

Computer Science Teaching Handbook



UNIVERSITY OF
CAMBRIDGE

Last updated November 10, 2008

Computer Laboratory
University of Cambridge

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Preface

The purpose of this handbook is to provide an overview of the Computer Laboratory's teaching, in all its aspects. It aims not to be comprehensive but to provide links to the many other Laboratory documents: for example, on the Examination structure or the procedures for Part II supervisions. The handbook is intended for all staff whose work relates to teaching.

Compared with many other subjects, Computer Science is not straightforward to teach. There are huge differences among our incoming students in their programming skills. Moreover, the body of knowledge is constantly changing. Computer power has increased thousand-fold over the past 25 years, and countless new techniques and application areas have developed in that time. Much of what was known 25 years ago remains relevant today and will continue to be valuable for understanding techniques yet to be invented. Much else has become obsolete (such as algorithms for sorting on magnetic tape), and many other things have arrived with great fanfare and then faded away. To cope with the pace of change, we review our teaching annually, identifying which new topics must be added to the curriculum and which old ones must go to make way for them. Somehow we have to determine whether a new idea will prove to be of lasting value or is just a fad.

The key idea behind our teaching is that we are *educating the people who will create the future*. We provide an education in Computer Science that will retain its value throughout a graduate's career, in the presence of technological change. We emphasize the principles which underlie the construction and the analysis of computing systems. We strike a balance between theory and applications, and we include in our curriculum appropriate elements of recent research. We expect our graduates to play leading roles in industry, the professions and government. Rather than just cope with the future, we expect our graduates to create the future.

Course Structure

The course structure is described in detail elsewhere [10]. The syllabus for the Computer Science Tripos is available on the Web [7]. Here is a brief overview of these courses:

1. **Part IA.** In the first year, the Computer Science Tripos provides several different options. All students take Paper 1 and Paper 2 Computer Science, and two other papers. For some, these two other papers will be Papers 1 and 2 of Part IA of the Mathematical Tripos. All others will take Mathematics from the Natural Sciences Tripos, together with *either* one other Natural Science subject *or* Paper 3 of Part I of the Politics, Psychology and Sociology Tripos.

In addition, those taking Part IA of the Natural Sciences Tripos, or Part I of the Politics, Psychology and Sociology Tripos may, if they wish, take Computer Science as a first-year option: they take the Paper 1 courses only.

Computer Science Tripos Part IA is the recommended route into Part IB Computer Science, whereas the other first-year options allow students to learn some Computer Science while pursuing a different course of study.

In Part IA, students take courses on Foundations of Computer Science, Discrete Mathematics, Java, etc.

2. **Part IB.** The second year course gives students broad coverage of the subject and a foundation for the more specialized final-year options. Students are expected to acquire a reasonable grounding in all the major areas of Computer Science, both hardware and software. The practical work includes a group project, which gives students the experience of working collaboratively.
3. **Part II.** The third year covers advanced topics, which often build upon lecture courses given in Part IB. The examination structure gives students the freedom to specialize. The practical work consists of an extended project, agreed between the student and the Department. The student submits a dissertation describing the project.

Admissions

Undergraduate admissions is one topic on which we can say little, for it is almost entirely a matter for Colleges. The Department's requirements appear in the *Undergraduate Prospectus* [17], which the University publishes annually. The current edition stipulates single subject Mathematics as the only mandatory A-level. Also desirable will be a physical science (Physics, Chemistry or Geology) at A level and Further Mathematics at AS level if not taken at A level. We do not ask for Computer Science at A-level or even demand prior experience with computing.

About this Handbook

This Handbook was originally compiled by Professor Paulson; it is now maintained by Christine Northeast, to whom any comments or corrections should be sent.

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Chapter 1

Teaching Procedures

The teaching process consists of many levels. In this chapter, we describe it starting at the coalface and working upwards. At the lowest (most important) level is the core process, the teaching and learning itself; this occurs via lectures and associated supervisions, and by practical work. Above that is the feedback and monitoring of this process. Higher again is the assessment process. At the uppermost is the design and modification of syllabus. The following sections correspond to this outline.

Of course, one can go higher still and speak of educational strategy and the introduction of new programmes of study. The Department's Teaching Committee (§3.2) exists partly for this strategic purpose, but follows no defined procedure in its strategic deliberations. It will be influenced from many sources: the evolution of Computer Science as an academic discipline; the academic strengths of the Department; student demand and the availability of funding; and the influence of external organizations and reviews (Chapter 6), some of which reflect the concerns of industry and commerce.

1.1 Lectures and supervisions

In the core process of learning and teaching, other than in practical work,¹ three groups interact: students, lecturers and supervisors. The lecturers work on behalf of the Department and are assigned courses by its Head on the advice of the Teaching Committee; the supervisors work on behalf of the Colleges and are enlisted by each College's Director of Studies for Computer Science.

