



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## COURSE SYLLABUS

# Computational Physics with Applications to Astrophysics

86R-XXXVI-CPAA

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### Aims

The main aim of this short course is to introduce some basic concepts for the numerical solution of equations describing the dynamics of fluids, with a focus mainly on astrophysical scenarios.

### Contents

This course will present some of the modern numerical algorithms and codes used to solve hyperbolic systems of partial differential equations, with a particular focus on fluid dynamics. This course will in particular introduce the students to open-source codes used to solve astrophysics problems, such as accretion disks, stellar collapse, and compact object binary mergers. It will also briefly present an open-source code to study the dynamics of fluids in industrial applications.

### Detailed program

1. Introduction to hyperbolic PDEs and basic numerical methods to solve them
2. A brief overview of some Open Source Software:
  1. GRHydro (numerical code for relativistic fluid dynamics)
  2. OpenFOAM (Computational Fluid Dynamic Solver for industrial applications)

### Prerequisites

A degree in Physics or Astrophysics.

## Teaching form

1 CFU, 10 hours, language: English.

## Textbook and teaching resource

- "Introduction to Computational Astrophysical Hydrodynamics"  
[http://bender.astro.sunysb.edu/hydro\\_by\\_example/CompHydroTutorial.pdf](http://bender.astro.sunysb.edu/hydro_by_example/CompHydroTutorial.pdf)
- <https://python-hydro.github.io/pyro2/>
- <http://einstein toolkit.org/>
- <https://openfoam.org/>

## Semester

March-April 2021 (2 hours per week for a total of 5 weeks)

## Assessment method

Written exam. The exam will consist on using one of the codes discussed during the lectures to solve some simple problems. Students will have to write a short report presenting their results.

## Office hours

It is possible to contact the teacher to schedule an appointment.

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