BIO-463
Genomics and bioinformatics

Lecture 1: Introduction

Professors: Jacques Rougemont, Anne-Florence Bitbol, Raphaëlle Luisier

TAs: Mariam Ait Oumelloul, Remo Bättig, Eliane Duperrex, Vi Anh Nguyen, Schuyler Stoller, Mylène Berruyer, Maud Dupont-Roc, Camille Pittet

EPFL

Objectives of this class

Learning outcomes:

- Understand sequence data and bioinformatics methods for sequence analysis
- Perform genomic analyses in R
- Design analysis strategies to interpret complex, heterogenous genomic data
    - Extract information
    - Recognize and remove biases
- Understand and assess publications based on genomic data

Methods of this class

Teaching methods:

- Lectures, introducing theoretical and methodological concepts
- Problems to apply methods and perform bioinformatic analysis of genomic data
- Slides (and lecture notes), problems and solutions: on Moodle + GitLab

Assessment methods:

- **2 assignments** (graded problem classes), **25%** of the grade each:
  - One week between problem handout and deadline
  - The problem class that week is dedicated to working on the graded problems
  - TAs are there to help, as usual, but will not solve the problems for you
  - You must hand in your personal solution – detected plagiarism will be penalized
- **Final mini-project**, **50%** of the grade: analyze data from a recent publication
  - 8 papers total, you can choose on which one you work (first-come first-served)
  - 4 problem classes devoted to working on the mini-project
  - Again, you must hand in your personal analysis

Schedule of this class

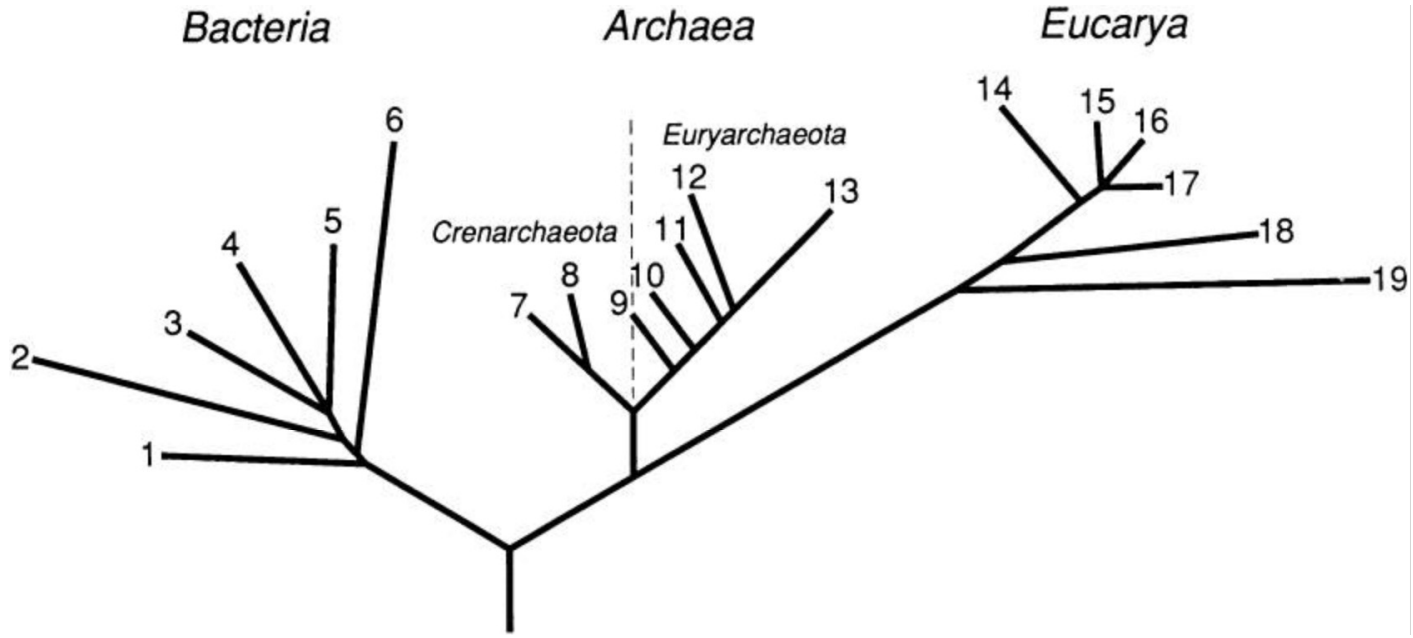
date	week	lectures	exercises	teacher
18 feb	1	Structural genomics	R exercises	**Jacques Rougemont**
25 feb	2			
4 mar	3			
11 mar	4	Population genetics	R exercises	**Anne-Florence Bitbol**
18 mar	5			
25 mar	6		Assignment 1: 25%	
1 apr	7	Gene expression	R exercises	**Raphaëlle Luisier**
8 apr	8			
15 apr	9			
22 apr		holidays		
29 apr	10	Gene expression	Assignment 2: 25%	**Raphaëlle Luisier**
6 may	11	Regulation, chromatin	Mini-projects	**Jacques Rougemont**
13 may	12			
20 may	13			
27 may	14			
			Report: 50%	

