

To: Ph.D. students in the CMS department

Subject: Navigating the Ph.D. programs in the CMS department

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This document gives an overview of the typical student path through the four Ph.D. programs in the CMS department: ACM, CDS, CS, and CMS. Note that it is not a replacement for discussions with your faculty advisor, the Option Representative, or the information in the Caltech Catalog, which lists the official degree requirements. Rather, this document is intended to outline the typical progression students follow through the degree and to summarize most of our policies regarding milestones in the program.

The requirements in the departmental Ph.D. programs fall into four categories: coursework, exams, research, and teaching. In each option, the coursework consists of a set of core courses taken during the first year, followed by a set of elective courses meant to encourage breadth and depth of knowledge. Beyond the coursework, students have three exams: a preliminary exam during the first year, a candidacy exam during the 2nd or 3rd year, and a thesis defense that typically occurs during the 5th or 6th year. Additionally, all students are expected to attend departmental seminars regularly (and are required to do so in the first year of their studies). Students are also encouraged to serve as a teaching assistant at least once (often more than once) during their time at Caltech.

Milestone	Deadline
Find an advisor	Year 1
Preliminary exam	Year 1
Core Course requirements	Year 1
Breadth and Depth Course requirements	Year 3
Candidacy exam	Year 3
Defend thesis	Year 5 or 6

Table 1: Summary of major milestones in CMS department Ph.D. programs.

Yearly progress letters are an important component of the feedback students receive during their Ph.D. At the end of each year, students receive a progress letter from the Option Representative, summarizing discussions with the advisor and the broader department faculty. These letters provide feedback on students' progress toward the Ph.D. and outline required hurdles and advice for the coming year.

We encourage students to spend a majority of their professional time on campus during their Ph.D. Hallway discussions with other students and faculty are a crucial part of the Ph.D. experience that are lost if students are not physically present.

1 What to expect during year 1

The goal for the first year of the program is to ensure that students get started on research and build a basic core knowledge through coursework. So, during the first year, students focus on three things: (1) finding a research advisor and starting research, (2) completing the core courses, and (3) passing the preliminary exam. Additionally, students are encouraged to apply for relevant fellowship opportunities during their first year. Previous students have been successful with programs such as the NSF, DOE, NDSEG, and Hertz fellowships. Fellowships are prestigious for students and provide flexible support during their time at Caltech.

1.1 Finding an advisor and beginning research

Most students have either matched with a research advisor during the admissions process or have identified a few possible research advisors before arriving at Caltech. In the case where the student has not matched with an advisor before arriving at Caltech, the task for the first year is to attend the group meetings of several possible advisors, speak with their students, take courses on related topics, and (of course) meet with them to discuss possible research projects, etc.

In many cases, such students find a strong match with an advisor during the first or second term, so that they have already begun working on an initial project by the time the third term begins. *All students must identify an advisor by the end of the summer term in their first year.* Note that it is common for students to work with multiple faculty members (or be co-advised) throughout the first year and beyond.

You should make sure to spend time getting to know many of the CMS faculty and students (not just your advisor and lab mates). Do not underestimate the importance of building your intellectual and social cohort with students inside and outside of CMS.

The most important goal for the first year is to build your foundational knowledge through courses and the prelims. You will need to learn a lot and learn it thoroughly. But, we hope that you don't get lost in the coursework – remember courses are a tool for research and so try to find time to read papers and attend talks too! To that end, first-year students are required to sign up for CMS 290abc, which requires attendance of the Keller Colloquium.

The colloquium requirement. The Keller Colloquium in CMS is a seminar series that brings in well-known academic and industry speakers from across CS, ACM, EE, and CDS. Students in the department are required to attend during their first year, and students are strongly encouraged to attend during their entire time at Caltech.

The colloquium is run by students chosen from all the PhD options in the CMS department. For each invited speaker, a student is designated as a host to help arrange a meeting schedule for the speaker during their visit, including both student and faculty meetings. The administrative staff will help with travel and scheduling arrangements. If you would like to serve as a host for invited speakers, please let your faculty advisor know to nominate you.

