High Performance Computing + Cloud Computing A, B

INSTRUCTIONS FOR USAGE

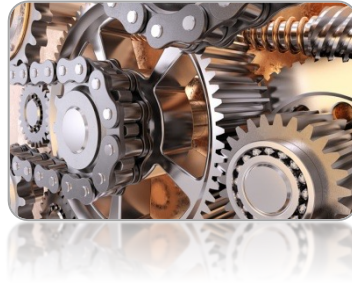DATA SCIENCE & ARTIFICIAL INTELLIGENCE

SCIENTIFIC & DATA-INTENSIVE COMPUTING

2024-2025 @ Università di Trieste

Outline

What you will learn

How it works

Some common rules & principles

What you will learn

High Perform. Computing	Cloud Computing	
	Basic	Advanced
simple introduction to HPC and parallel programming. propedeutic to Advanced HPC.	Basic concepts of Cloud Computing	Kubernetes & HPC on cloud infrastructures
curriculum SDIC+DSAI	SDIC+DSAI+more	SDIC+more

What is High Performance Computing

Tools, basic and not-so-basic concepts

Modern computer architecture

Why is it there and what will be next; how, and why, to «optimize» a code for such an architecture

Parallel programming

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

Attitude

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

What is Cloud Computing

Cloud, XaaS, Properties and basic implementations

Modern cloud architecture and infrastructure

Basic concepts and tutorials. Computing and Data Cloud

Virtual Machines and Containers

What is a VM and how to use it, experiments with VBox
What is a container and how to use it (Docker)

Attitude

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

Tools, basic and not-so-basic concepts
Tutorials and experiments

Introduction to Kubernetes

Kuberetes orchestrate services. Here we will understand what stuff is needed to keep a service up and running.

Installing and managing Kubernetes

After the understanding, here we will deploy and manage this stuff.
Once the orchestrator elements are covered we will deploy client server applications and test their behaviour.
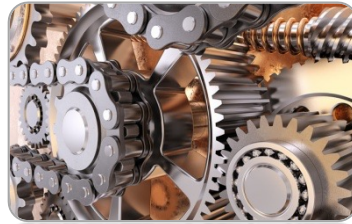
Installing and benchmarking HPC applications on Kubernetes
Finally we will go deeper in to container primitives and explore the challenges that HPC workloads face in a kubernetes environment.

Outline

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How it works

The baseline is:

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

Some of the lectures are actually hands-on sessions and tutorials

The lectures will be recorded and you'll find the related files both in the Teams and on a Google Drive in the long-term.

The pdfs that we will use and the example codes will be put in a GitHub repository.

How it works

Lecture timetable for the first semester:

orario	gio 26	ven 27	gio 3	ven 4	gio 10	ven 11	gio 17	ven 18	gio 24	ven 25	gio 31
Sett						**Ottobre**					
(11:00 - 14:00) - Aula 5C (Edificio H2bis)		Intro to cloud (2h)		Networking (2h)		Benchmark (2h)		LIBERO PER ADVANCED		coud demo (2h)	
(17:00 - 19:00) - Aula 2A Morin (Edificio H2bis)	Intro al corso 1h		coud main concepts (2h)		Virtualization (2h)		LIBERO PER ADVANCED		Cloud models (2h)		data cloud (2h)

orario	gio 7	ven 8	gio 14	ven15	gio 21	ven 22	gio 28	ven 29	gio 5	ven 6	gio 12
November										**Dicer**	
(11:00 - 14:00) - Aula 5C (Edificio H2bis)		containers (2h)		1 Advance (2h)		3 Advance (2h)		5 Advance (2h)		7 Advance (2h)	
(17:00 - 19:00) - Aula 2A Morin (Edificio H2bis)	containers (2h)	containers (2h)	k8s Intro (2h)		2 Advance (2h)		4 Advance (2h)		6 Advance (2h)		8 Advance (2h)

	gio 12	ven 13	gio 19	ven 20
Dicembre				
				11 Advance (2h)
		9 Advance (2h)		
	8 Advance (2h)		10 Advance (2h)	12 Advance (2h)

Basic

Advance

Fridays afternoon on demand….

How it works

The baseline is:

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

`github.com/Foundations-of-HPC`

`/High-Performance-Computing-2024`
`/Cloud-Basic-2024`
`/Cloud-Advanced-2024`

The repos are online and public; in the landing page you find the detailed list of the lectures.

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:

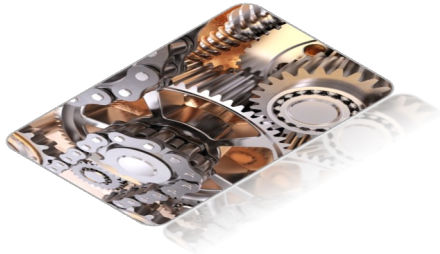1) **lectures**: we prepare slides and examples

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

Outline

What you will learn

How it works

Some 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*.

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 (among them there is following this course).

8) Although we firmly believe in **sharing and commons.**
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 remind you that **learning is a process in our personal brain, not in others' one**.
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.

NOTE: *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..* :-)

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

The evaluation consists in **2 steps**

1. You complete a final assignment that will be given before the end of the lecture;

2. you attend the exam session

    a) at the begin all the attendees will answer to some simple written questions on the topics covered in the lectures (~15min)

    b) every candidate will discuss individually its own assignment and the answers to the questions given at the begin of the exam

The final assignment

We will prepare a set of exercises, and you will have to pick **2 for HPC**, **1 for CC Basic** and **1 for CC Advanced**.

You must solve the problems, write a report about your work and send us the report 1 week before the exam session.
You must also upload the code that you have written on a git.

No working group is allowed (i.e. everyone has to write its own report).

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.

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

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.

Please fill the questionare:
https://forms.gle/XLP4MpTxvq78zn5d9

Questions, comments, doubts, fears... ?

Now is the time (but another one will fit as well).
But, in case that later on you feel *l'esprit de l'escalier*, you can still contact us:

stefano.cozzini @ areasciencepark.it
ruggero.lot @ areasciencepark.it
giuliano.taffoni @ inaf.it
luca.tornatore @ inaf.it

Communication channel: telegram group...if you like