Bioinformatics for Research

HORT 550 — Lecture: Tu, Th 1200-1315

4 credits — Lab: F 1310-1600

Prerequisites: Recommend students have background knowledge of molecular biology and genetics

Course web page: www.bioinfo.wsu.edu
Students will be provided with login info

Instructor: Dorrie Main

Office hours: by appointment

Phone: 335-2774

email: dorrie@wsu.edu

Course Overview:

The goal of this class is to provide students with foundational knowledge about advanced bioinformatics analyses of next-generation sequencing data. Not only will students learn how to conduct the analyses, and the principles behind the analyses, but also learn how to critically examine the data produced by the analyses and the implications to the greater study of biological questions.

Student Learning Outcomes:

The student will understand the differences between the applications of next-generation sequencing data for biological and genetics research.

The student will analyze different next-generation sequencing datasets and learn how to interpret and evaluate the results of the analyses.

The student will apply the skills learned during class to their own graduate research studies through an individual class project as well a group project during class.

The student will understand the strengths and weaknesses of using bioinformatics to test research questions.

Materials and Resources:

Required:

All students must have access to a laptop (Windows or Mac) on which they can install provided programs over the course of the semester in order to complete class exercises.

Optional:

For students who want a resource for general bioinformatics, a good book is:

- *Essential Bioinformatics* (Jin Xiong)

We recommend students purchase a Perl book if they feel that they want to become proficient with the Perl language after this class. Here are a couple options:

- *Beginning Perl for Bioinformatics* (Tisdall) is designed for biologists who want to learn some basic Perl for use in their research.
- *Learning Perl* (Schwartz, Foy, Phoenix) is a good intro to Perl book and is meant for an audience with some basic programming knowledge.

For students who want a resource for basic Unix/shell commands and some basic Python programming (not covered in this class, but also widely used), a good book is:

- *Practical Computing for Biologists* (Haddock and Dunn), also see practicalcomputing.org

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Course Schedule:

	Lecture and lab topics	**Points***
Weeks 1-2	***Module 1: Fundamentals of Genomics and Bioinformatics***	
Jan. 10	Course overview (Introductions, Syllabus Overview, Bioinformatics Movie)	
Jan. 12	Introduction to genomics and bioinformatics	
Jan. 13	*Lab: Student laptop software set up*	
Jan. 17	DNA and protein alignments	
Jan. 19	How to use BLAST effectively and sequence alignment exercises	25
Jan. 20	*Lab: Student research project presentations*	25
Weeks 3-5	***Module 2: Genome Analysis***	
Jan. 24	Next-gen sequencing technologies	
Jan. 26	Application of next-gen sequencing technologies	
Jan. 27	*Lab: Tour of WSU sequencing core lab*	
Jan. 31	How genome assembly works	
Feb. 2	Evaluating genome assemblies	
Feb. 3	*Lab: Genome Assembly Evaluation*	25
Feb. 7	Genome annotation concepts	
Feb. 9	How to use GenSAS	
Feb. 10	*Lab: Annotation of DNA with GenSAS*	25
Weeks 6-7	***Module 3: Simple Data Manipulation***	
Feb. 14	Introduction to Unix	
Feb. 16	Introduction to Perl programming	
Feb. 17	*Lab: Running BLAST and other tools with the command line*	25

Feb. 21	Running Perl scripts	
Feb. 23	Modifying Perl scripts	
Feb. 24	*Lab: Practical exercises in data manipulation with Perl*	25
Weeks 8-9	***Module 4: Analyzing Transcriptome Data***	
Feb. 28	Transcriptome experiment concepts and design	
Mar. 2	How transcriptome analysis works	
Mar. 3	*Lab: Running transcriptome analyses in CLC Genomics Workbench*	25
Mar. 7	Making sense of transcriptome results	
Mar. 9	Transcriptome analysis with the command line	
Mar. 10	*Lab: Running transcriptome analyses in the command line and group project details*	25
Weeks 10-12	***Module 5: Analyzing RADSeq and GBS data***	
Mar. 21	GBS analysis basics	
Mar. 23	Running STACKS and SAMtools	
Mar. 24	*Lab: STACKS and SAMtools exercise*	25
Mar. 28	Interpreting STACKS and SAMtools results	
Mar. 30	Running UNEAK GBS pipeline	
Mar. 31	*Lab: UNEAK GBS pipeline exercise*	25
Apr. 4	Interpreting UNEAK GBS analysis	
Apr. 6	How and what to submit to GenBank	
Apr. 7	*Lab: Work on group/individual projects*	
Weeks 13-15	***Module 6: Group and Individual Projects***	
Apr. 11	Work on group projects	
Apr. 13	Work on group projects	
Apr. 14	*Lab: Group Project Presentations (30 min each)*	100
Apr. 18	Work on individual projects	
Apr. 20	Work on individual projects	
Apr. 21	*Lab: Individual Project Presentations (15 min +5 min questions for each)*	175
Apr. 25	Individual Project Presentations (15 min +5 min questions for each)	
Apr. 27	Individual Project Presentations (15 min +5 min questions for each)	
Apr. 28	What have you learned about bioinformatics? Is it the answer to everything? Class wrap-up and course evaluation.	
	total points	500

Note:
(1) 25 points from weekly exercises will be split between a quiz (10 pts) and homework assignment (15 pts), except for week 1 when the student presentation will be worth 25 pts. (2) 175 points available for the individual projects will be split as follows 75 pts for the presentation and 100 pts for the report.

Evaluation Criteria:

Students will be required to complete ***10 exercises*** based on topics presented in the lectures and labs. These assignments are 15 points each (see above course outline) and will require the students to interpret analysis results. These assignments will be assigned during the lab class and are due at the start of the subsequent lab class. During lab classes, there 10 point quizzes given to assess whether students have learned the key points of the week's lectures. Together, these assignments and quizzes account for 50% of the total grade.

Students will also be assigned to groups and work together with their classmates to complete ***a group project***. This exercise is worth 100 points and the grading will be based on the group presentation of the analysis process and methods and the results, plus peer evaluations about each group member's contribution to the final results and presentation.

Students will complete an ***individual project*** that is related to their graduate research project. This exercise is worth 175 points and grading will be based on the student presentation (75 pt) and written report (100 pt)

Late assignments *will result in a 10% grade penalty per day beginning the first day the assignment was due.*

Grading scale

100-93%	A	76-79%	C+
90-92%	A-	73-75%	C
86-89%	B+	70-72%	C-
83-85%	B	66-69%	D+
80-82%	B-	62-65%	D
		< 62%	F

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.

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.

Roles and Responsibilities:

Students

- Students are expected to bring a positive learning attitude to class and participate in discussions in class
- Students are expected to bring their laptops to class for in-class exercises and focus on those exercises while in class

- It is requested that students silence their cell phones and leave them in their pocket or bag during class as well as close social media and email on their laptop during class
- We expect that all students will contribute to the completion of the group project and work as a team towards that goal

Instructor

- Assignments and quizzes will be graded and returned by the instructor before the next assignment is due
- Feedback on why any points were unearned will be noted on the graded assignment, and students are encouraged to seek clarification
- Active learning exercises will be used in this class as much as possible and students are encouraged to ask questions during class

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Policies:

Students with Disabilities

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.