BMB 961 Section 730 – Imaging, Processing and Analysis of Cryo-EM Data - Spring 2021

Class Meetings
Virtual

Instructors

Course Coordinator
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Lecture Schedule

Module	Week of	topic	Instructor	Lecture
1	15-Mar	Introduction to the course and history of EM	KP	Pre-recorded
2	22-Mar	Theory of single particle reconstructions (image pre-processing)	KP	Pre-recorded
3	29-Mar	Theory of single particle reconstructions (3D reconstructions)	Sundhar	Pre-recorded
4	5- Apr	Theory and practice of tomographic reconstructions	KP	Pre-recorded
5	12-Apr	EMDB, PDB, and the Basics of protein modeling into maps	KP	Pre-recorded
6	19-Apr	Discussion on various other methods and software (what's available beyond the class)	KP/Sundhar	Pre-recorded
"Final"	26-Apr	Presentations of final Projects	The students	Times TBD**

Laboratory Schedule

Module	Week of	topic	Instructor	Lab time*
1	15-Mar	Accessing the system and Linux Basics	KP/Pappan/Sundhar	TBD
2	22-Mar	cisTEM tutorial (apoferritin)—CTF estimation and boxing	KP/Sundhar	TBD
3	29-Mar	cisTEM tutorial (apoferritin)—2D class averages and 3D	KP/Sundhar	TBD
4	5- Apr-	IMOD tutorial (mitochondria)	KP/Sundhar	TBD
5	12-Apr	Chimera protein modeling and docking into maps (apoferritin) Plus the start of Individual Projects—solve an "unknown" Part I	KP/Pappan/Sundhar	TBD
6	19-Apr	Finish Individual Projects—solve an "unknown" Part II	KP/Pappan/Sundhar	TBD

** Time(s) of the final presentations will be coordinated at the start of the semester

* Since the course is online for SS21, students can coordinate between various open time slots to complete the lab activities. Open computer times will generally be M-F 9 am to 5 pm. Although students may also be able access the computers outside this time window. One-on-one help with the instructors will be arranged on an individual basis.

Course Description

This is a hands-on, project-oriented course dealing with several aspects of cryo-electron microscopy (cryo-EM). We will start with an overview and history of the field and provide hands on experience in evaluating images and data quality. Finally, we will perform computational analysis using single particle and tomography approaches and couple this with

protein structure docking and modeling. We will go through some of the most commonly used graphics software packages for visualizing and manipulating macromolecule structures. Then we will look at the databases of three-dimensional structures of proteins which are determined by cryo-EM and how one can assess the quality of these structures. Then we will cover the various methods for protein structure prediction such as homology modeling, fold recognition, and flexible fitting. We will be using modern high throughput computational tools which are available online and other programs which are installed on our workstations and our RTSF Cryo-EM facility computational suite. Lectures will cover the theory and demonstrate the methods used; lab hours will provide hands-on experience.

Inclusion in BMB 961

It is our intention that this class is a safe and productive learning environment for every person. However, we recognize that inclusion is a complex issue and we still have much to learn about and from the diverse backgrounds and perspectives of students. If actions of the instructional team or other students make you feel uncomfortable, please let us know and we will do our best to correct the situation. If you do not feel comfortable discussing this directly, you can reach us through your academic advisor, another student, or another avenue that is more comfortable.

Grades

Your grade in BMB 961 is based on a Pass/Fail final option. The following components shows the composition of the course and what you must achieve to guarantee a passing grade.

Assessment Type	%	Notes
Completion of Lab Assignments	(50%)	It is mandatory to complete ALL labs in the course in order to earn a Pass
Homework	(20%)	Due weekly
Presentation	(30%)	Final week of the course, counts as final exam

- A Pass for a graduate course is a 3.0 (*i.e* earning >80% of the points in this course).
- A Pass for an undergraduate course is a 2.0 (*i.e* earning >70% of the points in this course).

