PX281-15 Computational Physics

23/24

Department
Physics
Level
Undergraduate Level 2
Module leader
Yorck Ramachers
Credit value
15
Module duration
10 weeks
Assessment
100% coursework
Study location
University of Warwick main campus, Coventry

Description

Introductory description

This module develops programming in the Python programming language and follows from PX150 Physics Programming Workshop

Module web page

Module aims

To acquire programming skills necessary to solve physics problems with the help of the Python programming language, a language widely used by physicists

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

1. Vectorized programming in Python using Numpy
2. Handling, processing and analysing physics data: plotting distributions, data fitting, hypothesis testing
3. Monte Carlo simulation for physics modelling: Different types of random numbers, generation of random numbers according to specific distributions. Brownian motion and diffusion

4. Digital Signal Processing: the Fourier transform and convolution method, digital filters
5. Numerical solutions of ordinary differential equations: the Verlet algorithm for many coupled ODE's
6. Speeding up Python: why, when and what again is a compiler

Learning outcomes

By the end of the module, students should be able to:

- Explain how computers can be used to solve physics problems
- Model physics problems using a computer
- Design algorithms and implement them.
- Handle and analyse physics data

Indicative reading list

M. Newman, Computational Physics, CreateSpace Independent Publishing Platform, ISBN: 978-1480145511 (2012).

H.P. Langtangen, A Primer on scientific programming with Python, Springer e-books (2012): http://link.springer.com/book/10.1007%2F978-3-642-18366-9

Ch. Hill, Learning Scientific Programming with Python, CUP (2016) (e-book)

- Python documentation: http://www.python.org/doc/
- Scientific Python: http://docs.scipy.org/doc/scipy/reference/

View reading list on Talis Aspire

Subject specific skills

Knowledge of programming. Skills in numerical modelling.

Transferable skills

IT skills, analytical, communication, problem-solving, self-study

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Study

Study time

Type	Required
Lectures	10 sessions of 2 hours (13%)
Total	150 hours

Type	Required
Practical classes	20 sessions of 1 hour (13%)
Private study	110 hours (73%)
Total	150 hours

Private study description

Working through lecture notes, formulating problems, programming and testing code, discussing with others taking the module, preparing and submitting coursework

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group A

	Weighting	Study time
Assessed Computing Assignments Programming and reports	100%	

Feedback on assessment

Timetabled workshops

Availability

Courses

This module is Option list A for:

- UPXA-F300 Undergraduate Physics (BSc)
  - Year 2 of F300 Physics
  - Year 2 of F300 Physics
  - Year 2 of F300 Physics
- UPXA-F303 Undergraduate Physics (MPhys)
  - Year 2 of F300 Physics
  - Year 2 of F303 Physics (MPhys)

- UPXA-F3F5 Undergraduate Physics with Astrophysics (BSc)
    - Year 2 of F3F5 Physics with Astrophysics
    - Year 2 of F3F5 Physics with Astrophysics
- Year 2 of UPXA-F3FA Undergraduate Physics with Astrophysics (MPhys)

This module is Option list B for:

- Year 2 of UMAA-G105 Undergraduate Master of Mathematics (with Intercalated Year)
- UMAA-G100 Undergraduate Mathematics (BSc)
    - Year 2 of G100 Mathematics
    - Year 2 of G100 Mathematics
    - Year 2 of G100 Mathematics
- UMAA-G103 Undergraduate Mathematics (MMath)
    - Year 2 of G100 Mathematics
    - Year 2 of G103 Mathematics (MMath)
    - Year 2 of G103 Mathematics (MMath)
- Year 2 of UMAA-G106 Undergraduate Mathematics (MMath) with Study in Europe
- Year 2 of UMAA-G1NC Undergraduate Mathematics and Business Studies
- Year 2 of UMAA-G1N2 Undergraduate Mathematics and Business Studies (with Intercalated Year)
- Year 2 of UMAA-GL11 Undergraduate Mathematics and Economics
- Year 2 of UECA-GL12 Undergraduate Mathematics and Economics (with Intercalated Year)
- UPXA-GF13 Undergraduate Mathematics and Physics (BSc)
    - Year 2 of GF13 Mathematics and Physics
    - Year 2 of GF13 Mathematics and Physics
- UPXA-FG31 Undergraduate Mathematics and Physics (MMathPhys)
    - Year 2 of FG31 Mathematics and Physics (MMathPhys)
    - Year 2 of FG31 Mathematics and Physics (MMathPhys)
- Year 2 of UMAA-G101 Undergraduate Mathematics with Intercalated Year