1.2 Core course requirements

Each option in the department has its own set of core course requirements that students take during their first year (many of the options overlap). Depending on the joint goals set by students with their advisors, students may choose to defer some core courses to the second year or to take courses outside their core during their first year. Students without a background in the areas of the core courses may consider deferrals, and they should consult with the Option Representative about this possibility. Students wishing to get started quickly on research should likely not take courses beyond the required core during the first year given the heavy load of the core courses.

ACM option core courses

The core ACM classes include the list below, plus an application elective course. The application elective course in the first year is selected, with the recommendation of the student's advisor, from among a wide range of courses offered by an outside option within the Institute.

Core classes are primarily offered in the 1st and 2nd quarters. Students select a subset of these classes to take during their first year in consultation with their advisor. A typical load is 3 or 4 courses per term.

Fall ACM core courses:

- ACM/IDS 101a. Methods of Applied Mathematics
- ACM/EE 106a. Introductory Methods of Computational Mathematics
- CMS/ACM/IDS 107a. Linear Analysis with Applications
- CMS/ACM/EE 122. Mathematical Optimization
- CMS/ACM 117. Probability Theory and Computational Mathematics
- MA 108a. Classical Analysis

Winter ACM core courses:

- ACM/IDS 101b. Methods of Applied Mathematics
- ACM/EE 106b. Introductory Methods of Computational Mathematics
- CMS/ACM/IDS 107b. Linear Analysis with Applications
- MA 108b. Classical Analysis

Spring ACM core courses:

- MA 108c. Classical Analysis

CDS option core courses

The core classes consist of five courses, with three offered in the Fall and the remaining two offered in the Winter and Spring. Specifically, the core classes are the following:

- CDS courses: CDS 131, CDS 232, and either CDS 231 or CDS 233.
- ACM courses: CMS/ACM/IDS 107a, and either CMS/ACM/EE 122 or CMS/ACM 117.

Students are expected to take all these courses during their first year. The Fall term focuses on mathematical fundamentals and linear systems, while the Winter and Spring focus on nonlinear dynamics and control, along with advanced concepts in control. Additional courses are recommended depending on interests, e.g., CMS/CS/Ec/EE/IDS 144, and EE/CMS/CNS/CS/IDS 181 in the Winter, and advanced topics courses (e.g., CDS 231, CDS 242, CDS 244, CDS 245) in the Spring. Outside the CMS option, other courses that are often of interest are from the robotics sequence, i.e., ME/CDS 234ab and ME/CDS 235ab. The following is a list of core and recommended courses by term.

Fall CDS core courses:

- CMS/ACM/IDS 107a. Linear Analysis with Applications
- CMS/ACM 117. Probability Theory and Computational Mathematics
- CMS/ACM/EE 122. Mathematical Optimization

Winter CDS core courses:

- CDS 131. Linear Systems Theory
- CDS 232. Nonlinear Dynamics
- For Robotics Students: ME/CDS 234a or ME/CDS 235a

Spring CDS core courses:

- CDS 212. Optimal Control and Reinforcement Learning
- CDS 231. Robust Control Theory
- CDS 233. Nonlinear Control
- CDS 245. Data-driven Control
- For Robotics Students: ME/CDS 234b or ME/CDS 235b

CMS option core courses

The core classes include three ACM-focused courses and three CS-focused courses. The fall term focuses on mathematical fundamentals, and the winter term on computing fundamentals. The spring term is then open for research and topic courses.

Fall CMS core courses

- CMS/ACM/IDS 107a. Linear Analysis with Applications
- CMS/ACM/EE 122. Mathematical Optimization
- CMS/ACM 117. Probability Theory and Computational Mathematics
- CMS/CS/IDS 139. Analysis and Design of Algorithms or CMS/CS/IDS 150a Probability and Algorithms (each offered alternate years)

Winter CMS core courses

- CMS/CS/Ec/EE/IDS 144. Networks: Structure & Economics

- EE/CMS/CNS/CS/IDS 181. Deep Learning

Students come in with widely varying backgrounds. It is not required, or expected, that students complete all six courses during their first year. It is required that students complete at least two courses per term in order to prepare for the preliminary exam.

