

# Advanced Scientific Programming in Python

a Summer School by the G-Node, the Bernstein Center for Computational Neuroscience Munich and the Graduate School of Systemic Neurosciences

Scientists spend more and more time writing, maintaining, and debugging software. While techniques for doing this efficiently have evolved, only few scientists have been trained to use them. As a result, instead of doing their research, they spend far too much time writing deficient code and reinventing the wheel. In this course we will present a selection of advanced programming techniques, incorporating theoretical lectures and practical exercises tailored to the needs of a programming scientist. New skills will be tested in a real programming project: we will team up to develop an entertaining scientific computer game.

We use the Python programming language for the entire course. Python works as a simple programming language for beginners, but more importantly, it also works great in scientific simulations and data analysis. We show how clean language design, ease of extensibility, and the great wealth of open source libraries for scientific computing and data visualization are driving Python to become a standard tool for the programming scientist.

This school is targeted at Master or PhD students and Post-docs from all areas of science. Competence in Python or in another language such as Java, C/C++, MATLAB, or Mathematica is absolutely required. Basic knowledge of Python is assumed. Participants without any prior experience with Python should work through the proposed introductory materials before the course.

**Date and Location:** August 31–September 5, 2015. Munich, Germany.

## Preliminary Program

### Day 0 (Mon Aug 31) — Best Programming Practices

- Best Practices for Scientific Computing
- Version control with git and how to contribute to Open Source with github
- Object-oriented programming & design patterns

### Day 1 (Tue Sept 1) — Software Carpentry

- Test-driven development, unit testing & quality assurance
- Debugging, profiling and benchmarking techniques
- Advanced Python: generators, decorators, and context managers

### Day 2 (Wed Sept 2) — Scientific Tools for Python

- Advanced NumPy
- The Quest for Speed (intro): Interfacing to C with Cython
- Contributing to Open Source Software/Programming in teams

### Day 3 (Thu Sept 3) — The Quest for Speed

- Writing parallel applications in Python
- Python 3: why should I care
- Programming project

### Day 4 (Fri Sept 4) — Efficient Memory Management

- When parallelization does not help: the starving CPUs problem
- Programming project

### Day 5 (Sat Sept 5) — Practical Software Development

- Programming project
- The Pelita Tournament

Every evening we will have the **tutors' consultation hour**: Tutors will answer your questions and give suggestions for your own projects.

## Applications

You can apply on-line at <https://python.g-node.org>

Applications must be submitted before **23:59 UTC, March 31, 2015**. Notifications of acceptance will be sent by **May 1, 2015**.

**No fee is charged** but participants should take care of travel, living, and accommodation expenses.

Candidates will be selected on the basis of their profile. Places are limited: acceptance rate is usually around 20%.

**Prerequisites:** You are supposed to know the basics of Python to participate in the lectures

## Preliminary Faculty

**Francesc Alted**, freelance developer, author of PyTables, Spain

**Pietro Berkes**, Enthought Inc., UK

**Kathryn D. Huff**, Department of Nuclear Engineering, University of California - Berkeley, USA

**Zbigniew Jędrzejewski-Szmek**, Krasnow Institute, George Mason University, USA

**Eilif Muller**, Blue Brain Project, École Polytechnique Fédérale de Lausanne, Switzerland

**Rike-Benjamin Schuppner**, Institute for Theoretical Biology, Humboldt-Universität zu Berlin, Germany

**Nelle Varoquaux**, Centre for Computational Biology Mines ParisTech, Institut Curie, U900 INSERM, Paris, France

**Stéfan van der Walt**, Applied Mathematics, Stellenbosch University, South Africa

**Niko Wilbert**, TNG Technology Consulting GmbH, Germany

**Tiziano Zito**, Forschungszentrum Jülich GmbH, Germany

Organized by Tiziano Zito (head) and Zbigniew Jędrzejewski-Szmek for the German Neuroinformatics Node of the INCF Germany, Christopher Roppelt for the German Center for Vertigo and Balance Disorders (DSGZ) and the Graduate School of Systemic Neurosciences (GSN) of the Ludwig-Maximilians-Universität Munich Germany, Christoph Hartmann for the Frankfurt Institute for Advanced Studies (FIAS) and International Max Planck Research School (IMPRS) for Neural Circuits, Frankfurt Germany, and Jakob Jordan for the Institute of Neuroscience and Medicine (INM-6) and Institute for Advanced Simulation (IAS-6), Jülich Research Centre and JARA. Additional funding provided by the Bernstein Center for Computational Neuroscience (BCCN) Munich.