Carnegie Mellon University

Academic Year 2024-2025

School of Computer Science

Machine Learning Department

Master's Student Handbook

Degree Programs Covered by This Handbook:

Master of Science in Machine Learning

Master of Science in Machine Learning – Applied Study

Table of Contents

SECTION 1: Welcome & Introduction

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:

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

The Graduate Student Handbook can be found online on the Machine Learning Department website: https://www.ml.cmu.edu/current-students/

If the handbook is needed in a different format to address accessibility needs, the student should contact the Machine Learning Master's Programs Manager.

SECTION 2: Program Vision, Mission, and Values

Machine Learning is a scientific field addressing the question "How can machines *learn*, i.e., how to create algorithms and corresponding effective computer implementations capable of automatically analyze data and improve their performance with 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 models of their environments by gathering navigational experience from their sensors and actively interacting with people, or designing computer aids for scientific discovery that combine initial scientific hypotheses with new experimental data to automatically produce refined scientific hypotheses that better fit observed data.

To tackle these problems, we develop algorithms that discover general conjectures and knowledge from specific data and experience, based on different methods, including sound statistical and computational principles, as well as instruction and self-exploration. We also develop theories of learning processes that characterize the fundamental nature of the computations and experience sufficient for successful learning in machines and in humans.

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 may achieve competence through a variety of methods, 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.

SECTION 3: Degrees Offered

PhD in Machine Learning

PhD in Machine Learning and Public Policy *(offered jointly with Heinz College)*

PhD in Neural Computation and Machine Learning *(offered jointly with the Neuroscience Institute)*

PhD in Autonomous & Human Decision Making *(offered jointly with the Department of Social and Decision Sciences)*

PhD in Statistics and Machine Learning *(offered jointly with the Department of Statistics & Data Science)*

Master of Science in Machine Learning Research *(earned on the way to the PhD)*

Master of Science in Machine Learning *(including a Fifth-Year pathway)*

Master of Science in Machine Learning – Applied Study

For information on the requirements for the PhD programs and the Master of Science in Machine Learning Research, see the Machine Learning PhD Handbook, which is available on the Machine Learning Department's webpage for current students.

SECTION 4: Departmental Personnel

For emergencies, contact Campus Police: 412-268-2323

- Martial Hebert, Dean of School of Computer Science (SCS)
- David Garlan, Associate Dean for Master's Programs, SCS
- Jodi Forlizzi, Associate Dean for Diversity, Equity and Inclusion, SCS

- Zico Kolter, Department Head, Machine Learning Department (ML)
- Nihar Shah, Director, Master's Programs, ML
- Dorothy Holland-Minkley, Master's Programs Manager, ML
- Laura Winter, Undergraduate Programs and Master's Admissions Coordinator, ML
- ML Core Faculty
- ML Affiliated Faculty
- ML Related Faculty
- ML Staff
    - Russ O'Lare, Business Manager, ML
    - Mary Stech, Student Employment Processes Manager, ML
    - Sara Werner, Assistant to the Dept. Head, ML
- SCS Help Desk

The ML Program Directors serve as ombudspeople for graduate students to assist with difficult 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.

An additional resource for students is the Machine Learning Department Wellness Network, which is a group of faculty, staff, and students committed to promoting wellness in the department. Students can attend the office hours to talk about concerns and/or seek advice on a wide variety of issues (including program-related, career-related, and personal issues), or even just for a friendly chat.

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.

There are many other resources students can use to seek help for themselves, and all community members are strongly encouraged to use CMU Cares if they believe a fellow student needs additional support or resources.

SECTION 5: Departmental Resources

Key Locations

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

Location of multi-function printers, available to those with a CS account, and printing etiquette is found here: http://www.cs.cmu.edu/~help/printing/index.html

Information about public computer clusters and printers can be found at: http://www.cs.cmu.edu/~help/printing/index.html

Machine Learning MS students can use their CMU student ID to access the MSML/MSCS Lounge in TEP 1400, and can request access to a locker in the lounge from the Master's Programs Manager. Students who use the lounge are responsible for keeping it in good shape.

Additional rules for the TEP 1400 lounge include:

- This is not a sleeping area. Do not bring in pillows, blankets, etc.
- While you are welcome to eat in the lounge, food cannot be stored there, including in the lockers. Everything in the refrigerator will be thrown out monthly when the refrigerator is cleaned.
- You can use the sink to wash your hands or for drinking water, but you **cannot** use it to clean dishes. The lounge is underground and wastewater is pumped upward, and any food debris will cause the pump to clog and overflow into the room.
- You cannot claim a space when you leave the room, since the lounge is shared by around 200 students in Fall semesters. When you leave (even for just the length of a class), pick up all of your belongings and take them with you or store them in a locker. This includes papers and books. Check to make sure you have thrown out all your trash and that you're leaving the space clean for your next colleague to use.

