Carnegie Mellon University

Academic Year 2024-2025

School of Computer Science

Machine Learning Department

Doctoral Student Handbook

Machine Learning

Ph.D. Degree Program

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Welcome

Welcome to CMU's Ph.D. program in Machine Learning, and to the Machine Learning Department. We look forward to getting to know you!

We are proud to be the world's first Ph.D. program in Machine Learning, with a deep and diverse pool of students and researchers who study all aspects of machine learning, from its theoretical basis, to new algorithms and problem framings, to novel applications. We are also proud of our graduates, many of whom have gone on to become professors at other universities, to start their own companies, or to join top research laboratories elsewhere. We are sure you will find your time in the PhD program rewarding, and we look forward to getting to know you!

This handbook will introduce you to the Ph.D. program as well as a static text document can, and you should certainly read it. But we urge you also to get to know its people - our students, faculty and staff have a wealth of knowledge and practical advice which they are happy to share, and they look forward to learning from you as well. When our students graduate, most look back to find that they have learned a tremendous amount here, but that beyond the technical expertise they have gained, they have made lifelong friends and contacts, who will continue to be colleagues throughout their careers. We look forward to welcoming you into our department family.

Director of the PhD Program in Machine Learning

While this handbook is specific to your academic experience in the department, it is just one element of the Graduate Student Handbook Suite. There are several other resources within the suite that you should consult when needed:

- Your Program Handbook
- University-Wide Graduate Student Handbook (Office of Graduate & Postdoctoral Affairs)
- The Word Student Handbook

If you would like a printed copy of this handbook, please send a request to your PhD Program Manager.

Philosophy & Mission

Philosophy

Machine Learning is a scientific field addressing the question "How can we design machines that automatically improve through experience?" We study learning from many kinds of experience: predicting which medical patients will respond to which treatments by analyzing experience captured in databases of online medical records, or building mobile robots that learn to navigate and manipulate their environment through experience gained from their sensors, or large language models trained on vast quantities of unlabeled internet text. To tackle these problems, we develop new algorithms and new theories of learning processes that characterize the fundamental nature of the computations and experience sufficient for successful learning in machines and in humans.

Mission

The mission of the Machine Learning Department is to help lead the development of the discipline of machine learning, by performing leading research in this field, by developing and propagating a model academic curriculum for the field, and by helping society to benefit from the knowledge gained by the field.

We are committed to the principle that students can achieve competence through a variety of experiences, including courses, seminars, projects, and independent and guided research. Our curricula are designed to give students the tools they need to solve real-world problems by using advanced machine learning techniques and developing their own learning algorithms. We are dedicated to providing exceptional training for future leaders in the field.

Degrees Offered

PhD in Machine Learning
Joint PhD in Machine Learning and Public Policy
Joint PhD in Neural Computation and Machine Learning
Joint PhD in Statistics and Machine Learning
Joint PhD in Autonomous and Human Decision Making
Master’s in Machine Learning Research (on the way to the PhD)
Primary Master's in Machine Learning
Fifth-Year Master's in Machine Learning
Master’s in Machine Learning – Applied Study

Departmental Personnel

For Emergencies, contact Campus Police 412-268-2323

- Martial Hebert, Dean of School of Computer Science (SCS)
- Robert Frederking, Associate Dean for Doctoral Programs, SCS
- David Garlan, Associate Dean for Master's Programs, SCS
- Zico Kolter, Department Head, Machine Learning Department (ML)
- Tom Mitchell, Director, Doctoral Programs in ML
- Nihar Shah, Director, Master's Programs in ML
- Matt Gormley, Director, Undergraduate Programs in ML
- Diane Stidle, PhD Programs Manager
- Dorothy Holland-Minkley, Master's Programs Manager
- Laura Winter, Academic Programs Coordinator
- ML Core Faculty
- ML Affiliated Faculty
- ML Related Faculty
- ML Staff

The PhD Director serves as ombudsperson for graduate students to assist with academic or personal situations where a confidential sounding board and/or an intermediary can be helpful. Examples of situations where students are encouraged to seek advice or assistance include:

- Difficulty in communications with advisor, particularly when those difficulties may lead to considering changing advisors or leaving the program
- Conflict with other group members that is difficult to resolve within the group
- Issues related to diversity or the departmental climate for those in groups who are historically underrepresented in science, or
- Personal concerns that interfere significantly with the ability to make timely progress in research or program requirements. These might be due to health, family or financial challenges.

Upon the student's request, information shared will be kept in confidence, as long as no laws require otherwise. Should help be needed from additional sources, the student would be asked before sharing confidential information.
In the event that a difficulty cannot be resolved within the department, please see the grievance procedures for resolving difficult matters, which are available here:
https://www.cmu.edu/graduate/policies/appeal-grievance-procedures.html

Students can also confer with Angie Lusk, alusk@andrew.cmu.edu, the SCS Student Affairs contact. Angie Lusk is listed as an emergency contact for all graduate students in SCS, since she serves as a liaison, and students are particularly welcomed to reach out to her with inter-departmental concerns.

Departmental Resources

The Machine Learning Department is located on the 8th floor of Gates Hillman Center (GHC).

- Information about public computer clusters and printers can be found here: https://computing.cs.cmu.edu/desktop/printing
- Office keys: Please see your PhD Program Manager for a key if you have assigned office space.
- Mail is located on the 8th floor of GHC, next to the printer. If you need to send a package you will have to go to the US Post Office, located in the basement of the Cohon University Center (CUC).

There is a bin for outgoing mail that the post office will pick up, located next to the Gates 8th floor printer. Please make sure it is campus mail or stamped mail only. If you have department sponsored mail, it will require filling out a form with the correct charge string.

For package delivery use the following address:

ANDREW ID: - SCS/MLD
CMU BUILDING: WEAN HALL - RECEIVING - ROOM #3613
311 HAMERSCHLAG DRIVE
PITTSBURGH, PA 15213
United States

For regular mail:

Your Name
School of Computer Science – MLD *[Omit this line if necessary]*
Carnegie Mellon University – GHC 8009
4902 Forbes Ave.
Pittsburgh, PA 15213

Purchasing and Reimbursement Procedures and Policies

- The university has detailed and strict policies relating to the purchase of goods, services, equipment, etc., whether using a general ledger account, restricted account, or grant. There are also reimbursement policies, along with tax exempt considerations that graduate students must adhere to. Previously approved legitimate business expenses can be reimbursed. Receipts must be submitted within 30 days of the expense. Any receipts

submitted after 90 days will be considered income and you will be taxed. Your advisor's administrative assistant will help you claim reimbursement provided you have the following:

- receipt indicating item purchased and proof of payment
- business purpose for purchasing item
- account to be charged for reimbursement
- Approval (by faculty) in email, for reimbursement

Please consult with your advisor ***prior*** *to* incurrent the expense, and check with your advisor's assistant prior to incurring the expense for any additional instructions.