Students may petition the Option Representative to replace one core course requirement with an alternative ACM, CDS, CS, CMS, or EE graduate-level course. Additionally, CMS 290, a.k.a., attending the Keller Colloquium, is required for all CMS first-year graduate students during each term (fall/winter/spring).

CS option core courses

Students are required to satisfy the following four core course requirements:

1. Theory: One course from among: Analysis and Design of Algorithms (CMS/CS/IDS 139), Probability and Algorithms (CMS/CS/IDS150a), or Complexity Theory (CS151).
2. Networks: One course from among: Networks: Algorithms & Architecture (CS/EE/IDS 143) or Networks: Structure & Economics (CMS/CS/EE/IDS 144).
3. AI/ML: EE/CMS/CNS/CS/IDS 181 Deep Learning
4. Mathematical Foundations: One course from among: Mathematical Optimization (CMS/ACM/EE 122), Linear Analysis with Applications (CMS/ACM/IDS 107a), or Probability Theory and Computational Mathematics (CMS/ACM 117).

Note that these core courses are only the minimal set of courses for the first year. A typical program of study includes 2–3 courses during each of the first two terms. First-year students should especially consider filling out their schedule with relevant courses for their research in the CMS option Fall and Winter Core, as these are taken by a large subset of the first-year cohort.

Learning topics in depth will normally entail a continuation of coursework in CS or allied fields through the first 2–3 years of the graduate program. Students should consult with their advisor about their broader program of study.

1.3 The preliminary exam

The timing and format of the preliminary exam differ across options. However, in all cases, the exam is held during the first year, and passing it is required for continuation in the program.

The format for each option is described below. To get additional information about the exam, including previous exams, students should talk with the Option Representative and Option Administrator. The professors of the core courses can also provide advice and point students to relevant references for their studies. All material covered in the syllabi of the core courses is fair game for the exam. The level of the questions is comparable to that of a homework problem in the courses.

Four types of results to the exam are possible: pass, remediation, (full or partial) retake, or fail. A student with a pass has passed this hurdle of the program and is eligible to form a committee and enter candidacy. A student who receives remediation may be required to meet additional requirements before receiving a pass, such as successfully completing specified coursework or serving as a teaching assistant for a specific course to obtain further background. In some options, students may be allowed to take a full or partial retake if they do not pass the initial exam. It is not unusual for students to have to retake one or more subjects, so students should not be discouraged if that occurs. We do not view prelims as a “pruning” mechanism, and we hope that every student eventually passes the preliminary exam. The retake format varies by option and is described below. In the event of receiving a fail, a student must leave the program; however, they will be allowed to enroll for up to two academic terms in order to complete their core coursework to earn a terminal MS degree.

ACM option preliminary exam format

The ACM preliminary exam consists of 3 written exams, each of 3 hours duration, administered at the end of the summer term of the first year. All first-year students will be contacted during the summer term about scheduling of the exam. The purpose of the exam is to evaluate expertise in the topics included in the fall and winter core courses listed above. To this end, the student, in collaboration with their academic advisor, selects 3 subject areas to be examined. These are selected from the following list: ACM/IDS 101a, ACM/IDS 101b, ACM/EE 106a, ACM/EE 106b, CMS/ACM/IDS 107a, CMS/ACM/IDS 107b, CMS/ACM 117, ACM 118, and CMS/ACM/EE 122.

CDS option preliminary exam format

The CDS preliminary exam will take place during the third term in residence, and all first-year students will be contacted during the second term about scheduling the exam. The purpose of the exam is to evaluate expertise in the topics included in a subset of core courses listed above. The exam consists of modules related to each of the core courses taken in the first two quarters of study. Students will be examined on the two core CDS courses, CDS 131 and CDS 232, along with concepts from CMS/ACM/IDS 107a or CMS/ACM/EE 122.

Two and a half hours are allotted to the exam. During the first 90 minutes, students will be given a written copy of the exam questions, and will have the opportunity to prepare answers; during the final 60 minutes, students will answer the questions orally at the direction of the committee. While preparing answers, students are not allowed to consult references of any kind. All information that students are not expected to know (or be able to derive) will be supplied as part of the question.