- The lounge contains office supplies for the students' use; email Dorothy Holland-Minkley if supplies run out.
- The lounge also contains games, sports equipment, and reference books that have been purchased for students' use by CSD, MLD, or donated by the programs' alumni or program administrators. These should generally be used in the lounge, or in the case of sports equipment, may be borrowed briefly but should be returned promptly for other students to use.
- The lounge continues a classroom area that is used for some MSCS-only classes. You will need to vacate the classroom when classes are being held.

A phone booth (privacy booth) can be found on the 8th floor of GHC for Machine Learning master's students to use. The phone booth can be reserved for relatively brief phone/video interviews. (For interviews longer than an hour, students are asked to conduct those from home.)

Mail folders for incoming mail are located on the 8th floor of GHC. A US Post Office for outgoing mail is located in the basement of University Center.

To have packages delivered to you, please use the following address:

Your Name

Carnegie Mellon University/Computer Science

311 Hamerschlag Drive/Wean Hall room 3613

Pittsburgh, Pennsylvania 15213-3891

United States

Information on how to collect a package from the SCS Receiving office can be found at https://computing.cs.cmu.edu/business/receiving

To report damages, needed repairs, or routine security concerns within GHC, contact the SCS Building Facilities Department. For immediate security concerns, contact the CMU Campus Police at 412-268-2323.

Reimbursements

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.

Business Expenses

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
- Signed expense report

Please consult with your advisor's assistant prior to incurring the expense for additional instruction.

Travel Expenses

Previously 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 at $0.67 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
- Signed travel expense report

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 Graduate Student Committees

Departmental committees consist of the Doctoral Review Committee (DRC), PhD & MS Admissions Committees, Speaking Skills Committee, Social Committee, MS Student Committee, and Wellness Network.

We also have a student representative for the department for the University Graduate Student Assembly and SCS Dean's Master's Advisory Committee.

SECTION 6: Advising

6.1: Role of an Advisor and Advisor Assignments

Research is not a mandatory part of the Machine Learning master's programs, and many students will not have research advisors while studying here. Research matches are not guaranteed.

Students who wish to incorporate research into their degree should take the lead role in finding a research advisor. The Machine Learning Department Orientation is a good resource for hearing from many different faculty about their research. Students are encouraged to reach out to faculty directly to discuss starting research with them.

Students are expected to work with only one research group at a time. If a student would like to attend additional research group meeting(s) to learn more about different fields of research, they are expected to be upfront with the faculty about their other research commitment.

6.2: Advisor/Advisee Collaboration

Most research advising relationships are arranged for one semester at a time, usually in conjunction with registration for 10-620 Independent Study. Before registration for Independent Study, the student and advisor are expected to discuss both the expected

content of the research and the deliverables that will be used as part of assessing the student's performance. The research topic and description of expected deliverables must be provided to the Master's Programs Manager in order to be enrolled in Independent Study.

The research advisor is expected to report on the student's progress to the Machine Learning Department faculty at the end of semester meeting, including providing feedback for future improvement if appropriate.

Since research is not a mandatory part of the degree, the research advisor must re-affirm each semester if the research collaboration will be continuing.

Regardless of whether or not a student has a research advisor, the Master's Programs Manager and Master's Programs Director are the student's main contacts for academic advising and information about the program requirements.

6.3: Review/Redress of Academic Conflicts

Graduate students will find the Summary of Graduate Student Appeal and Grievance Procedures on the Office of Graduate and Postdoctoral Affairs webpage. This document summarizes processes available to graduate students who seek review of academic and non-academic issues.

Generally, graduate students are expected to seek informal resolution of all concerns within the applicable department, unit or program before invoking formal processes. 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 on that page.

SECTION 7: Master's Degree Requirements

7.1: Residency Requirements

Full-time graduate student status, according to the University and the Department, is 36 units in Fall and Spring.

Primary Master's in Machine Learning (including Applied Study)

Students in the Primary Master's in Machine Learning and Master's in Machine Learning – Applied Study program must complete at least 72 units of MSML coursework and the

practicum while enrolled in the program, regardless of previous coursework.

Most students complete the program full-time in three consecutive semesters plus a full-time summer practicum. However, part-time enrollment is allowed. Students should contact the Master's Programs Manager for approval before enrolling part-time.

Fifth-Year Master's in Machine Learning

Students in the Fifth-Year Master's in Machine Learning program are considered undergraduates until they have completed the requirements for their bachelor's degree, at which point they are certified by their undergraduate academic program and become master's students.

Students in the Fifth-Year Master's in Machine Learning program must complete 72 units of MSML coursework and the practicum while enrolled in the master's program, after completion of their bachelor's degree.

Fifth-Year Master's students must be enrolled full-time for both of the master's semesters and the summer. They may overload to take additional courses with advisor approval, but must remain enrolled full-time for both semesters regardless.

7.2: Registration Process

Students are responsible for registering for courses via Student Information Online.

During the during the fall and spring semesters, MS students should normally be registered for at least 36 units. During the summer, students should be registered for 3 or 36 units, depending on how they are completing the practicum.

