

# COMPUTATIONAL SYSTEMS BIOLOGY

INFO-B646

**Department of BioHealth Informatics  
Indiana University School of Informatics and Computing  
Indianapolis  
Fall 2017**

*Section No.:* 25528

*Day:* Thursday

*Time:* 6:00pm to 8:40pm

*Location:* IT 256

*First Class:* Jan 12th

*Instructor:* Meeta Pradhan, Ph.D.

*Office Hours:* 4:30-5:30pm on Thursday or by appointment

*Office:* WK 306, Walker Plaza Building

719 Indiana Avenue, Indianapolis, IN 46202

*Phone:*

*Email:* mpradhan@iupui.edu

*Prerequisites:* Stats in BioHealth and Introduction to Bioinformatics

## COURSE DESCRIPTION

Network analysis has been used to understand socio-economic sciences for decades. With the advent of World Wide Web the application of large network theories gained more publicity. These applications were then extended to study the biological networks. Nonetheless, the analysis of biological networks is very complex as it involves interdisciplinary integration of knowledge such as biology, biochemistry, statistics and computer science. Handling, understanding and extracting knowledge from biological data requires the application of different system biology principles. This course will teach students how to apply the different system biology principles to understand biological data. This course introduces the basic and advance network analysis methods and provides hands-on experience of working with real data. The course aims to equip students with highly demanded network analytics skills to select, prepare, analyze, interpret, evaluate, and present data for the purposes of improving outcomes. The data will be analyzed using the Python and R.

## REFERENCES

- (i) Analysis of Biological Networks Edited by Björn H. Junker, Falk Schreiber  
ISBN: 978-0-470-04144-4
- (ii) An Introduction to Systems Biology: Design Principles of Biological Circuits  
(Chapman & Hall/CRC Mathematical and Computational Biology) 1st Edition  
ISBN-13: 978-1584886426  
ISBN-10: 1584886420
- (iii) Computational Systems Biology of Cancer (Chapman & Hall/CRC  
Mathematical and Computational Biology) Aug 25, 2012  
by Emmanuel Barillot and Laurence Calzone  
ISBN-13: 978-1439831441  
ISBN-10: 1439831440
- (iv) Network Science Book and Papers: Author: Albert-László Barabási  
ISBN: 1107076269

## EXPECTATIONS, GUIDELINES, AND POLICIES

### Attendance

- Class attendance is required for classroom-based courses.
- Attendance shall be taken in every class. If you do not sign the attendance sheet while in class, you shall be marked absent.
- Signing the attendance sheet for another student is prohibited.
- The instructor is required to submit to the Registrar a record of student attendance, and action shall be taken if the record conveys a trend of absenteeism.
- Absences must be explained to the satisfaction of the instructor, who will decide whether omitted work may be made up.
- Missing class reduces your grade through the following grade reduction policy.
- You are allowed ONE excused or unexcused absences.
- Regardless of the reason, a 2nd absence results in a 25% reduction in your final grade
- A 3rd absence results in a 50% reduction.

- Further absences result in an F in the course.
- Missing class may also reduce your grade by eliminating opportunities for class participation.

### **Class Preparation**

- You are expected to read the chapters and the material given in the class
- Research shows that regular attendance, preparation and active class participation have a positive impact on your final grade for a course.
- Ask questions pertaining to the course in the class.

### **Late Assignments and Submission of Assignments**

- All work (unless otherwise noted) should be submitted via an attachment.
- Assignments will be due by 11:55 PM of the specified day. If your Assignment is late, your respective assignment will be assessed a 25% late penalty. Any assignment that is not turned in by 24 hours after the due date will not be accepted and you will receive a zero (0) for that particular assignment.
- Also, if I give out a solution and you have not submitted your work, you will not be able to turn the assignment.

### **Paper Presentation**

- Groups have to select the papers one week in advance.
- Upload the papers in the specified folder atleast five days in advance.

### **Final Project Presentation**

- Each group will present the project and it will be evaluated based on the principles of computational system biology taught in the class.

## Grade Allocation

- Attendance 5%
- Assignments 25%
- Paper 1 10%
- Paper 2 10%
- Paper 3 10%
- Paper Assessment 10%
- Project 30%

## Grading Scale

- A+ 100% - 95%
- A 94.99% - 90%
- B+ 89.99% - 85%
- B 85% - 80%
- C 79.99% - 75%
- F 74.99%

## ACADEMIC INTEGRITY STATEMENT

Cheating is absolutely not tolerated at IUPUI!