Reimbursement of Travel Expenses

Previous approved legitimate travel expenses can be reimbursed. Receipts must be submitted within 30 days of the expense. Any receipts submitted after 90 days of the dates of travel will be considered income and you will be taxed. Your advisor's administrative assistant will help you claim reimbursement provided you have the following:

- Flight receipts must show full itinerary (dates/times), class that was traveled, and last 4 digits of your credit card number.
- Hotel receipts must show a zero balance with proof of payment and your name
- Receipts for meals must be collected, unless you claim per diem meals; both daily meals and per diem meals cannot be claimed for the same travel expense report
- Personal car mileage is calculated per mile; mileage covers gas, but not tolls.
- Business purpose for travel
- Account to be charged for reimbursement
- Approval (by faculty member) in email, for reimbursement

Conditions:
All receipts must have proof of purchase indicated. For business expenses, tax will not be reimbursed under any circumstance, except for non-travel business meals. To avoid paying tax, see if a staff member can purchase the item for you with a University-provided Procurement Credit Card.

Tax will be reimbursed for expenses incurred due to normal business-related travel (hotel, airfare, meals), but NOT for miscellaneous expenses such as the purchase of a replacement mouse for a department laptop, poster board for a presentation, etc., purchased while traveling or preparing for travel. These items should have been purchased through a department approved buyer thus not incurring tax expense.

Department Office/Building Security, Repairs and Services

Please contact (building@cs.cmu.edu) for reporting damages, needed repairs, security concerns for routine items. **For immediate security concerns, please contact the CMU Campus Police at 412-268-2323**

Department committees consist of the Doctoral Review Committee (DRC), PhD & MS Admissions Committees, Open House Committee, Presentation Skills Committee, Social Committee, PhD Student Retreat Committee and Wellness Network.

We also have a student representative for the department for the University Graduate Student Assembly (GSA).

Advising

Role of the Advisor

The faculty advisor is a student's primary contact, both in research and in academic matters. Typically, a student has strong interests in the research area of the faculty advisor and will closely collaborate with the faculty member. The advisor is typically the primary person directing the student's research, and is also expected to provide financial support (stipend and tuition) for the student.

SCS Doctoral Advising Values

In SCS, we believe that excellent Ph.D. Advising is core to our mission. To ensure this, our Ph.D. Advising Committee has established the following values for advisers and students in our programs: https://www.cs.cmu.edu/academics/phd/doctoral-advising/values

Advisor/Advisee Collaboration

In addition to the research fit, the quality of your relationship with your advisor is one of the biggest factors in determining your quality of life during grad school. You should think about whether your prospective advisor seems like someone you would feel comfortable approaching with any problem. Being able to communicate openly about anything on your mind with your advisor makes the PhD journey much more enjoyable and less stressful.

If you are having issues with your advisor, there are people in the department to talk to that may be able to help navigate the relationship. You are encouraged to contact any of the following for help: PhD Program Director, PhD Program Manager, a member of the Wellness Network (members) or Doctoral Review Committee.

Of course whomever you have as your advisor, you are welcome to collaborate with other students, faculty and postdocs, as many students do. But you must also keep up your primary research responsibilities, and keep your advisor informed of any such collaborations.

Co-Advisors

The ideal scenario for co-advising is that both advisors are interested in working together with you on research. They might work in the same or different areas. This means the three of you would be collaborating on the same research. A typical advantage of having co-advisors is that you will have two faculty to collaborate with on your research. A possible disadvantage is that if one or both of your advisors is very busy, you might "fall through the cracks" because each assumes you can still meet with the other. It is important that the co-advisors meet jointly with you, to assure their advice is consistent.

Individual Development Plan (IDP)

An Individual Development Plan (IDP) serves as a guide for, at minimum, an annual conversation between you and your advisor. An IDP is meant to promote professional and personal growth by formally documenting your goals and facilitating dialogue, collaboration, and accountability between you and your advisor.

Your IDP is a dynamic roadmap tailored specifically to your academic and career goals, as well as your overall professional development and personal well-being. The IDP is meant to augment the mentoring relationship between you and your advisor by giving direction to your discussions and shaping the process for individual outcomes. IDPs are not for evaluation and assessment of your progress. Review of your progress happens at the end of each academic semester at the Doctoral Student Review meeting.

IDP Form

The Research Advisor Matching Process in MLD

Carnegie Mellon is a research institution. We are strongly committed to scientific excellence, both in research and education. In particular, we believe that a close personal interaction among students, faculty, and staff is of the utmost importance for educating the next generation of leaders in academia and industry. MLD students are therefore matched to a faculty advisor in the beginning of the program who will guide their research and advise them in academic matters.

Initial Matching to Advisors

Students participate in all MLD Faculty Research talks and any other relevant SCS faculty talks during Orientation. Contact and schedule a meeting with the various faculty that you are potentially interested in as an advisor.

Meet with many faculty, not just one, to ensure you have more than one option in case the first option doesn't work out. You will probably need to meet a faculty several times before you both feel comfortable choosing to work together. You should also talk with their current students to see what their advising style is so you can see if that is right for you. Attending their research group meeting would be a good idea. Having a good personal connection with your advisor is really important.

A matching form will be sent out to the PhD students to list who they would like as their advisor/co-advisors, and a form will also be sent to faculty to list who they would like as their advisee. You should inform the faculty member that you plan to list them on your form and get confirmation that they are considering you as an advisee. **You are able to submit your matching form anytime up until the deadline of September 30th.**

Once the student form and faculty form are received, the department will review the proposed match and confirm faculty financial support for the student. Once MLD confirms the match to both student and faculty, you are able to begin/continue working with that advisor. Official matches won't be announced to the ML community until after the September 30th deadline.

