Foundations of High Performance Computing

INSTRUCTIONS FOR USAGE

“Foundation of HPC” course

DATA SCIENCE &
SCIENTIFIC COMPUTING
2021-2022 @ Università di Trieste

Important notices / 1

The Lectures will actually start on

Monday, 10th of October

Today I'm just presenting the course and giving some practical directions.

On Thursday, 6th of October, Stefano Cozzini will be present accordingly to the schedule to start the accounts on a linux cluster that you will use during the course.
Please be present.
Please try also to login on your account at SISSA's Ulysse cluster.

Important notices / 2

Starting from the next year this course will be split in 2 parts:

Foundations of HPC *mandatory for all curricula*
a basic introduction to HPC and to parallelism in distributed and in shared memory

HPC *mandatory for Scientific computing curriculum*
a much more advanced step into the same matters

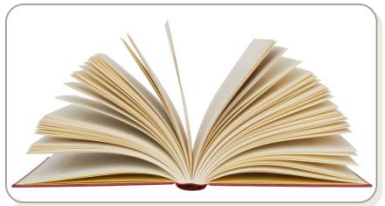
Important notices / 2

This year ou still have a unique course, but we will split it in two parts that follows the same rationale than in the previous slide.

The first part will cover the basic topics, and will be mandatory for all of you.

The second one will cover advanced topics, and as for the exam, we will try to account for the difference in curricula as much as possible. We'll still figuring out the details, we'll let you know asap.

Outline



What you will learn

How it works

Some common rules & principles

What you will learn

What is High Performance Computing

Tools, basic and not-so-basic concepts

What you will learn

Modern computer architecture

Why is it there and what will be next

How, and why, to «optimize» a code for such an architecture

What you will learn

Parallel programming

Why & how

Grow-up and use large HPC facilities to tackle large (and complex) problems

What you will learn

Attitude

Don’t be (only) a user of pre-cooked tools that you consider as black-boxes

What you will learn

Attitude

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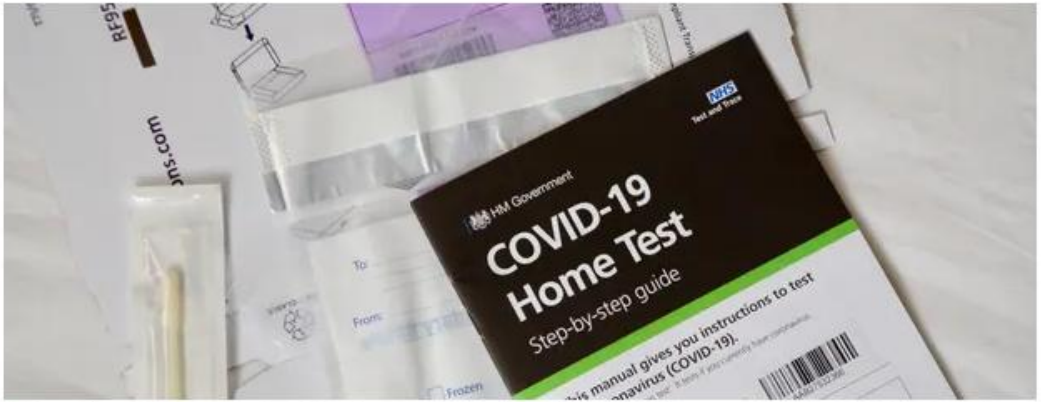
Covid: how Excel may have caused loss of 16,000 test results in England



▲ More than 50,000 potentially infectious people may have been missed by contact tracers after 15,841 positive tests were left off the daily figures. Photograph: Simon Leigh/Alamy

The Guardian

6/10/2020

https://www.theguardian.com/politics/2020/oct/05/how-excel-may-have-caused-loss-of-16000-covid-tests-in-england

A million-row limit on Microsoft’s Excel spreadsheet software may have led to Public Health England misplacing nearly 16,000 Covid test results, it is understood.

Outline

What you will learn

How it works

Some common rules & principles

How it works

The baseline is:

1) **lectures**: we prepare slides and examples and we expose them.

The lectures will be recorded and you'll find the related files both in the Teams and on GDrive (we'll ommunicate the address).

The pdfs that we will use and the example codes will be put in this GitHub repository (we'll make our best effort to upload the files *before* the lecture).

How it works

The baseline is:

1) **lectures**: we prepare slides and examples and we expose them.
2) **questions**: you ask what you want whenever you want; if we say something wrong or stupid, you notice that and you raise your hand.

