An Introduction to Data Analysis in Systems Biology

Course Objective: An introduction to the analysis methods used in systems biology. The course provides an overview of biological systems including gene, protein, metabolic and signaling systems, and instruction in network analysis. Network analysis will focus on large genome-wide gene expression datasets using RNA-Seq, including an overview of the underlying statistics and tools, development of pipelines, and use of high-performance computing resources.

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Office Hours: 3:00-5:00pm Tuesdays; 4:00-5:00pm Thursday; or by appointment.
Note: Office hours may change during the semester and if so, notification will be given.

Class Times: Pullman - Tues/Thus 9:10-10:25. Vogel Plant Sciences Bldg. #31

Class Communication: This course will not use blackboard unless specifically requested. All class communication will occur using Slack (https://slack.com/), which is a popular project management software. Students are encouraged to post questions to slack for the instructor and other students to respond to. While it is possible for one-on-one communication within slack, communication regarding class performance should be conducted in person or via email. This class has a dedicated slack project and the subscription link is https://join.slack.com/t/hort503-02-fall2017/signup. You must use your WSU email address to sign up. Slack can be installed on a desktop or laptop (at https://slack.com/downloads), or on a tablet or smart phone (via Google Play Store or IOS App Store).

Prerequisites: Required preparation includes an introductory course in statistics, and an introduction to biochemistry is recommended. A laptop is required.

Required Text:

1. Albert-László Barabási. *Network Science.* Free online edition: http://barabasi.com/book/network-science
2. Eberhard O. Voit. *A First Course in Systems Biology*. 2013 by Garland Science. ISBN 978-0-8153-4467-4. Resources at Garland Science
3. During the course additional reading assignments will be provided from journal articles, and online tutorials.

Expected Student Learning Outcomes:

1. Gain a fundamental understanding of methods for data analysis in Systems Biology
2. Gain experience working with static networks, in particular gene interaction networks

Course Schedule: This course is meant to be flexible and adjust to the learning needs of students. Adjustments to the following schedule may occur. If changes do occur an updated course schedule will be provided.

Week	Day	Date	Topic
1	1	Aug 22	Course Introduction
1	2	Aug 24	UNIX Basics
2	3	Aug 29	UNIX Basics
2	4	Aug 31	UNIX Basics
Sep 4th, Labor Day Holiday			
3	5	Sep 5	High Performance Computing 1
3	6	Sep 7	High Performance Computing 2
4	7	Sep 12	UNIX Review/Biological Systems

4	8	Sep 14	Gene Systems
5	9	Sep 19	Graph Theory 1
5	10	Sep 21	Graph Theory 2
6	11	Sep 26	Project Presentations
6	12	Sep 28	Network Visualization (Exam #1 Given).
7	13	Oct 3	Network Visualization / OSG (Exam #1 Due.)
7	14	Oct 5	Communities
8	15	Oct 10	Community Detection
8	16	Oct 12	Community Analysis
9	17	Oct 17	Review of Protein Systems
9	18	Oct 19	Protein-Protein Interaction Networks
10	19	Oct 24	Review of Metabolic Systems
10	20	Oct 26	Methods for Metabolic Networks
11	21	Oct 31	Flux Balance Analysis (FBA)
11	22	Nov 2	Review of Signaling System
12	23	Nov 7	Signal Transduction Networks
12	24	Nov 9	Take Home Exam #2 (No class – spend time on exam)
Nov 10, Veterans Day Holiday			
13	25	Nov 14	Basics of Modeling 1
13	26	Nov 16	Basics of Modeling 2
Nov 20-24, Thanksgiving Vacation			
14	27	Nov 28	Basics of Modeling 3
14	28	Nov 30	Methods for Regulatory Networks
15	29	Dec 6	Systems Genetics
15	30	Dec 7	Final Presentations
16		Dec 11 - Dec 16	Finals Week

Assessment: A final grade will be assigned at the end of the course in accordance with the following percentages.

Assessment Item	**Percentage**	**Points**
Project phase 1-6	30%	300
Presentations	10%	100
Class Assignments	40%	400
Exams	20%	200
Total	**100%**	**1000**

Changes during the course may increase or reduce the total number of points that can be earned. However, the percentage for each type of assessment item will remain unchanged.

