Advanced Toolkit for Bioinformatics Research

Field of study Bioinformatics **Specialty** - **Department** Faculty of Biochemistry, Biophysics and Biotechnology **Study level** First cycle **Study form** Full-time degree program **Education profile** General academic **Mandatory** No, optional	**Education cycle** 2023/2024 **Subject code** **Lecture languages** English **Subject related to scientific research** Yes **Disciplines** Biological science **ISCED classification** 0588 Interdisciplinary programmes involving broad field 05 **USOS code**
Subject coordinator	Guillem Ylla
Lecturer	Guillem Ylla

Period Summer semester	**Examination** Graded credit **Activities and hours** Lectures: 15 Seminars: 15	**ECT points** 3.0

Goals

C1	This course will provide the students with advanced tools for performing high-quality and reproducible research in the field of Bioinformatics. It will cover the different

	aspects of bioinformatics research including experimental design, technical skills (in Bash, Python, and R), keeping track of the analysis (git and notebooks), preparing figures for articles, and writing bioinformatics manuscripts.

Subject's learning outcomes

Code	Outcomes in terms of	Effects	Examination methods
Knowledge - Student knows and understands:			
W1	The student will know and understand all the steps involved in performing scientific research in the field of bioinformatics.	BIN_K1_W06, BIN_K1_W09, BIN_K1_W10	report, passing test
Skills - Students can get:			
U1	Students will be able to perform good experimental designs in the field of bioinformatics, including NGS experiments.	BIN_K1_U01, BIN_K1_U07	credit with grade, report, passing test
U2	Students will have the necessary skills in Bash, Python, R, and SQL to perform common research tasks in bioinformatics. This includes connecting to remote servers (ssh), accessing databases through APIs, and managing the data in SQL.	BIN_K1_U01, BIN_K1_U03, BIN_K1_U05, BIN_K1_U06,	credit with grade, report, passing test
U3	Students will be able to perform reproducible research in bioinformatics using programming notebooks, git, and Github.	BIN_K1_U01, BIN_K1_U14	credit with grade, report, passing test
U4	Students will be able to identify the most appropriate type of plot depending on the data and message to convey. The students will be able to create high-quality plots using R and ggplot2.	BIN_K1_U01, BIN_K1_U05	credit with grade, report, passing test
U5	Students will know how to write a scientific article in bioinformatics in English. This will include knowing how to write clearly, how to use reference managers, and how to use Markdown and Latex for scientific reports.	BIN_K1_U05, BIN_K1_U11	credit with grade, report, passing test
Social competences – Student is ready to:			
K1	After successfully completing the course, the student should be ready to perform research in bioinformatics	BIN_K1_K01, BIN_K1_K03,	report

	and present their findings in clearly reports with informative data visualizations.	BIN_K1_K04, BIN_K1_K07	

Calculation of ECTS points

Activity form	**Activity hours***	
Lecture	15	
Exercises	15	
Preparation for classes	20	
Reading	20	
Preparation for the exam	10	
Writing report	10	
Student workload	**Hours** 90	**ECTS** 3.0
Workload involving teacher	**Hours** 30	**ECTS** 1.0

* hour means 45 minutes

Study content

No.	**Course content**	**Subject's learning outcomes**
1.	Introduction to Bioinformatics Research	W1, U1
2.	The Bioinformatics Scientific Ecosystem	U1, U5
3.	Advanced Bioinformatics Skills	U2, U3, U4
4.	Bioinformatics Case Studies	U4, U5
5.	The Lab Notebook for Bioinformatics	U3
6.	Data Visualization	U4, K1
7.	Best Practices in Scientific Writing	U4, U5, K1

8.	Future Directions of Bioinformatics	W1, U1, K1

Course advanced

Teaching methods

Activities	Examination methods	Credit conditions
Lectures	Report, Passing test , Written assignments	Final grade will be composed of attendance and participation in seminars (5%), deliverables (15%), final report (30%), and passing test with multiple-choice and open questions (50%).
Seminars	Report, Passing test , Written assignments	

Entry requirements

Fluent in spoken and written English.
Basic knowledge of R and Python.

Literature

Obligatory

1. The Science of Scientific Writing. George Gopen & Judith Swan. https://www.americanscientist.org/blog/the-long-view/the-science-of-scientific-writing
2. Defining the scientific method. Nat Methods 6, 237 (2009). https://www.nature.com/articles/nmeth0409-237

Optional

1. Science Fictions: How Fraud, Bias, Negligence, and Hype Undermine the Search for Truth. Stuart J. Ritchie
2. An Introduction to Statistical Learning: with Applications in R. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani.
3. Knowledge synthesis through scientific visualization. Gael G. McGill https://www.nature.com/articles/s41564-021-01048-x
4. Writing Guide; Tips for what to do and what not to do when writing for Harvard Library. https://library.harvard.edu/writing-guide
5. Wakefield's article linking MMR vaccine and autism was fraudulent. Fiona Godlee. https://www.bmj.com/content/342/bmj.c7452
6. Open access: The true cost of science publishing. Richard Van Noorden https://www.nature.com/articles/495426a

7. Journal citation reports and the definition of a predatory journal: The case of the Multidisciplinary Digital Publishing Institute (MDPI) . M Ángeles Oviedo-García. https://academic.oup.com/rev/article/30/3/405/6348133?login=false