Here are some suggestions of topics to discuss when meeting with potential advisors:

- What is their advising style (e.g., more hands-on or hands-off)
- How often do they meet their students 1:1
    - If not very often, what's the primary source of mentorship for junior students (e.g. senior PhD / post doc)?
- What do they expect from students when evaluating whether they are making satisfactory progress toward the PhD degree?
- Their views on you collaborating part-time on independent projects with other faculty/students
- Does their funding put any constraints on the type of work you can perform as their advisee?
    - Faculty often fund students from research grants that have a particular research focus, and some grants require specific deliverables.
- What is their expectation on the balance between coursework and research in the first year? (Is it true that coursework could take more than 50% of my time?)
- Their policy on summer internships (frequency/venue/topic)

Here is a video / some guidelines on what to ask to your potential advisor.

MLD Process for Switching to a New Advisor

While most PhD students in MLD stay with the same advisor throughout their time at CMU, a significant fraction (15-20%) choose to switch advisors along the way. Some students find that they would like to switch advisors due to a change in their research interests (so that a different advisor makes more sense), or due to stylistic mismatch (e.g., mismatched expectations about frequency of meeting, or working style, etc.). The ML Department supports changing advisors when appropriate, but expects that you will first discuss any issues with your current advisor, and try to work them out. Switching to another advisor is not considered negatively or to be a failure.

Throughout, keep in mind that we live in an imperfect world with imperfect people. Faculty are not perfect, and can be unaware of the issues that are on your mind. So try first to resolve any issues that come up with your current advisor, but if you find you cannot, then feel free to look for a new one. There is no provably correct process for changing advisors, and no guarantee that you will be more successful with a new advisor. The department recommends the three steps below as an informal process that has worked well for many students.

We recommend the following process for students who are considering an advisor switch:

Step 1:
Speak with your advisor about the issue that's on your mind. Surprisingly to many students, advisors may be totally unaware of issues that are troubling you. So speak with them, and try to work it out. If your research interests are changing to a topic outside their expertise, explain this to your advisor, and suggest that you'd like to talk with other faculty in your area of interest (perhaps take an independent study course with another faculty to see how that interest develops). If it is a stylistic difference, such as feeling your advisor is demanding more progress than you can make, but not spending enough time to help you progress, speak up. You might tell them something like "When we started working together, I was expecting we'd be meeting weekly and going over my code together, but that's not happening and I feel I need that in order to make the kind of progress you're requesting." As an opposite example, you might feel that your advisor is micromanaging you, and you would rather have more autonomy in conducting your research. Again, you should start by bringing this up to the advisor. It might be awkward, but you owe it to yourself and your advisor to discuss whatever is making you think about switching. Many problems are solvable, once identified and discussed!

Step 2:
If you can't work out the issue with your advisor, then let your advisor know that you would like to explore other possible advisors (or a co-advisor if appropriate), and meet with other faculty you'd like to work with (remember that all SCS faculty have automatic advising privileges in all SCS PhD

programs). In the meantime, most students would continue to work with their current advisor who is funding their work. In addition, feel free to reach out to the MLD wellness network, and other people (e.g., Ph.D. Program Director) if you feel comfortable discussing this issue with them. If at any point in the year you find a new advisor you like, who is willing and able to take you on as a funded student, then you should notify the PhD Program Manager, who will verify the arrangement, have it approved by the Program Director, and notify all involved, after which you can immediately start working with your new advisor.

Step 3:
If step 2 doesn't work out, then you may join the fall semester advisor-matching process along with the new incoming students. This is usually the best time to look for a new advisor, because it's the time when advisors are looking for new students. However, switching need not happen only through the fall semester matching process: see last sentence of point 2. No matter which option is pursued, please keep your advisor informed so that it is not a surprise.

Please note that the department guarantees your financial support as long as you remain in good academic standing, and this applies whether or not you switch advisors.

Review/Redress of Academic Conflicts

Please see the **Graduate Student Appeal and Grievance Procedures** university policy. https://www.cmu.edu/graduate/policies/appeal-grievance-procedures.html

Summary of Graduate Student Appeal and Grievance Procedures

Generally, graduate students are expected to seek informal resolution of all concerns within the department before invoking formal processes. If you would like to seek an appeal or have a grievance you should first contact the PhD Program Manager and or the PhD Director.

When an informal resolution cannot be reached, however, a graduate student who seeks further review of the matter is to follow the formal procedures outlined here. https://www.cmu.edu/graduate/policies/appeal-grievance-procedures.html

These appeal and grievance procedures shall apply to students in all graduate programs of the University.

Doctoral Degree Requirements

Residency Requirements

The university requires PhD students to have a minimum of one year in residency on a CMU campus. However in order to reach your program milestones we estimate your residency would be a minimum of 3-4 years. If milestones are not met, it will be discussed at the Doctoral Student Review meeting and you will be informed of the needed requirements.

Expected Timeline

By the end of the third year, coursework, presentation skills, writing skills and TA requirement should be completed.

During the third or fourth year, a thesis proposal should be presented to the MLD community.

By the end of the fifth year, the dissertation should be completed and the student should give the final defense of the thesis.

Registration Process/Procedures

Students are able to register for courses by going to SIO (Student Information Online).
For the very first semester the PhD Program Manager will register incoming students in the MLD PhD program for their courses. In subsequent semesters students should register themselves always making sure to register for Reading & Research and always register for at least 36 units. To be considered in full-time status you must be registered for at least 36 units every semester. If you are below 36 units it will affect how your stipend is taxed and may cause immigration problems for international students.

During the during the fall and spring semesters, PhD students should normally be registered for 36-48 units. During the summer, students should be registered for 36 units.

Required Units for Degree Attainment

PhD students must complete the (7) 12 unit courses for a total of 84 units.

Core Courses

The four set core courses and two menu core courses listed below together provide a foundation in machine learning, statistics, probability, algorithms, and AI. They also provide depth in both theory and the practice of applying machine learning to problems in the real world. The elective can be used to deepen the student's knowledge in their chosen subfield.

Set Core

All PhD students take **all four** courses from the following Set Core:

- 36-705 Intermediate Statistics
- 10-715 Advanced Introduction to Machine Learning
- 10-716 Advanced Machine Learning: Theory and Methods
- 10-718 Machine Learning in Practice
  (This course is designed to give students hands-on experience in using ML to tackle real-world problems and develop a sensitivity to the issues surrounding transitioning machine learning algorithms to practice, including working with stakeholders to frame the problem appropriately, developing machine learning pipelines, taking into account concerns such as fairness and bias, and measuring the impact of the adopted system.)