Projects: This course will contain a single course-long project divided into 6 phases. Each phase builds on the previous thus each phase must be completed before proceeding to the next. Each student will choose the species and biological process to study for the project, thus each student's project will be different. This may result in unexpected complications depending on the availability and types of data. Additionally we will be working on national computing resources which may be temperamental. Therefore, project objectives may be adjusted during the course if needed, and due dates may be relaxed to respond to unexpected delays. The project will count for 30% of your final grade.

Presentations: Two presentations are required. The first will present the student's project to the class. The second will present final project results to the class.

Assignments: On any given lecture day there may be an out of class assignment that is due. Assignments will be provided at least one lecture prior to being due and should be completed prior to class. We may discuss answers to assignments in class, therefore late assignments will result in a 10% penalty per day beginning the first-day the

assignment was due. Typically full credit is given for assignments for just completing it. At times however, assignments credit will be awarded for correctness. Each assignment will indicate how credit is earned. Please email your completed assignment prior to class.

Exams: Three exams will be administered during the semester.

Mid-Term Grade: The mid-term grade will be will be composed from scores of the assignments that have been turned in to that point and the same percentage based scores will be used as at the end of the semester.

Grading scale:

100 - 93% = A	86 - 83% = B	76 - 73% = C	65 - 60% = D
92 - 90% = A-	82 - 80% = B-	72 - 70% = C-	≤59 = F
89 - 87% = B+	79 - 77% = C+	69 - 66% = D+	

Expectations: Assignments are geared towards the expectation that student will spend 1-3 hours per credit hour outside of the class meetings. This includes reading, study or working on projects (3-9 hours per week). Please see the instructor if your efforts require more or less than this. It is important that the course meet learning expectations for the topic but also not be over burdensome. Please bring laptops for in class exercises, but silence cell phones and turn off social media during class (e.g. skype, facebook, twitter, etc.).

Attendance: Attendance of this class is highly encouraged for student success on the graded exercises and projects. Absences because of illness, personal and/or family crises, mandated court appearances, university approved events, or similar reasons will be accommodated as long as such absences are not excessive and notification is provided to the instructor in advance. Excused absences should be arranged prior to any known or planned event. Required University activities will be excused absences if an official Class Absence Request form signed by the sponsoring faculty or organization is given to the instructor before the event.

Disability Statement: Reasonable accommodations are available for students with a documented disability. If you have a disability and need accommodations to fully participate in this class, please either visit or call the Access Center (Washington Building 217; 509-335-3417) to schedule an appointment with an Access Advisor. All accommodations MUST be approved through the Access Center. For more information contact a Disability Specialist: 509-335-3417, http://accesscenter.wsu.edu, Access.Center@wsu.edu

Academic Integrity: "As an institution of higher education, Washington State University is committed to principles of truth and academic honesty. All members of the University community share the responsibility for maintaining and supporting these principles. When a student enrolls in Washington State University, the student assumes an obligation to pursue academic endeavors in a manner consistent with the standards of academic integrity adopted by the University. To maintain the academic integrity of the community, the University cannot tolerate acts of academic dishonesty including any forms of cheating, plagiarism, or fabrication. Washington State University reserves the right and the power to discipline or to exclude students who engage in academic dishonesty."

Students found responsible for academic integrity violations may receive an F on the particular assignment or exam, as well as an F for the course. Repeated and/or serious offenses may result in referral to the conduct board and expulsion from WSU. For graduate students, academic integrity violations may also result in the loss of teaching and/or research assistantships.

Academic Integrity Statement and link to WSU's policy:

- http://www.wsulibs.wsu.edu/plagiarism/main.html
- http://conduct.wsu.edu/academic-integrity-policies-and-resources/

Safety: Washington State University is committed to enhancing the safety of the students, faculty, staff, and visitors. It is highly recommended that you review the Campus Safety Plan (http://safetyplan.wsu.edu/) and visit the Office of Emergency Management web site (http://oem.wsu.edu/) for a comprehensive listing of university policies, procedures, statistics, and information related to campus safety, emergency management, and the health and welfare of the campus community.