

Laboratory Methods for Automated Biology I

Computational Biology Department

Comp Bio 02-761

Fall 2019

Instructors:

Joshua D. Kangas, Ph.D.

Office: GHC 7715

E-mail: jkangas@cmu.edu

Lab Office Hours: Mondays, 1PM-4PM

Office Hours: Friday, 10AM-11AM

(Also by appointment)

Class Times and Locations

Lecture – Mondays, 10:30 AM – 11:50 AM. Location NSH 3002.

Lab (Section 1) – Wednesdays, 1:30 – 4:20 PM. Location Mellon Institute 196.

Lab (Section 2) – Fridays, 1:30 – 4:20 PM. Location Mellon Institute 196.

Units

12 units

Prerequisites: None. **Co-requisites:** None.

Course Description

This is a graduate level laboratory-based course designed to teach technical and biological laboratory skills used to design and execute automated biological experiments. Students will learn the principles, experimental paradigms, and

techniques for automating biological experimentation with the goal of enabling complete automation of biological experimentation. Students will learn the biological principles underlying various automatable experimental methods, the design concepts for automated experiments, engineering elements enabling hardware for preparing samples and doing automated data collection, and software for controlling that hardware. These topics will be taught in lectures as well as through laboratory experience using multi-purpose laboratory robotics. Instruments used will include liquid handling robots, plate readers, and automated microscopes. Grading will be based mainly on satisfactory completion of assignments.

Course Objectives

(Principles and parameters of lab automation with focus on specific devices)

During this course, students should gain experience in many aspects of automated scientific research, including:

- Liquid handling capabilities, control, and parameterization
- Plate reading for absorbance, fluorescence, and luminescence
- Integrated Automation System Control
- Lab Information Management Systems
- Automated widefield and confocal microscopy
- High Content Screening
- Automated maintenance of cell cultures
- Developing methods for automated analysis of cell images
- Communicating results to peers and colleagues

During this course students should learn to:

- Design and execute automation driven scientific experiments
- Develop protocols for liquid handling systems, automated microscopes, and plate readers
- Analyze data generated by automated microscopy and plate reading platforms

Class Website

All registered students will have access to the class website via Canvas.

(<http://www.cmu.edu/canvas/>). Class announcements, course information, instructor and information, discussion forum, course documents, and assignments are contained on this website. This website will be updated with relevant information throughout the semester, so please check it regularly.

Course Work

Grading

The final grade will be computed in the following manner:

Protocol Development Assignments	35%
Data Analysis Assignments	25%
Software Assignments	20%
Programming Assignment	10%
Attendance/Professional Demeanor/Participation	10%
Total	100%

Protocol Development Assignments

For each of the systems we will use in this course, you will be required to generate protocols to accomplish specific experimental goals. These protocols will be submitted and your grade will be determined based on how well your protocol matches the provided experimental specification.

Data Analysis Assignments

For each lab experiment you run generating experimental results, you will be required to design and submit a figure and caption describing the results of your experiment, a brief

discussion of your conclusions about the those results and about likely experimental problems that were encountered.

- **Figure:** Your figure should be designed to most clearly show the outcome of your experiment with the best type of figure (scatter plot, box plot, bar chart, histogram, etc.).
- **Caption:** This should describe in modest detail how the data were generated as well as any information pertinent to understanding your figure design (figure labels, etc.)
- **Conclusions:** You will describe your conclusions from the data you generated and what evidence you used to support those conclusions.
- **Experimental issues:** If there are any experimental issues evident, you will describe those as well as what you would do differently to address the issues if given the opportunity to run the experiment again.

Software Assignments

You will learn to use some software systems which do not necessarily yield data or protocols. Your task will be to demonstrate mastery of essential tasks using these systems through your submissions.

Programming Assignments

Programming assignments will involve controlling automated instruments and will be graded both on accuracy and programming style.

Attendance: Some of the laboratories in this course build on one another, therefore your attendance is critical for your success. If you are sick and miss a lab, then you **MUST** provide a doctor's note in order for a make-up lab session to be scheduled. The lab you miss will be made up at a mutually convenient time and may require you to perform an alternate lab. If you are missing class due to a University activity, this must be arranged ahead of time and documentation **MUST** be provided upon your return to class in order for the lab to be made up for credit.

There will be **NO** make-up labs for unexcused absences. In addition, all assignments must still be submitted on time. If you will be away when the assignment is due, you must make arrangements with the instructor for an alternative way to submit. If you

arrive late to lecture or lab or leave early without an excuse it will be reflected in your grade.

