Toolkit for network analysis

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Course structure

From	To		Thursday March 13	Friday March 14	Tuesday March 18	Wednesday March 19	Thursday March 20	Friday March 21	Tuesday March 25	Wednesday March 26	Thursday March 27	Friday March 28	Tuesday April 1	Wednesday April 2	Thursday April 3
10:15	12:00	LECTURE	Outline and Intro	Food webs		Mutualistic networks	Null models	Spatial networks		Network robustness	Genetic networks	Ecological dynamics in networks		Evolutionary dynamics in networks	Exam
	Speaker	LECTURE	Bascompte	Bascompte		Bascompte	Bascompte	Román		Gonçalves	Román	Bhandary		Cosmo	Pedraza
12:00	13:00		Lunch		Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch		Lunch	Lunch
	Lead	EXERCISE	Pedraza	Pedraza	Knop	Cosmo	Pedraza	Bhandary		Gonçalves	Román	Bhandary		Cosmo	
13:00	17:00	EXERCISE	Toolkit for network analysis	Measuring modularity	Sampling an ecological network	Measuring nestedness	Null models	Spatial networks	Open time	Measuring network robustness	Analyzing genetic networks	Models of ecological dynamics in networks	Open time	Models of evolutionary dynamics in networks	

Plan for today

i. Rules of the game

ii. Introduction to the Course website, RStudio Server, and submitting assignments

iii. Introduction to today's exercise: *Toolkit for network analysis*

Rules of the game

i. Your grade will be determined by the exercise sessions (up to 3 points) and by the final exam (up to 2 points).

ii. The exam consists of a multiple-choice test on the topics of the morning lectures.

iii. Each exercise sessions (afternoons) will be graded on a scale from 1 to 6 by the instructor responsible for that session.

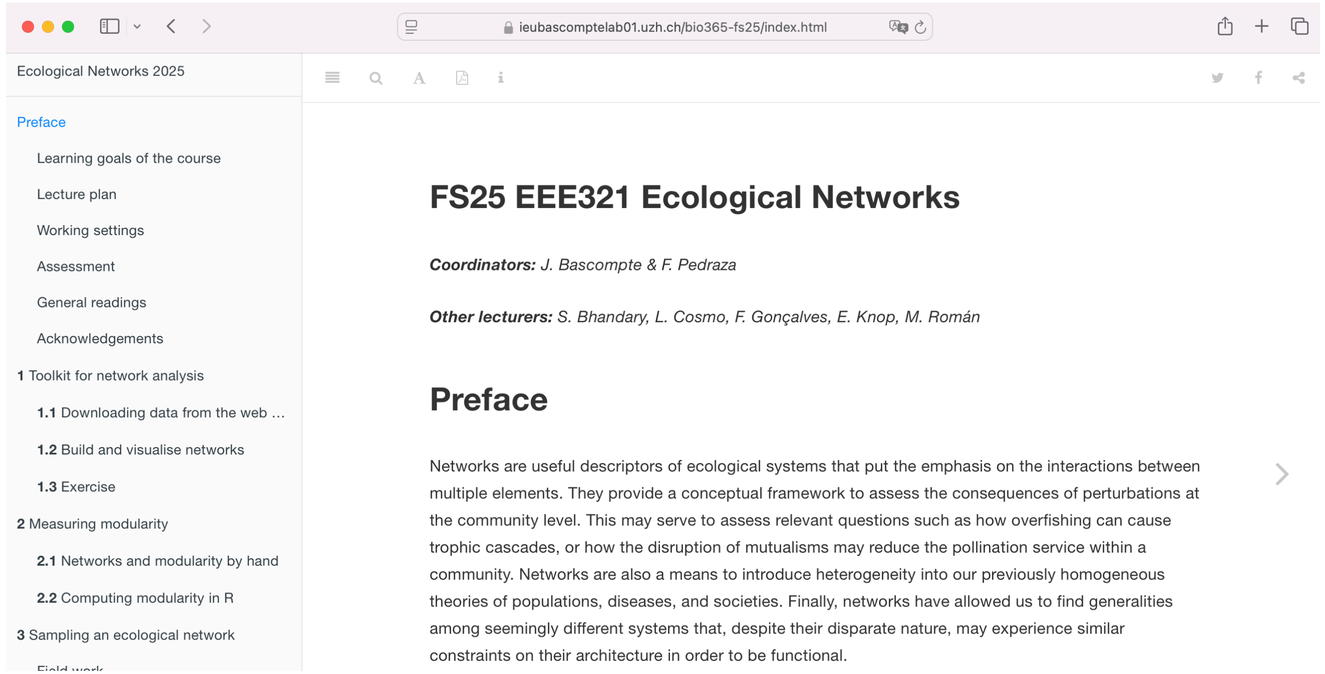
iv. You are expected to complete the exercise assignments directly on the RStudio Server, after having logged in with their personal credentials. Please make sure that you're code runs without errors on the server (more on this later).

v. Each afternoon assignment must be submitted on OLAT by **midday of the next day** (more on this later). An exception is the exercise session Sampling an ecological network, for which the assignment should be handed in by Saturday, April 5th at 13:00.

