

Syllabus

Course Bioimage Informatics



General Course Information

Bioimage informatics is a new discipline

- Course introduced in 2019 (one of the few of its kind)
- Covers all essential aspects of the field
- Spans from basic concepts to SOTA advancements
- Built on real-world experiences of teachers
- Specially tailored for EPFL Master students

Dr. Daniel Sage

Biomedical Imaging Group
Center for Imaging

[School of Engineering](#)

daniel.sage@epfl.ch

Office hours

Thursday 11-12PM

Dr. Arne Seitz

Head of the PT-BIOP
BioImage and Optics Platform

[School of Life Science](#)

arne.seitz@epfl.ch

Office hours

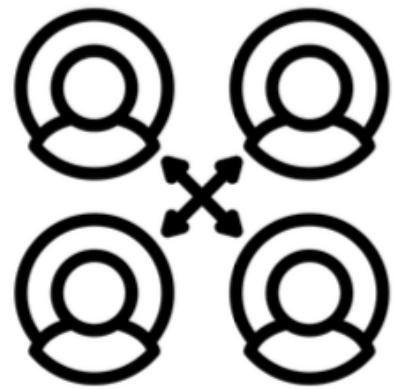
Wednesday 10-11PM

Learning outcomes

- ✓ Understand the fundamental concepts of bioimage processing and analysis
- ✓ Grasp the principles behind key algorithms (engineering and machine learning)
- ✓ Analyze, select, combine techniques for specific applications
- ✓ Learn how to use widely adopted bioimage software
- ✓ Design and code basic routines and workflows real-world applications
- ✓ Are able to produce and evaluate reliable data analysis from images

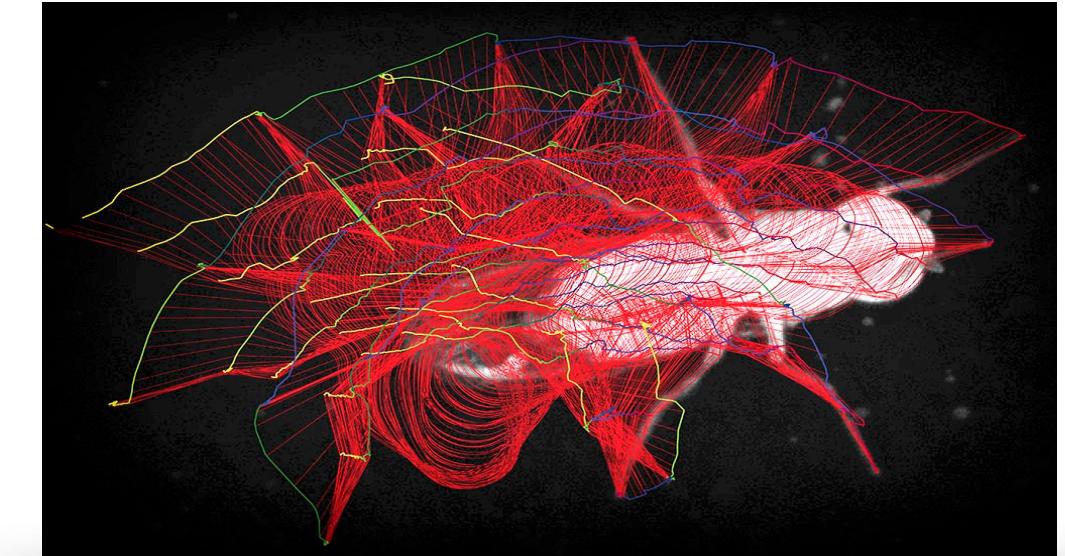
Structure

- Lectures
- Demos
- Workshops
- Exercises
- Homeworks
- Project



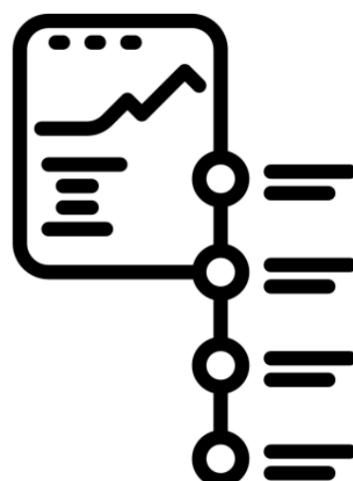
Personal involvement

- Be open for **interdisciplinary**: biology, microscopy, SP, coding
- Be actively **engaged**, encouraging interactivity, sharing with peers
- Be ready to write **code** as part of the learning experience
- Be **resilient** in dealing with technical issues of open-source software