The Department makes three important inputs to the process:

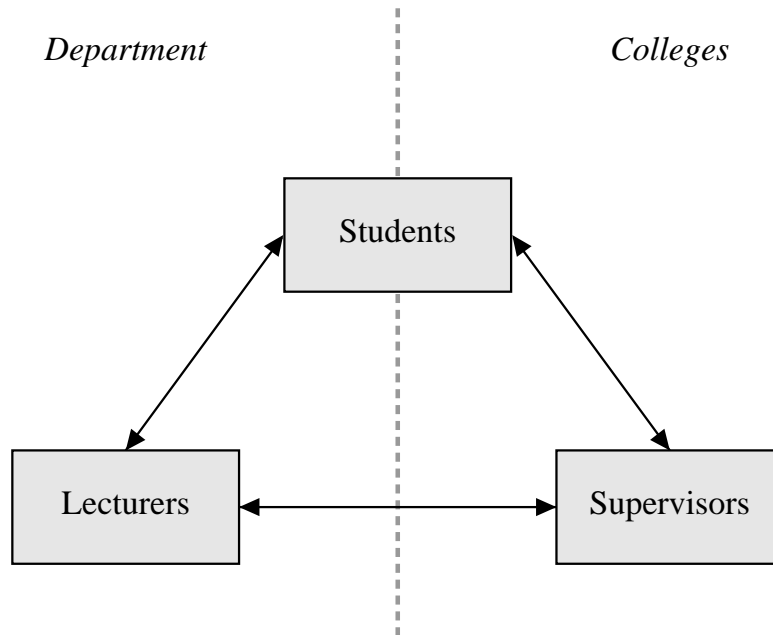
1. At the start of the academic year the Department distributes a 'Directors of Studies pack,' containing full information about examinations, set practical work, and the year's teaching programme.
2. Before each lecture course, the lecturer typically prepares lecture notes for the students, presenting the material in detail either directly or via textbooks to which they refer. Many lecturers will place the notes or other course material on the Laboratory's teaching material Web pages [8].

¹Practical work is treated below (§1.2).

- The lecturer also prepares a Supervision Guide for supervisors. It may be on the Web page, or in paper form in the Student Administration Office (§2.2). It contains any material useful for supervisors which is not made available to students; for example, an indication of how the material is divided among the available lecture hours, solution notes for exercises and past Examination questions, and a list of Frequently Asked Questions. Which of these are provided will vary from course to course.²

On the basis of this information the Director of Studies in each College enlists supervisors, each of whom will supervise students in small groups (usually of size two) for one or more courses. It is up to each Director of Studies to decide how many hours of supervision to provide for each course. It is not unusual to have one hour of supervision per four or five lectures.

During each course there is strong interaction among students, lecturers and supervisors. The following diagram shows Department activity to the left, College activity to the right:



Communication flows both ways between each pair of groups. Lecturers and students interact in lectures; students and supervisors interact in supervisions. In addition, there are general mechanisms for communicating with lecturers:

- During the course, the lecturer may post any up-to-the-minute information on the course web page. This may take various forms: a change in the timing or ordering of topics in the lectures, a supplement to what was said in a lecture, or an answer to a supervisor's query which is of general interest. The Laboratory maintains mailing lists for each category of students, and students will be alerted to such changes either directly by the lecturer or via the Student

²The Laboratory's policy is that solution notes are made available only to supervisors, via the Student Administration Office. The Laboratory prefers that these notes are not passed on to students, except in cases where a course lecturer decides to make solution notes available to *all* students via the course website.

Administrator. Messages can also be broadcast to all students using the newsgroup `ucam.cl.students` and to all Directors of Studies using the mailing list `directors-of-studies@cl.cam.ac.uk`.

2. Supervisors may at any time send queries or suggestions to the lecturer, who may choose to respond either publicly via the noticeboard or personally.

1.2 Practical work

Practical work is a vital part of the teaching process. There are several kinds. First, there are exercises associated with lecture courses; these are not formally assessed, but play an important part in the interaction between students and supervisors. It is the responsibility of each supervisor to choose appropriate exercises for students to do; typically students will hand in solutions and the supervisor will discuss them in a supervision.

Second, there is assessed practical work, which contributes to the final examination result. The type of work varies from year to year. In Part IA, there are 24 tickable problems (17 for Paper 1 candidates). They are discussed with a demonstrator appointed by the Department, who also assesses them. Part IB has six assessed exercises. Four of them are set and marked by members of the Laboratory's teaching staff. The other two exercises take the form of a Group Project design exercise, for which the class divides into teams of about six members. Each team is given a product specification, in response to which they must design and implement a working system, in consultation with an external client. These projects are carried out in the Lent term, at the end of which there is a public exhibition and presentation of final products [4].