7.3: Required Units for Degree Attainment

Master's in Machine Learning: 9 12-unit courses + 3-unit Practicum (111 units total)

Master's in Machine Learning, Fifth-Year pathway: 3 12-unit courses taken as an undergraduate + 6 12-unit courses taken as a master's student + 3-unit Practicum completed as a master's student (111 units total)

Master's in Machine Learning – Applied Study: 9 12-unit courses + 3-unit Internship + Professional development (111 units total)

7.4: Program Overview

Regardless of program, all students must satisfy all university requirements for the graduate degree: http://www.cmu.edu/graduate/policies.

Primary Master's in Machine Learning

This highly selective program consists primarily of coursework, with a very limited research component, and typically takes three to four semesters to complete.

To complete the degree of Master of Science in Machine Learning, we require that each student:

- Complete the MSML Course Requirements, described below
- Complete a practicum, described below

Fifth-Year Master's in Machine Learning

The Fifth-Year Master's in Machine Learning allows CMU undergraduates to complete a Master of Science in Machine Learning in one additional year by taking some of the required ML courses as an undergraduate.

To complete the degree of Master of Science in Machine Learning, we require that each student:

- Complete the MSML Course Requirements, described below
- Complete a practicum, described below
- Be enrolled full-time (at least 36 units per semester)

Note: A student may use one 400- or 500-level elective taken as an undergraduate if its requirements are identical to an approved cross-listed graduate-level course, as indicated by the course syllabus or an email from the instructor.

Primary Master's in Machine Learning – Applied Study

This highly selective program combines coursework, an internship, and professional development to train students to be the next leaders in industry. This alternative to the traditional Master of Science in Machine Learning provides certification that the student has experience in industry and is prepared for the distinct challenges of applying machine learning in non-academic settings. It typically takes three to four semesters to complete.

To complete the degree of Master of Science in Machine Learning – Applied Study (MSML-

AS), we require that each student:

- Complete the MSML Course Requirements, described below
- Complete an internship, described below
- Complete professional development activities, described below

7.5: Core Courses

The six core courses together provide a foundation in machine learning, statistics, probability, algorithms, and AI. They also provide depth in both theory and application of machine learning to problems in the real world. The three electives can be used to deepen the student's knowledge in their chosen subfield.

Students take all six courses from the Core:

- 10-701 Introduction to Machine Learning *or* 10-715 Advanced Introduction to Machine Learning
- 10-617 Intermediate Deep Learning *or* 10-703 Deep Reinforcement Learning *or* 10-707 Advanced Deep Learning
- 10-708 Probabilistic Graphical Models
- 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 societal impact of the deployed system.
- 10-725 Convex Optimization
- 36-700 Probability & Mathematical Sciences *or* 36-705 Intermediate Statistics

Note: MS students interested in pursuing the ML PhD should consider taking 10-715 and 36-705 instead of 10-701 and 36-700, due to the course requirements of the ML PhD.

7.6: Electives

Students take their choice of three courses from the Electives:

- 10-613/10-713 Machine Learning Ethics and Society

- 10-605/10-805 Machine Learning with Large Datasets
- 10-623 Generative AI
- 10-703 Deep Reinforcement Learning & Control *or* 10-707 Advanced Deep Learning
- 10-714 Deep Learning Systems: Algorithms and Implementation
- 10-716 Advanced Machine Learning: Theory and Methods
- 10-717 The Art of the Paper (6 units = ½ Elective)
- 10-719 Federated and Collaborative Learning
- 10-721 Philosophical Foundations of Machine Intelligence (6 units = ½ Elective)
- 10-730 Advanced AI and Brain Seminar (6 units = ½ Elective)
- 10-732 Robustness and Adaptation in Shifting Environments
- 10-733 Representation and Generation in Neuroscience and AI
- 10-734 Foundations of Autonomous Decision Making under Uncertainty
- 10-735 Responsible AI
- 10-741 Representation Learning
- 10-742 Machine Learning in Healthcare
- 10-745 Scalability in Machine Learning
- 10-777 Historical Advances in Machine Learning
- 10-813 Advanced Topics in Machine Learning Theory
- 10-880 Game Theoretic Probability, Statistics and Learning
- 10-XXX Special Topics in Machine Learning (course numbers vary)
- 11-711 Advanced Natural Language Processing
- 11-741 Machine Learning for Text and Graph-based Mining
- 11-747 Neural Networks for NLP
- 11-777 Multimodal Machine Learning
- 15-750 Algorithms in the Real World *or* 15-850 Advanced Algorithms
- 15-780 Graduate Artificial Intelligence
- 16-720 Computer Vision *or* 16-820 Advanced Computer Vision
- 17-716 AI Governance: Identifying and Mitigating Risks in the Design and Development of AI Solutions (6 units = ½ Elective)

- 36-707 Regression Analysis
- 36-709 Advanced Statistical Theory I
- 36-710 Advanced Statistical Theory II
- 10-620 Independent Study (see the Independent Study section below)
- 10-620 Independent Study
- 10-620 Independent Study

Additional elective options may be listed on the curriculum webpage when they are approved.

Generally, most students complete their Electives requirement entirely with courses from this list. If a student would like to petition for an elective that is not on this list, they should email the course URL (or syllabus if course URL is not available) and 2-4 lines on the course's relevance to machine learning studies to the Master's Program Director (ml-ms-directors@cs.cmu.edu), who will evaluate it for acceptability.