Policies

- Students are expected to attend all course activities
- Slides alone are not sufficient to master the course
- Coding are essential to fully grasp the fundamental concepts
- A fair attitude is expected when working in groups



Coding – Programming by examples

- **Macro** Scripting for automation – **ImageJ**
- **Java** Developing robust, GUI-based, and powerful applications – **Fiji**
- **Python** Prototyping, fast, enabling DL & GPU – **Napari** or **Notebook**

Full support
Limited support





Grading

Homeworks (4)

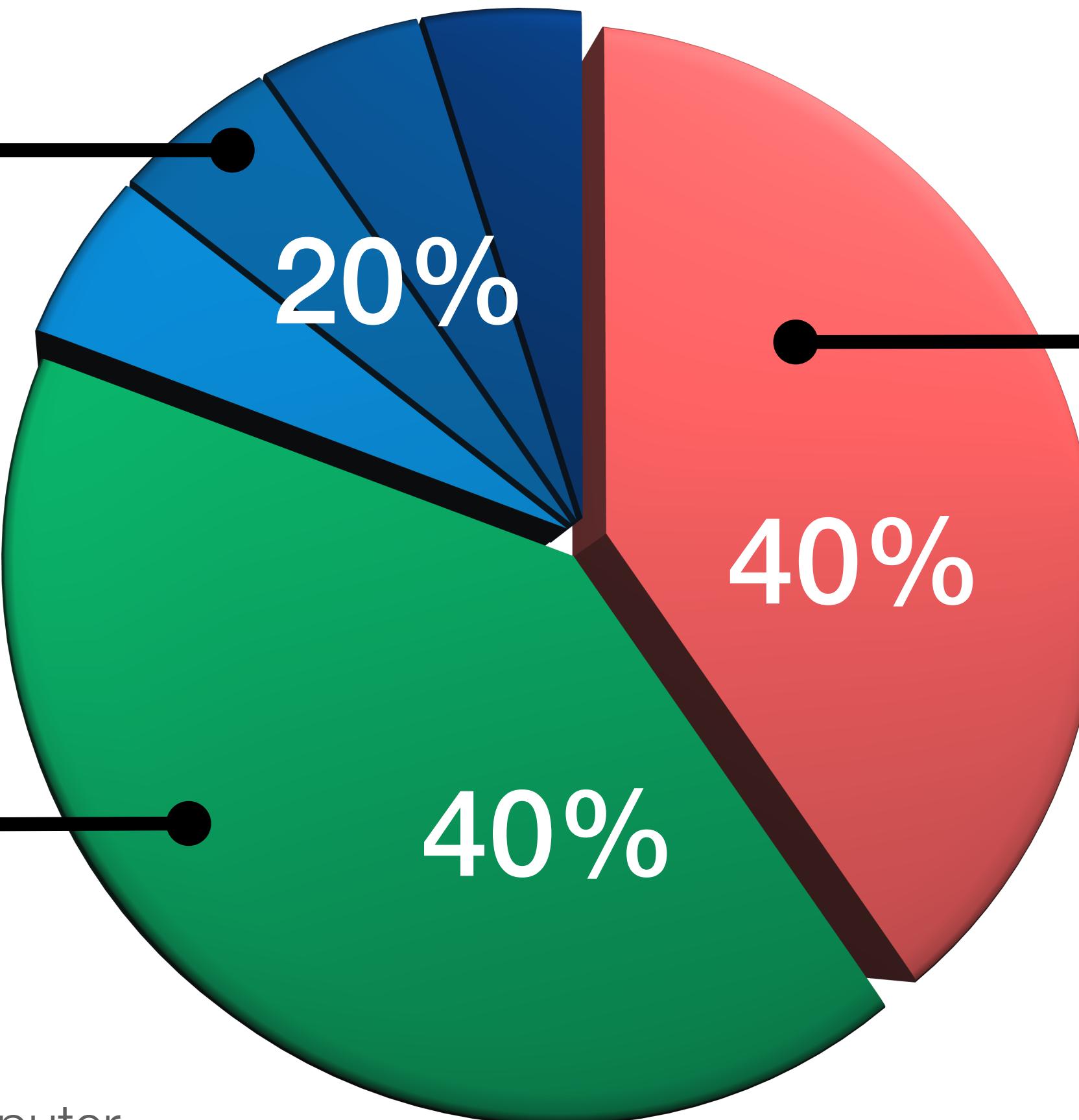
Individual
Computer hand-ons
~11 days

Exam

Individual
Written

Handwritten notes, no computer
Mock-exam

~3h in June or July



4 ETCS

Project

Group of 2-3 students
Practical
Bioimage analysis
on real data
Methodology
implementation
Oral presentation
~7 weeks

Deadlines are strict, and late submissions will not be accepted.



Computer & Software



Personal computer

8Gb RAM at least

Disk space ~4Gb

Java 1.8

Python 3.9

Backup

Open-source software for this course

Fiji Complete software package for life science. Distribution of ImageJ

ImageJ Standard software for bioimage analysis Vanilla version (NIH)

Napari Multidimensional image viewer. Python-based bioimage platform