CMS and CS options preliminary exam format

The CMS and CS preliminary exams will take place during the third term in residence, and all first-year students will be notified of the exam schedule during the second term. The purpose of the exams is to evaluate expertise in the topics covered by the core course requirements and to ensure that students are prepared to begin research. In each option, the exam consists of written modules related to each of the option core courses at the beginning of the spring term, followed by an oral exam at the end of the spring term.

For the written component of the exam, CMS students select 3 courses on which to be examined, including at least one from the ACM-focused core courses and one from the CS-focused core courses. CS students select one course from each of categories (1)–(3). These choices are made before seeing the exam. The exam modules for the three selected courses each last 3 hours and are administered on separate days. If students pass all three of their selected written exams, they are exempt from the oral component and have passed their preliminary exam.

A student who does not pass all three of the written exams must take an oral exam at the end of the spring term. The oral exam is one hour long and includes: (1) approximately 30 minutes of questions about topics from the courses, with a focus on areas where students had trouble during the written exam, and (2) approximately 30 minutes of discussion focused on the student's research area, during which the student may present an overview of a classic paper in their area or discuss their own ongoing research. The topic for part (2) requires approval of the advisor and the Option Representative. Following this oral exam, the outcome of the preliminary exam is determined by the student's performance on both the written and oral components. Students receive a decision of either pass or fail.

2 What to expect during years 2–3

During the second and third years, students are expected to begin to pursue independent research in earnest. Students are required to have determined a primary advisor before the start of the fall term of their second year.

Students typically complete all course requirements (core, breadth, and depth) in their second year, and these requirements must be completed before the end of the third year. The breadth and depth requirements are option-specific and are described below. Upon completion of all course requirements, students may petition their Option Representative in order to receive an MS degree. Specific requirements for the MS degree in each option are listed in the catalog.

Beyond courses, the other hurdle during this period is the candidacy exam, which must be completed before the end of the third year in order to maintain good standing.

This period is also when students are encouraged to take on teaching responsibilities in order to develop their communication skills, further their understanding of the material, and gain experience with all the aspects that go into running a course. Beyond serving as teaching assistants, students are also encouraged to participate in programs organized by the Center for Teaching, Learning, and Outreach (CTLO), which organizes courses, workshops, and lectures focused on all aspects of teaching.

There are a number of external fellowship opportunities that students can apply for during this period, including fellowships from companies such as Adobe, Apple, Google, IBM, Jane Street, Microsoft, Schmidt Futures, Simons, etc. Students should consult with their advisor to find out about relevant opportunities.

2.1 Breadth and depth course requirements

Breadth and depth course requirements should be completed before the end of the third year to ensure the students enter candidacy at that point. The requirements vary across options but are designed to be flexible, allowing students to focus on courses relevant to their research interests. Note, while students may take any course at Caltech they are interested in, only research-relevant courses may be used to fulfill the option requirements.

ACM option breadth and depth requirements

In the second and third years, students are expected to take additional graduate-level courses appropriate to their chosen research area beyond the core requirements. In total, students are required to take 12 graduate courses of 9+ units each. The courses ACM/IDS 104, ACM/EE/IDS 116, IDS/ACM/CS 157, IDS/ACM/CS 158, ACM 190, and CMS 290 do not count toward the Ph.D. requirements. The 12 classes must include no fewer than 3 from the core set (ACM/IDS 101ab, ACM/EE 106ab, CMS/ACM/IDS 107a, CMS/ACM 117, ACM 118, CMS/ACM/EE 122); no fewer than 6 from the the core set together with any other ACM 100+ classes; and no fewer than 9 from the previous sets together with any 100+ level classes in EE/CMS/CS/Math. All classes must be taken for grades. The remaining classes will be selected among all level 100+ classes from any option. Three of the core classes are selected by the student, in consultation with their advisor, as the subject matter considered for the preliminary examination. This written exam is administered shortly before the start of the beginning of the second year of study, typically during the month of September (see below). In addition, CMS 290 is required for all first year ACM graduate students during each term (fall/winter/spring).