How it works

The baseline is:

1) **lectures**: we prepare slides and examples

2) **questions**: you ask what you want whenever you want

3) **discussions**: you ask to discuss much deeper some aspects or topics from previous/future lectures; you read other materials and bring them into the discussions.

How it works

The baseline is:

1) **lectures**: we prepare slides and examples

2) **questions**: you ask what you want whenever you want

3) **discussions**: you ask to discuss much deeper

4) **Office hours:** each of us will be available weekly an hour (we'll communicate which one). However, we are ready for chatting, Q&A or alike upon appointment, just send us an email

Pre-requisites

1. A *nix box, preferably a Linux box
   The best would be to install it as dual boot on your laptop; fall-back options are to use the `Windows` sub-system or the `iOS`

2. Be comfortable with basic shell commands
   have a look at bash manual

3. We expect that you are familiar with basic C/C++

4. A basic knowledge of `git`

Outline

What you will learn

How it works

Some common rules & principles

Common rules & principles

1) **Don't be shy**, every question is legitimate and useful; ask what you do not understand (or we explain poorly), comment what you want to explore.
2) Our main focus is that you **learn**, not to grade you.
3) Learning is a **process**, not a result; we're interested in both your learning process *and* in your final level.
4) This course is gonna be **tough** for many, if not all, of you; it is because we'll challenge you to go beyond your (supposed) limits, and we'll consider you as intelligent adults not as *poor students*.

Common rules & principles

let us spend a bit more time on this point

« This course is gonna be **tough** for many, if not all, of you; it is because we'll challenge you to go beyond your (supposed) limits, and we'll consider you as intelligent adults not as *poor students*. »

This year the course we'll be shallower, at least for those that are not in the Scientific Computing curricula.

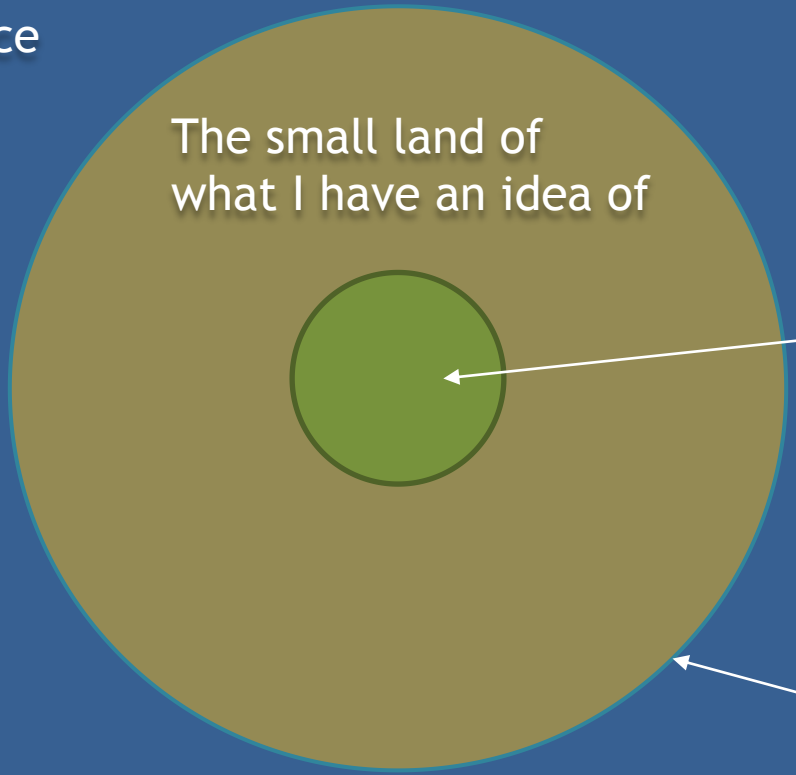
Common rules & principles

The following is just to explain how I see it.

I do not want to lecture anyone about life.