lIastik Software for machine learning pixel classification and more

QuPath Java-based platform, user-friendly software for digital pathology

ICY Java-based, open community platform for bioimage analysis



Open-source coding environment for this course

IntelliJ IDEA Community Edition Integrated development environment (IDE) for Java

Python environment

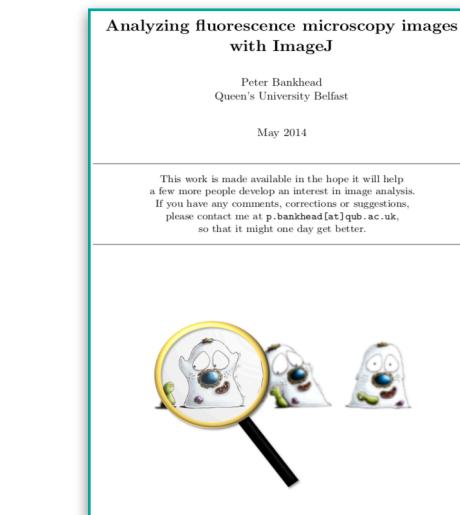
Visual Studio code / Conda / Jupyter Notebook



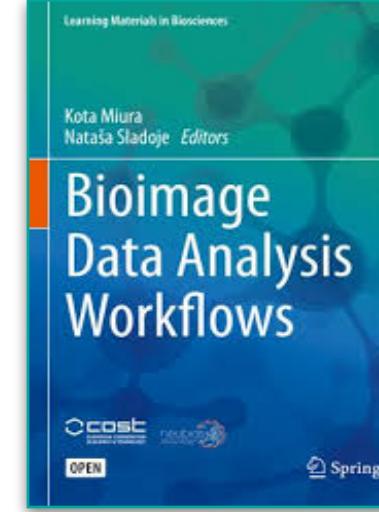
Books

 [image.sc](https://forum.image.sc) <https://forum.image.sc>

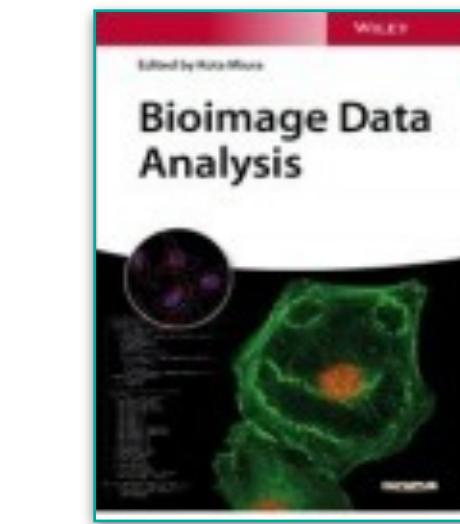
All Topics AGAVE AICSImageO Arkitekt Aydin BAND
BIAFLOWS BiaPy BII BiofilmQ Bio-Formats Biolma
BoneJ BrainGlobe CAREamics Cell-ACDC Cellpose CellPrc
CLIJ CytoMAP Cytomine DAIM DeepLabCut Fiji
FLIMLib GerBI GloBIAS Icy IDR ilastik
ImageJ ImageJ2 ImgLib2 ImJoy ImSwitch iRODS
JIPipe JuliaImages Mars MCMICRO MIA MIB
μManager MoBIE ModularImageAnalysis MorphoGraphX napari
NEUBIAS NFDI4BIOIMAGE OME OMERO OmeSliCC OpenFL
OpenSPIM Orbit Piximi PolusAI PYME Python
QUAREP-LiMi QuPath scenery SCIFIO scikit-image sciview
SmartMicroscopy SR-Tesseler StarDist TeamTomo TissUU
vedo VVDViewer webKnossos ZeroCostDL4Mic ... Your Icon Here Dorma