All students have 100 attendance points at the beginning of the course. If you are on time to lecture and lab each time, you will have 100 points at the end of the course. Every time you are late to lecture or lab, you will lose 5 points. Every time you miss class you will lose 10 points. These points will be used for the attendance portion of the final grade.

Professional Demeanor and Participation: By nature, a laboratory course requires active participation and preparation. You are expected to have read over any supplied background materials prior to each lab.

During lectures, always feel free to ask questions when you are unsure of the basis behind a concept or technique. Preparation is key to succeeding in both the laboratory and classroom.

Alternative Laboratory Times

Some of the laboratory tasks may require additional time outside of class to complete. In order to help with this, Lab Office Hours will be offered to give you additional time in the lab if necessary. Additional time may be scheduled as well depending on the instructor's schedule.

Grading Policies

Assignment Due Dates

All assignments are to be submitted on Canvas.

Any assignment turned in after the due date will be deducted 5 percentage points for the first day it is late, and 20 percentage points for every day after that.

Assignments cannot be turned in after one week (7 days, including weekends), and will receive a zero. They can however be turned in after one week (7 days, including weekends) for corrections and comments, **but will receive a zero.**

Regrade of Assignments

In the event that you feel an assignment was graded incorrectly, you must make the request in writing within one week of receiving the graded material. Your request should include a reference to the section of the assignment you believe was incorrectly graded. By asking for your assignment to be regraded, the whole assignment will be regraded and it is possible that fewer points may be awarded than the previous grade in light of new consideration.

Assignment Resubmission/Correction

One goal of this class is to teach you about the potential conclusions you can make from data generated in the laboratory. Often in the wet lab, experiments do not yield the expected results and making accurate conclusions can be very difficult. You will be graded on the quality of your conclusions and that may seem rather subjective. **You may receive half of your points from any mistaken conclusions by either resubmitting an assignment with corrections or talking to the instructor during office hours.**

Other policies and expectations

- Please note, the use of cell phones is not permitted during lecture or lab. These should be left in your backpack or not brought to class. Throughout the course, there may be a need for a calculator. Calculators will be available in the lab.
- Laptop computers may be used for taking notes or for in-class assignments, but cannot be used for other activities during lecture or lab.
- No student may record any classroom or laboratory activity without the express written consent of the instructor. If a student believes that he/she is disabled and needs to record or tape classroom activities, he/she should contact the Office of Equal Opportunity Services, Disability Resources to request an appropriate accommodation.
- Eating is only permitted in the lecture room! **No food or beverage is allowed in any of the laboratories.**

Please keep in mind that these guidelines are necessary to maintain an environment that is safe and conducive for learning.

Lab Safety

The laboratory safety guidelines presented in class will be strictly enforced. This includes proper attire, the use of gloves, etc. You will be provided with a lab coat when needed.

Expectations of Students and Instructors

The instructors and teaching assistants have the right to expect the following of students:

(Adapted and modified from those developed by Howard Culbertson at Southern Nazarene University,

<http://home.snu.edu/~HCULBERT/contract.htm>).

1. Students will arrive to class on time and will be prepared for the lecture or laboratory.
2. Students will turn in assignments on time (see policy on assignment due dates).
3. Students will immediately inform the instructor or the teaching assistants if extenuating circumstances prevent the student from attending a lecture or laboratory.
4. Students will follow the code of conduct regarding academic integrity, cheating, plagiarism, and collaboration as outlined in the syllabus.
5. Students will seek assistance when they need it.
6. Students will follow the lab safety guidelines as presented in class.
7. Students will work together effectively in lab groups to successfully complete the assigned laboratory tasks.

8. Students will be flexible and willing to perform laboratory tasks outside of the allocated class time.
9. If contacted by the instructor or teaching assistant, students will respond within 24 hours during the week and 48 hours on weekends.

The students have the right to expect the following of the instructor and teaching assistants:

1. A syllabus that describes class procedures, policies, and a course description will be provided.
2. Class sessions that will start and end on time.
3. Any changes to the course schedule will be provided to the students within 48 hours of the change.
4. The instructor will be available outside class either during their posted office hours or during other pre-arranged times.
5. Lab reports, lab notebooks, and homework assignments will be returned within two weeks after the due date.
6. If contacted by a student, the primary instructors or teaching assistants will respond within 24 hours during weekdays and 48 hours on weekends.

Academic Integrity

(See: <https://www.cmu.edu/policies/student-and-student-life/academic-integrity.html>).

Students in all CMU programs, because they are members of an academic community dedicated to the achievement of excellence, are expected to meet the highest standards of personal, ethical, and moral conduct possible.