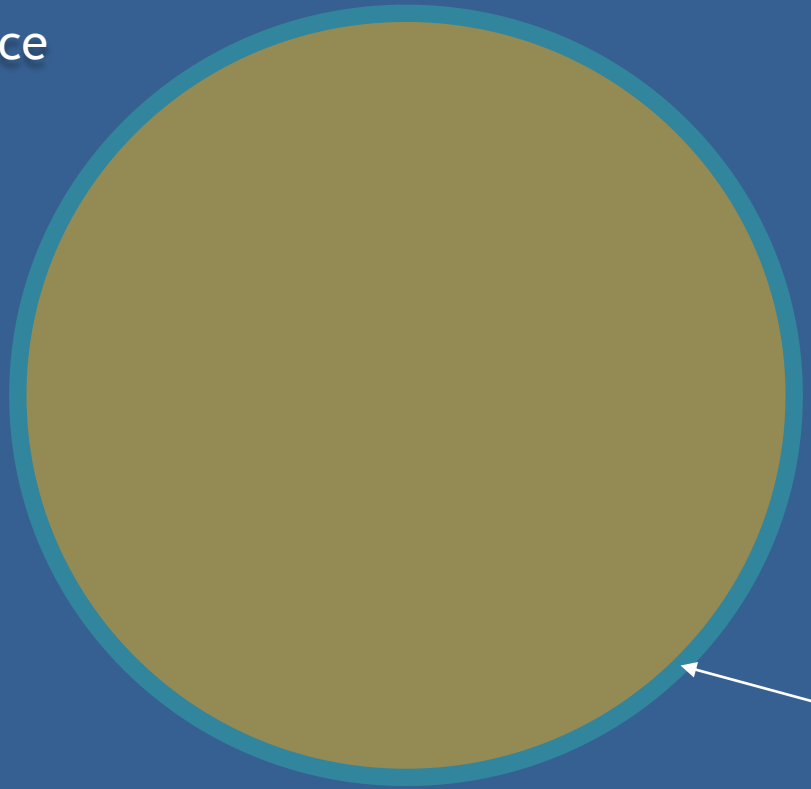
Common rules & principles

My ocean of ignorance



Common rules & principles

My ocean of ignorance



Appreciate the apparent paradox for which the larger is my knowledge, the larger is my ignorance (and the more I realize that).
And vice-versa.

The horizon of my ignorance

Common rules & principles

The message is:

If I want to reach some deep knowledge in something, I do have to

have heard of / had a glance at / tasted / looked at / read about / have an idea of

much **m u c h** more.

Common rules & principles

5) We (you and us) will be **honest** in all respects (giving/doing assignments, in the mutual relationships, …).
6) Nobody is perfect or always right: **errors and mistakes are natural**; what matters more is what will follow-up.
7) We're not the guardians of your life: you decide how much you want to learn and how much to profit from opportunities.

Common rules & principles

8) We believe in sharing and commons. We also believe that learning is a process in our personal brain, not in others' one.
Open source is among the greatest achievements in this field.
We all have learnt from other people's codes, but we all have learnt even more from our own mistakes and efforts.

We encourage you to clash with your limits long before you decide to take inspiration from available code (for sure you may find something useful for the assignments) online.

It may be risky supposing that at the examination we will be unable to spot whether you fully understand the code you have submitted or not.. :-)

Exam

Eventually, this journey ends with an exam and an evaluation of your level of comprehension and acquired skills.

There will be an assignment **at the end of the first part** (the basic introduction) and one assignment **at the end of the second part** (the advacend topics).

1. If you complete in due time the 2 assignments, then you can access directly the final oral examination
2. If you do not complete the assignments, then you'll be recquired to complete an equivalent project *before* to access the oral examination (a list of projects from which you could pick-up yours will be published at the end of the course).

Exam

You will be allowed to repeat the oral exam without any constraint:
however, please

(i) do not try multiple times in a short time span (save our time and take yours to digest better)

(ii) self-organize with your peers so to have groups of you that ask for an exam

(iii) there will be regular exam sessions, however usually we do prefer to agree with small groups of students to have exams whenever it ifts at best.

Exam

Here is what ideally you should expect as final grade:

18–20	Too embarassing to mention
21–23	You got a basic understanding of the matter; slightly more advanced topics or unexpected facts put you in trouble
24–26	You have a robust understanding of the matter, upon thinking you can explore rough terrain
27	You have a firm comprehension of the matter, you sense the right direction and solution
28	Like 27 + you *see* the solution; some added shining
30	Like 28, but with shining
30*cum laude*	Like 30, but you really surprise us
29	Some accident happened along the route to 30

Basic principles, *resumé*

Learning is a process that happens only together, among human beings.

Racism, sexism, homophobia, culturalism, discrimination in every sense are not allowed and definitely rejected.

Help us in building a better milieu and a wonderful experience in sharing this journey together.

Questions, doubts, fears?

Now is the time (but another one will fit as well).

But, in case that later on you will experience *l'esprit de l'escalier*, you can still contact us:

luca.tornatore @ inaf.it stefano.cozzini @ areasciencepark.it