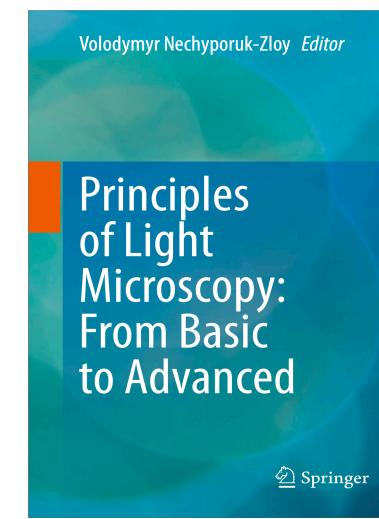
Analyzing fluorescence microscopy images
P. Bankhead
open access



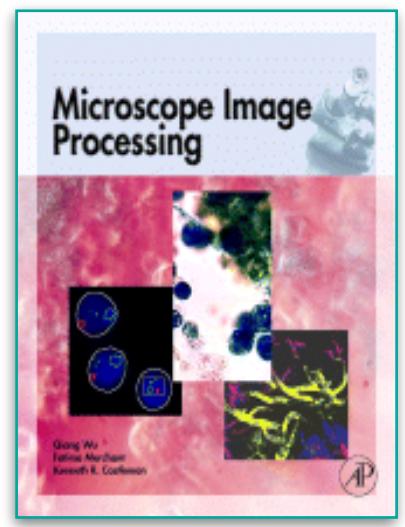
Bioimage Data Analysis Workflow
K. Miura, N. Sladoje
Springer 2019
open access



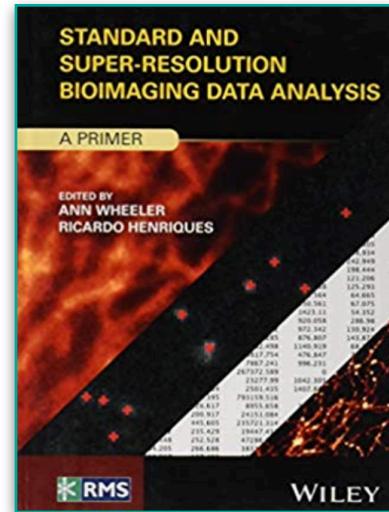
Bioimage Data Analysis
K. Miura
Wiley 2016
open access



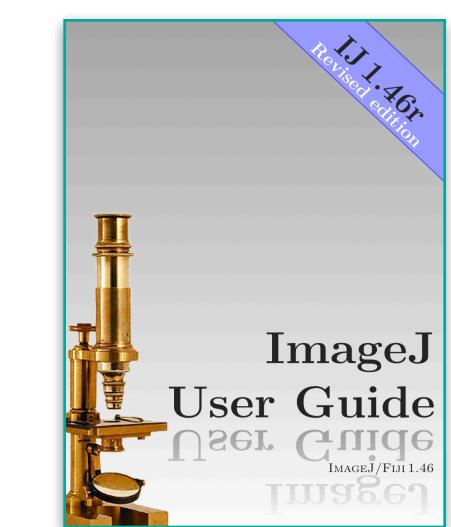
Principles of Light Microscopy
V. Nechyporuk-Zloy
Springer 2024
open access