Menu Core

PhD Students take their **choice of two** courses from the following Menu* Core:

- 10-703 Deep Reinforcement Learning *or* 10-707 Topics in Deep Learning
- 10-708 Probabilistic Graphical Models
- 10-725 Convex Optimization
- 10-734 Foundations of Autonomous Decision Making under Uncertainty
- 10-805 Machine Learning with Large Datasets
- 15-750 Algorithms in the Real World *or* 15-850 Advanced Algorithms
- 15-780 Graduate AI
- 36-707 Regression Analysis
- 36-709 Advanced Statistical Theory I
- 36-710 Advanced Statistical Theory II

Note: The Menu Core courses must be chosen from two different lines (e.g., if 15-750 Algorithms in the Real World , then 15-850 Advanced Algorithms may not be the second Menu Core course).

*Students in the Statistics & ML joint program must choose two of the Menu of Core courses with a prefix in a department that is not their home department. Thus, Statistics joint students should choose two 10- and 15- prefix courses, and Machine Learning joint students should choose two 36- and 15- courses. Students accepted to the Statistics & ML joint program before Spring 2021 are grandfathered and follow the previous rules.

Electives

MLD PhD students must take **one elective,** while in the program, which may be any course at the 700 or higher level in the School of Computer Science or Department of Statistics and Data Science (36-xxx), including additional courses from the Menu Core, or other courses by approval. The elective is chosen in consultation with the student's advisor. Courses outside SCS or Statistics and Data Science must have approval from the student's Advisor. Have your advisor send the approval to the PhD Program Manager.

Note: All courses, including the electives, must be 12 units or greater. Two 6-unit mini courses can count as a single 12-unit elective.

Department Policy on Double Counting Courses

Some students will have taken some of the required courses at CMU before entering the PhD program: for example, as a ML MS student entering the ML PhD program or coming in from another MS program at Carnegie Mellon. If students have previously taken the above-named courses at Carnegie Mellon before joining the program, those may be used to satisfy the requirements and do not need to be repeated in the PhD program. (Note that courses can only be used for a single Master's degree and may not be double-counted for the Master's in Machine Learning Research degree.)

If a student entering the MLD PhD program has already taken 10-701 and received an A (A+, A, A-) as the final grade you are able to waive the 10-715 requirement. If the final grade is a B+ or below, then you should take 10-715 to fulfill the requirement.

Department Policy for Courses Outside of the Department/College

Some students will have taken similar courses at other universities before entering the ML PhD program. Based on such equivalent coursework, any student can apply to replace (not reduce) up to two courses with either menu cores or electives. All electives must be supported by the advisor, and will be evaluated by the PhD Director.

PhD Students who want to replace a course should send a formal request to the PhD Program Manager. The document should contain the transcripts and describe the contents of those courses. Student must also identify the replacement course. The course instructor and the PhD Director of the program must approve the course replacement.

Course Waiver Policy

Waiving a course is rare and will only be considered on a case by case basis. PhD students who follow their advisors from another university and enter the MLD PhD program are considered exceptional cases and will be reviewed on an individual basis to determine course waivers.

Transfer credit

The Machine Learning Department does not accept transfer credit. Requirements may sometimes be replaced if students have taken equivalent coursework elsewhere. The Director of the program will decide whether a certain course may be replaced based on the accreditation of the institution offering the course, the course description, your grade in the course, the course syllabus, and other student work products.

Proficiencies in Teaching, Presentation and Writing Skills

Teaching Requirement

Each PhD candidate must participate in two terms of instruction, either through teaching assistant (TA) duties or serving as the instructor for a class to fulfill the teaching requirement. Teaching before entering the MLD PhD program as an undergraduate or MS student does not count for the PhD requirement.

For a student to be considered for a Teaching Assistant (TA) position for one of our courses, they should have previously taken that course or a similar course. MLD PhD students are asked to TA for MLD courses. It is also possible to TA for a course outside of MLD but you will need permission from Matt Gormley or Henry Chai to do so.

If the student's native language is not English, they will be required to receive International Teaching Assistant (ITA) certification as described here: https://www.cmu.edu/student-success/programs/ita-certification/index.html

Evaluation and Certification of English Fluency for Instructors

Graduate students are required to have a certain level of fluency in English before they can instruct in Pennsylvania, as required by the English Fluency in Higher Education Act of 1990. Through this Act, all institutions of higher education in the state are required to evaluate and certify the English fluency of all instructional personnel, including teaching assistants and interns.

In addition to administering the International Teaching Assistant (ITA) Test (a mandatory screening test for any non-native speaker of English), Language Support in the Student Academic Success Center helps teaching assistants who are non-native English speakers develop fluency and cultural understanding to teach successfully at Carnegie Mellon.

MLD also holds a TA training for our courses.

The responsibilities of a TA vary with different courses.
Examples are:

- Help design homework assignments and other instructional materials
- Give recitations

- Grading
- Help with organizing poster sessions (if applicable)
- Advise small groups of students for class projects (if applicable)
- Hold office hours for individual tutoring

Presentation (Speaking) Skills Requirement

In order to satisfy the Speaking Skills requirement, students must give a talk that is at least 30 minutes long and invite members of the Speaking Skills Committee to attend and evaluate it. You may give a talk in one of the existing seminars or schedule a separate talk.

The committee evaluation form is found here: https://www.ml.cmu.edu/current-students/speaking-skills-form-4.1.22.pdf

Sign up for your talk and view the committee here:
https://docs.google.com/spreadsheets/d/1oE6PtWUbQGXVvaBIuums-vDisqkh9cd7xn_hHufHz2g/edit?usp=sharing

Writing Skills Requirement

In order to satisfy the Writing Skills requirement the student must be the first author on a paper. The quality of the paper must be such that if submitted to a major conference or journal it has the possibility of acceptance. It doesn't have to actually be submitted. The student must have a Review Committee of two reviewers.
The Review Committee consists of one faculty from Carnegie Mellon, who may be the faculty advisor, and one PhD student who is not a co-author on the paper. If the Faculty Reviewer is a co-author, they must explicitly indicate the student's contribution to the writing. The Review Committee fills out the Writing Skills Review Form and must unanimously approve the paper to satisfy the requirement. If the student fails, the evaluators give guidance on the necessary revisions and the student tries again.

