- Oral presentation of results using slides (not handed in)

Programming project

Evaluation

- Source code: structure, quality, comments
- Presentation: oral presentation skills, quality of slides and plots
- Results: correctness of produced results, parameter study, extra's
- Insight: in the physical processes and numerical methods

Peer evaluation

- Group members rate the contribution of all members in the same group (via an electronic form on Minerva)
- Results of peer review and performance during presentation influence individual grades
- Difference between the lowest and highest individual grade within the same group will not exceed 3 points
  - » Except for special cases, e.g. a student drops out

Resources

Practice sessions & Minerva

- These and future slides available on Minerva
- Tabulate example available as source code
- Further C++ introduction during upcoming practice sessions

Internet

- cplusplus.com — C++ tutorial and reference material
- cppreference.com — C++ reference material

- docs.python.org/2/ — Python 2.7 documentation
- docs.scipy.org/doc/numpy/ — numpy documentation
- matplotlib.org/api/pyplot_api — matplotlib documentation

- stackoverflow.com — Q&A forum for programmers
- Google search

Questions?