

CS 学生手册

计算机科学是一个动态的，多用途的领域，充满了开放的问题和创新发明的机会。计算机科学不仅涉及工具和技术。无论是昆虫，基本粒子，市场中的理性因素，还是大脑中的神经元，计算视角都被证明是理解自然，社会和工程系统的极其有效的方式。相应地，计算机科学专业不仅与工程学密切相关，而且与经济学，法学，生物学，物理学，统计学，数学等也有着紧密的联系。

Computer science is a dynamic, versatile field, full of open problems and opportunities for creative invention. Computer science is not just about tools and technology. Whether it is swarms of insects, elementary particles, rational agents in a market, or the neurons in the brain, the computational viewpoint has proven an extremely fruitful way to understand natural, social, and engineered systems. Correspondingly, the Computer Science concentration has strong ties not just to engineering, but also economics, law, biology, physics, statistics, mathematics, and more.

计算机科学方向的目的是向学生传授他们：1）能够立即使用的技能；2）在将来，会以目前无法想象的方式，得以利用的思想。由于信息技术影响着社会的方方面面，因此拥有计算机科学学位的毕业生可以选择各种各样的职业，包括工程，教学，医学，法律，基础科学，娱乐，管理等。

The concentration in Computer Science is designed to teach students skills they will use immediately and ideas they will exploit in the future in ways unimaginable today. Because information technology affects every aspect of society, graduates with computer science degrees have open to them an enormous variety of careers—engineering, teaching, medicine, law, basic science, entertainment, management, and countless others.

计算机科学方向的学习目标如下。我们的毕业生应该能够：

The Computer Science concentration has the following learning objectives. Our graduates should be able to:

设计和编码正确的问题解决方案。（田发伟老师）

Design and code correct solutions to problems.

设计一个系统，在性能，可用性，健壮性，安全性和耐用性等维度上进行权衡。（田发伟老师）

Design a system, identifying trade-offs on dimensions such as performance,

usability, robustness, security, and durability.

设计解决问题的算法，考虑算法的正确性，规范，时间复杂度。（李志老师）

Design an algorithm to solve a problem. Reason about the algorithm's properties—correctness, specifications, time complexity.

从问题的非正式自然语言描述开始，给出形式化的问题描述，模型分析系统行为，进行相关的理论证明。（魏林老师）

Starting from an informal, English language description of a problem, give a fully formal description of it, and prove something about the behavior of the system.

从网络信源中获得大规模数据集，据此进行推断，并将结论以视觉和语言方式，有效地传达给其他人。（陈一帅老师）

Compose a large data set from networked sources, draw some inferences about it, and convey those conclusions effectively to others visually and verbally.

能够向新手解释，从硬件到用户可见的应用程序，计算机的工作方式。（超洪老师）

Be able to explain to a novice about how computers work, from the hardware to a user-visible application.

说明为特定领域设计的解决方案，如何应用于另一个域。（田发伟老师）

Explain how a solution designed for a specific domain can be applied to another domain.

向使用一个系统的社会外界，解释系统设计的各种方案的适用性。（魏林老师）

Explain the appropriateness of alternative system designs to the social context in which the system would be used.

遇到一个已提出的、拟解决一个问题的技术解决方案时，能够提出一系列问题，考察该方案的可靠性。（魏林老师）

When presented with a technical solution to a problem, formulate a set of questions that probe the solution for its soundness.

进行一项“实验”，以研究学习一种算法或系统，最好是别人设计的算法或系统。（李志老师）

Conduct an “experiment” to study an algorithm or system, ideally one designed by someone else.

独立、高效、快速地接受、理解并使用一个新环境（语言，API，操作系统，模拟器等）（罗明杨老师）

Pick up and work with new environments (languages, APIs, OS-es, simulators, etc.) independently and efficiently.

听完一个 CS 讲座后，客观地分析和批判工作。（张鑫老师）

After listening to a CS colloquium talk, objectively analyze and critique the work.

将计算方法应用于自然科学，社会科学和人文科学。（张鑫老师）

Apply computational approaches in the natural sciences, the social sciences, and the humanities.

将大问题分解为可管理的，相互关联的任务的集合。（魏林老师）

Decompose a large problem into a collection of manageable, interrelated tasks.

In addition to these technical objectives, we identified five softer objectives. We hope our graduates will be able to:

除了这些技术目标，我们还确定了五个较软的目标。我们希望我们的毕业生能够：

Present ideas clearly and forcefully, both orally and in writing.

