

## GENE 452 – Applied Bioinformatics

9:00-10:15 am, Tue/Thu

Fall Semester, 2023

Jett Hall 109

**Instructor:** Dennis N. Lozada                      Office: N354, Skeen Hall  
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**Credit Hours:** 3.0

**Office Hours:** By appointment; in-person or Zoom (Personal Meeting ID: [248 297 3965](#))

**Textbook:** Assigned articles and readings

**Course description and goals:** Recent advances in genome sequencing, various ‘omics’ technologies, and computational tools have revolutionized our understanding of different biological systems. The Science of Bioinformatics has become more relevant as we seek to understand the structure and function of biomolecules such as the DNA, RNA, and proteins. This course will focus on the application of bioinformatics tools in understanding biological systems and processes. The goals of the course are:

1. To provide students a survey of bioinformatics tools available.
2. To apply these tools in solving biological problems.
3. To develop a presentation and research project proposal related to bioinformatics.

**Course materials:** Readings and homework assignments will be provided through the Canvas site for this class. All students in this class **are required** to use their **NMSU accounts** for contact and information about this course. Furthermore, all students in the class **are required** to be able to access computers with the following applications: an internet browser, a PDF viewer, and able to open and send files used by MS Word, Excel, and PowerPoint. Computers with these functions are found in the NMSU student computer labs, libraries, and other campus sites.

**Class email:** There is a dedicated email account for any course-related communication (e.g., scheduling appointment with the instructor, submitting class requirements, requesting for an authorized absence from class, etc.): [\*\*gene452.nmsu@gmail.com\*\*](mailto:gene452.nmsu@gmail.com). **Please use this email for these correspondences and expect a response within 48-72 hrs.**

**Class format:** In-person and online format (as needed)

**Class rules:** Three simple rules to follow in GENE 452: (1) use our dedicated class email; (2) turn in class requirements on time; and (3) always bring your laptop/personal computer in class.

<b>Grading:</b>	Homework and class exercises	500 points
	Journal discussion	100 points
	Final project	200 points
	Class attendance and participation	100 points
	<b>Total:</b>	<b><u>900 points</u></b>

**GENE 452 – Applied Bioinformatics**  
**CLASS SCHEDULE – Fall 2023\***

Lecture/Module	Date	Topic
1	Aug 17	Introduction
2	Aug 22/24	Review of Nucleic Acids and Proteins
	<b>Aug 25</b>	<b>Due: Homework 1 (WHOLE GENOME SEQUENCES) +</b>
3	Aug 29	Information Sources for Genomics
4	Aug 31/Sep 5	Sequence Alignments
	Sept 7	<b>EXERCISE 1: BLAST (Due: Sept 11)</b>
	<b>Sept 15</b>	<b>Due: Homework 2 (NCBI and GENBANK)</b>
5	Sep 12/14	Gene Expression
	<b>Sept 19/21</b>	<i>Gene Expression (Bioinformatics Journal Discussion)</i>
	Sep 26	<b>EXERCISE 2: GENE EXPRESSION OMNIBUS (Due: Sep 29)</b>
6	Sep 28/Oct 3	Multiple Sequence Alignments
	Oct 5	<b>EXERCISE 3: SUM OF PAIRS (Due: Oct 9)</b>
	<b>Oct 10/12</b>	<i>Multiple Sequence Alignments (Bioinformatics Journal Discussion)</i>
	Oct 17	<b>EXERCISE 4: CLUSTAL OMEGA (Due: Oct 20)</b>
7	Oct 19	Evolution, Genetic Diversity, and Phylogenetic Trees
8	Oct 24	Secondary Structure of Proteins
	Oct 26	<b>EXERCISE 5: PROTEIN STRUCTURE (Due: Oct 30)</b>
9	Oct 31	Tertiary Structure of Proteins
	Nov 2	<b>EXERCISE 6: PREDICT PROTEIN (Due: Nov 6)</b>
10	Nov 7	Genomic Analysis
	Nov 9	<b>EXERCISE 7: KASP MARKER DESIGN (Due: Nov 13)</b>
	Nov 14	<b>FINAL PROJECT DISCUSSION</b>
-	Nov 16	<b>EXERCISE 8: CANDIDATE GENE ANALYSIS (Due: Nov 20)</b>
	<i>Nov 21/23</i>	<i>Thanksgiving Break (No Classes)</i>
11	Nov 28/30	Bioinformatics and Plant Breeding
-	Dec 5/7	Integration and Final Project Presentations
	<b>Dec 8</b>	<b>Final proposal submission</b>

\*Schedule is subject to change.

+ All homework and requirements are due at 5:00 PM. Submission is through the class email. Penalties will be given to late assignment submission.

### **Journal discussion**

Each student will select an original, peer-reviewed research article related to (1) gene expression or (2) multiple sequence alignments for journal discussion. The research article may focus on the description of a bioinformatics software/program or application of bioinformatics tools. Review papers are not accepted. The student will facilitate the discussion by providing a brief overview and three to five discussion questions based on the article to be discussed with the class. Interactive activities (either by individual or by group) during the journal discussion are encouraged. Final grade will be based on the (a) **overview and summary of the journal** (30 points); (b) **discussion questions** (50 points); and (c) **moderation and interaction with the class and following the allotted time** (20 points). A prior approval of the article from the Instructor is required. Please send copies of 2-3 journal articles to the Instructor for approval at least two weeks before the journal discussion date. Total discussion time per journal article should be between 25-30 minutes.

### **Final project proposal narrative and presentation**

The Final class project will consist of a bioinformatics research proposal and presentation. Two students will be randomly assigned to either one of four major groups of organisms, namely, **(1) animals (including humans), (2) angiosperms/flowering plants, (3) gymnosperms/seed bearing vascular plants, and (4) microorganisms (bacteria, fungi, viruses)**. Students will propose a project with gene(s) and trait(s) of interest to be studied using different bioinformatics databases and molecular/genomic approaches discussed in class. The pair will work on putting together a research proposal based on the guidelines set by the Plant Genome Research Program of the National Science Foundation (NSF; [https://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=nsf16614](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf16614)). ***At least one bioinformatic database discussed in class should be proposed in the research project.*** Please note that the project guidelines can be applied to all organisms, including animals and microorganisms. ***Using your research organism(s) for the research proposal is not encouraged.*** **Each group (pair) will present a 25-30-minute research proposal seminar on the week of the final exams.**

### **Disability, Special Accommodation, and Academic Misconduct**

Please visit <https://provost.nmsu.edu/faculty-and-staff-resources/syllabus/policies> for university policies and student services, including Discrimination and Disability Accommodation, Academic misconduct, Student services, Final exam schedule, Grading policies, and more.