A ML PhD student may waive the writing skills requirement if the student already has a first author paper accepted at a top ML conference/journal since these papers already went through peer review.
Acceptable conferences include: AISTATS, AAAI, COLT, ICML, ICLR, KDD, NeurIPS, etc.
Acceptable journals include: JMLR, Machine Learning

To waive the Writing Skills requirement based on this criterion, please fill out the Writing Skills Waiver form and send to your PhD program manager.

Research Requirements

Directed Research
Different students, and different advisors, have different ideas of what directed research means and how progress can be demonstrated. It is the responsibility of both the student and their advisor to formulate for each semester a set of reasonable goals, plans, and criteria for success in conducting directed research. Advisors are individually responsible for adequately supervising this portion of the graduate program.

During a PhD student's first two years, you should be working on directed research at least half time; once all coursework is completed, the directed research increases to full time (except when serving as a teaching assistant or taking additional courses).

Summer Research
During the summer semester, PhD students may choose to either secure an external summer internship or continue research with their advisor. Students must discuss their summer plans with their advisor and register for the appropriate course. Students must register for the Reading & Research course if staying to continue research with their advisor or one of the internship courses if going on a summer external internship. The student's advisor will determine the pass/fail grade for the semester. The Practicum course, PhD Internship and the Reading & Research courses will count towards the program research requirements but will not count toward coursework.

Research Grades
Research is the fundamental part of the PhD program. PhD students will work on research with their faculty advisor. The advisor has the option to give a letter grade or pass/fail grade for research courses. The default grade is a "P" pass which converts to "S" satisfactory on your transcript. The units with "S" grade are counted toward degree requirements but are not included in your GPA.

PhD Dissertation Preparation & Requirements

No PhD Qualifying Exam Requirement
Students in the MLD PhD program do not have a Qualifying Exam.

The thesis committee should be assembled by the student and their advisor, and approved by the PhD Program Manager to ensure the rules are met. The thesis committee must include:

- At least one MLD Core Faculty member
- At least one additional MLD Core or Affiliated Faculty member
- At least one External Member, usually external to CMU
- A total of at least four members, including the advisor who is the committee chair

ML PhD students are expected to present their thesis proposal during their third or fourth year.

Typically, the proposal is completed by the beginning of the fourth year. Fulfilling the requirement involves writing and orally presenting a proposal, and obtaining advice and approval from the thesis committee. Students should meet with the thesis committee members at least once to discuss the proposed work before the proposal.

Students should allocate at least 2 hours for the proposal presentation and examination. The presentation by the candidate is normally about 45 minutes. The student and the committee chair must be physically present at CMU for the proposal; other committee members may attend remotely.

The thesis proposal is a public presentation and must be announced two weeks prior to the talk. It is the candidate's responsibility to ensure that the proposal information is sent to the PhD Program Manager at least two weeks before the presentation. The draft thesis proposal document should be sent to the thesis committee members at least one month prior to the proposal presentation; committee members may require the document earlier, in some cases.

Format Guidelines for Thesis Proposal

Machine Learning PhD thesis proposal should be no longer than 15 pages plus references, and will include;
(a) a clear statement of the research problem and proposed research,
(b) a discussion of related research and how the proposed work fits into the field,
c) a description of the technical approach,
(d) preliminary research results that demonstrate the proposed research is plausible and worthwhile,
(e) a discussion of research issues to be pursued, and
(f) a tentative schedule for completing the work.

Of course, in a proposal it is impossible to predict precisely which research issues will be solved in the future. Nevertheless, the proposal should include a list of specific research directions and questions that are likely to be addressed, and for each of these an assessment indicating what could be a baseline approach, and a discussion of ideas for pursuing the issue, along with an assessment of what will be easy versus difficult. The student needs to show that the proposed research will be original and interesting, and that it is likely to succeed. During the later thesis defense, the student will not be required to show that he or she has done everything that was proposed. In this sense, the proposal is an opportunity to present the student's best current ideas about the thesis research and obtain some useful early feedback from experts in the research area. The proposal need not have answers to every question it raises, but it should bring up a good list of questions that will drive the research.

For Successful Completion of Thesis Proposal

The student will provide a written thesis proposal to their committee at least two weeks, but preferably one month, before a public oral presentation of the thesis proposal. During that oral presentation, the committee and the public are invited to ask questions. After the presentation, the committee will meet in private to determine whether the PhD proposal is approved, and to decide on any advice to the student. The committee chair (the student's advisor) will inform the Graduate Programs Manager of the committee decision. In case the proposal is not approved, the student may present a new or revised thesis proposal at a later date.

PhD Criteria for Advancement to Candidacy

All But Dissertation (ABD) status is reached when the student has completed all requirements for the PhD program and has proposed their thesis topic and gotten approval from the thesis committee to proceed.

Dissertation Committee

The Dissertation Committee is typically the same as the Proposal Committee but may change due to change in research or a committee member who is no longer available.

The dissertation committee must include:

- At least one MLD Core Faculty member
- At least one additional MLD Core or Affiliated Faculty member
- At least one External Member, usually meaning external to CMU
- A total of at least four members, including the advisor who is the committee chair

The thesis committee should be assembled by the student and their advisor, and approved by the PhD Program Manager to ensure the rules are met. The final thesis defense is a public presentation and must be announced two weeks prior to the talk. It is the candidate's responsibility to ensure that the proposal information is sent to the PhD Program Manager at least two weeks before the presentation.

Work with the PhD Program Manager to determine timing so as to avoid department and class conflicts. Contact your thesis committee to get their availability. The date should be scheduled two months in advance. You should send a draft of the thesis to your committee about one month before you plan to defend. Your committee should get back to you with their approval to defend before the announcement goes out, two weeks before your defense date.

Communication of Committee's Review

If the student passes the oral presentation, the options of the committee are:

- To approve without corrections
- To approve subject to minor changes, to be approved later by the thesis chair only
- To require a resubmission after major changes and re-approval of the entire committee
- Not to approve the thesis

  If the student fails to pass either the oral or the written defense, the faculty will discuss their status by the next end-of-semester meeting.