CDS option breadth and depth requirements

The courses taken during the 2nd and 3rd years are meant to provide both depth into the student's proposed research area and breadth across CDS-related areas. Both of these requirements are extremely flexible. Students must complete 36 units in CDS or other advanced courses in systems theory, dynamical systems, robotics, and/or applied mathematics (outside of the core CDS classes CDS 131, 232, or 233). Examples in CDS include CDS 241, CDS 242, CDS 243 and CDS 244, and examples in ACM/CDS/CMS include CMS 117, CMS 144 and CMS 155. Additionally, students must complete 27 units in a particular area outside of CDS. Courses taken must represent a coherent program of advanced study in a chosen field. Examples include courses in Robotics and Autonomy (ME/CDS/EE 234ab and 235ab) or the course sequence in flight control (Ae 103abc). The plan for both depth and breadth courses should be discussed and approved by the student's advisor and the Option Representative.

CMS option breadth and depth requirements

The courses taken during the 2nd and 3rd years are meant to provide both depth into students' proposed research areas and breadth across CMS-related areas. Both of these requirements are extremely flexible. For the breadth requirement, students must complete 27 units of 100+ level courses in Engineering, Science, Mathematics, or Economics. These can be almost anything and are meant to provide expertise in topics beyond the core research focus. For the depth requirement, students must complete 27 units of courses within one particular subject area. The plan for these 27 units should be discussed and approved by the student's advisor and the Option Representative.

CS option breadth and depth requirements

The courses taken during the 2nd and 3rd years are meant to provide both depth into their proposed research area and breadth across CMS-related areas. Depth is provided by the completion of the 54 units of CS graduate-level courses, and breadth is provided by 27 units of courses outside of computer science. The plan for these 27 units should be discussed and approved by the student's advisor and the Option Representative.

2.2 The candidacy exam

All students must pass a candidacy oral examination administered by a committee comprising at least four faculty members and approved by the Option Representative. The committee may not be chaired by the student's research advisor. The committee must include at least three Caltech faculty and at least two faculty from the CMS department. The committee members' expertise should enable them to evaluate the student's research direction and its contributions effectively. The Option Representative has final discretion over the appropriateness of a committee.

The examination will ascertain the student's breadth and depth of preparation for research in the chosen area. To pass the exam, a student must demonstrate the ability to pursue independent research in their area and present a promising research agenda. Students are required to complete the candidacy examination by the end of their third academic year at Caltech. A student who fails to satisfy the requirements of the Division for candidacy by the end of the third term of the third year in residence must obtain special permission from the Division to continue in the program. In the event that students have not completed their candidacy exam by the end of their third year, students must form a candidacy committee before starting the fourth year.

The procedures for scheduling and taking the exam are as follows.

- Select a tentative date and an examining committee of at least four members, subject to the constraints described above. The committee is determined by the candidate and their research advisor and must be approved by the Option Representative before the exam is scheduled. When scheduling the exam, check with the department option administrator to avoid conflicts. The exam should be scheduled for a 2-hour period.
- Go to the Graduate Degree Progress in REGIS and select the Ph.D. Candidacy Tab. Complete your Plan of Study. If you choose to pursue a minor, please see department option administrator.
- It is strongly suggested that students meet individually with all committee members prior to the exam to provide an overview of their research and receive feedback and advice. Committee members can request additional information prior to the candidacy exam. Commonly requested information includes the student's prior research and future research plans. In some cases, the committee can request a 2–3 page research progress report; such a report should concisely state your progress to date, your proposed research topic, and the nature of the contribution that you expect to make in the general problem area. Confirm with your committee's requirements at least 1 month before your candidacy date.

- The oral examination will consist of a 50-minute presentation followed by a closed-door examination of the candidate by the committee. The student and their advisor may choose whether the oral examination is public or limited to the committee. The presentation should include an overview of the general research area, a description of (at least) one original successful research project, and a proposed research direction. The examination is a crucial test of communication skills, and students are evaluated on both the research details and the communication of the work.
- Upon successful completion of the candidacy examination, the members of the examining committee will approve it in the Graduate Degree Progress system. The student will be notified later by the Dean of Graduate Studies that they have been admitted to candidacy for the Degree of Doctor of Philosophy.