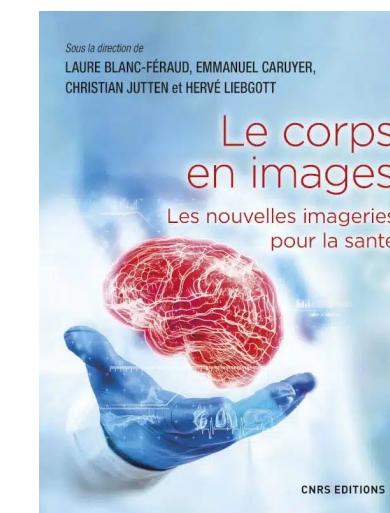
Microscopy Image Processing
Qiang et al.
Castleman 2010



Standard and Super-Resolution Bioimaging Data Analysis
A. Wheeler, R. Henriques
Wiley 2019



ImageJ User Guide
T. Ferreira, W. Rasband
2012
open access



Le corps en images
Les nouvelles imageries pour la santé
CNRS Edition 2022



External Online Resources

► Cell Biology and Molecular Biology	
iBiology	https://www.ibiology.org/online-biology-courses/cell-biology-flipped-
► Microscopy	
Molecule Expressions	https://micro.magnet.fsu.edu/primer/
MicroscopyU	https://www.microscopyu.com/microscopy-basics
iBiology	https://www.ibiology.org/online-biology-courses/microscopy-series/
► Imaging	
iBiology	https://www.ibiology.org/techniques/image-acquisition/
Lice Cell Imaging, KI	https://www.youtube.com/@Livecellimagingfacility
iBiology	https://www.ibiology.org/playlists/imaging-in-biology/
► Methods	
Pete Bankhead	https://petebankhead.gitbooks.io/imagej-intro/content/
Robert Haase	https://haesleinhuepf.github.io/BiolImageAnalysisNotebooks/intro.html
iBiology	https://www.ibiology.org/online-biology-courses/bioimage-analysis-course/
► Tools	
Neubias Academy @ Home	https://eubias.org/NEUBIAS/training-schools/neubias-academy-home/
Johanna Dela Cruz	https://www.youtube.com/@johanna.m.dela-cruz
► Coding in Java	
Introduction to Java Programming	https://math.hws.edu/javanotes/
Thinking in Java	https://github.com/BruceEckel/TIJ4-code
► Code in Python	
Python for Everybody	https://www.py4e.com/lessons
Learn Python	https://www.learnpython.org/



