

BCBio 444

Bioinformatic Analysis

Fall 2017

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Office Hours:	TBD	
Teaching Assistant:	David Hufnagel	Email: davehuf@iastate.edu
TA Office Hours:	During lab sessions T 3 – 4	Location: MBB 1340 Location: Bessey 201A
Lectures:	TR 11:00 – 12:20 (3 cr.)	Location: Ross 026
Lab:	W 2:10 – 4 (1 cr.)	Location: MBB 1340
Prerequisites:	MATH 165 or STAT 401 or equivalent.	
Course Web Page:	Blackboard	
Last Day to Drop:	without appearing on record/adding to drop limit: Friday, August 25, 2017 without extenuating circumstances: Friday, October 27, 2017	
Final Exam:	Monday, December 11 2017 from 9:45 – 11:45 pm	

Course Description

Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: bioinformatic data processing, PerlPython programming, genome assembly, database search, sequence alignment, gene prediction, next-generation sequencing, comparative and functional genomics, and systems biology.

Target Audience

This course is primarily designed for undergraduate students from all disciplines. Biology and life science students are particularly encouraged to take this course to learn important topics in modern bioinformatics and computational biology, and to practice some basic data processing skills needed in modern biology. These skills are increasingly critical in biology and will support your chosen career. Computer science, computer engineering, mathematic and other types of students can also benefit from this class and learn about computations specific to modern biology. This knowledge will help you understand how your discipline contributes to the various expanding and exciting modern biological research fields.

Required Materials

There is no required textbook for this class. All required class material will be provided by the facilitator via Blackboard Learn.

Resources

- **Bioinformatics.** Frankly, I don't know the best books, but I'll list a couple. Here's the complete list at Amazon and the International Society for Computational Biology's list.
 - Bioinformatics and Functional Genomics by Jonathan Pevsner: I actually decided to buy this one because it is recent, deep enough, and from a reputed author/researcher in the field.

- Understanding Bioinformatics by Marketa Zvelebil and Jeremy O. Baum has a good reputation and was the recommended reference in previous iterations of this class, but I cannot invest in it because of the 2007 publication date.
- Bioinformatics Data Skills by Vince Buffalo will teach you “how to use freely available open source tools to extract meaning from large complex biological data sets.”
- **Python.** There are many good free resources to help you learn Python. Below, I list two books and then point you to several websites.
 - Learning Python, 5th edition by Mark Lutz is “a comprehensive, in-depth introduction to the core Python language with this hands-on book.”
 - Practice of Computing Using Python by Punch and Embody “introduce[s] both [students] ... to computational thinking using Python, with a strong emphasis on problem solving through computer science.”
 - Online resources (mostly free): Software Carpentry for biologists, python.org, The 50 Best Websites to Learn Python, Python at Coursera, Python at EdX.

Homework

There will be regular homework assignments to help you reinforce your learning. Completion of the homework assignments is essential to the preparation of the midterms and final exam. You will often be given time to answer some homework questions during lab. Please make sure your solutions are your own (see plagiarism).

Exams

There will be two midterms and one final exam. Midterm exam topics are mostly non-overlapping, but the final exam is comprehensive.

Grading

The final semester grade may be based on a nonlinear scaling “curve” of the total score according to class performance. The graded content in this class will be weighted in the overall score as follows:

Homework	40%
Midterm Exam I	20%
Midterm Exam II	20%
Final Exam	20%

Policy on Missed Exams or Homeworks.

There will be no makeup exams. If your absence from an exam is legitimate due to illness or personal emergency, please provide sufficient proof to the facilitator. Except for special circumstances, the request should be made *before* the absence. If the absence is excused, your average performance on all other exams will substitute for the missing exam. If you miss another exam, your score for the missed exam will be recorded as 0. Your lowest homework score will be dropped.

Course Information and Procedures

Course Objectives

At the **metacognitive** level:

1. Monitor your own mindful and meaningful effort to learn. Develop habits of thinking relevant to implementing the scientific method with a focus on bioinformatics data analysis.
2. Work effectively individually and with your peers to accomplish course-required tasks.

At the **biology/genetics/bioinformatics** level:

1. Understand and be able to complete simple applications of the most common bioinformatics and computational biology methods.
2. Understand what is systems biology, why it is important for understanding biology, and be able to complete simple applications of data analyses in systems biology.
3. Understand common formats for biological data and be able to convert among different formats.
4. Identify important bioinformatics software tools, know when to apply them, and be able to use them.
5. Be able to combine existing software tools into bioinformatic data processing pipelines.
6. Understand common next-generation sequencing datasets and how they are used to answer questions in biology.
7. Understand the limits of traditional algorithms and data analysis techniques as they apply to big data in biology.
8. Understand, manage and interpret the noise of measurement / uncertainty in data and conclusions.

Brief Course Outline We do not have a complete outline at this time, but I will list the topics.

Topic	Week
Linux/Python	1–3
Some topic in Machine Learning	4
Working with genomic data	TBD
Microbiome	TBD
Genome assembly	TBD
Protein structure	TBD
Biological networks	TBD
CRISPR design	TBD
Molecular evolution	TBD

Miscellaneous

- **Academic Dishonesty.** The class will follow Iowa State University's policy on academic dishonesty. Anyone suspected of academic dishonesty will be reported to the Dean of Students Office.
- **Disability Accommodation.** Iowa State University is committed to assuring that all educational activities are free from discrimination and harassment based on disability status. All students requesting accommodations are required to meet with staff in Student Disability Resources (SDR) to establish eligibility. A Notification Letter form will be provided to eligible students. The provision of reasonable accommodations in this course will be arranged after timely delivery of the Notification Letter to the instructor. Students are encouraged to deliver Notification Letters as early in the

semester as possible. SDR, a unit in the Dean of Students Office, is located in room 1076, Student Services Building or online at <http://www.dso.iastate.edu/dr/>. Contact SDR by e-mail at <mailto:disabilityresources@iastate.edu> or by phone at 515-294-7220 for additional information.

- **Dead Week.** This class follows the Iowa State University Dead Week guidelines as outlined in <http://www.provost.iastate.edu/academic-programs/dead-week>.
- **Harassment and Discrimination.** Iowa State University strives to maintain our campus as a place of work and study for faculty, staff, and students that is free of all forms of prohibited discrimination and harassment based upon race, ethnicity, sex (including sexual assault), pregnancy, color, religion, national origin, physical or mental disability, age, marital status, sexual orientation, gender identity, genetic information, or status as a U.S. veteran. Any student who has concerns about such behavior should contact his/her instructor, Student Assistance at 515-294-1020 or email <mailto:dso-sas@iastate.edu>, or the Office of Equal Opportunity and Compliance at 515-294-7612.
- **Religious Accommodation.** If an academic or work requirement conflicts with your religious practices and/or observances, you may request reasonable accommodations. Your request must be in writing, and your instructor or supervisor will review the request. You or your instructor may also seek assistance from the Dean of Students Office or the Office of Equal Opportunity and Compliance.
- **Contact Information.** If you are experiencing, or have experienced, a problem with any of the above issues, email <mailto:academicissues@iastate.edu>.