Filing and Submission of Dissertation

Format of the title page:

https://www.ml.cmu.edu/current-students/thesis-title-page-format.html

Month Year (i.e. Month 2024)
Technical Report number (Both should be smaller font than your name on the page)

Request the Technical Report number from the PhD Program Manager.
Request funding information from the MLD Business Manager.

Second page is blank except for keywords at the bottom.

Once formatted and approved by your thesis committee, send the final .pdf document to the PhD Program Manager.

Needed for CMU's Hunt Library to publish your thesis:
Link to Hunt Library Dissertation Checklist

Details about the Dissertation submission

Your degree will not be certified until you send the thesis document and Dissertation Checklist.

Dissertation Retention

Your dissertation document will be retained in the department files and also published on the department dissertation web page (unless there is an embargo).

Your First Year

The ML Department realizes that the transition to a PhD program can put students into new situations they haven't been in before. To help with this transition, each first year student meets 1-on-1 with the PhD Program Director at least once during their first year. The point of these meetings is to give each student an opportunity to discuss, confidentially, their own experiences and reflections about how things are going, and to raise any questions and concerns they might have.

Examples of things to discuss in this confidential meeting include:
How is coursework going? Are you able to keep up? Happy with your coursework-research balance?
Have you had a chance to launch your research? Are you happy with your work and plans?
How is your relationship with your advisor? Are you two well-aligned in your research interests and style of working together?
Are you happy overall with your PhD life so far? Are you happy with your interactions with other students, staff and faculty? Finding interesting things to do in Pittsburgh?
Is there anything causing you stress that the department might be able to help with?
Is there anything the ML Department can do to improve the PhD experience?

Again, these are just possible topics, anything goes.

Registering for Directed Research
There are official course numbers associated with directed research in MLD, 10-920 Reading & Research or if you have proposed your thesis topic and finished all program requirements, 10-930 Dissertation Research. Active PhD students (excludes Leave of Absence and All But Dissertation in Absentia status) should strive to complete 24-36 units of Graduate Reading and Research each Fall and Spring semester.

Registering for External Internships
There are official course numbers associated with external internships. Your faculty advisor will assign a pass/fail grade that will count towards your program research requirements. Advisors are individually responsible for adequately supervising this portion of the program.

10-935 Practicum course – If internship will be during the academic year and within the dates defined in the semester by the university.

10-936, Section I, PhD Internship course (summer semester only)
If PhD students will end their internship after the summer semester end date but before the fall classes begin they must use the extended PhD timeline as set by the university for PhD students.

Additional Department Policies

Process for Completing a Master's Degree enroute to a Ph.D.

*This degree is only available to current students in the Machine Learning PhD program or one of the *Machine Learning joint PhD programs.*

You may be able to earn a Master of Science in Machine Learning Research degree on the way to your PhD in Machine Learning.

Degree requirements:

- Complete all course requirements (84 units) for the MLD PhD program
- Complete 48 units of Directed Research
- Complete at least one of the two TA requirements

Once you have finished the requirements, you must make a request for the degree to the Graduate Programs Manager, it will not automatically be awarded.

A student who has already received a MS degree from another department in the School of Computer Science will not typically receive the MS degree from MLD.

* If you are a student in one of the Machine Learning Joint PhD programs you are able to choose this MS in Research degree from MLD or you may be able to earn a MS degree in your home department but you are not able to earn both.

Applying to a joint PhD Degree

In order to apply to a Joint ML PhD degree, a student must already be enrolled in one of the participating PhD programs in Statistics, Heinz, PNC or SDS.

Before applying, a student must:

- Take 10715, 36705, 10716 and earn at least a grade of A- in your first attempt to take each course. Letter grades are required. (Students who took courses before June 2023, will be Grandfathered in under the previous of B+ for the courses already taken.)
- Identify a MLD Core Faculty member who agrees to serve as their *MLD mentor*.

Applications must be submitted by May 31st.

MLD Mentor is a core faculty member in MLD who:

- Provides ML expertise, advice and oversight to support the student's research work.
- Influences the student's research direction to ensure that their PhD thesis makes sufficient contribution to machine learning to warrant a joint PhD in machine learning (a Joint ML PhD thesis will make a contribution to the combination of Machine Learning and the other field). For this influence to be successful, a mentor must engage with the student early in their research explorations.
- Meets with the student at least once per semester, preferably including the student's home advisor, to discuss progress and plans. The student is responsible for scheduling this meeting.
- Maintains contact with the student's home advisor.
- Represents the student in MLD's end-of-semester Doctoral Student Review meeting.
- A MLD mentor does not have a financial responsibility to the student, unless otherwise agreed in advance.

Fellowship Nomination Policy

MLD often is asked to nominate one or more PhD students for support from outside fellowships. We follow a process of announcing each opportunity to the MLD home department PhD students and faculty. Nominations are sent to the PhD Program Manager. The PhD Program Director selects the MLD nominations that the department will put forward.

In this selection process, we follow two principles:

- 1. Attempt to nominate students who are most likely to win the fellowship if nominated. Criteria here include the academic and research record of the student, the relevance of their research to the interests of the fellowship funder, and any specific connections the student or their advisor might have to the fellowship funder.
- 2. Attempt to give as many students as possible a chance. For example, if two students appear equally qualified to be nominated, but one has recently been nominated for a different fellowship, we lean toward nominating the other student this time.

New Policies / "Grandfather" Policy

When policies are changed it is because the department believes the new rules offer an improvement; any such changes are communicated to the current graduate students. The students currently enrolled whose degree program is affected by a change in policy may choose to be governed by the older policy that was in place at the time they joined the department. In case degree requirements are changed and certain courses are no longer offered, the department will try to find some compromise that allows those students to satisfy the original requirements.

Time Away from Academic Responsibilities

We recognize that everybody, including graduate students, needs time off to relax and we support that. However, Graduate Students should not assume that their time-off follows the academic calendar of courses. The default assumption is that graduate students continue research during academic breaks, unless they get approval in advance from their advisor to take time off. University Holidays are student holidays as well and students need to consult with their advisor/s about coverage during University Holidays if they have challenges with taking time off during that time, i.e. if experiments are running that need to be monitored continuously. Arrangements can be made for students to take an equal number of days off at another time.