The IUPUI Code of Ethics is based on the need for trust in an academic community. IUPUI's system is developed by and maintained for the welfare of its students, and all students should make sure that they read and understand the provisions outlined in the Student Handbook. The code, which is available in the Office of the Dean of Students and in all school office, spells out what constitutes unacceptable behavior and the procedures to be followed when there are alleged cases of misconduct. The dean of students also has some very brief pamphlets on key areas of the code. The link that follows is not the code but rather abbreviated and paraphrased statements on key elements of the code: academic and personal misconduct as well as a section on what students should do if they believe that other students, faculty, or staff have violated their rights. The code also explains the procedures employed and how students may appeal decisions. For more information, consult the Code of Student Rights, Responsibilities, and Conduct as well as brochures located in the Office of the Dean of Students.

Indiana University Purdue University Indianapolis Code of Conduct

Any form of cheating/plagiarism on an assignment, homework or quiz will result in both a zero score for the assignment, and a one-letter grade penalty in the course. The case will be reported to the Chairman of the School of Informatics and Computing and a letter describing the infraction will be placed in your student file. Further disciplinary action will be pursued according to university policy as described in Part III of the Code of Student Rights, Responsibilities, and Conduct (Issued August 15, 1997). Cheating, or helping another student to cheat, are considered equal cases of academic dishonesty and will be dealt with as noted above.

What constitutes cheating?

Giving another student access to your computer account, or negligently permitting another student to access your computer account constitutes cheating on your part if that other student copies any files that become implicated in a cheating case. Protect your account as if your academic career depends on it!

Giving another student your code "just to look at" has resulted in serious problems for both students in the past-even with the best of intentions. Do not give your code to other students.

If you are confused as to the difference between helping each other (which is encouraged) and plagiarism (which will not be tolerated), please ask me.

## **PRINCIPLES OF UNDERGRADUATE LEARNING (PUL)**

Learning outcomes are assessed in the following areas:

- |  |                   |
|--|-------------------|
| 1. Knowledge and skills mastery        | Major emphasis    |
| 2. Critical thinking and good judgment | Moderate emphasis |
| 3. Effective communication             | Some emphasis     |
| 4. Ethical behavior                    |                   |

### **Learning Outcomes**

Upon completion of this course, students will

	PGPL	Assessment
1. Understanding the concepts of networks	1, 2	EQMFP
2. Different types of biological networks	1, 2	EQMFP
3. Conceptualization and application of graph theories	1, 2	ELQMFP
4. Randomized networks and scale free networks	1, 2	ELQMFP

5. Exploration and visualization techniques	1, 2	ELQMFP
6. Hands-on application of system biology principles	1, 2	ELQMFP
7. Hands-on application on biological, clinical and personalized data	1,3,4	ELQMFP
8. Paper presentation	1,2,3,4	L
9. Project Designing, Writing, Analysis and presentation	1, 2, 3, 4	LQMFP
10. Write programs to perform network analytics on large, complex datasets in python and R	1, 2	ELQMFP

### WEEKLY CLASS TIME TABLE

Lecture Time	6:00 – 7:00 pm
Paper 1	7:15 – 7:40 pm
Paper 2	7:45 – 8:05 pm
Paper 3	8:10 – 8:30 pm

## SCHEDULE

<i>Week_Date</i>	<i>Lect._Num_Topic</i>	<i>Assignment</i>	<i>Paper Presentation Group</i>
WK1_Jan 12 <sup>th</sup>	1_Introduction to Course		
WK2_Jan 19 <sup>th</sup>	2_Graph Theory	Open: Assign_1	
WK3_Jan 26 <sup>th</sup>	3_Global Network Property and Random Networks		Paper Presentation Begins
WK4_Feb 2 <sup>nd</sup>	4_The Scale Free Networks	Due: Assign_1 Open: Assign_2	
WK5_Feb 9 <sup>th</sup>	5_Network Motifs and Clustering		
WK6_Feb 16 <sup>th</sup>	6_Evolving Networks	Due: Assign_2 Open: Assign_3	
WK7_Feb 23 <sup>rd</sup>	7_Network Robustness		
WK8_Mar 2 <sup>nd</sup>	Project Presentation	Due:Assign_3	
WK9_Mar 9 <sup>th</sup>	Project Presentation		
WK10_Mar 16 <sup>th</sup>	SPRING BREAK		
WK11_Mar 23 <sup>rd</sup>	8_Correlation Networks And Disease Networks		
WK12_Mar 30 <sup>th</sup>	9_Signal Transduction and Regulatory Networks	Open: Assign_4	
WK13_Apr. 6 <sup>th</sup>	10_Metabolic Network and Phylogenetic Networks		

WK14_Apr.13 <sup>th</sup>	11_Patient Phenotypic Networks	Due: Assign_4 Open: Assign_5	
WK15_Apr. 20 <sup>th</sup>	12_Application to Personalized Medicine		
WK16_Apr.27 <sup>th</sup>	FINAL EXAM	Due: Assign_5	
WK17_May 4 <sup>th</sup>	FINAL EXAM		