7.7: Professional Development

Professional development activities are mandatory for students in the Master's in Machine Learning – Applied Study program, and optional for other students.

To help them prepare for their internship, MSML-AS students will complete the CPDC's Canvas Course Module before beginning the program.

MSML-AS students will be expected to join the Machine Learning Department LinkedIn group to connect with alumni and to provide their resume to the MSML-AS program coordinator to share with prospective employers, unless the student has privacy concerns that would prevent the sharing of their information.

Students who do not already have industry experience in a related field will be guided to strengthen their professional skills by participating in workshops and seminars like those hosted by the Career and Professional Development Center (such as the Resume Lab or Interview Prep Lab) and the Student Academic Success Center (such as Communicating Data to Non-Experts, Presentation Skills, Creating Effective PowerPoint Presentations, or Team Communication), such as their individual needs require.

7.8: Department Policy on Double Counting Courses

The policies for previously taken courses vary by program and are described below.

Primary Master's in Machine Learning (including Applied Study)

Courses taken at other Universities

Some students will have taken courses similar to ours at other universities before entering the Primary Master's program. Based on such equivalent coursework, any student can apply to replace (not reduce) up to two courses with MSML electives.

In order to petition for such course replacement, they should email the Master's Program Director (ml-ms-directors@cs.cmu.edu) with the following information:

1. **Coverage:** A side-by-side comparison of the syllabus of the MSML course and that of the previous course they would be using to justify the replacement, showing how most topics in the MSML course were covered in their previous course.
2. **Depth:** Different courses and different universities offer courses in different depths. For instance, even for us, 10-715 and 10-601 are both graduate-level Introduction to Machine Learning courses but they are poles apart, with 10-715 going into far more depth. The student should provide justification for waiving the MSML course, which usually goes into significant depth. In particular, if a student is asking to waive the Introduction to Machine Learning requirement (10-701 or 10-715) or the Statistics requirement (36-700 or 36-705), their justification should be with regards to the more advanced version of the course (i.e., 10-715 or 36-705).
3. **Performance:** A petitioning student should have exhibited a strong performance in the previous course, and should include the relevant transcript with their email. Since different universities are calibrated differently, the appropriate grade cut-off will be handled on a case-by-case basis.

Courses taken at Carnegie Mellon University

Courses taken at Carnegie Mellon University *used to fulfill the requirements of another degree or credential* cannot be counted towards the Primary Master's in Machine Learning program.

Course Replacement: Any student who took courses from the Master's in Machine Learning curriculum at Carnegie Mellon before entering the program can apply to replace (not reduce) those courses with MSML electives if the grade obtained was B- or above.

Course Reduction: If students have previously taken courses from the Master's in Machine Learning curriculum at Carnegie Mellon and have not used them towards another degree, up to three of them may be used to satisfy the Primary Master's in

Machine Learning requirements and do not need to be repeated or replaced if the grade obtained was B- and above.

Fifth-Year Master's in Machine Learning

To enter the Fifth-Year Master's in Machine Learning, you will have to have successfully completed the "Introduction to Machine Learning" course requirement (10-701) and two other required courses during your undergraduate years at Carnegie Mellon. These three courses taken as an undergraduate may be counted towards both your undergraduate degree and the Fifth-Year master's degree (though note that triple-counting, such as between a minor, major, and the master's, is never allowed). Taking more than three courses from the MSML curriculum as an undergraduate does not further decrease the number of courses that must be taken from the MSML curriculum as a master's student.

For any additional courses taken from the MSML curriculum beyond the standard three, if you earned at least a B- grade, you do not need to repeat them and can instead replace them with MSML electives.

For the "Introduction to Machine Learning" course requirement, instead of taking 10-701 you may instead take both 10-315 Introduction to Machine Learning (SCS Majors) and 15-281 Artificial Intelligence: Representation and Problem Solving. Together, these two courses can fulfill the "Introduction to Machine Learning" course requirement. Note that they will remain listed as 10-315 and 15-281 on your transcript, and the two of them together count as "one course" for the purpose of the Fifth-Year MS. For the purposes of double-counting, only 12 units' worth of 10-315 or 15-281 is used towards the MS.

7.9: Department Policy for Courses Outside the Department/College

The list of Elective courses includes options outside the Machine Learning Department. The program cannot guarantee enrollment in any Elective course, and in particular it common for departments to prioritize enrolling students from their own department before enrolling students from other departments.

7.10: Course Exemptions

See 7.6: Department Policy on Double Counting Courses.

7.11: Protocol for Evaluation of Transfer Credit

While it is rare, 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, the learning outcomes of the course, the course syllabus, and student work product. This replacement is rare, and students should not expect to have requirements replaced based on courses taken at other institutions. Refer to the Previously Taken Courses section for more information.