Course Website

The rules of the game, schedule, slides, and afternoon exercises can be found in the course website:

https://ieubascomptelab01.uzh.ch/bio365-fs25/index.html

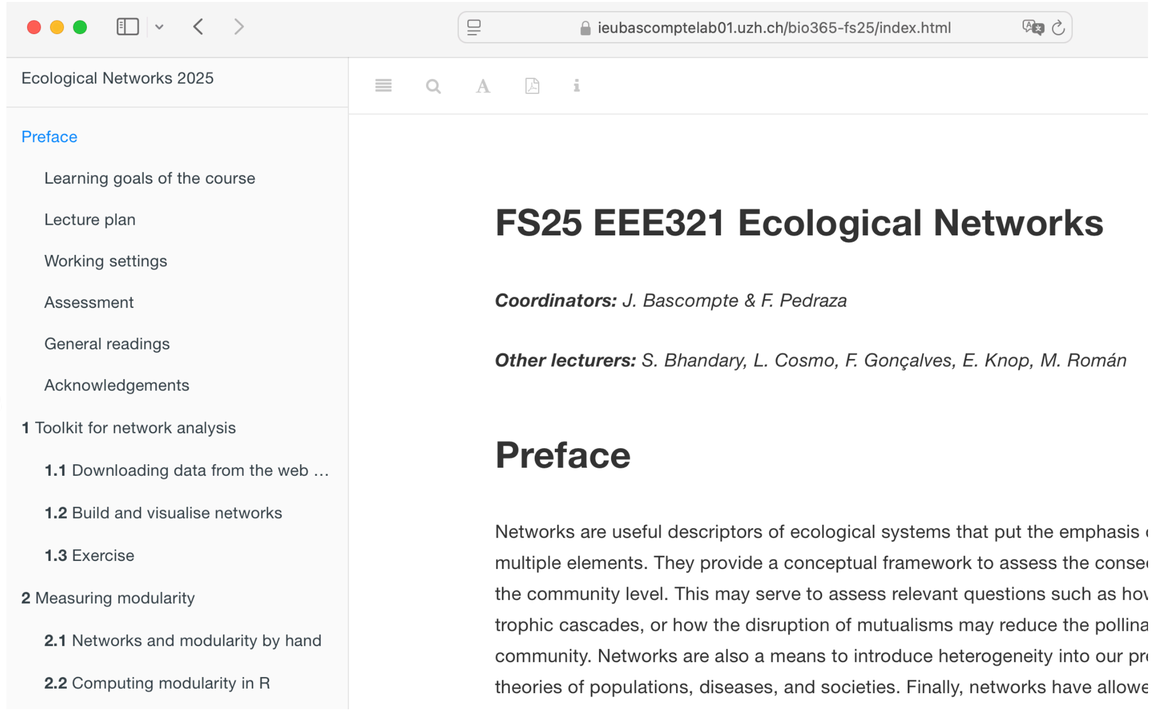


Course Website: Practical exercises

Each chapter in the website corresponds to an afternoon's practical exercise.

The website will be continuously updated as the course progresses to make all exercises available.

Solutions to the exercises will be added as a final subsection to each exercise, after the submission deadline.



Course Website: Practical exercises

Chapter 1 Toolkit for network analysis

Fernando Pedraza

session 13/03/2025

An ecological network is a data set describing a group of species and their reciprocal interaction. Typically, this data is collected by ecologists in the field trough observations. Often, ecologists share their data sets to the wider scientific community. This valuable information then sparks additional research.

Some research groups have gathered network data sets from different publications and compiled them into public databases to facilitate access to the scientific community. Two of such examples are Mangal and Web of life.

In this session you will learn how to download datasets from the Web of life database of experimental ecological networks. You will also learn how to plot the networks and convert them into several formats that are suitable for further analysis.

