

Course Outline for 752-5500-00G Applied Bioinformatics: Microbiomes

[Version 2.0: September 14, 2022]

Welcome! In this course you will learn to apply practical bioinformatics/computational skills for analysis of microbiomes in foods and human health! You will apply basic programming skills for scientific computing and bioinformatics, and learn and discuss the importance of microbiomes to foods and human health, through recognition and comparison of ecological theory and methodology across systems.

Warning: This course requires a significant amount of work outside of class! It is a 5 ECTS credit unit course, which translates to ~150 hours of semester work, but we only meet for 14 lectures and 14 exercise sessions, for a total of ~56 hours of face-to-face time. The remainder (~6-7 hours each week!) will be spent doing readings, tutorials, practice, individual work (e.g., homework), and group work (semester project work) outside of class.

Details

Lecture sessions:	Tuesdays	10-12 AM	LFW C 1
Exercise sessions:	Wednesdays	10-12 AM	LFW C 4

Instructor

Prof. Dr. Nicholas Bokulich (Nicholas.Bokulich@hest.ethz.ch)

Teaching assistants

Dr. Michal Ziemski (Michal.Ziemski@hest.ethz.ch)

Anja Adamov (Anja.Adamov@hest.ethz.ch)

Lina Kim (Lina.Kim@hest.ethz.ch)

Contents

The course is split into four “modules” covering four main themes. These are:

1. Introduction to microbiomes and microbial bioinformatics toolkit. Python 3, pandas, Jupyter, git/GitHub, visualization libraries for Python.
2. Analysis of marker-gene *sequence data*. QIIME 2, database searching, taxonomic classification, phylogenetics.
3. Analysis of microbial *community data*. Microbial diversity, function, and ecology. Molecular ecology, diversity metrics, ordination methods.
4. Advanced topics in microbial bioinformatics. Metagenomics, machine learning, functional analysis, data visualization.

Assessments

Homework: 30% of overall grade

- Homework assignments are on the moodle. One is due on or after the end of each Module 1-3 (see course Timeline for due dates). There are three total end-of-module homeworks, worth 5% (module 1), 7.5% (module 2), and 7.5% of the total grade (module 3).
- In addition to the end-of-module homeworks, **all weekly exercises must be submitted before class** on Moodle as homework. Two will be selected at random for grading (5% each). Missing, incomplete, or late assignments from *any week* will result in lost points, 2% per exercise (for a total of 10%).
- Homework is **individual work** and should not be completed with others. All answers should represent your own words, solutions, and thought process. Consider it an “open book test” if that helps.

Group Project: 70% of overall grade

- This is a semester-long project done as a group, analyzing a real microbiome data set. Each group has a unique dataset and unique task.
- The goal is to **write a report in the form of a journal article** (see the assigned reading for examples).
- Should use all or most of the skills learned in this course, as appropriate to the specific task, and the assigned objectives.
- The group project is an assessment of **individual work and teamwork**. Individual contributions should be transparent and evenly and fairly distributed among group members. All group members should engage in all learning activities, but some amount of task delegation is appropriate (e.g., to answer different sub-objectives). Group members will provide peer assessments, and bonus points will be distributed according to contributions. Thus, all group members receive the same grade if contributing equally, but those who do not contribute equally will not benefit equally.
- See separate document “Group Semester Projects” for more details on content and grading.

In addition, there are ungraded weekly assessments in the form of Moodle quizzes. Please finish these before coming to class each week.