In rare circumstances, the Machine Learning Department allows students to count courses taken at outside universities while at MLD; these are listed as Independent Study credit, and are not subject to the 12-unit requirement above. The approval process is the same as for other Independent Study courses: the deliverable is the outside course grade, while the supervising faculty member certifies that the course is appropriate for the student and the number of credit hours, and is responsible for recommending a grade threshold to the program director at the beginning of the course, as well as verifying the threshold at the end of the course.

7.12: Teaching Requirements/Opportunities

Teaching is not a required component of the program. 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.

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
- Advise small groups of students for class projects
- Hold office hours for individual tutoring

The Eberly Center for Teaching Excellence is a resource for TA and instructor training and included in the section Additional University Resources, Appendix A. Students who will be TAs for the department are encouraged to visit the Teaching Center and to take advantage of the information and services located there.

Students can apply for Teaching Assistantships on our webpage: https://www.ml.cmu.edu/academics/ta.html

English Proficiency for TAs

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. The full university policy can be reviewed at:

https://www.cmu.edu/policies/faculty/evaluation-certification-english-fluency-instructors.html

The fluency of all instructional personnel will be rated by Language Support in the Student Academic Success Center to determine at what level of responsibility the student can TA. 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. Visit the Student Academic Success Center website for additional information: https://www.cmu.edu/student-success/

7.13: Research Requirements/Opportunities

Grading system for research

Research done as an Independent Study is graded with a letter grade assigned by the research advisor.

Research done to fulfill the practicum requirement is graded Pass/Fail.

Research funding options

Many Machine Learning MS students do research only for course credit or solely for their professional development. Funding is not guaranteed for students conducting research.

In a very limited number of cases, a research assistantship may be provided by projects which are funded by government agencies, private industries, and consortia. Research assistants (RAs) are expected to conduct appropriate research under the direction and guidance of their research advisor.

RA positions can be funded in one of the following ways, as determined by the advisor and department business office based on the scope and nature of the research being performed:

- Hourly wage for time worked
- 25% coverage of the MSML program tuition and ML PhD stipend for the semester
- 50% coverage of the MSML program tuition and ML PhD stipend for the semester
- 75% coverage of the MSML program tuition and ML PhD stipend for the semester

Health insurance and student fees are always the responsibility of the student.

Work performed for the Machine Learning Department, including TAships and RAships, is considered taxable income. This may include the tuition and stipend coverage, when relevant.

7.14: Internship/Co-op Requirements and Opportunities

To earn the MSML, students must complete one 3-unit practicum. This practicum may be either directed research or an internship related to machine learning. Unlike Independent Study, directed research for the practicum does NOT need to be under ML Core Faculty. Most students complete the practicum during the summer, and it may be paid or unpaid.

Master's in Machine Learning (including Fifth-Year pathway)

During the summer semester, Master's in Machine Learning students need to secure a summer internship or summer directed research. You must discuss your summer plans with your advisor and register for the appropriate course: 10-635 Practicum (3 units) for an internship or 10-697 Reading and Research (usually 36 units) for research at Carnegie Mellon. The Practicum course and the Reading and Research course will count towards your program requirements.

At the end of the practicum, you must submit a short, written report to your advisor, who will determine your pass/fail grade for the semester. In the case of research, the grade is determined in conjunction with the research advisor.

Master's in Machine Learning – Applied Study

During the summer semester, MSML-AS students need to secure a full-time summer internship related to machine learning. You must discuss your summer plans with your advisor and register for 3 units of 10-635 Practicum. At the end of the practicum, you must

submit a written report to the program director, who will determine your pass/fail grade for the semester. The Practicum course will count towards your program requirements.

The MSML-AS program does not guarantee that each student will be able to secure a summer internship, and so MLD will offer summer research opportunities as a backup option for students unable to obtain external internships. MLD faculty can provide research opportunities in a wide range of applied fields to any MSML-AS students who are unable to secure an internship. However, the expectation is that all MSML-AS students will secure summer internships; research is only allowed as a substitute in the case of extenuating circumstances.

Practicum Grading

Students must submit a report to the Master's Program Manager at the end of the practicum, answering a set of assigned questions. The practicum is graded Pass/No Pass.

International Students

International students are required to consult with the Office of International Education for eligibility for work authorization before starting or seeking an internship/co-op or consulting opportunity. International students will benefit from proactively reviewing OIE guidance regarding off-campus work authorization. Off-campus work authorization processing times can take several weeks or months, and international students will benefit from starting the off-campus work authorization process as early as possible.

Practicum Tuition

Practicum tuition is not charged to master's students who complete the practicum during the summer semester.

Resources to Explore Potential Internships

- Department and college internship announcements
- University Career Fairs
- Career and Professional Development Center

7.15: Thesis Requirement

The Machine Learning master's programs do not have a thesis option.

7.16: Requirements for Application/Consideration for Entry into PhD Program

There is not an internal transfer process from the master's to the doctoral program. Interested Machine Learning master's students would typically apply to the PhD in Machine Learning via the standard application process in their final Fall semester.

While not required, students interested in the PhD program are encouraged to consider taking 10-715 instead of 10-701 for the Introduction to Machine Learning requirement, and 36-705 instead of 36-700 for the Statistics requirement. However, it is most important that students take the course that is a better match for their academic preparation, and having taken 10-715 and 36-705 is not required for admission to the PhD program.