1.1 Downloading data from the web of life

Web of life is a database of ecological networks developed and maintained by the Bascompte lab. You can find more information on the project in this paper or in this user's manual.

The practical exercises aim to develop concepts introduced during the morning lectures and are designed to be self-contained.

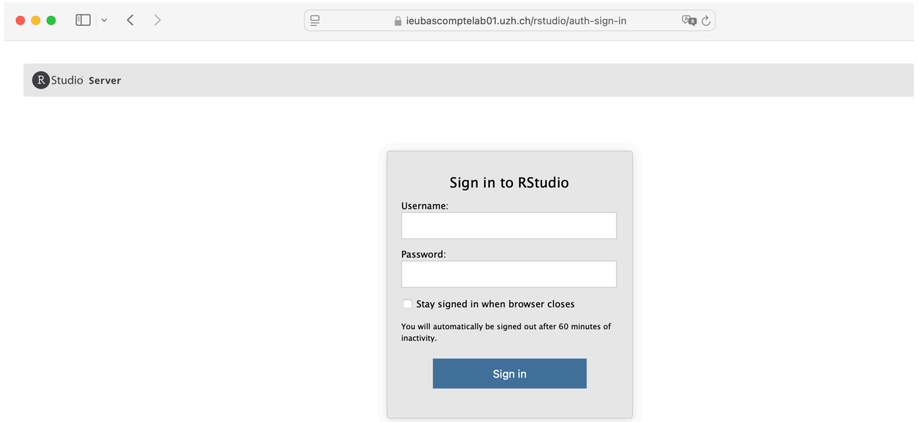
They demonstrate how to perform network analyses using R.

We ask you to develop your own R script where you replicate the analyses using different parameters, data, etc.

Course Website: RStudio Server

The RStudio Server can be accessed here:

https://ieubascomptelab01.uzh.ch/rstudio/auth-sign-in

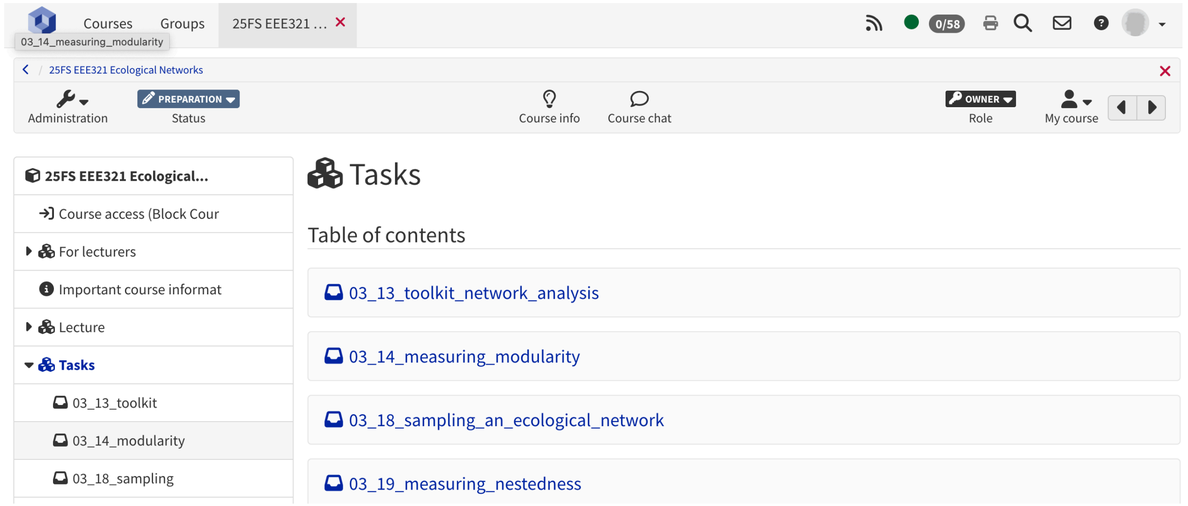


Note that to connect to the server you will need to be connected to the UZH/ETH VPN and have your user credentials (sent to you via email).

Submitting assignments

The R script and files you create to solve the assignments should be uploaded to OLAT in the corresponding assignment folder.

You should make sure that your scripts run without errors on the server, so that we can mark them.



Toolkit for network analysis

The main goal for today's exercise is for you to learn:

- How to download networks from the Web of Life using R.
- How to construct a network in R.
- How to visualise a network in R.

