551-1119-00L Microbial Community Genomics

Introduction to the course:

Time plan, room plan, assessments

Organization team

Teaching & Supervision

Samuel Miravet-Verde

Martin Sperfeld

Coordinator

Shinichi Sunagawa

IT support

Urs Blumentritt

Hans-Joachim Ruscheweyh

Learning objectives

THEORY

- Understand the basics of community genomics, including how this information is produced, reconstructed and analyzed.
- Ecological, biomedical and biotechnological relevance of microbiomes.
- Methods for genomic mining.

PRACT

- Data exploration and analysis using ecologically relevant metagenomic information.
- Bioinformatic applications to perform genomic mining.
- Gain skills in planning and developing scientific projects.

scientific skills

- Critically assess current literature in microbial genomics.
- Gain skills in oral presentation of scientific results and scientific writing.

What to expect

- Introduction to the research area of microbial community genomics
- We will balance tutorials with REAL scientific research for the next 3.5 weeks:
  - Things may not work out as planned.
  - Your supervisor will be managing multiple projects (and their own!). Please be patient with them. If you have “spare time”, read papers, practice some of the skills you acquire, etc.
  - You will get out what you put in…
  - Evaluation is not based on the novelty or positive results of what you obtain!

Important points for *real* research

- Scientific Integrity
  - You will be working in an environment and with equipment that is shared with the Microbiome Research laboratory.
  - Do not remove/modify any data on the systems that are unrelated to your work. If in any doubt ASK (questions better than accidents!)
  - When doing original work, you need to document what you do, so that it is reproducible for anyone else.
    - Comment your code
    - Keep track of ideas, analysis, main research questions, etc. You can use slides, a task manager or a simple notepad.
  - Take time to think and talk through course content so you understand what you are doing.

Plan for the next 3 weeks

- Learn the basics of how genomes are reconstructed from metagenomic data.
- Learn the basics of the information we can extract from genomes and how this can be used.
- Apply data analysis to address molecular, genetic, ecological and/or evolutionary questions.
- Identify and work on research questions you would like to address.

Methods

- Use of diverse bioinformatics software and the programming language python.
  - This is just a recommendation, you are free to use your favorite programming language (R supported in the server)
- Use a collection of marine metagenome assembled genomes (MAGs) together with enriched information to explore genetic-related questions.
- Use command line software and programming to analyze this data.
- Work on specific research questions in groups involving topics such as biosynthetic gene cluster or antimicrobial peptides.

Assessment

1) Written report (1/2) in the format of a short scientific paper.

Title, Abstract, Introduction, Methods, Results, Discussion (+Figure/Table)

- Each student should prepare at least one figure/table with legends/headers
- Each participant should produce their own report. Plagiarism will not be tolerated.
- Font size 12, 1.5 line spacing. Maximum 10 pages in total including figures, legends and references.

Hand in by December 11th 2024

2) Oral presentation (1/2): 20 min (15+5) on **November 27th**

- Invite lab or not?

Use of AI

- You can make use of tools such as ChatGPT to help you during coding in your projects but not during the hands-on and practical sessions.
  - Always spend time understanding what the code actually does if produced by AI!
  - You still have the control! (e.g. does the AI code produce the expected no. of rows?)
- It is not allowed (nor recommended) to use AI to produce text for the reports as the goal is to learn about how to explain your science effectively.

Timing – week 1

Week 1: 05.-8.11.2024			
Tue	**Wed**	**Thu**	**Fri**
	3. Introduction to genomics and mining	7. Hands-on tutorial	11. Exercise: intro to OMD
	4. Introduction to computational genomic mining	8. Hands-on tutorial	12. Exercise: intro to OMD
1. Introduction	5. Introduction to python programming	9. Hands-on tutorial	13. Exercise: intro to OMD
2. Setup infrastructure UNIX intro	6. Introduction to data analysis with python	10. Hands-on tutorial	14. Explanation of potential group projects

Timing – week 2

Week 2: 12.-15.11.2024			
Tue	**Wed**	**Thu**	**Fri**
	17. Group projects + Institute Seminar	21. Group projects	25. Group project **presentations**
	18. Group projects	22. Group projects	26. Institute Seminar: Martin Steinegger
15. Best practices for data analysis	19. External Talk: Serina Robinson	23. External Talk: Shini	27. Group project **presentations**
16. Wrap up / Plan group projects	20. Group projects	24. Group projects	28. Wrap up / plan next week

Shinichi Sunagawa

Serina Robinson (EAWAG Group Leader)

Timing – week 3

Week 3: 19.-22.11.2024			
Tue	**Wed**	**Thu**	**Fri**
	31. Group projects + Institute Seminar	35. Group projects	40. Group project **presentations**
	32. Group projects	36. Group projects	41. Group project **presentations**
29. Report writing and presentation skills	33. Group projects	38. Group projects	42. Group project **presentations**
30. Group projects	34. Group projects	39. Group projects	43. Wrap up and freeze results

Timing – week 4

Week 4: 26.-27.11.2024	
Tue	**Wed**
	46. Final Presentations
	47. Final Presentations
44. Prep. presentation	**48. Final Presentations**
45. Prep presentation	49. Discuss based on presentations for writing the project

Important information: learning resources

- Main source of material:

https://sunagawalab.ethz.ch/share/teaching/home/551-1119-00L_Fall2024/index.html

Questions and details TBD

- Any question on the overall organization of the course?

- Discussion: Adjusting the schedule
  - ETH suggested:
    - First day 12:45 - 16:30 w/ 30’ break
    - Rest of the month on Tuesday 13:30 - 17:30 w/ 30’ break
    - 8:45 - 17:30 w/ 2x30’ break + 1h15’ lunch break
  - Previous BC editions:
    - 13:00 - 16:30 w/ 15’ break
    - 9:00 - 17:00 w/ 2x15’ break + 1h lunch break