Information about the PhD in Machine Learning and how to apply can be found at https://www.ml.cmu.edu/academics/machine-learning-phd.html .

SECTION 8: Department Policies & Protocols

8.1: Petition Procedures

Students are encouraged to contact the Master's Programs Manager, Dorothy Holland-Minkley (dfh@cs.cmu.edu), for an initial discussion about desired program changes, course substitutions, or other changes. This optional step can help determine additional possibilities or procedures.

Approval for most changes will need to come from the Master's Program Director, Nihar Shah (ml-ms-directors@cs.cmu.edu). If necessary, the Program Manager, Program Director, or student can escalate the question to the Machine Learning Department Head.

8.2: Department Policy for Withdrawing from a Course

The Machine Learning Department follows the university's standard procedure regarding course withdrawals: https://www.cmu.edu/hub/registrar/course-changes/

8.3: Requirements for Those Without a Bachelor's Degree in Discipline

Incoming students are expected to have a bachelor's degree and must have a strong background in Computer Science, including a solid understanding of complexity theory and good programming skills, as well as a good background in mathematics. Specifically, the first-year courses assume at least one year of college-level probability and statistics, as well as matrix algebra and multivariate calculus. Experience in MATLAB/R/SciPy-NumPy is especially helpful, as is probability/stats, linear algebra, and matrix and tensor calculus. This background should be at least at the level of the following courses:

- 15-150 Principles of Functional Programming
- 15-210 Parallel and Sequential Data Structures and Algorithms
- 36-225 Introduction to Probability Theory
- 36-226 Introduction to Statistical Inference

We will accept equivalent coursework or experience from outside of CMU for these prerequisites.

8.4: New Policies / "Grandfather" Policy

When policies are changed it is because the department believes the new rules offer an improvement; any such changes will be 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 of their matriculation. 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.

8.5: Time Away from Academic Responsibilities

Students with graduate assistantships are expected to continue with their research during academic breaks (including the summer months) with the exception of the official university holidays. A complete list of the official university holidays can be found at the Human Resources website.

Due to federal regulations governing graduate student support, paid time off for personal business and vacations is not provided. A supported graduate student wanting to take a

one week break during one of the summer months in which they are receiving a stipend is expected to get approval for that break with their advisor and make up the work during the other three weeks of that month. Supported graduate students wishing to take longer periods of personal time off must do so without pay and must receive advanced approval from their research advisor a minimum of four weeks prior to the requested time off. The advisor must then notify the Master's Programs Manager and Business Manager of this approval so that stipend adjustments can be processed.

8.6: Other Policies and Protocols

Academic Integrity

Please review the University Policy on Academic Integrity (https://www.cmu.edu/policies/student-and-student-life/academic-integrity.html). The policy includes the University expectations around academic integrity and provides definitions of cheating, plagiarism, and unauthorized assistance.

A review of the University's Academic Disciplinary Actions procedures (https://www.cmu.edu/student-affairs/theword/academic-discipline/index.html) is also recommended. These procedures outline the process for investigating, reporting, and adjudicating violations of the University Policy on Academic Integrity. The procedures also outline the appeal process.

A first violation usually has repercussions at the course level, such as failure of the course. Depending on severity, however, a first violation may result in program-level repercussions, including dismissal from the program and recommendation for expulsion from the university. Academic integrity on research papers, including a dissertation, is also enforced strictly; citations are required to avoid plagiarism, including self-plagiarism. A second academic integrity violation usually results in dismissal from the program and recommendation for expulsion from the university.

Violations will be discussed at the end of semester review meeting and the department reserves the right to assess additional penalties to the student, as outlined in the University Policy found at: https://www.cmu.edu/student-affairs/theword/academic-discipline/outcomes.html

Machine Learning master's students are required to complete the OLI online course on Academic Integrity in both of their first two semesters in the program: https://oli.cmu.edu/

Personal Computing Resources

Machine Learning master's students must provide their own laptop computer.

Certification of Degree and Commencement Participation

The master's degree will be certified at the end of the semester the student completes the degree requirements.

Students who graduate in May participate in the Commencement that month. Students who graduate in December participate in Commencement the following May. Students who graduate in August participate in Commencement the preceding May if the program believes there is a high likelihood of successful degree completion in August.

The degree titles are:

- Primary Master's in Machine Learning and Fifth-Year Master's in Machine Learning: **Master of Science in Machine Learning**
- Primary Master's in Machine Learning – Applied Study: **Master of Science in Machine Learning – Applied Study**

SECTION 9: Grading & Evaluation

9.1: Grading Scale/System

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.

9.2: Department Policy on Grades for Retaking a Course

The minimum grade requirement of B- for a course to count towards the degree continues to apply to courses that are retaken due to not earning a B- or better grade in that course previously.