以口头和书面形式，清晰，有力地表达想法。（欧阳老师）

Solve problems cooperatively and in an ethically principled way.

以合乎道德的原则，合作解决问题。（欧阳老师）

Apply their strengths to areas of known weakness and discomfort.

将自己的优势运用到实际中，解决社会上的不公、脆弱、和让人不舒服的地方。（欧阳老师）

Work productively, responsibly, and effectively within a group.

在小组内高效，负责任和有效地工作。（田发伟老师）

Adapt to changes in the technological landscape.

适应技术格局的变化。（陈一帅老师）

REQUIREMENTS

要求

The number of credits required for each degree depends on the student's mathematics placement. The ranges given here depend on whether the student

starts mathematics at the Mathematics 1a, Mathematics 1b, or Mathematics 21a level. (With good planning it is also possible to earn a Computer Science degree starting with Mathematics Ma.) For example, a basic concentration requires 48 credits (12 courses), of which Mathematics 1a and/or Mathematics 1b can be waived, depending on placement, to reduce the number to 44 or 40 credits (11 or 10 courses).

计算机学位所需的学分取决于学生的数学基础。此处给出的范围取决于学生是否从数学 1a, 数学 1b 或数学 21a 级别开始学习。(通过良好的计划, 还可以从 Ma Mathematics Ma 开始获得计算机科学学位。)例如, 基础集中课程需要 48 个学分(12 个课程), 其中数学 1a 和/或数学 1b 可以免学。根据学生情况, 可以将数量减少到 44 或 40 个学分(11 或 10 个课程)。

In all of the requirements below, a student may replace a course with another course covering the same material at a more advanced level. For example, Mathematics 21b can be replaced with Mathematics 25a. For information on which courses are considered acceptable replacement, see our website or ask the Director of Undergraduate Studies.

在下面的所有要求中, 学生可以用另一门涵盖相同材料的高级课程替换一门课程。例如, 数学 21b 可以被数学 25a 代替。有关可以替代哪些课程的信息, 请访问我们的网站或咨询本科研究主任。

No student may reduce concentration requirements by omitting any other course other than Mathematics 1a or Mathematics 1b: any other required course not taken must be replaced by a similar course at a more advanced level.

除了数学 1a 或数学 1b 以外, 任何学生都不能跳过其他任何课程: 任何其他未修过的必修课程都必须由更高水平的类似课程代替。

The four concentration options share the following common requirement structure.

四个专业方向具有以下共同的要求结构。

Basic mathematics 基础数学(张纯老师)

Basic software 基本软件(魏林老师)

Theory 理论(李志老师)

Technical electives (including the breadth requirement) 技术选修课(包括广度要求)(陈一帅老师)

英语（李老师，Elsie）

Basic Requirements: 10-12 courses (40-48 credits)

基本要求：10-12 门课程（40-48 学分）

Required courses:

必修课程：

Basic Mathematics (2-4 courses):

基础数学（2-4 门课程）：

Mathematics 1a and Mathematics 1b, if needed as preparation.

数学 1a 和数学 1b（如果需要的话，作为准备）。

Linear algebra: Any one of Mathematics 21b, Applied Mathematics 22a, Applied Mathematics 21b, Mathematics 22b, Mathematics 23a, Mathematics 25a, or Mathematics 55a, or a more advanced linear algebra course.

线性代数：数学 21b，应用数学 22a，应用数学 21b，数学 22b，数学 23a，数学 25a 或数学 55a 中的任何一种，或更高级的线性代数课程。

Probability/statistics or Multivariable calculus: One of the following. Either Statistics 110 or a more advanced probability or statistics course, or one of Mathematics 21a, Applied Mathematics 22b, Applied Mathematics 21a, Mathematics 22a, Mathematics 23b, Mathematics 23c, Mathematics 25b, Mathematics 55b, or a more advanced multivariable calculus or analysis course.

概率/统计或多变量微积分：以下之一：统计 110 或更高级的概率或统计课程，或数学 21a，应用数学 22b，应用数学 21a，数学 22a，数学 23b，数学 23c，数学 25b，数学 55b 之一，或更高级的多变量微积分或分析课程。

Students that take all three of a linear algebra course, multivariate calculus course and probability/statistics course can count the probability/statistics course as a technical elective (see below).