Grading and Evaluation

Department Policy on grades

For Machine Learning students, course work with a grade of C+ or lower is not acceptable toward graduate degree requirements. Students receiving a grade of C+ or lower will either have to retake the course or work with the instructor to do remedial work to prove they have learned the material.

Department policy on grades for retaking a course

Students who do not pass a core course will be asked to take the course again. Both course grades will be on your transcript and in the Doctoral Review system.

Department policy on pass/fail, satisfactory/unsatisfactory

The Machine Learning Department requires letter grades in courses for our students.

Regular Reviews and Evaluations by Department

Every fall and spring semester the entire faculty of the department meet to collectively discuss, evaluate, and formulate advice for every doctoral candidate. The result of the meeting is a determination of the student's status in the program and feedback about progress and performance.

Purpose of the Review

It is the aim of the faculty that every doctoral candidate succeeds. Everyone admitted to the program is believed to be capable of completing their doctoral studies and obtaining a Ph.D. This biannual review helps to ensure that success.

The purpose of the review is to provide individualized advice and guidance to Ph.D. students so that they know what is expected of them in the coming semester and overall. It is not the purpose of the review to eliminate candidates from the program; this may rarely occur as a consequence but it is never an objective.

Discussion of all Doctoral students

The majority of doctoral candidates are making satisfactory progress toward their Ph.D. Any difficulties must be reviewed, yet the faculty discusses every case to learn about significant developments, see what strategies are working and not, and to stay informed about everyone. The faculty's primary source of information about the student is the student's advisor but through courses, committees, and research many of the faculty will have knowledge and perspective to impart. It is also helpful to the advisor to learn about the student from different perspectives.

Progress Status

The status indicates whether the faculty agrees the student is making reasonable progress, doing well, and on track. The highest status is Satisfactory and students should strive to maintain satisfactory progress throughout their doctoral studies. Each semester may be different in activities and accomplishment, but all may be satisfactory in the evaluation of the faculty. The faculty will assign a status that will be communicated in the student's semiannual review letter.

Faculty Participation

By having all the faculty meet together to discuss all of the students we help to ensure uniformity and consistency in the evaluation by all of the different advisors. The faculty measure each student's progress against the goal of completing the program in a reasonable period of time. In their evaluation, the faculty consider courses taken, directed research, teaching if applicable, skill, development, papers written and lectures.

It is the responsibility of the faculty to advise and evaluate all candidates in the department. The collective nature of the review serves several purposes. The faculty and students function as a collaborative research community with knowledge and experience dispersed among the members so it makes sense to get diverse input about student activities. It is also important to have the faculty well-informed about students to help identify and foster continuing collaboration. Additionally, participation helps faculty to learn and become better advisors.

Advice and support is guaranteed, not by the individual advisor, but by the department (the faculty body). All students making satisfactory progress will receive financial support, regardless of advisor funding and similarly all students will have a doctoral advisor even if their current advisor cannot continue for any reason.

Lastly the review expresses the perspective of faculty and their consent on the advice given, so all must be able to participate in the review process.

Importance to the Department and University

The overarching goals of the faculty when advising Ph.D. students are to produce high-quality research and to graduate highly successful Ph.D. students. The number and success of a faculty member's PhD graduates is a major part of their reputation, and thus their own career success. The faculty truly want their advisees to have successful Ph.D. careers, both before and after graduation. Similarly, the success of the departments within SCS, and the university as a whole, is judged in part by the production of successful Ph.D. graduates. Thus the departments have an interest in promoting the production of successful Ph.D. graduates, and ensuring a consistent and high level of academic quality. In order to achieve these goals, it is crucial for departments to evaluate Ph.D. students carefully, consistently, and fairly.

What happens in the Doctoral Student Review Meeting

The meeting is held in closed session with the faculty who advise students, the Ph.D. chairperson, and the PhD program manager attending. To the greatest extent possible faculty attend in person for the entire meeting.

The discussion proceeds by annual cohort, alternating each semester between increasing seniority and decreasing seniority order, alphabetical within cohort. The graduate student database is accessible by all faculty and during the meeting each student's record in turn is projected on the screen for common reference. The draft letter (prepared in advance by the student's advisor(s)) and the student statement are viewable.

The advisor is responsible for assembling information about the case and presenting it. The student should make sure their advisor is informed about participation in activities and research progress made during the semester. This can be both through advisor meetings and through the online student statement.

For each student:

- present the case, initially by the advisor or designated proxy
- view the student statement and draft letter
- discuss the case with emphasis on progress
- identify any areas of concern
- formulate specific advice
- determine expected or required activities or accomplishments
- decide on status

The faculty review the student's previous semester's coursework and research progress and the student's next semester's plans to ensure that the student is making satisfactory progress. The evaluation of a student's progress in directed research often depends on the student having produced some tangible result; examples include the implementation of pieces of a software system, progress in theoretical formulations, a written report on research explorations, an annotated bibliography in a major area, or, as part of preparation for doing research, a passing grade in a graduate course (beyond the required core courses and electives).

It is quite common for a dozen or more faculty to contribute to the discussion and advice for any one student. The student's advisor speaks first but others, particularly committee members, course instructors, and research collaborators offer their thoughts. The faculty decide whether a student is making satisfactory progress in the program. If so, the faculty usually suggest goals for the student to achieve over the next semester. If not, the faculty make more rigid demands of the student.

Ultimately, permission to continue in the program is contingent on whether or not the student continues to make satisfactory progress toward their degree. If a student is not making satisfactory progress, the faculty may choose to terminate the student in the program. This only happens after an N-1 warning letter and continuing lack of progress towards requirements prescribed by the faculty.

The review is serious and the tone is of constructive discussion of how to help students to succeed. Natural moments of humor almost always regard the foibles of the faculty itself. There is very little complaining, and no insulting or demeaning is tolerated. This is not a venue for gossip or rumor, evaluation focuses on the facts of the case. Faculty hold each other to a high standard and the chair keeps the discussion positive.

The faculty limits any discussion or comment on personal lives. Personal circumstances change for better and for worse, times can be easy or hard, events can be happy or sad. The faculty recognizes that it is not fully aware of these details and cannot fairly understand or account for them. The review focuses on public not private persona and particularly on academic performance. Advisors do not share known private information without prior permission and only when relevant to the evaluation.