If the candidacy exam is not completed satisfactorily, the committee may either allow the student to retake the candidacy exam or deny the student admission to candidacy. If the student is denied admission to candidacy, they may graduate with an MS upon completion of their course requirements. If the student is offered the opportunity to retake the candidacy exam, the membership of the candidacy committee will remain unchanged, except in rare cases, when a change is approved by the Option Representative in consultation with the committee members and the advisor.

CDS-specific candidacy requirements

The CDS program has a few additional requirements for the candidacy exam beyond what is listed above. First, the committee must include at least one core CDS faculty beyond the student's advisor. Second, the oral exam is required to be a committee-only non-public presentation. Finally, a research progress report must be submitted to the committee two weeks before the candidacy exam. The report is to be based upon the Ph.D. research project and is expected to exhibit a professional quality of exposition. As a guide, the report should outline the research problem, the progress of the student at the time of writing, and the areas proposed for future study. It is also important that the report provide clear evidence of the student's understanding of the motivation for the research problem and its relevance to the general research area, as well as an appreciation of relevant techniques and methodology. The student should strive for a precise and concise format. Normally, the text itself should not exceed 20 pages, and shorter reports are acceptable if they accurately capture the research problem, progress, and proposed future directions.

3 What to expect during years 4–6

This period represents the final leg of the Ph.D. A student focuses on executing the research agenda presented during their candidacy in order to prepare and defend their thesis. Students are also encouraged to engage in teaching during this period through serving as teaching assistants and potentially helping to design topic courses.

After candidacy, students should immediately form a thesis committee (possibly the same as the candidacy committee) consisting of at least four faculty members. The committee must include at least three Caltech faculty and at least two faculty from the CMS department. (In CDS, at least two must be core CDS faculty.) The chair of the committee must be distinct from the advisor. If no thesis committee has been explicitly formed yet, the candidacy committee will serve in that role *de facto* for any issues that arise. Students are encouraged to meet with their thesis committee regularly (e.g., once per term) to discuss their research and get advice on career planning. At a minimum, students should meet with their committee members yearly.

It is typical for the time between the candidacy exam and the thesis defense to be approximately two years. In some cases, it may be shorter if the candidacy was delayed or the post-candidacy research proceeded more quickly than usual. However, there must be at least one full term between the candidacy exam and the thesis defense, e.g., if the candidacy exam is held in the fall term, the defense may not be held earlier than the spring term.

Students typically complete the program in about 5–6 years, with some variation depending on the scope and direction of the dissertation work. Graduation in fewer than four years is rare and requires clear evidence of extraordinary contribution and impact. Students who take longer than six years must communicate a clear timeline for completion with their advisor and Option Representative, and they must demonstrate consistent progress toward that timeline.

3.1 The thesis defense

Caltech policies for submitting a thesis and scheduling a thesis defense are maintained on the [Degree Requirements](#) page of the Graduate Office’s website. Here, we summarize CMS department-specific policies and advice that apply on top of the Institute requirements:

- Students are encouraged to schedule their defense date one term in advance in order to avoid conflicts and ensure faculty are available. Students should schedule two hours for the thesis defense.
- Before scheduling a date for the defense, students must receive agreement to hold the defense from all committee members. If there is disagreement among committee members, the Option Representative will mediate or appoint another faculty member as mediator.
- The student must provide their committee with a draft of the thesis at least 14 days prior to the thesis defense. If this deadline is not met, the thesis defense must be rescheduled.
- Students are encouraged to use Caltech proofreading services for their dissertations. This process requires a three-week lead time, and students should plan accordingly.
- The thesis defense consists of a one-hour public lecture followed by a closed-door examination of the candidate by the committee. All committee members must be present, either in person or virtually, for the thesis defense lecture and closed-door examination.
- In the event that the committee requires the student to redo their thesis defense, the committee should remain unchanged. The Option Representative may, on rare occasions, approve changes with input from the advisor and committee members.

Note that the department offers several dissertation awards, with nomination calls during the spring term. Students are encouraged to discuss with their advisors which awards may be best suited to their work.