Schedule of this class

Lecture 1: Feb 18
Lecture 2: Feb 25
Lecture 3: March 4
Lecture 4: March 11
Lecture 5: March 18 – Assignment 1 available on March 20
Lecture 6: March 25 – Problem class devoted to **assignment 1**; deadline on **March 28**
Lecture 7: April 1
Lecture 8: April 8
Lecture 9: April 15 – Assignment 2 available on April 18
Lecture 10: April 29 – Problem class devoted to **assignment 2**; deadline on **May 2**
Lecture 11: May 6 – Mini-projects available on April 28; choose yours by May 6
Lecture 12: May 13
Lecture 13: May 20
Lecture 14: May 27 – Mini-project deadline on **May 30**

Part 2: Outline

- **Lecture 4 (March 11): phylogeny and homology**



3 major domains of life

Inferred from analyzing (rRNA) sequences

Woese et al 1990 – redrawn in Pace et al 2012

Part 2: Outline

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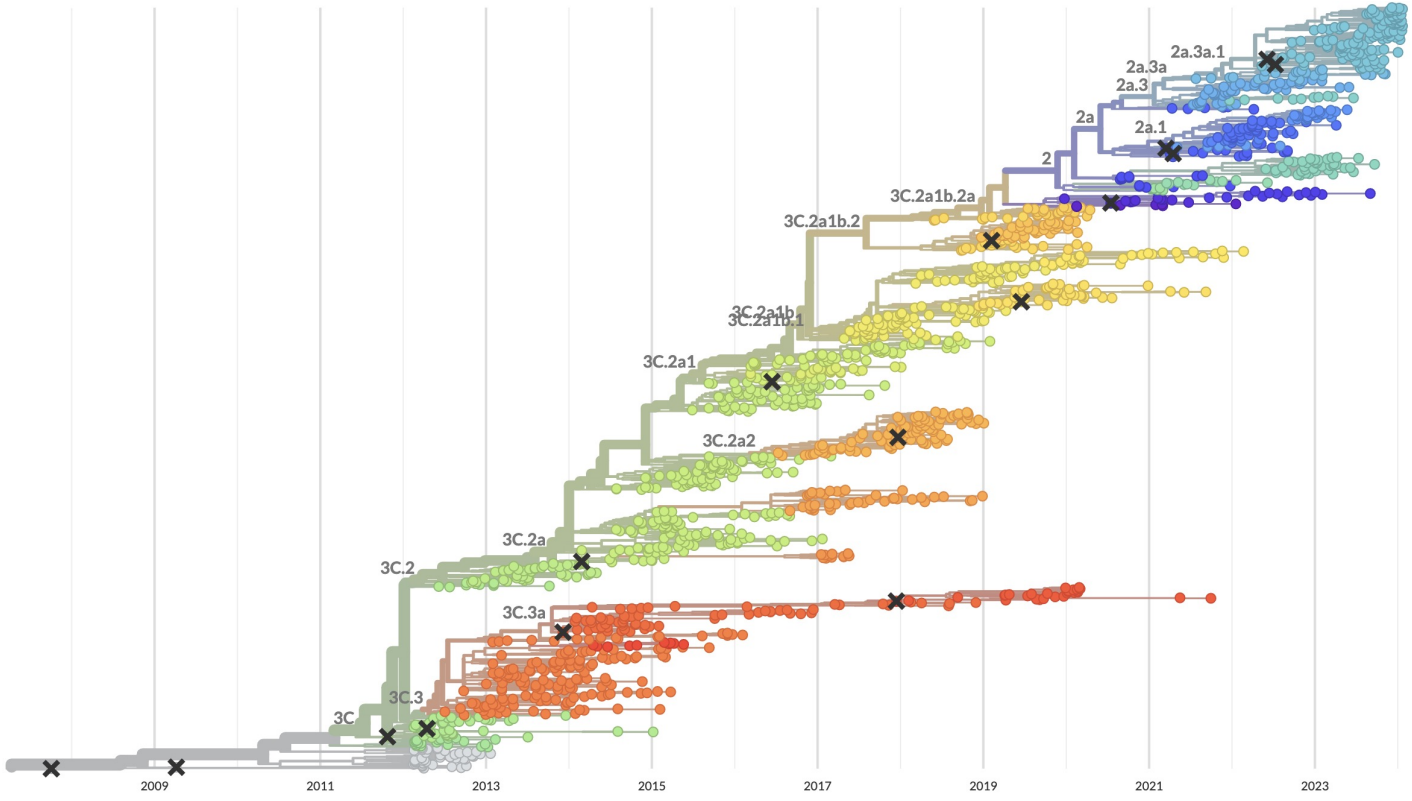
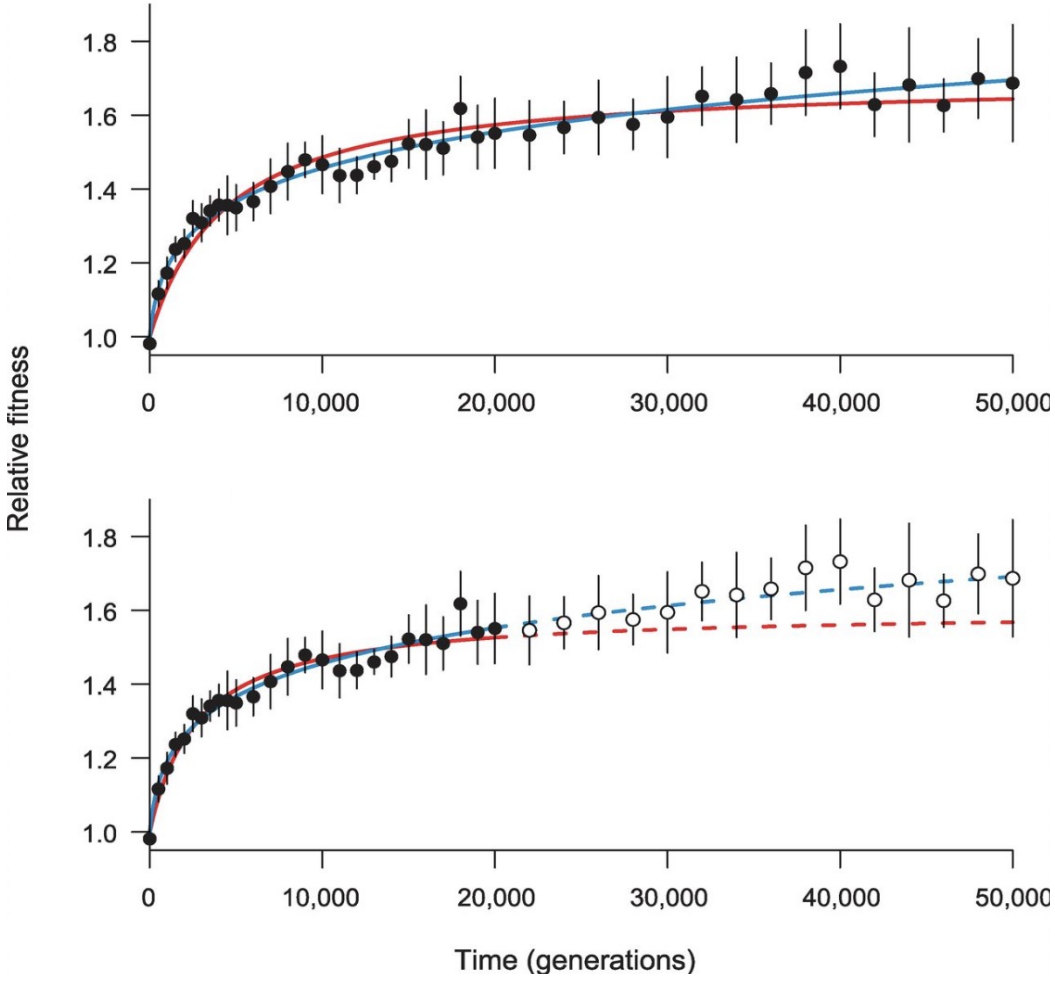