These standards require personal integrity, a commitment to honesty without compromise, as well as truth without equivocation, and a willingness to place the good of the community above the good of the self. Obligations once undertaken must be met, commitments kept.

Rarely can the life of a student in an academic community be so private that it will not affect the community as a whole or that the standards above do not apply.

The discovery, advancement and communication of knowledge are not possible without a commitment to these standards. Creativity cannot exist without acknowledgment of the creativity of others. New knowledge cannot be developed without credit for prior knowledge. Without the ability to trust that these principles will be observed, an academic community cannot exist.

The commitment of its faculty, staff and students to these standards contributes to the high respect in which the CMU degree is held. Students must not destroy that respect by their failure to meet these standards. Students who cannot meet them should voluntarily withdraw from this course.

Cheating and Plagiarism:

Students in at CMU are engaged in preparation for professional activity of the highest standards. Each profession constrains its members with both ethical responsibilities and disciplinary limits. To assure the validity of the learning experience a university establishes clear standards for student work. In order to deter and detect plagiarism, online tools and other resources are used in this class.

In any presentation, creative, artistic, or research, it is the ethical responsibility of each student to identify the conceptual sources of the work submitted. Failure to do so is dishonest and is the basis for a charge of cheating or plagiarism, which is subject to disciplinary action.

Cheating includes but is not necessarily limited to:

1. Plagiarism, explained below.
2. Submission of work that is not the student's own for papers, assignments or exams.
3. Submission or use of falsified data.
4. Theft of or unauthorized access to an exam.
5. Use of an alternate, stand-in or proxy during an examination.

6. Use of unauthorized material including textbooks, notes or computer programs in the preparation of an assignment or during an examination.
7. Supplying or communicating in any way unauthorized information to another student for the preparation of an assignment or during an examination.
8. Collaboration in the preparation of an assignment. Unless specifically permitted or required by the instructor, collaboration will usually be viewed by the university as cheating. Each student, therefore, is responsible for understanding the policies of the department offering any course as they refer to the amount of help and collaboration permitted in preparation of assignments.
9. Submission of the same work for credit in two courses without obtaining the permission of the instructors beforehand.

Plagiarism includes, but is not limited to, failure to indicate the source with quotation marks or footnotes where appropriate if any of the following are reproduced in the work submitted by a student:

1. A phrase, written or musical.
2. A graphic element.
3. A proof.
4. Specific language.
5. An idea derived from the work, published or unpublished, of another person.

Any disciplinary actions regarding charges of cheating or plagiarism will follow the procedures of the home university of the student involved.

Collaboration vs. Cheating

Collaboration is defined by Merriam-Webster's Collegiate Dictionary (10th edition) as "to work jointly with others or together, especially in an intellectual endeavor." Much of the work that is performed in this laboratory (and in biomedical research as a whole) is collaborative in nature. Therefore, collaboration in this class is encouraged during the

execution of the labs. In addition, discussion regarding the content of homework assignments, lab reports, and the final project is also encouraged.

You are encouraged to discuss the course material, concepts, and assignments with other students in the class. **However, each student must eventually submit his/her own unique work (i.e. laboratory notebook, final report, etc).** If any collaboration was used to complete an assignment, record the names of the collaborators and the nature of the collaboration. Any attempt to submit work that is not the student's own work will be considered to be an act of cheating. In addition, any student who knowingly supplies their homework assignment for review to another student is violating the cheating policy, and will be subject to disciplinary action.

ANY VIOLATION OF THIS POLICY WILL NOT BE TOLERATED AND THE PENALTY WILL BE FAILURE IN THE COURSE.

If you have any questions regarding this policy, please contact the instructor.

Accommodations for Students with Disabilities:

If you have a disability and have an accommodations letter from the Disability Resources office, I encourage you to discuss your accommodations and needs with me as early in the semester as possible. I will work with you to ensure that accommodations are provided as appropriate. If you suspect that you may have a disability and would benefit from accommodations but are not yet registered with the Office of Disability Resources, I encourage you to contact them at access@andrew.cmu.edu.

Statement of Support for Students' Health & Well-being

Take care of yourself. Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress.

All of us benefit from support during times of struggle. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is almost always helpful.

If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. Counseling and Psychological Services (CaPS) is here to help: call 412-268-2922 and visit their website at <http://www.cmu.edu/counseling/>. Consider reaching out to a friend, faculty or family member you trust for help getting connected to the support that can help.

If you or someone you know is feeling suicidal or in danger of self-harm, call someone immediately, day or night:

CaPS: 412-268-2922

Re:solve Crisis Network: 888-796-8226

If the situation is life threatening, call the police

On campus: CMU Police: 412-268-2323

Off campus: 911