Web of Life

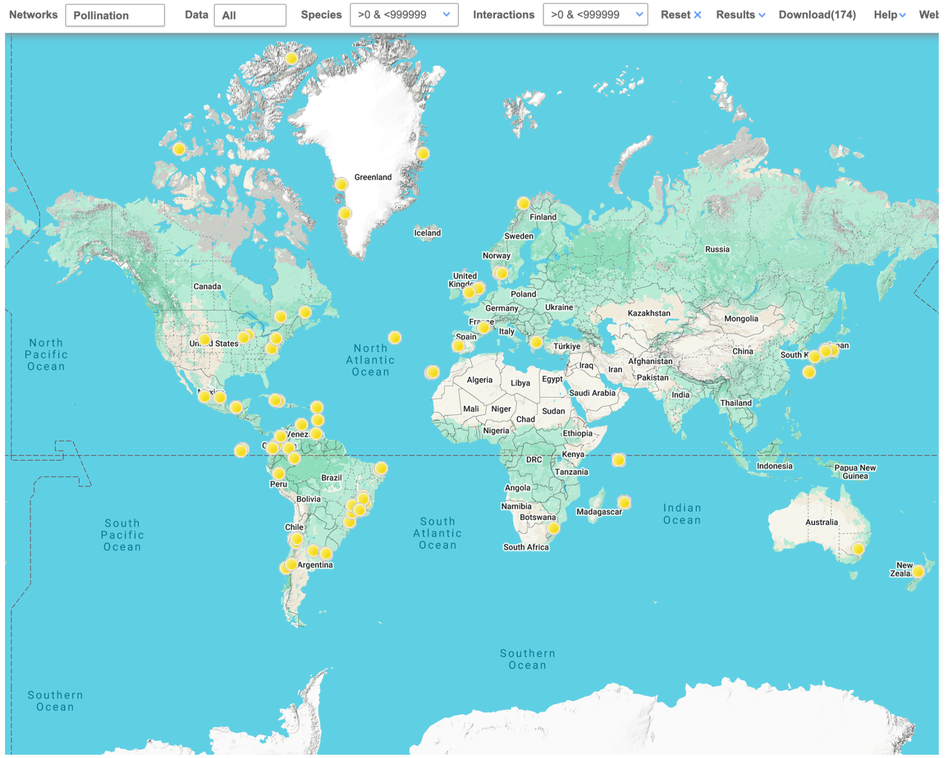
You can access the web of life data base at: https://www.web-of-life.es/

web of life
ecological networks database

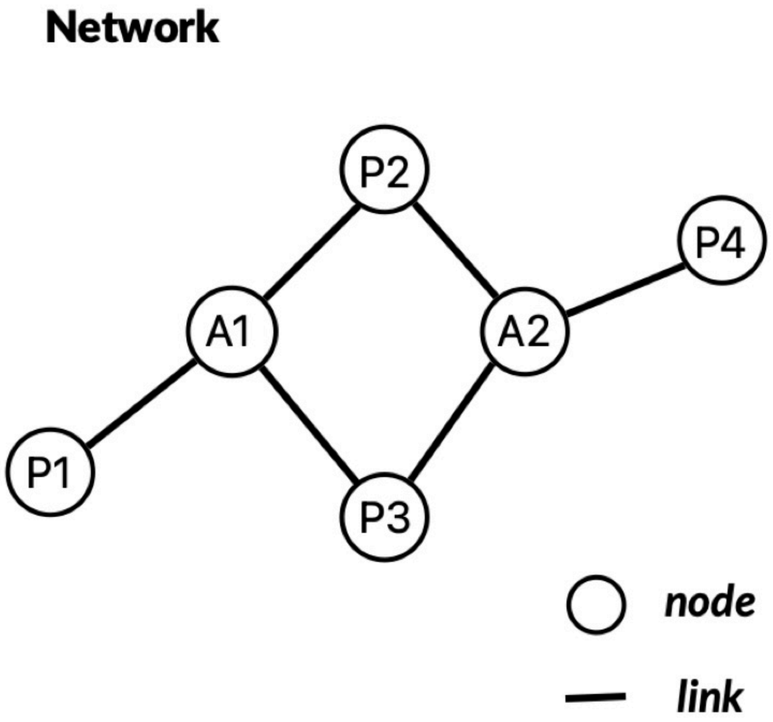
ascompte lab

University of Zurich

This project was initially supported by an ERC Advanced Grant of the European Union