修完线性代数课程，多元微积分课程和概率/统计课程的全部三个课程的学生可以将概率/统计课程算作技术选修课（见下文）。

Basic Software (2 courses): Two out of the following three courses: Computer Science 50, Computer Science 51, and Computer Science 61. Students who take all three courses may count one of Computer Science 51 or Computer Science 61 as a technical elective (see below).

基本软件（两门课程）：以下三门课程中的两门：计算机科学 50，计算机科学 51 和计算机科学 61。参加全部三门课程的学生可以将计算机科学 51 或计算机科学 61 中的一门视

为技术选修课（见下文）。（魏林老师）

Theory (2 courses): Computer Science 121, plus any one additional theory course, including Computer Science courses numbered in the 120s and 220s, and Applied Mathematics 107. The recommended way to satisfy the theory requirement is to take both Computer Science 121 and Computer Science 124.

理论（2门课程）：计算机科学 121，以及任何一门附加的理论课程，包括编号为 120 和 220 的计算机科学课程和应用数学 107。满足理论要求的推荐方法是同时修读计算机科学 121 和计算机科学科学 124。（陈一帅老师）

Technical Electives (4 courses): Courses may be drawn from the following list:
技术选修课（4门课程）：这些课程可能来自以下列表：

Computer Science courses numbered greater than 50 (including 91r). A student who takes all three of Computer Science 50, Computer Science 51, and Computer Science 61 may count either Computer Science 51 or Computer Science 61 as a technical elective.

计算机科学课程的编号大于 50（包括 91r）。选修计算机科学 50，计算机科学 51 和计算机科学 61 的全部三个的学生可以将计算机科学 51 或计算机科学 61 视为技术选修课。

Statistics 110 and 195; Computer Science 20; Mathematics 154; Applied Mathematics 106, 107, 120, and 121; at most one of Engineering Sciences 50, 52, or 54; Engineering Sciences 153 or Physics 123; Engineering Sciences 170 and 256; Applied Computation 221.

统计数据 110 和 195；计算机科学 20；数学 154；应用数学 106、107、120 和 121；最多为工程科学 50、52 或 54 之一；工程科学 153 或物理 123；工程科学 170 和 256；应用计算 221。（陈一帅老师）

Many—but not all—MIT “Course 6” courses can be used as technical electives. Consult the DUS before enrolling.

麻省理工学院的“Course 6”课程中有很多（但不是全部）课程可以用作技术选修课。注册前请咨询 DUS。

Breadth Requirement: In order to ensure breadth in the program two of the four technical electives must be Computer Science courses from different course groupings from the following lists, as identified by the penultimate digit of the course number:

广度要求：为了确保程序的广度，四个技术选修课中的两个必须是以下列表中不同课程组的计算机科学课程，并由课程编号的倒数第二位标识：

Computer Science courses with penultimate digit 0, 1, 2, and 9 are valid

technical electives if not used to satisfy other concentration requirements, but do not contribute to the breadth requirement

如果倒数第二位数字为 0、1、2 和 9 的计算机科学课程不满足其他集中要求，但又不满足广度要求，则它们是有效的技术选修课

3: Economics and Computation (any course of the form CS13x or CS23x)

3: 经济学和计算 (CS13x 或 CS23x 形式的任何课程) (长江商学院老师)

4: Hardware and Networks (any course of the form CS14x or of the form CS24x. Physics 123 and Engineering Sciences 153 count in this group as well).

4: 硬件和网络 (CS14x 形式或 CS24x 形式的任何课程。物理 123 和工程科学 153 也在该组中)。(超洪老师)

5: Programming Languages (CS51 if counted as a technical elective, or any other course of the form CS15x or CS25x).

5: 编程语言 (如果将 CS51 视为技术选修课，或采用 CS15x 或 CS25x 形式的任何其他课程)。(魏林老师)

6: Systems (CS61 if counted as a technical elective, or any other course of the form CS16x or CS26x)

6: 系统 (如果将 CS61 视为技术选修课，或采用 CS16x 或 CS26x 形式的任何其他课程) (超洪老师)

7: Graphics, Visualization, and User Interfaces (any course of the form CS17x or CS27x).

8: Artificial Intelligence (any course of the form CS18x or CS28x).

7: 图形，可视化和用户界面 (格式为 CS17x 或 CS27x 的任何课程)。(罗明杨老师)

8: 人工智能 (格式为 CS18x 或 CS28x 的任何课程)。(陈一帅老师)

Tutorial: Optional. Available as Computer Science 91r. This course is repeatable, but may be taken at most twice for academic credit, and only one semester of Computer Science 91r may be counted toward concentration requirements. Students wishing to enroll in Computer Science 91r must file a project proposal to be signed by the student and the faculty supervisor and approved by the Director of Undergraduate Studies. The project proposal form can be found on the Computer Science website.