Review Letter Progress Code Definitions

SP (satisfactory progress) means the faculty have determined that progress toward the PhD is satisfactory. This is the highest status that can be received.

USP (unsatisfactory progress) means the faculty have determined that progress is unsatisfactory. The letter will explain how progress is deficient and give instructions for how to return to satisfactory progress.

N-2 (imminent N-1 if there is no improvement); means the faculty has determined that there are significant problems with the current rate of progress. The student is in danger of receiving an N-1 letter in the next review period unless progress in the program is improved. The letter will contain specific steps for how to return to SP standing.

N-1 (continuation not guaranteed beyond the coming semester) means the faculty has determined that there are significant problems with the current level of progress. You may not be allowed to continue in the program past the next semester unless you satisfy specific conditions

that will be given in the letter. The N-1 letter gives the student one semester and instructions on how to make satisfactory progress.

M-2-M (month-to-month) may rarely be applied to manage and guide student progress with monthly milestones. Like N-1 but in this case continuation is not guaranteed beyond the coming month.

Funding & Financial Support

Statement of Department Financial Support

The Machine Learning Department is committed to providing full tuition and stipend support for the academic year, for each full-time ML PhD student who is making satisfactory progress, for a period of 5 years. Research opportunities are constrained by funding availability. Students are strongly encouraged to compete for outside fellowships and other sources of financial support. The department will supplement these outside awards in order to fulfill its obligations for tuition and stipend support. When a student is awarded an external fellowship the student will earn their PhD stipend +1% bonus on the external funds.

Stipend

A monthly stipend is provided for the first 12 months and for the academic year thereafter. Summer funding in future years may be available through working on continued research or through a summer internship.

Funding Payment Schedule

Stipend pay periods begin Aug 16 of each year. Stipends are paid semi-monthly on the 15^{th} or the last day of the month.

Health Insurance Requirement & Support

All Carnegie Mellon students are required to have health insurance. Please visit the University Health Services (UHS) website at https://www.cmu.edu/health-services/student-insurance/ for additional information.

In addition to the tuition, stipend, and fees support referenced above, if you elect to enroll in the Carnegie Mellon University's Student Health Insurance Plan (SHIP), the University will cover the premium cost for your individual coverage. While you will have the opportunity to purchase partner, spouse or dependent coverage under the SHIP plan, the University's support is limited to the enrolled student's coverage as an individual. Please note that if you wish to satisfy the health insurance requirement under an alternate plan you will not be eligible for the University support referenced here.

In order to be eligible for the financial support, you must enroll in the SHIP program not later than July 31st. Please be advised that we will verify your enrollment with University Health Services prior to processing the insurance premium support. For those who elect spouse or dependent coverage, the University has a payment plan available. Information can be found here: https://www.cmu.edu/sfs/billing/payments/monthly-plan/index.html

Travel/Conference Funding

The department encourages PhD students to travel to conferences and workshops to enhance their professional and career development.

Policy: If a PhD student wishes to attend a conference or workshop, the student's advisor or research sponsor should support the trip through either a research contract or a discretionary account. Student travel is unlimited as long as there is money available from research contracts and/or discretionary funds of a sponsoring faculty member.

If no such funding is available to the student, then limited departmental funds may be available upon request from the Machine Learning Department. Since departmental funds are limited, the maximum to be reimbursed will be $200 plus the registration fee if the student is only attending the conference or workshop; $600 plus the registration fee if the student is presenting a paper. Department funding is only available to the student for one trip per year and will not be transferred to the following year. This funding is only available if the advisor agrees with the student's decision to attend the conference but does not have funds to cover their attendance.

Process: To obtain travel support, the PhD student and their faculty advisor/research sponsor must first agree that the student should take the trip. Then in advance of the trip the student must fill out and print the Student Travel Authorization Form and get their advisor's signature before forwarding the form to the PhD Program Manager.

The faculty member must (i) indicate the amount and the reason for providing partial support (be sure the charge number is filled in) or (ii) state on the Comments line that no funds are available from any research or discretional account. Student then submits the form to the PhD Program Manager to request approval from the Department Head.

Internship Opportunities

The Machine Learning Department recognizes that an external internship can be a valuable educational and research experience, especially if access to proprietary data is required for the student's research. We will allow PhD students to accept up to four external internships during their Ph.D. studies. Interning more than 4 times requires approval from the Ph.D. program Director. International students who wish to pursue an external internship or consulting opportunity must consult with OIE and obtain off campus work authorization before starting the work.

You must discuss your plans for an internship with your advisor for approval. The summer semester is the optimal time for an internship. Internships during the academic year are rare -- the only way to complete an internship during the academic year is to take a Leave of Absence or to adhere to the department rules for Consulting.

If your research resulting from the internship is not complete at the end of the internship you may petition to extend that internship in order to complete your research, by following the department consulting policy. Consulting is not counted towards the internship limit of 4.

Students with summer internships may occasionally benefit from continuing their internship into the fall semester (e.g., to complete submission of a conference paper describing their summer research). To extend their internship, students must get their advisor's approval, and submit a request to the department by using the Consulting Form. **Extensions to summer internships must be requested by Aug. 15th**

International students are required to consult with Office of International Education for eligibility before seeking an internship/co-op or signing an offer contract (required addition to ensure the university is in compliance with immigration laws for F & J status students).

Resources to Explore Potential Internships

- Faculty Recommendations
- College Career Services
- Career and Professional Development Center
  https://www.cmu.edu/career/
- Department Internship announcements

Consulting (Outside Employment)

MLD PhD Students enrolled in our program and funded by research grants, fellowships or other funding mechanisms are expected to spend all their work time on their academic activities towards completing their degree. Outside paid work is not normally compatible with full time PhD student status. However, in some circumstances the Machine Learning Department may permit full-time PhD students to devote up to 8 hours per week (averaged over any one semester) to outside, paid, professional activities, where that activity is consistent with the student's role as a member of the student body, and where that activity also enhances the contribution of the student to the university. To obtain that permission, a student must apply ahead of time by filling out the PhD Student Consulting Policy & Agreement form. The start and end dates must be within the semester dates, as determined by the university. Of course, the student must also make sure they comply with all applicable U.S. laws, including specific terms of their visa, if applicable.

International Students will have to contact OIE and fill out the CPT Form.
https://www.cmu.edu/oie/foreign-students/docs/cpt-advisor-recommendation.pdf