In the first year, practical work is returned to the student after marking. The student keeps a portfolio of marked work and submits it at the end of the year. This submission is a formality of the Examination process; the work is not re-marked.

In the second year, the practical work is retained by the Laboratory after marking and is submitted to the Examiners as a portfolio on the students' behalf.

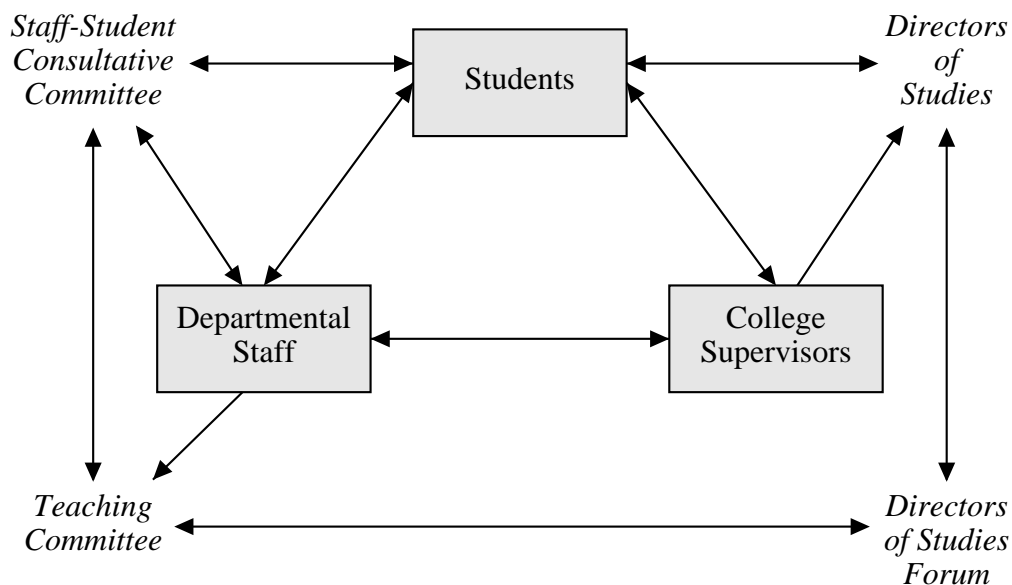
Finally, in Part II there is an individual project for each student. When choosing their project topics, students receive considerable assistance.

1. Past project dissertations are available for inspection in the Library.
2. The student's Director of Studies will offer advice, and is also responsible on behalf of the College for appointing a project supervisor.
3. For each student the Department appoints two teaching staff members as *project overseers*, whose job is to scrutinize the project proposal. They look for a suitable level of difficulty, realistic milestones, objective criteria for success and an acceptable degree of risk. Later they monitor the project's progress.

Thus the support for students in project work is another instance of Department/College collaboration. The procedure for projects is fully described in the Project Briefing Document [13].

1.3 Feedback and monitoring

There are many forms of feedback between the teaching activity and other individuals and groups, including committees. A lecturer is often also a supervisor or a Director of Studies, so there is much informal interaction which is often of great value. In addition, important feedback is formally recorded. The feedback paths are shown in an extended diagram, as follows. Note that feedback may be concerned with either lecture courses or practical work, so 'Departmental Staff' includes lecturers and demonstrators, while 'College Supervisors' includes both course supervisors and project supervisors.



The four committees mentioned here are described in more detail below (Chapter 3). The feedback works as follows:

1. In each College, both students and supervisors interact formally or informally with the College's Director of Studies, who in turn will raise matters of concern in the Directors of Studies forum.
2. The Directors of Studies forum sends appropriate comments to the Teaching Committee.
3. Students raise problems and make suggestions via their representatives on the Staff-Student Consultative Committee.
4. The Staff-Student Consultative Committee usually publishes its minutes on the Department's Web page [5]; it also transmits problems and suggestions to the Teaching Committee.
5. Students offer comments at the end of each lecture course via an electronic questionnaire. These are considered by the Teaching Committee on a termly basis.
6. Members of the Teaching Committee often sit in on one or more lectures (sometimes even the whole) of a course, especially when it is given for the first

time. This provides the Teaching Committee with detailed understanding of course content, and especially of the relationship between the content of different courses.

7. The Teaching Committee builds experience of course content and logistics, as reported by all the above means, into future design of courses and syllabus, in liaison with lecturers where appropriate (§1.6). It reports back to the Staff–Student Consultative Committee when appropriate.
8. The Teaching Committee advises the Head of Department on future teaching strategy and modification of teaching procedures, in the light of experience reported by the Directors of Studies forum.