iBIOLOGY



Neubias Academy
neubias.academy.org
Series of open webinars

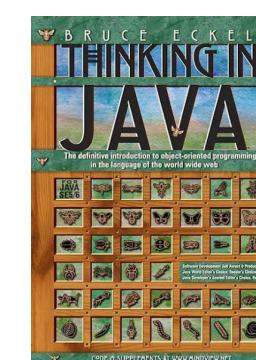


Bio-image Analysis
Notebooks of R. Haase

DOI 10.5281/zenodo.10465773



Video tutorials (Fiji)
Dela Cruz



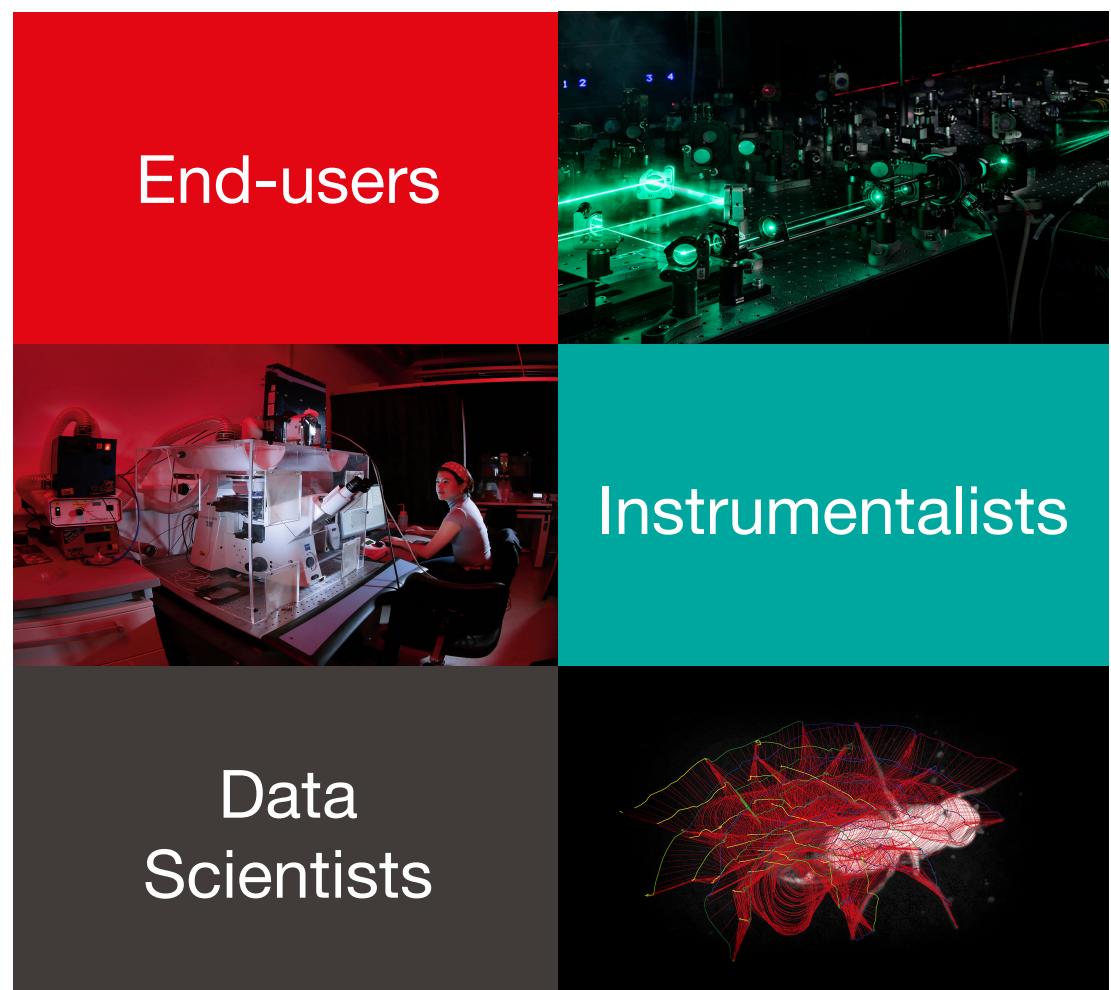
Thinking in Java
Bruce Eckel



EPFL Center for Imaging

<https://imaging.epfl.ch/>

EPFL's exceptional concentration of academic strengths in imaging

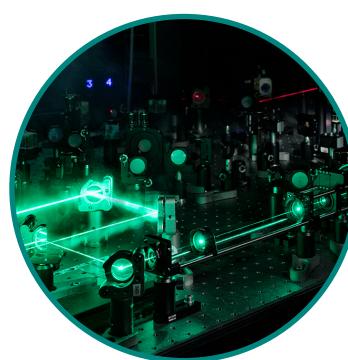


A transversal effort across EPFL Schools, Sections, Platforms, Centers, Innovations, Industry



Top-level training in imaging

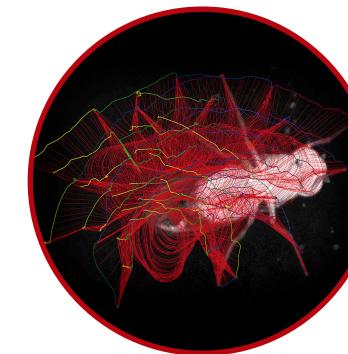
Coordinated imaging infrastructure



Catalyst for interdisciplinary research



Advanced support in image analysis



Minor in Imaging

<https://imaging.epfl.ch/minor-in-imaging>

A holistic program in imaging from sensors to AI
Open to all EPFL master students – 30 ECTS



Transversal program

Transversal program that covers theoretical and practical aspects in imaging



Interdisciplinary

Imaging is the interdisciplinary field par excellence



Increasing demand

Imaging skills are in increasing demand by the industry and academic world

Student Project

Practice image analysis in a lab immersion, master semester project, or master project