教程：可选。可作为计算机科学 91r 获得。该课程是可重复的，但最多可修两次以取得学分，并且只有一学期的计算机科学 91r 可计入集中度要求。希望报名参加计算机科学 91r

的学生必须提交项目建议书，该建议书应由学生和教职主管签署，并由本科研究主任批准。该项目建议表可以在计算机科学网站上找到。

Thesis: None.

论文：没有。

General Examination: None

普通考试：无

Other Information:

Other Information:

Approved courses: With the approval of the Director of Undergraduate Studies, courses other than those listed above may be used to satisfy requirements. If a course is cross-listed with another department it meets the same requirements for the concentration as the Computer Science numbered course. To satisfy any of the requirements 1.1, 1.2, or 1.3, a substituted course must be in the same area of mathematics or computer science but more advanced than the stipulated course. Students must secure advance approval for course substitutions by filing a Plan of Study to be approved by the Director of Undergraduate Studies. The Plan of Study form and a description of the process to submit the form can be found on the Computer Science website.

批准的课程：经本科课程主任批准，可以使用上述课程以外的其他课程来满足要求。如果某门课程与另一部门交叉列出，则其满足的集中度要求与计算机科学编号的课程相同。为了满足 1.1、1.2 或 1.3 中的任何要求，替代课程必须在数学或计算机科学的同一领域，但比规定的课程更高级。学生必须提交由本科学习主任批准的学习计划，以获得课程替代的事先批准。学习计划表格和提交表格的过程说明可以在计算机科学网站上找到。

Pass/Fail and Sat/Unsat: None of the courses used to satisfy concentration requirements may be taken Pass/Fail. Computer Science 50 will count for concentration credit if it is taken for a grade of SAT.

通过/失败和满足/未满足：满足任何课程均不得以通过/失败评分。如果参加 SAT 考试，则计算机科学 50 将计入集中学分。

Credit for prior work: Except for Math lab, there is no reduction in concentration requirements for prior work. As noted in 1.2 above, students who skip CS50 must take both CS51 and CS61. Rarely, students wish, on the basis of prior experience, to skip CS51 or CS61 or courses such as Math 21a or Math 21b. They may be allowed to do so, with the prior approval of the Director of Undergraduate Studies, if they substitute a more advanced course of the same

kind: for example, CS152 in place of CS51, CS161 in place of CS61, Math 112 or Applied Math 105 in place of Math 21a, and Math 121 or Applied Math 120 in place of Math 21b.

对先前工作的认可：除了数学 1ab 之外，对先前工作的集中要求没有降低。如上文 1.2 所述，跳过 CS50 的学生必须同时参加 CS51 和 CS61。很少有学生根据以往的经验，希望跳过 CS51 或 CS61 或 Math 21a 或 Math 21b 等课程。如果他们替代了同一类型的更高级课程，则可以在本科学习主任的事先批准下允许他们这样做：例如，用 CS152 代替 CS51，CS161 代替 CS61，Math 112 或 Applied 用数学 105 代替数学 21a，用数学 121 或应用数学 120 代替数学 21b。

Plans of study: Concentrators must file a Plan of Study showing how they intend to satisfy these degree requirements, and keep their plan of study up to date until their program is complete. If the plan is acceptable, the student will be notified that it has been approved. To petition for an exception to any rule, the student should file a new plan of study and notify the Director of Undergraduate Studies of the rationale for any exceptional conditions. Approval of a plan of study is the student's guarantee that a given set of courses will satisfy degree requirements. The Plan of Study form and a description of the process to submit the form can be found on the Computer Science website.

学习计划：学生必须提交学习计划，以表明他们打算如何满足这些学位要求，并保持其学习计划最新，直到课程完成。如果该计划可以接受，则将通知学生该计划已被批准。要请求任何规则的例外，学生应提出新的学习计划，并在任何特殊情况下将其基本原理告知本科研究主任。批准学习计划是学生保证给定课程将满足学位要求的保证。学习计划表格和提交表格的过程说明可以在计算机科学网站上找到。

双学位

Joint concentrations with certain other fields are possible. This option is intended for students who have interests in the intersection of two fields, not simply in the two fields independently; for example, a combined concentration in computer science and linguistics might be appropriate for a student with a special interest in computational linguistics. Course requirements are the same as for the Requirements for Honors Eligibility, except that only three technical electives are required. These three technical electives must satisfy the breadth requirement as stated in Breadth Requirement, with the further provision that one semester of Computer Science 91r may be used to satisfy the breadth requirement for joint concentrations.

