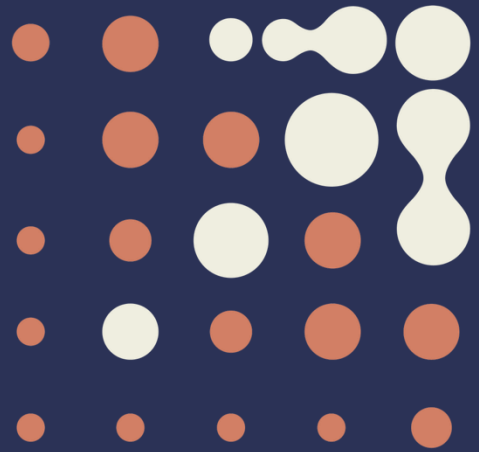
Medical Genomics course

N. Alcala & M. Foll

Computational Cancer Genomics Team

2025



International Agency for Research on Cancer

World Health Organization

Computational Cancer Genomics

Philosophy

Hands-on course with a focus on real-world medical problems

>to know if you want to dedicate your professional career to medical genomics research, you need to **experience what working on a typical medical genomic project is like**

> We will see just enough theory to grasp the main concepts and then **code and do actual data analysis**, and do **team work**

General information

Venue: IARC – WHO: the world's cancer agency https://www.iarc.who.int

Attendees: INSA students + CanBioS doctoral school students + IARC early career scientists (normally ~20 students in total)

IARC nouveau centre in the Gerland biodistrict

Nicolas Alcala
Computational Cancer Genomics team, cancer ecology and evolution
alcalan@iarc.who.int

Matthieu Foll
Computational Cancers Genomics team leader, head of bioinformatics
follm@iarc.who.int

International Agency for Research on Cancer

World Health Organization

IARC's Mission: research on cancer prevention

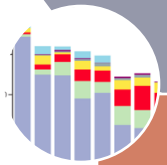
- .. is the specialized cancer agency of the World Health Organization (WHO).
- .. promotes international collaboration in cancer research.
- .. identifies the causes of cancer so that preventive measures may be adopted.
- .. conducts research in LMICs through partnerships and collaborations with researchers in these regions.

27 Participating States
+2 who recently joined

A global reference for cancer information ◆ Causes and prevention of cancer ◆ Global cancer biobank ◆ Producing evidence-based science for global cancer control policies

Main areas of IARC's research

Pillar 1 Data for action



Cancer Surveillance

Pillar 2 Understanding the causes

Nutrition & Metabolism

Genomic Epidemiology

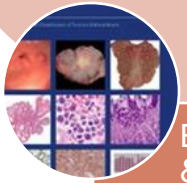
Laboratory Support & Biobanking

Pillar 3 From understanding to prevention

Early Detection, Infections & Prevention

Environment & Lifestyle

Pillar 4 Knowledge mobilization



Evidence Synthesis & Classification

Learning & Capacity Building

The Computational Cancer Genomics team

Multi-omics characterization of tumors. Identify aggressive phenotypes.

> **Cancers of interest**: mesothelioma, neuroendocrine neoplasms (focus on lung), rare cancers (https://rarecancersgenomics.com)

> **Approaches:** bioinformatics, computational biology, deep-learning, modeling, evolution and ecosystems

> **Techniques:** genome, transcriptome, epigenome, single-cell and spatial omics, images

Program

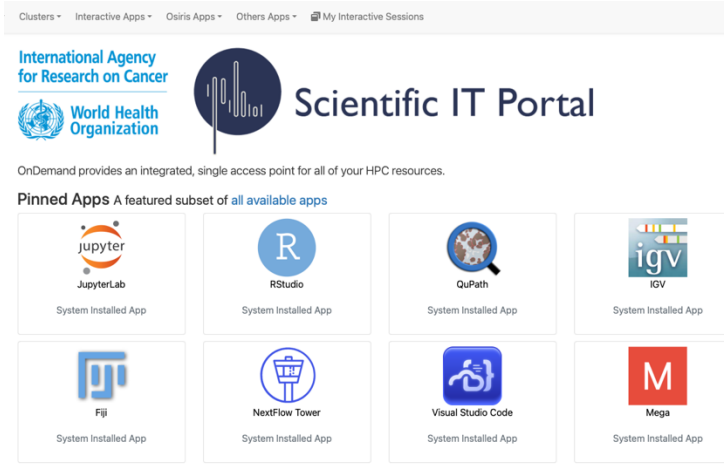
- Monday November 24*th*
  - 11-12:00 welcome and general introduction
  - 13-15:00 genomics lecture
- Tuesday November 25*th*
  - 9-10:00 single-cell RNA-seq lecture
  - 10-12:00 single-cell practical part I
  - 12-13:00 spatial RNA-seq lecture
  - Lunch break
  - 14-16:00 single-cell practical part II
  - 16-18:00 epigenomics and multi-omic integration lecture

- Wednesday November 26*th*
  - 9-10:00 AI for digital pathology
  - 10-12:00 AI for digital pathology practical part I
  - 12-13:00 AI for multi-modal integration
  - Lunch break
  - 14-16:00 AI for digital pathology practical part II
  - 16-18:00 projects
- Friday November 28*th*
  - 9-12:00 projects
- Tuesday December 16*th*
  - 14-16:00 project presentations
  - 16-18:00 networking event

Practical information

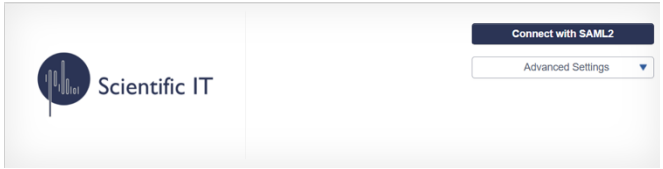
Computing resources

Scientific IT platform: dedicated portal for data analysis
http://portal.sit.iarc.fr / HPC: **`osiris.iarc.lan`**
Training-MG folder on Osiris
Accounts and gateway created for **external participants**:
https://ovd-esg.iarc.who.int/ovd/
login: firstname.lastname@iarc.who.int
password: received by email
Connection instruction were sent your (insa) email address
Teams channel: IARC-Medical genomics course | General | Microsoft Teams
GitHub page: https://github.com/IARCbioinfo/medical_genomics_course



Lunch / coffee break

Cafeteria on ground floor



International Agency for Research on Cancer
World Health Organization

Practicals

1. **Single-cell and spatial transcriptomic analyses**

2. **Deep learning analysis of whole-slide pathological images**

Data on IARC's HPC Osiris
Launch jupyterlab from the IARC SIT platform (web browser)
Both using python, use links sent if needed (in particular the R to Python tutorial)

Group projects

5 projects based on actual research done at the agency
- ranging from more bioinformatics oriented to more data analysis oriented
- Groups of 3 students

Group presentation on December 16th (10 min + 10 min of questions per group).
Note the cafeteria will be unavailable this day for external participants.

Evaluation for INSA students
- grade is 50% supervisor evaluation and 50% presentation evaluation
- Criteria are: understanding of subject, clarity of explanations, organization and structure of the presentation, visuals, engagement, and answer to questions
- All group members should present something

Practical setup

- Log in to Inuvika using the login information sent to you on Friday
- Once in Inuvika, follow the steps listed in ***/data/Training-MG/files/scripts/Practical1/2025/TODO_BEFORE_PRACTICAL1.txt*** to setup your environment for the first practical.
- If you have some time left, follow the steps listed in ***/data/Training-MG/files/data/AI_practicals_2025/practical_setup.md*** to setup your environment for the second practical.
- If you encounter any issues during the installation of your environments, let us know!