

# Course information

PH-204 is about *Physics Simulation*. Broadly, this means using one physical process (that we can control) to simulate another (in which we're interested).

Historically, mechanical systems were used (e.g. Tide-predicting machines). We now have computers, which are *general purpose* machines which can be *programmed* to simulate any physical system. A notable gap is *quantum mechanics*, for which no known *classical* algorithm exists for efficient simulation. Using quantum systems which we can control (e.g. cold atoms) to simulate other quantum systems in which we're interested (e.g. solid state) is an active area of research. A *general purpose quantum computer* is the obvious next step.

## Approach

There is not enough time to teach programming properly. There **is** enough time to teach recipes which will bootstrap your ability to use programming as a problem solving tool, and hopefully spark an interest.

The course is 100% continuously assessed, and time is extraordinarily tight to set a meaningful first assignment.

We will cover sufficient material before an assignment is set; you may use any additional material learned during the course.

## Python

Python is a real language used by science and industry. It is not just a teaching aid. Concepts learned here are applicable to other programming languages.

Python is remarkably flexible: it matters what something can **do**, not what something **is**.

You will see examples of typical use. Please follow through, step-by-step. Appreciate that there are different ways to achieve the same thing, so be creative and try things.

## Timetable

Scheduled contact time including Competence Tests (C0,C1,C2,C3,C4) and Assignments (A1,A2,A3).

Competence Tests can be re-taken the following week (except for C0, which carries no marks).

Attendance is mandatory at all workshops, even when there is no scheduled test.

Practice problems (unassessed) will be available to stretch your abilities.

Assignment deadlines are for illustration only; please refer to individual sheets for exact deadlines.

Week	Date	Event	Description	A
1	2018-10-02 Tue	Lecture 0	Review PH113	
1	2018-10-02 Tue	Workshop 0	Competence 0	
1	2018-10-04 Thu	Lecture 1	flow control, newton, plotting, slicing	
2	2018-10-09 Tue	Workshop 1	Competence 1	1
2	2018-10-11 Thu	Lecture 2.1	dicts & sets, procedural & functional, trapz & quad	1
3	2018-10-15 Mon	Workshop 2.1		1
3	2018-10-18 Thu	Lecture 2.2	interpolation, curve fitting, unpacking (*opt)	1
4	2018-10-23 Tue	Workshop 2.2		1
4	2018-10-25 Thu	Lecture 2.3	vectors, matrices, errorbars, 2D arrays	
5	2018-10-30 Tue	Workshop 2.3	Competence 2	2
5	2018-11-01 Thu	Lecture 3.1		2
6	2018-11-06 Tue	Workshop 3.1		2
6	2018-11-08 Thu	Lecture 3.2		2
7	2018-11-13 Tue	Workshop 3.2		2
7	2018-11-15 Thu	Lecture 3.3		
8	2018-11-20 Tue	Workshop 3.3	Competence 3	3
8	2018-11-22 Thu	Lecture 4.1		3
9	2018-11-27 Tue	Workshop 4.1		3
9	2018-11-29 Thu	Lecture 4.2		3
10	2018-12-04 Tue	Workshop 4.2		3
10	2018-12-06 Thu	Lecture 4.3		
11	2018-12-11 Tue	Workshop 4.3	Competence 4	
11	2018-12-13 Thu	Lecture 5		

## Assessment

Assessment is by in-class competence checks and assessments with the following weighting:

Component	C0	C1	C2	C3	C4	A1	A2	A3	Total
Weighting	0	5	5	5	5	20	30	30	100

## Competence checks

Competence checks ensure that you know the building blocks necessary for the assignment.

If you struggle, we can tackle issues **before** they impact your ability to do the assignment.

Competence checks are intended to be straightforward and take no more than 30 minutes.

Course notes and recommended texts are permitted. **No discussion. No Googling.**

Upload to Blackboard as a **working** Python3 script. No Jupyter. No cut-and-paste from the terminal.

Once complete, if you are satisfied, **please leave** and start the assignment.

If you had difficulty, please discuss with teaching staff over the next 60 minutes.

## Assignments

While you are encouraged to discuss problems, as you would any other problem sheet, work which you submit **must be your own**.

If you are struggling, please contact me.

Upload to Blackboard as **working** Python3 scripts. No Jupyter. No cut-and-paste from the terminal.

Copy-and-paste from the notes is **encouraged**: you are not expected to remember all the boilerplate, but you must know enough to use it.

Copy-and-paste from your colleagues is **forbidden**: while you are encouraged to discuss problems, work you submit must be your own.

## Broad outline

**Part 1** is about Python fundamentals, functions, and finding numerical solutions to equations  $f(x) = 0$ .

**Part 2** is about numerical integrals, interpolation, and fitting to experimental data.

**Part 3** is about matrices, randomness, and solving Ordinary Differential Equations.

## Reading material

These webpages are tutorials and useful references. They may be consulted during Competence checks.

During Competence Checks, you may also consult the course notes, your own notes, and the following, but please **no other on-line resources**.

Tutorial; NumPy; SciPy; matplotlib; PH-113 Python Primer; SciPy Lectures; SciPy cookbook

## Contact

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