Required Course Materials –

1. Textbook : There is **no** texbook assigned for this course. I will make online resources available and suggest books for those who wish for additional content. However we will not use these directly in the course. We will supply PDF instructions for laboratory assignments and homework.

2. Computational Access : Students will need to be able to access the computers designated for the course remotely.

3. D2L and Email

We will make announcements by D2L e-mail. Course materials including study aids and grades will be posted on D2L. Questions regarding grades, course mechanics, or of a personal nature should be sent by e-mail directly to Dr. Parent from your MSU email account (other email accounts may be marked as spam). You can expect responses to email communication within 2 business days.

Assessments

1. Completion of Lab Assignments and Weekly Homework:

- Each week there will be a series of laboratory exercises that you can complete on your own time. These activities are meant to be independently completed, although you can schedule time with an Instructor to help guide you through steps that need troubleshooting, or for discussion regarding the outcome of the experiment.

- At the end of each Laboratory assignment, there will be a checklist of items required for completion of the activity. The products of each computational activity will be saved to your individual computational workspaces. Assessment of these items will be done in two ways: you will email a screenshot of the final product to Dr. Parent (kparent@msu.edu) for evaluation. Additionally, we will log into your workspace and evaluate individual files as needed.
- All laboratory work must be completed by 5 pm of the Friday of each week in order to be considered completed "on time".
- There will be a short series of questions (5-10 per assignment) related to each weekly laboratory activity and lecture topic posted in D2L. This will be completed independently from each student as the "homework" for that week. Homework is due by 5 pm each Friday in order to be accepted as completed "on time".

2. Presentation of Individual Project (30%):
- Each student will pick an "unknown" data set for an individual project. If students are using cryo-EM as part of their research, this can be their own data. If not, we will supply data sets for use. This could be *EITHER* a project on single particle reconstruction methods, *OR* tomographic reconstruction methods. Students will have two weeks to complete the reconstruction and are welcome to meet with the instructors during this time to help with assessing progress, troubleshooting, and answering questions.
- Each student will prepare and give a 10 minute presentation (via Zoom) to the class using power point, or other to present their independent project.

3. Extra credit
- There is no extra credit for this course.

Attendance and Absences

Given this course is online and the laboratory assignments can be completed at any time, we will not allow any excused absences. All laboratory work must be completed by 5 pm of the Friday of each week in order to be considered completed "on time".

If you unexpectedly miss a laboratory due to extenuating circumstances, you *must* contact Dr. Parent. It is your responsibility to provide adequate documentation of the extenuating circumstance. You may or may not be eligible for a makeup assignment at the discretion of the instructional team. Make-up assignments are administered at the instructor's convenience.

Academic Integrity/Cheating Policy

According to the MSU policy on the integrity of scholarship and grades, "The principles of truth and honesty are fundamental to the educational process and the academic integrity of the University". Every student should be familiar with this policy (https://www.msu.edu/unit/ombud/academic-integrity/index.html). All students have a right to expect fair and honest evaluation of their work. Cheating undermines this expectation and will not be tolerated. Any student found by the instructors to be cheating will receive a failing grade for the exam or other graded work and be reported to the Dean. The instructors may, at their discretion, decide to give a failing grade for the course in severe, repeat, or egregious cases of academic dishonesty. Please hold yourself, and your classmates, to the highest ethical standards in this regard!

Accommodations for Persons with Disabilities

Michigan State University is committed to providing equal opportunity for participation in all programs, services and activities. Requests for accommodations by persons with disabilities may be made by contacting the Resource Center for Persons with Disabilities at 517-884-RCPD or on the web at www.rcpd.msu.edu. Once your eligibility for an

accommodation has been determined, you will be issued a verified individual services accommodation ("VISA") form. Please present this form to Dr. Parent at the start of the term or two weeks prior to the first accommodation date. Requests received after this date may not be honored.