9.3: Department Policy on Pass/Fail, Satisfactory/Unsatisfactory

In general, a course must be taken for a letter grade and passed with a B- or better to

count towards the Master's in Machine Learning. However, a course offered by the Machine Learning Department as Pass/Fail may be declared by the Machine Learning Department as counting (if passed) towards degree requirements.

The Pass/No Pass Conversion Chart for graduate students can be found at https://www.cmu.edu/hub/registrar/student-records/transcripts/legend.html

9.4: Department Policy for Incompletes

The Machine Learning Department follows the university's standard procedure regarding Incomplete grades: https://www.cmu.edu/policies/student-and-student-life/grading.html

9.5: Independent Study/Directed Reading

The Machine Learning Department allows Independent Study for credit. To count, an Independent Study must be for 12 units and be supervised by a Machine Learning Department Core Faculty member. To request approval of an independent study, the student should give their program manager a description of the work to be undertaken and a short description of the deliverables that will be due to the research advisor at the end of each semester, such as a write-up of work done, a summary of the literature studied, a copy of the code produced, or a presentation to the research group. The research advisor will also need to confirm to the program manager that they are agreeing to supervise the student's research for the semester and that they will be assigning the student a letter grade at the end of the semester.

With pre-approval, research conducted under the guidance of a faculty member who is not Machine Learning Department Core Faculty can count as an Independent Study. To request approval for such an Independent Study, the student must email the Program Director (ml-ms-directors@cs.cmu.edu) with the name and affiliation of the proposed research advisor and a proposal of the work to be done and how it relates to machine learning (approximately one page).

Only one Independent Study can be completed per semester and it is expected that it will be with the same research group for the full semester.

Students should only make a commitment to work with one research group at a time. A student who is sitting in on multiple research groups' meetings should be sure to tell the faculty that they are doing so to learn about the group's work, not as a commitment to work with that group.

9.6: GPA Requirements and QPA Requirements for Graduation

The program does not have a QPA requirement. Instead, each individual course must be passed with a B- grade or better to count towards the degree.

9.7: Satisfactory Academic Standing

Most students are expected to successfully complete (with a B- grade or better) 36 units of coursework for the program each semester. Students may be part-time with permission of the Program Manager or Program Director, but they must be able to complete the program in-person in Pittsburgh before the end of the Statute of Limitations.

Students will be notified if they are not maintaining satisfactory progress after the end-of-semester review meeting, described below. Students may appeal decisions regarding their academic standing by following the Summary of Graduate Student Appeal and Grievance Procedures.

Standard program milestones are as follows:

Primary Master's in Machine Learning

Students completing the program full-time are expected to take at least 3 courses for the Primary Master's program in each semester, unless they have fewer than 3 courses remaining. Students may overload to take additional courses with advisor approval, though approval to overload is very rare in the first semester. Students with evidence of having taken 4 or more graduate-level courses in a single semester may present that as evidence to the Master's Programs Director (ml-ms-directors@cs.cmu.edu) when requesting approval for an overload. Students may be permitted to enroll in 3 courses plus an Independent Study in their first semester, but are expected to inform their research advisor, keeping in mind that doctoral students only take 2 courses plus research each semester. Small overloads to take a "hobby" course, such a physical education course, are permitted.

Full-time students are expected to follow this timeline:

- First semester: Complete 10-701 (or 10-715), 36-700 (or 36-705), and one other course
- Second semester: Complete three courses

- Summer: Complete the practicum
- Third semester: Complete the final three courses

Students completing the program part-time are expected to contact their advisor to determine an appropriate timeline for their situation.

Fifth-Year Master's in Machine Learning

Students are expected to complete at least 3 courses for the Fifth-Year Master's program in their first semester and complete the coursework in their second semester.

Most students follow the following timeline:

- By end of summer after senior year: Complete the practicum
- By end of the first semester of fifth year: Complete 36-700 (or 36-705) and two other courses
- By end of the second semester of fifth year: Complete the final three courses

In particular, it is the student's choice if they wish to complete the practicum in the summer between senior year and the fifth year or during the summer after the fifth year.

Student's in the Fifth-Year Master's program must be full-time for all semesters.

Primary Master's in Machine Learning – Applied Study

Students completing the program full-time are expected to take at least 3 courses for the Primary Master's program in each semester, unless they have fewer than 3 courses remaining. Students may overload to take additional courses with advisor approval, though approval to overload is very rare in the first semester. Students with evidence of having taken 4 or more graduate-level courses in a single semester may present that as evidence to the Master's Programs Director (ml-ms-directors@cs.cmu.edu) when requesting approval for an overload. Students may be permitted to enroll in 3 courses plus an Independent Study in their first semester, but are expected to inform their research advisor, keeping in mind that doctoral students only take 2 courses plus research each semester. Small overloads to take a "hobby" course, such a physical education course, are permitted.

Full-time students are expected to follow this timeline:

- Summer before coursework: Complete the CPDC's Canvas Course Module
- First semester: Complete 10-701 (or 10-715), 36-700 (or 36-705), and one other course

- Second semester: Complete three courses
- Summer: Complete the internship
- Third semester: Complete the final three courses

Students completing the program part-time are expected to contact their advisor to determine an appropriate timeline for their situation.