Such courses may also be double-counted towards the requirements of the other field. Joint concentrations are not “double majors.” Joint concentrators should be interested in the overlap between two fields, not simply in both. A thesis in the intersection of the fields is required for joint concentrators, read by both concentrations. The student is typically awarded the minimum honors recommended by the two concentrations separately. These requirements, including the thesis requirement, are the same whether Computer Science is the primary field or the allied field of the joint concentration. Students interested in combined programs should consult the Director of Undergraduate Studies at an early date and should work carefully with both concentrations to ensure all deadlines and requirements of both concentrations are met. Students with separate interests in more than one field should consider a secondary rather than a joint concentration, or simply using some of their electives to study one of the fields. We advise all our joint concentrators to make sure that they satisfy the non-joint requirements for at least one concentration, in case they are unable to complete a thesis.

与某些其他领域的联合学位也是可能的。此选项适用于对两个领域的交集感兴趣的学生，而不仅仅是对两个领域的兴趣；例如，计算机科学和语言学相结合的学位精力可能适合对计算语言学特别感兴趣的学生。课程要求与“荣誉资格要求”相同，只是只需要三个技术选修课。这三种技术选修课必须满足广度要求中所述的广度要求，并进一步规定计算机科学 91r 的一个学期可以用于满足联合学位度的广度要求。这些课程也可以根据其他领域的要求进行重复计算。联合学位不是“双主修”。联合学位人应该对两个领域之间的重叠感兴趣，而不仅仅是对这两个领域感兴趣。对于联合学位器，需要在领域的交集上通过两个学位读取论文。通常会分别向学生授予两种浓度推荐的最低荣誉。这些要求，包括论文要求，无论计算机科学是联合学位的基础领域还是联合领域，都是相同的。对合并课程感兴趣的学生应及早咨询本科研究主任，并应谨慎处理这两个学位课程，以确保满足两个学位课程的所有截止日期和要求。在一个以上领域中有不同兴趣的学生应该考虑中学而不是联合学位，或者只是使用他们的一些选修课来学习其中一个领域。我们建议所有联合学位人，以确保他们无法完成论文，以确保他们至少满足一个学位的非联合要求。

ADVISING

咨询

Students interested in concentrating in Computer Science are urged to consult the Director of Undergraduate Studies early and often for advice on placement in courses and selection among courses. The Director of Undergraduate Studies is happy to talk with freshmen and sophomores about their Plans of Study and to answer questions. When a student enters the concentration mid-way through the sophomore year, the Director of Undergraduate Studies assigns a professor to serve as the student's faculty adviser. Every effort is made to match the

student's special interests to the expertise of the adviser. Students should consult their advisers regularly, certainly at the beginning of each term. When a faculty adviser is on leave, the student is temporarily reassigned to a new adviser. Students desiring a change of adviser for any reason should contact the Director of Undergraduate Studies. The Director of Undergraduate Studies is also available to discuss problems or questions of any kind with students in the concentration.

对计算机科学感兴趣的学生请及早咨询本科研究主任，并经常就课程安排和课程选择征求建议。本科学习主任很高兴与新生和二年级学生讨论他们的学习计划并回答问题。当学生在二年级中途进入学位课程时，本科研究主任会指派一名教授担任该学生的教职顾问。将尽一切努力使学生的特殊兴趣与顾问的专业知识相匹配。学生应该在每个学期开始时定期咨询他们的顾问。当教师顾问休假时，该学生将暂时重新分配给新顾问。出于任何原因想要更换顾问的学生应联系本科研究主任。本科研究主任还可以与集中的学生讨论各种问题。

HOW TO FIND OUT MORE 如何查找更多

Students interested in computer science are invited to join the mailing list for the Computer Science Newsletter, which carries announcements of new courses, colloquia, job and internship opportunities, and a variety of get-togethers for the Harvard computer science community. Information about the newsletter and other community resources can be found on the Computer Science website.

欢迎对计算机科学感兴趣的学生加入“计算机科学通讯”的邮件列表，其中包含有关新课程，座谈会，工作和实习机会以及哈佛计算机科学界各种聚会的公告。有关时事通讯和其他社区资源的信息可以在计算机科学网站上找到。