

# Network Analysis in Systems Biology

[www.coursera.org/learn/network-biology](https://www.coursera.org/learn/network-biology)

**About this course:** An introduction to data integration and statistical methods used in contemporary Systems Biology, Bioinformatics and Systems Pharmacology research. The course covers methods to process raw data from genome-wide mRNA expression studies (microarrays and RNA-seq) including data normalization, differential expression, clustering, enrichment analysis and network construction. The course contains practical tutorials for using tools and setting up pipelines, but it also covers the mathematics behind the methods applied within the tools. The course is mostly appropriate for beginning graduate students and advanced undergraduates majoring in fields such as biology, math, physics, chemistry, computer science, biomedical and electrical engineering. The course should be useful for researchers who encounter large datasets in their own research. The course presents software tools developed by the Ma'ayan Laboratory (<http://icahn.mssm.edu/research/labs/maayan-laboratory>) from the Icahn School of Medicine at Mount Sinai, but also other freely available data analysis and visualization tools. The ultimate aim of the course is to enable participants to utilize the methods presented in this course for analyzing their own data for their own projects. For those participants that do not work in the field, the course introduces the current research challenges faced in the field of computational systems biology.

**Created by:** Icahn School of Medicine at Mount Sinai

Basic Info	Course 3 of 6 in the <a href="#">Systems Biology and Biotechnology Specialization</a> .
Commitment	6-8 hours/week
Language	English
How To Pass	Pass all graded assignments to complete the course.
User Ratings	4.5 stars Average User Rating 4.5 <a href="#">See what learners said</a>



## Syllabus

### WEEK 1

#### Course Overview and Introductions

The 'Introduction to Complex Systems' module discusses complex systems and leads to the idea that a cell can be considered a complex system or a complex agent living in a complex environment just like us. The 'Introduction to Biology for Engineers' module prov...

3 videos, 4 readings

**Graded:** Introduction to Complex Systems

**Graded:** Introduction to Cell Biology

**Graded:** Introduction to Molecular Biology

### WEEK 2

Topological and Network Evolution Models

In the 'Topological and Network Evolution Models' module, we provide several lectures about a historical perspective of network analysis in systems biology. The focus is on in-silico network evolution models. These are simple computational models that, based o...

4 videos

**Graded:** Rich-Get-Richer

**Graded:** Duplication-Divergence and Network Motifs

**Graded:** Large Size Motifs

**Graded:** Topological Properties of Biological Networks

WEEK 3

Types of Biological Networks

The 'Types of Biological Networks' module is about the various types of networks that are typically constructed and analyzed in systems biology and systems pharmacology. This lecture ends with the idea of functional association networks (FANs). Following this ...

4 videos

**Graded:** Types of Biological Networks

**Graded:** Genes2Networks and Network Visualization

**Graded:** Functional Association Networks with Sets2Networks

**Graded:** Functional Association Networks with Genes2FANs

WEEK 4

Data Processing and Identifying Differentially Expressed Genes

This set of lectures in the 'Data Processing and Identifying Differentially Expressed Genes' module first discusses data normalization methods, and then several lectures are devoted to explaining the problem of identifying differentially expressed genes with t...

5 videos

**Graded:** Data Normalization

**Graded:** Characteristic Direction

WEEK 5

Gene Set Enrichment and Network Analyses

In the 'Gene Set Enrichment and Network Analyses' module the emphasis is on tools developed by the Ma'ayan Laboratory to analyze gene sets. Several tools will be discussed including: Enrichr, GEO2Enrichr, Expression2Kinases and DrugPairSeeker. In addition, one...

9 videos, 1 reading

**Graded:** The Fisher Exact Test and Enrichr

**Graded:** Gene Set Enrichment Analysis (GSEA) - Part 1

**Graded:** Gene Set Enrichment Analysis (GSEA) - Part 2

**Graded:** Principal Angle Enrichment Analysis (PAEA)

**Graded:** GATE and Network2Canvas

**Graded:** Expression2Kinases

**Graded:** DrugPairSeeker and the New CMAP

**Graded:** Classifying Patients from TCGA

WEEK 6

Deep Sequencing Data Processing and Analysis

A set of lectures in the 'Deep Sequencing Data Processing and Analysis' module will cover the basic steps and popular pipelines to analyze RNA-seq and ChIP-seq data going from the raw data to gene lists to figures. These lectures also cover UNIX/Linux commands...

7 videos

**Graded:** RNA-seq and UNIX/Linux Commands

**Graded:** RNA-seq Pipeline

**Graded:** CummeRbund and R Programming

**Graded:** CummeRbund - Demo

**Graded:** RNA-seq STAR

**Graded:** ChIP-seq Analysis - Part 1

**Graded:** ChIP-seq Analysis - Part 2

WEEK 7

Principal Component Analysis, Self-Organizing Maps, Network-Based Clustering and Hierarchical Clustering

This module is devoted to various method of clustering: principal component analysis, self-organizing maps, network-based clustering and hierarchical clustering. The theory behind these methods of analysis are covered in detail, and this is followed by some pr...

6 videos, 1 reading

**Graded:** Principal Component Analysis (PCA) - Part 1

**Graded:** Principal Component Analysis (PCA) - Part 2

**Graded:** Principal Component Analysis (PCA) with MATLAB

**Graded:** Hierarchical Clustering (HC) with MATLAB

**Graded:** Self-Organizing Maps

**Graded:** Network-Based Clustering

WEEK 8

Resources for Data Integration

The lectures in the 'Resources for Data Integration' module are about the various types of networks that are typically constructed and analyzed in systems biology and systems pharmacology. These lectures start with the idea of functional association networks (...)

5 videos

**Graded:** Big Data in Biology and Data Integration

**Graded:** Resources for Data Integration

WEEK 9

Crowdsourcing: Microtasks and Megatasks

The final set of lectures presents the idea of crowdsourcing. MOOCs provide the opportunity to work together on projects that are difficult to complete alone (microtasks) or compete for implementing the best algorithms to solve hard problems (megatasks). You w...

2 videos

**Graded:** Crowdsourcing: Microtasks and Megatasks

WEEK 10

Final Exam

The final exam consists of multiple choice questions from topics covered in all of modules of the course. Some of the questions may require you to perform some of the analysis methods you learned throughout the course on new datasets.

**Graded:** Final Exam

FAQs

How It Works



Coursework

Each course is like an interactive textbook, featuring pre-recorded videos, quizzes and projects.



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The Icahn School of Medicine at Mount Sinai, in New York City is a leader in medical and scientific training and education, biomedical research and patient care.

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### Ratings and Reviews

Rated 4.5 out of 5 of 77 ratings

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