SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	**Babeş Bolyai University**
1.2 Faculty	**Faculty of Biology and Geology**
1.3 Department	**Department of Molecular Biology and Biotechnology**
1.4 Field of study	**Biology**
1.5 Study cycle	**Master**
1.6 Study programme / Qualification	**Bioinformatics applied in life sciences**

2. Information regarding the discipline

2.1 Name of the discipline (en) (ro)			**Plant genomics and transcriptomics** **Genomica și transcriptomica plantelor**					
2.2 Course coordinator			**Conf. Dr. Podar Dorina**					
2.3 Seminar coordinator			**Conf. Dr. Podar Dorina**					
2.4. Year of study	**2**	2.5 Semester	**2**	2.6. Type of evaluation	**C**	2.7 Type of discipline	**Opțional**	
2.8 Code of the discipline	**BME1133**							

3. Total estimated time (hours/semester of didactic activities)

3.1 Hours per week	**4**	Of which: 3.2 course	**2**	3.3 seminar/laboratory	**2**
3.4 Total hours in the curriculum	**56**	Of which: 3.5 course	**28**	3.6 seminar/laboratory	**28**
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					24
Additional documentation (in libraries, on electronic platforms, field documentation)					18
Preparation for seminars/labs, homework, papers, portfolios and essays					16
Tutorship					8
Evaluations					4
Other activities:					

3.7 Total individual study hours	70
3.8 Total hours per semester	126
3.9 Number of ECTS credits	5

4. Prerequisites (if necessary)

4.1. curriculum	• R programming for data analysis and visualisation • Genomics and functional genomics • (Fundamentals of programming)
4.2. competencies	• Beginner programming skills (bash and R)

5. Conditions (if necessary)

5.1. for the course	• Videoprojector
5.2. for the seminar /lab activities	• Computers, specific development environment

6. Specific competencies acquired

Professional competencies	• Understand key steps in plant genome and transcriptome assembly • Understand basic methods used in plant comparative genomics • Apply plant genome and transcriptome anaylis methods: differential expression analysis, building and visualizing transcription factor networks, inferring orthology and paralogy, building and visualising gene trees • Using online databases, tools and resources for plant genomes and transcriptomes exploration: Plant genome databases, Genome browsers, Plant expression tools, Genomic repositories and stress-related databases, Biotic stress databases
Transversal competencies	• Development of empathic capacity through helping and collaborationg in small groups • Oral presentation skills • Development of communication in a widely used foreign language • Development of abilities for knowledge exploration • Data foraging skills

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	• The aim of the course is to make students become familiar with genomics and transcriptomics advances in plant sciences
7.2 Specific objective of the discipline	• The students will learn independently using hands-on approach various plant genomic and transcriptomic data analysis methods and techniques as well as explore online databases, tools and resources for plant genomes and transcriptomes.

8. Content

8.1 Course	Teaching methods	Remarks
1. - 2. Introduction to Plant Genomics. Why Are Plant Genomes Special?	• Interactive exposure • Presentation • Explanation • Practical examples • Case-study discussions	
3. Current Sequencing Technologies Used for Plant Genomics and Transcriptomics		
4. Brief Introduction to Algorithms Used in Genomic Data Science		
5. - 6. Genome Assembly and Annotation Steps. Confounding Factors for Plant Genome Assembly		
7. - 9. Exploring Plant Genomes: GWAS (Genome Wide Association Studies), WGA (Whole Genome Alignment), Repetitive Elements, Orthology and Paralogy.		
10. Introduction to Plant Transcriptomics		
11. De novo Transcriptome Assembly Steps		
12. - 13. Exploring Plant Transcriptomes: Differential Gene Expression Analysis, Isoformes and Splice Variant Analysis, Transcription Factor Network Analysis, Analysing Different Types of RNAs		
14. The Importance of Plant Genomics and Transcriptomics in a Changing Climate. Exploring Genomic Repositories and Stress-related Databases.		