Influenza A/H3N2 evolution (sequence coding for hemagglutinin protein)

https://nextstrain.org/flu/seasonal/h3n2/ha/12y

Part 2: Outline

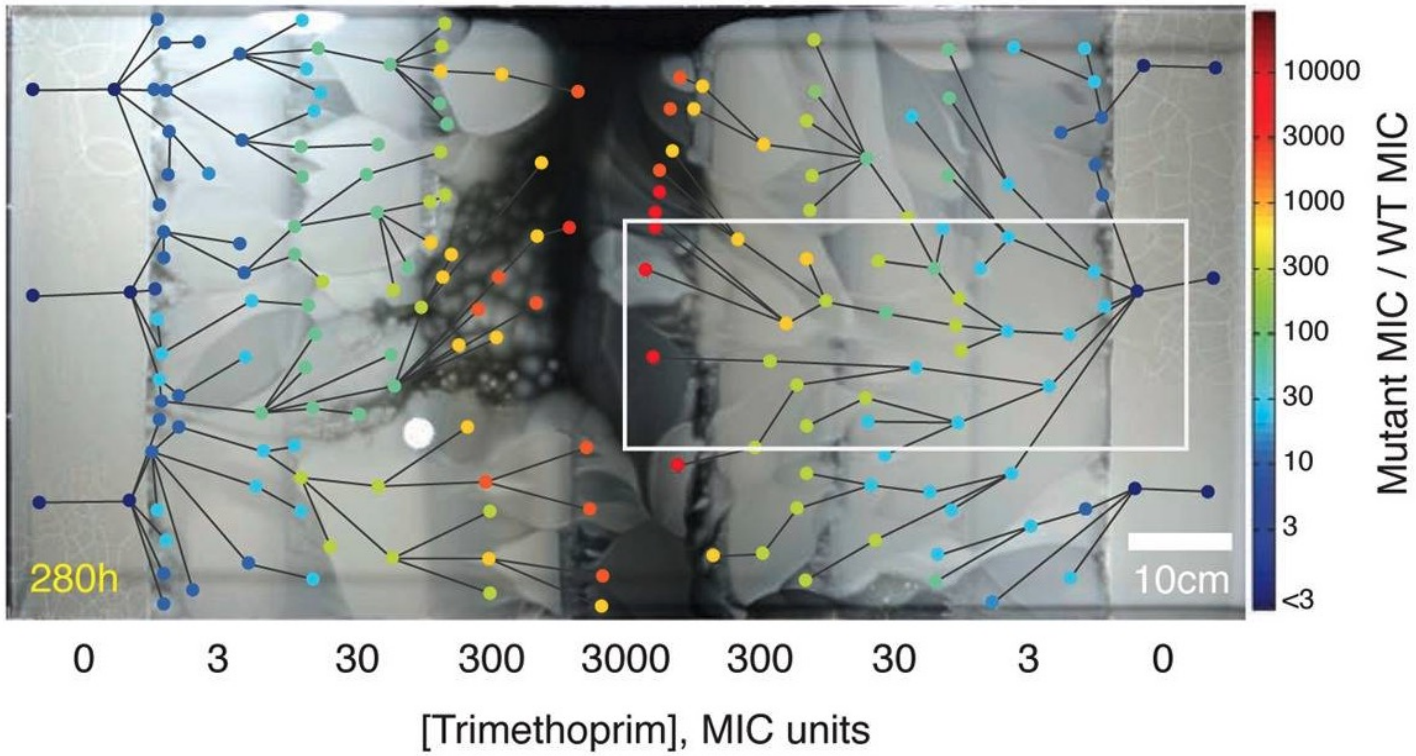
- **Lecture 5 (March 18): population genetics – selection and drift**



Lenski long-term evolution experiment (LTEE), started in 1988
Wiser et al 2013

Part 2: Outline

- **Lecture 6 (March 25): population genetics beyond selection and drift**



Discrete spatial variations of antibiotic concentration
Baym et al 2016