9.8: Regular Reviews and Evaluations by Department

Student progress will be evaluated at the end of each academic semester by the MLD faculty. Students will enter information into the Master's Student Review system to inform the faculty of their goals for the semester and if they were achieved. For students in the MSML-AS program, this includes a report to the program director on their coursework and professional development activities. The student will also enter their plans for the next semester.

The Machine Learning faculty meet at the end of each academic semester to make a formal evaluation of each student in the program. The program directors and faculty research advisors communicate in written form the assessment from these Master's Student Review meetings to the graduate students. Additional oral conversations take place, as and if needed.

Evaluation and feedback on a student's progress are important both to the student and to the faculty. Students need information on their overall progress to make long range plans.

At each semi-annual Master's Student Review meeting, the faculty review the student's previous semester's coursework and research progress (if applicable) 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, 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).

The purpose of having all the faculty meet together to discuss all of the students is 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.

The faculty's primary source of information about the student is the student's research

advisor, if they have one. The advisor is responsible for assembling the above information and presenting it at the faculty meeting. The student should make sure the advisor is informed about participation in activities and research progress made during the semester. Each student is asked to submit a summary of this information to the advisor at the end of each semester; this summary is viewable by all faculty during the Master's Student Review meeting.

Based on the above information, 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 the ML degree. If a student is not making satisfactory progress, the faculty may choose to drop the student from the program.

Terms of progress in Master's Student Review letters from faculty:

Each Master's Student Review letter will include a code indicating your current progress. The codes we use are:

- SP = In the semiannual evaluation of all our students the faculty reviewed your progress toward the MS. We have determined that your current level of progress is satisfactory.
- USP = We have determined that your current level of progress is unsatisfactory. The letter will contain specific instructions for how to return to SP standing.
- N-2 = We have determined that there are significant problems with your current level of progress. Accordingly, this is an N-2 letter: you are in danger of receiving an N-1 letter at the next Master's Student Review meeting unless you improve your rate of progress in the program. The letter will contain specific instructions for how to return to SP standing.
- N-1 = This is an N-1 letter. You may not be allowed to continue in the program past the next Master's Student Review meeting unless you satisfy specific conditions that will be given in the letter.

SECTION 10: Funding & Financial Support

10.1: Statement of Department Financial Support

The MS program does not offer any type of financial support. Tuition for this program is the responsibility of the student.

10.2: Stipend

The MS program does not offer any type of financial support. Tuition for this program is the responsibility of the student.

10.3: Department Fees

There are no departmental-level fees. Current tuition rates and cost of living including books, insurance, activities and technology fees, food and lodging costs can be found at the MS in Machine Learning Financial Information website.

There are no tuition or fees in the summer semester for a Machine Learning MS student who is only completing their practicum.

10.4: Travel/Conference and Research Funding

Conference Funding is a funding application process provided by the GSA and the Provost's Office for students, student work groups or groups to attend a conference, whether as a participant or as a presenter. The process is managed by the Office of Graduate and Postdoctoral Affairs.

GuSH Research Funding is a source of small research grant funds provided by GSA and the Provost's Office and managed by the Graduate Education Office.

Students can find more information about the application processes and deadlines at: https://www.cmu.edu/graduate/funding/index.html

10.5: Funding Payment Schedule

Students receiving hourly payment for work will receive pay biweekly and students receiving stipends will receive installments monthly, in accordance with standard CMU procedure.

10.6: Additional Sources of Internal & External Financial Support

We recommend students review the resources available on the National and International Fellowships and Scholarships website.

The School of Computer Science also maintains a list of Graduate Fellowship Opportunities that may be of particular interest to SCS students.

10.7: Availability of Summer Employment

See Internship/Co-op Requirements and Opportunities earlier in this handbook.

10.8: Department Policy on Outside Employment

Students are not allowed to be employed outside of the university during the academic year nor during the summer if they are being supported by the department, except as described in the next section, "Consulting."

Consulting

The department has traditionally granted full-time students the right to devote up to an average of one day (of university time) 8 hours per week to outside, paid, professional activities, where that activity is consistent with that person's role as a member of the student body and where that activity also enhances the contribution of the student to the university. Such activity benefits both the student and the university. Students must fill out a Student Consulting Application and Agreement, have their advisor sign in agreement, and submit it to their program administrator for Department Head approval. Any such consulting must be consistent with U.S. labor laws and for international students, with visa terms.

International students are required to consult with the Office of International Education for eligibility before signing an offer contract.

10.9: Requirements for the Continuation of Funding (if applicable)

Re-employment as a TA or RA for a subsequent semester is dependent upon the needs of the department or the research advisor as well as availability of funding.

10.10: Procedure for Written Notification of Change in Financial Support

Unless stated otherwise, employment as a TA or RA is on a semester-by-semester basis and is contingent upon satisfactory completion of work responsibilities.

International Students must notify the Office of International Education (OIE) if they lose their funding.

Graduate students who find themselves in need of immediate funds for emergency situations should contact the Office of the Dean of Students to inquire about an Emergency Student Loan.