Bibliography

1. (Poltronieri et. al, 2013) P. Poltronieri, N. Burbulis and C. Fogher, From Plant Genomics to Plant Biotechnology. Woodhead Publishing Series in Biomedicine. Springer International Publishing.
2. (Edwards et. al, 2016) Edwards, D., Batley, J., Plant Genomics and Climate Change

3. (Hakeem et al., 2019) Hakeem, K. R., Shaik, N. A., Banaganapalli, B., and Elango, R. Essentials of bioinformatics, volume III: In silico life sciences: Agriculture. Springer International Publishing.
4. (Kim et. al., 2019) Kim, J. H., Genome Data Analysis. Springer International Publishing.
5. (Anisimova et al., 2019) Editor, M. A. Evolutionary genomics statistical and computational methods, second edition, Methods in Molecular Biology.

8.2 Seminar / laboratory	Teaching methods	Remarks
1. Exploring Genome Visualisation and Plant Expression Data Tools	• Interactive exposure • Explanation • Conversation • Didactical demonstration • Hands-on case-study	
2. Running Differential Expression analysis on case-study		
3. Functional annotation and transcription factors identification of differentially expresed genes (obtained in previous step) using plant transcription factor databases		
4.- 7. Transcription factor network analysis. Transcription factor motif search and target genes identification		
8. Using online gene network exploration tools		
9. - 12. Finding orthogroups. Exploring gene duplications and gene losses across different plant species		
13. Building and visualizing orthogroup trees for genes of interest (i.e. transcription factors identified in earlier analysis)		
14. Results interpretation and discussion		

Bibliography

1. (Armstrong et al., 2018) Armstrong, J., Fiddes, I. T., Diekhans, M., and Paten, B. (2018). Whole-genome alignment and comparative annotation.
2. (Basantani et al., 2017) Basantani, M. K., Gupta, D., Mehrotra, R., Mehrotra, S., Vaish, S., and Singh, A. (2017). An update on bioinformatics resources for plant genomics research.
3. (Claros et al., 2012) Claros, M. G., Bautista, R., Guerrero-Fern´andez, D., Benzerki, H., Seoane, P., and Fern´andez-Pozo, N. (2012). Why assembling plant genome sequences is so challenging.
4. (Giani et al., 2020) Giani, A. M., Gallo, G. R., Gianfranceschi, L., and Formenti, G. (2020). Long walk to genomics: History and current approaches to genome sequencing and assembly.
5. (Jung et al., 2020) Jung, H., Ventura, T., Chung, J. S., Kim, W. J., Nam, B. H., Kong, H. J., Kim, Y. O., Jeon, M. S., and Eyun, S. I. (2020). Twelve quick steps for genome assembly and annotation in the classroom. PLoS Computational Biology, 16.
6. (Soltis and Soltis, 2021) Soltis, P. S. and Soltis, D. E. (2021). Plant genomes: Markers of evolutionary history and drivers of evolutionary change. PLANTS, PEOPLE, PLANET, 3:74–82
7. (Amarasinghe et al., 2020) Amarasinghe, S. L., Su, S., Dong, X., Zappia, L., Ritchie, M. E., and Gouil, Q. (2020). Opportunities and challenges in longread sequencing data analysis.

9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

- The course exists in the curriculum of many universities in the world.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	Know concepts and methods for genome as well as transcriptome assembly and exploration	Written essay on one of the topics discussed during the course	50%
10.5 Seminar/lab activities	Apply genome and transcriptome analysis methods	Oral presentation of workflow and results obtained during seminar	50%
10.6Minimum performance standards			
Each student should obtain minimum 5 for the research report and for the final grade. In order to obtain the minimum grade 5, the student must demonstrate the mastery of the basic concepts of data preparation in order to analyse them.			

Date	Signature of course coordinator	Signature of seminar coordinator
16.01.2023	**Assoc. Prof. Dorina Podar**	**Assoc. Prof. Dorina Podar**

Date of approval — Signature of the head of department

20.01.2023 — **Assoc. Prof. Beatrice Kelemen**