4 Policies & procedures

4.1 Progress letters

All students will receive annual “Progress Letters” during the summer term. These letters are an important source of feedback and advice for students (and their advisors), especially in the later years of the PhD program when the course and prelim exam requirements have already been satisfied.

To prepare these letters, during the spring term, students are asked to provide information on their accomplishments over the previous year. The advisor then provides additional feedback on the student’s progression. Additionally, the Option Representatives discuss each student individually, considering progress and performance in courses and research and reaching out to faculty for further information as needed.

Using this information, the Option Representative composes a letter to the student to provide feedback on their performance and offer advice for the coming year. If a student is not progressing as expected, the progress letter will include requirements to complete (with a timeline) for the student to maintain good standing.

4.2 Internships, Personal Leave, and Detached Duty

There are a number of reasons why students may need to take leave for a term (or more) during their Ph.D. The most common of these is due to an internship. To take leave, students must request and receive permission from the Dean of Graduate Studies by submitting a petition (available on the Graduate Studies Office website). There are specific petitions for different types of leave, e.g., internship, personal, or medical leave.

An important factor to be aware of is that students must be in residence for at least 12 terms in order to be eligible to graduate. Note that if you are doing thesis work in collaboration with a company or another university, you may apply for detached duty in which case you remain a full-time student and remain eligible for Caltech health care benefits.

4.3 Switching options

Students are encouraged to discuss their academic option carefully with their potential advisors during the admission process in order to ensure they are admitted to the option that is the best fit for their background and research goals. If a student realizes they would like to switch options between the point of admission and the beginning of the fall term of their first year, they may petition the Option Representative to switch. Acceptance of the switch is not guaranteed and requires an assessment of the student's background to ensure they are prepared to succeed in the core courses and the preliminary exam for the new option. The Option Representative will deny the switch if there is uncertainty about the student's preparation or about the appropriateness of the option to the student's research plans.

After the beginning of the fall term of the first year, switching options within the CMS department is discouraged. Differences between course requirements and preliminary exam coverage mean that the fall term course load already differs significantly across options. However, students may petition the Option Representative to change their option in exceptional cases. The petition should outline the reasons for the change and demonstrate the student's preparation for the requirements of the new option. The Option Representative will generally require an application folder similar to that of a new applicant to Caltech.

Students from outside of the CMS department are rarely allowed to switch into a Ph.D. option within the CMS department. A student seeking such a switch must demonstrate exceptional circumstances and clear preparation for the core courses and preliminary exam, typically by already taking, and succeeding in, a subset of the classes. Again, the Option Representative will generally require an application folder similar to that of a new applicant to Caltech.

4.4 Switching advisors

Students are required to identify a research advisor by the end of their first year. If they later wish to switch advisors or add a co-advisor, the student must fill out the "Change of Advisor Request" form from the Graduate Studies Office. This form requires discussion with and approval from both the new advisor and the Option Representative. When determining whether to approve the switch, the Option Representative should discuss the case with the student's current advisor and the requested new advisor.

In the rare event that a student wishes to disengage from their current research advisor but has not yet found another research advisor, the Option Representative must be petitioned and approve a plan for the student to remain in the program for a limited period of time. Students cannot remain in the program without a research advisor for longer than one term without the Option Representative's approval. Such approval is only granted in exceptional cases.

4.5 Unsatisfactory Academic Progress

The department strives to ensure all admitted students can graduate successfully; however, a small number of graduate students in the CMS department fail to make satisfactory academic progress, and some

of these cases end in termination from the graduate program. Students making unsatisfactory progress are cautioned prior to termination through at least one of the following: yearly progress letters, research unit grades, or meetings with the advisor. The following summarizes expectations for departmental best practices for these cases, and it should be interpreted subject to the Institute policies and procedures of the Graduate Studies Office, the Division, and the Dean of Graduate Studies:

- If the advisor believes that a student is not making sufficient progress, they should be open with the student about their observations and expectations. The advisor should meet with the student to discuss the fact that satisfactory academic progress is not being made, what improvements should be made, and provide expectations for future progress. The advisor should outline a timeline for improvement and the student should receive a written notice identifying the concerns, the expected improvements, and the timeline for improvement, and the possible consequences.
- If a student's progress has clearly not met academic expectations in research work, the advisor should consider documenting this deficiency with an "F" for the research course and in the yearly progress letter to the student. Note that a grade of "E" (Extension) grade can be given in cases where there is some correctable action and an agreed-upon timeline for meeting this expectation. If the student has not shown up to work due to sickness or other emergencies, an "I" (Incomplete) is appropriate. An "I" can be given when approved by the Graduate Studies Office.
- The Option Representative should be involved once the advisor believes that it is a possibility that the student will not complete a Ph.D. under their supervision. The Option Representative should be provided with a background on the student's record and communications with the student. If termination is a strong possibility, the Graduate Studies Office should be informed before any termination decision is made, and it will offer guidance about the process.
- If a student's progress is identified as unsatisfactory, it is best practice to allow the student time (typically at least one term), to substantially improve or seek alternative future plans before termination. The advisor remains financially responsible for the student during this transition period. If an advisor has financial constraints, they may contact the Executive Officer and/or Graduate Studies Office to query about the potential to borrow funds.
- Final decisions about termination from the Ph.D. program are made by the Option Representative, in consultation with the advisor, the Executive Officer, and the student's candidacy committee or thesis advising committee (when one has been formed). Termination by an advisor does not necessarily mean termination from the Ph.D. program, as the student may be able to obtain a commitment of support from another faculty advisor. An advisor may decide that they are no longer able to supervise or financially support a student, but this decision is distinct from termination from the Ph.D. program, which requires review by the Option Representative in consultation with the appropriate faculty and administrative offices. If termination from the Ph.D. program is determined to be the course of action, the Option Representative will communicate this to the Graduate Studies Office, which will follow up with an official termination letter summarizing the last date of enrollment and financial support.
- If a student is terminated from the Ph.D. program, a terminal MS degree can sometimes be conferred, depending on meeting the minimum Institute requirements of three terms of residency, 135 units of graduate-level courses (including research), and any additional Option requirements. Conferral of the M.S. degree must be approved by the Option Representative. If a student needs to meet additional course requirements, the Option Representative may allow the student to enroll as an M.S. student for up to two terms to complete those.

A Appendix

A.1 Acronyms

- ACM – Applied and Computational Mathematics option
- CAST – Center for Autonomous Systems and Technologies
- CDS – Control and Dynamical Systems option
- CMI – Center for Mathematics of Information
- CMS – Computing and Mathematical Sciences is both a department and an option
- CMX – Computational Math + X research group
- CNS – Computation and Neural Systems option
- DOLCIT – Center for Decision, Optimization, and Learning at the California Institute of Technology
- IQIM – Institute for Quantum Information and Matter
- IST – Information Sciences and Technology research initiative
- FALCON - Foundations of Algorithms, Learning, Control, and Optimization for Networks
- MPP – The Molecular Programming Project
- RSRG – Rigorous Systems Research Group
- CSIS – Center for Social Information Sciences (previously SISL)

A.2 Mailing lists and points of contact

Email Minzhi Zhou (minzhi@caltech.edu) to get added to these lists. She'll either add you or point you to the right place. You should be automatically on the appropriate building/student lists, but likely will need to email to get placed on the research group lists.

Building Lists:

- annenberg@caltech.edu
- steele-house@caltech.edu

Graduate Students:

- All grads across options: cms-grads@caltech.edu
- Women graduate students: gradcmswomen@caltech.edu

Departmental seminars:

- General CMS Seminars & Events: cms-seminars@caltech.edu
- IST Seminars: ist-seminars@caltech.edu
- Weekly CMS Event Digest: cms-thisweek@caltech.edu

Research groups:

- RSRG: rsrg@caltech.edu
- DOLCIT: dolcit@caltech.edu
- CMX: cmx@caltech.edu
- CSIS: csis@caltech.edu
- CDS: cds-all@caltech.edu (for anyone with interest in CDS)
- CS Theory: theory-list@caltech.edu

Who to ask for what

- Administrative questions: Maria Lopez, mlopez@cms.caltech.edu
- Office/Building related issues: Roberta Carvalho, robertac@caltech.edu