Centre of Excellence in Quark Matter

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JYVÄSKYLÄN YLIOPISTO
UNIVERSITY OF JYVÄSKYLÄ

Research Council of Finland

HELSINKI INSTITUTE OF PHYSICS

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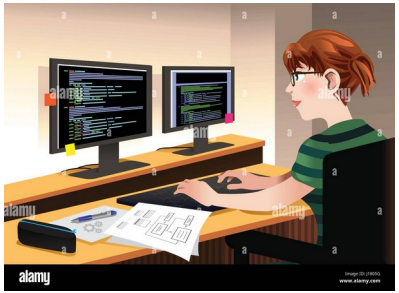
Computational and Statistical Methods

Particle and Nuclear physics graduate student retreat 2025

Outline

- Let me talk about some useful tools and concepts
- Split in teams á 3 persons:



- And then you will work on a practical example
- Sessions: Friday 15-17 & Saturday 12:30-14

git and GitHub

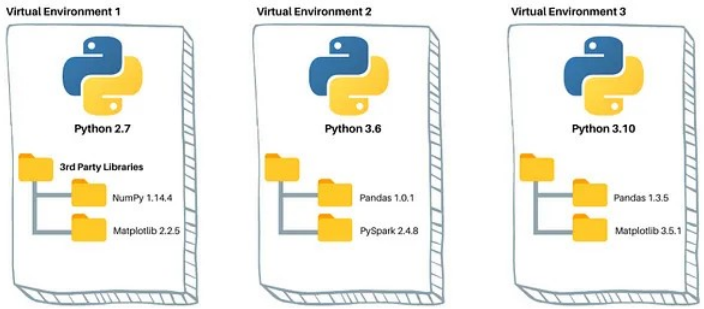
- Version control systems provide reproducibility
- Trackable changes
- Easy backup option
- Version control systems have a unique source of truth with which you have to sync your state (Collaborations!)
- GitHub is one popular online git provider

Important git commands

- `git help` open manual
- `git status` check current state
- `git pull` load most recent “true state”
- `git diff` check current changes
- `git add a.txt` add a file
- `git commit` take a snapshot of the current state
- `git push` transfer snapshots

Python

- **Python is very popular inside and outside academia**
- **Let's use virtual environments:**
  - We have a reproducible setup
  - We can control versions
  - We are independent from the host



Python Libraries: Numpy + SciPy + Matplotlib

- Efficient vector/matrix lib
- Basic Linear Algebra

- Includes all basic numeric algorithms, e.g. Integration, Differentiation, …

- Basic plotting tool

Why write your own library?

- Reuse parts of your code
- Split math/physics from pheno
- Easier access for externals
- Easier to extend

Program vs. Library

Testing your code

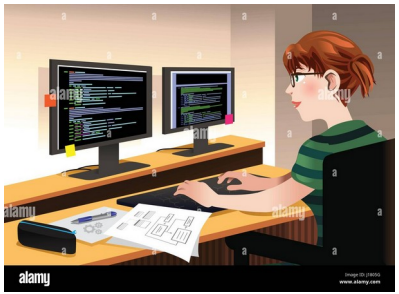
- When writing code we usually test along the way
  → let's keep those tests in a dedicated way
- Unit tests test atomic pieces of code
  → e.g. symmetries, analytic solutions
- Benchmarks test against external references
  → e.g. other papers, programs
- Most popular Python library: pytest

pytest

Let’s get practical!

- **Let’s rediscover gravity by observing a ski jumper!**

- TEAM CAPTAIN
- General overview
- Code Reviews
- Infrastructure



- Develop library
- Develop unit tests
- Generate data

- Solve exercises
- Apply library
- Analyze data

https://github.com/felixhekhorn/topi-git-template

Team split

- Aagrah Agnihotri, Jichao Li, Hira Sharif
- Madhav Chithirasreemadam, Denise Lazzaretto, Niklas Zimmermann
- Magnus Bertilsson, Mika Mäki, Nico Toikk
- Timo Ahola, Xin Li, Constantin Sporleder
- Duarte Miguel da Silva Feiteira, Manu Kanerva, Niels Landsman
- Daniel Bettaney, Aatu Rajala, Miikka Winter
- Michele Benaco, Yuan-Lin Lyu, Alexi Stadnitski
- Saikumar Chinthakayala, Henry Hiltunen, Pyry Runko
- Henry Hiltunen, Van Dung Le, Aapeli Kärkkäinen