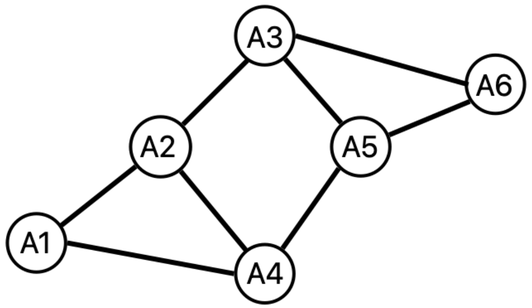
Network terminology



Network Science	Graph Theory
Network	*Graph*
Node	*Vertex*
Link	*Edge*

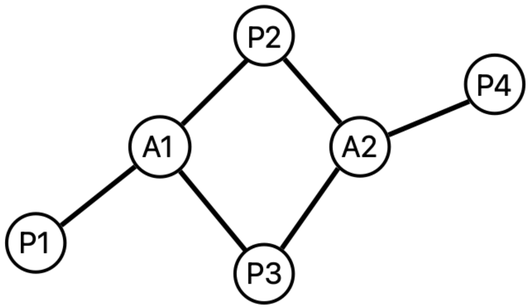
Types of networks

Unipartite Network



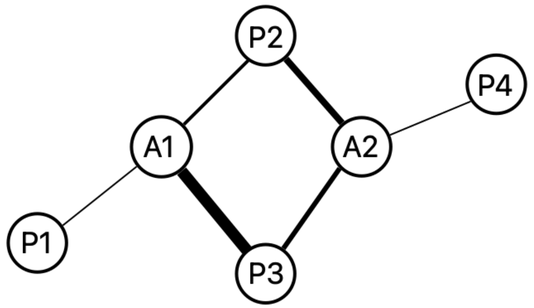
All nodes are of the same type

Bipartite Network



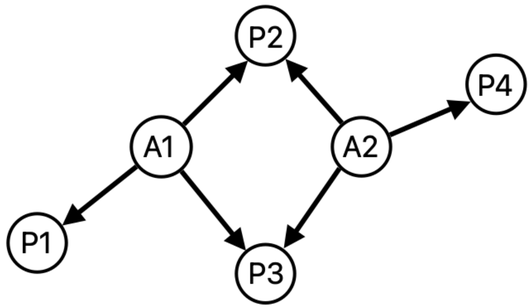
Nodes can be classified into two distinct groups

Weighted Bipartite Network



Links have different strengths

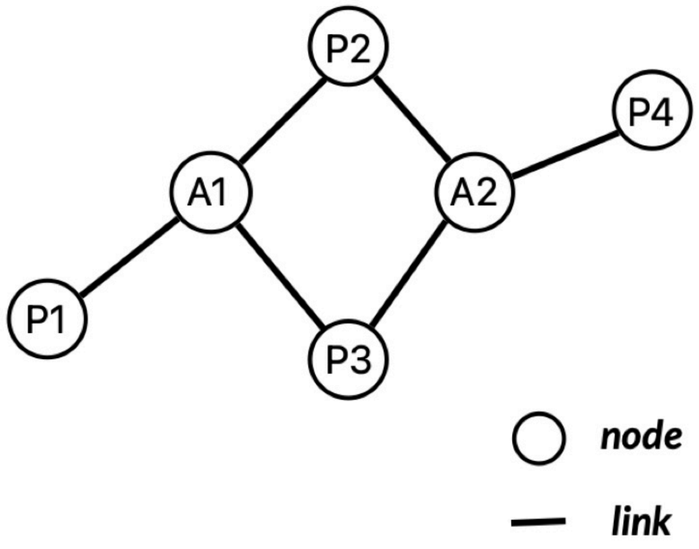
Directed Bipartite Network



Links have direction

Ways of representing a network

Network



Edge list

A1	P1
A1	P2
A1	P3
A2	P2
A2	P3
A2	P4

dataframe

Adjacency matrix

	A1	A2	P1	P2	P3	P4
A1	**0**	**0**	**1**	**1**	**1**	**0**
A2	**0**	**0**	**0**	**1**	**1**	**1**
P1	**1**	**0**	**0**	**0**	**0**	**0**
P2	**1**	**1**	**0**	**0**	**0**	**0**
P3	**1**	**1**	**0**	**0**	**0**	**0**
P4	**0**	**1**	**0**	**0**	**0**	**0**

matrix/array

Incidence matrix

	A1	A2
P1	**1**	**0**
P2	**1**	**1**
P3	**1**	**1**
P4	**0**	**1**

matrix/array

Example workflow

i. Connect to the Web of Life database

ii. Download data for a network

Edge list

A1	P1
A1	P2
A1	P3
A2	P2
A2	P3
A2	P4

dataframe

iii. Convert the data into a network