This feedback, and resulting action, is appropriately minuted by the committee concerned; this is often valuable when one wishes to trace the origin and subsequent effect of a particular action.

Besides this minuted feedback, additional private feedback to the lecturer is gained in other ways:

1. Student feedback from the electronic questionnaires is processed automatically and is available for view on the Web [14]. All comments are anonymous.
2. The lecturer’s appraiser (§7.5) sits in on a lecture given by the appraisee shortly before each appraisal interview. The appraiser, following a standard *aide-memoire*, records an assessment which is discussed at the appraisal. The appraisee completes the record with his/her own comments and the result is lodged confidentially.
3. Lecturers typically set and mark the examination questions for their courses (§1.5). The number and quality of the students’ scripts tell the lecturer much about the course’s effectiveness.

1.4 How supervisions are organized

Supervision, the teaching of undergraduates in small groups (often just two students), is one of the main pillars which support learning. Supervision is the responsibility of the Colleges. The Director of Studies for Computer Science in each College enlists supervisors for all the College’s students taking the Tripos, apart from Part II of the Tripos. As explained above (§1.1), the Director of Studies schedules supervisions appropriately for each student. At the end of each term, the supervisor reports to the Director of Studies on the progress of each student in each course, usually via CamCORS, the Cambridge Colleges’ Online Reporting System.

The situation is different with Part II of the Tripos. In science and engineering disciplines the third-year courses are often specialized, and it is difficult for Directors of Studies to enlist appropriate supervisors. For a few courses, supervisions are not needed, or are needed to a lesser degree; in some cases examples classes are more appropriate. The Laboratory organizes appropriate supervisions for Part II lecture courses on behalf of the Colleges. The main features of the scheme are as follows:

- supervisors are enlisted as appropriate by the course lecturer;

- the course lecturer recommends the number and timing of supervisions;
- the Department administers the assignment of students to supervisors;
- if not enough supervisors are available, the lecturer runs examples classes as a substitute.

The supervisor's report on each student still goes to the student's Director of Studies, and the supervisor is still paid by the College, for the College retains the responsibility to guide each student's learning. The Student Administrator further assists Directors of Studies by reporting on the number of courses each student has signed up for. A Laboratory document [9] describes the Part II supervision system in more detail. Almost all Colleges make use of the Laboratory scheme.

1.5 Assessment and examination

The full process of assessment and examination is documented in an official paper of the Faculty Board of Computer Science and Technology [11]. The summary in this section covers the Examiners, the marking structure and the method of assessment, but does not deal with the method by which marks are normalized, nor with how classes are assigned.

Great care is devoted to uniformity of process. This is applied both to the style (linguistic and typographical) of the papers, and also to the detailed execution of the examination task year-upon-year. An important role in this is played by the Teaching and Examinations Administrator, a member of staff who is not an Examiner but is the guardian of the Department's examination process through the years. This officer maintains a record of detailed changes to the process, and the reasons for changes, ensuring controlled improvement and avoidance of unnecessary change.

1.5.1 The Examiners

For Part IA two members of teaching staff are appointed as Examiners each year. Typically each member does a two-year stint, the second year as Chairman. They receive marks from the Mathematics, Natural Sciences, and Politics, Psychology and Sociology Examiners and supply marks to the Natural Sciences, and Politics, Psychology and Sociology Examiners (for students taking Paper 1 only).

For Parts IB and II three Examiners are appointed. Typically each member does a three-year stint, the third year as Chairman. In addition an External Examiner, a senior UK academic, is appointed for a spell of three years.

The Chairmen of Examiners report each year to the Faculty Board on the conduct of the examinations, and the External Examiner reports each year to the Vice-Chancellor. All these reports are seen not only by the Faculty Board but also by the Teaching Committee. Either of these committees may initiate appropriate action if a report raises a matter of concern. In addition, the reports are placed on the Web, together with assessors' comments on answers for individual questions and with summary statistics.

1.5.2 Marking structure

For Parts IA and IB of the Tripos the examination consists of four written papers and assessed exercises. For Part IA two of the written papers are from other Triposes, depending on which combination of papers the student has chosen. As indicated previously (§1.2), the nature and number of the assessed exercises varies between the years, but the principle of assessment is the same. There is no grading of the exercises — students are only required to complete them to an adequate standard. Students do not receive marks, but merely a ‘tick’ for each completed exercise; they are penalized for any tick not received, and the penalty is such that any student with no ticks would lose one quarter of the possible marks for the year. The intention is the students should succeed; to this end, a limited amount of resubmission is allowed.

For Part II there are three written papers, and an individual project. The project counts for a quarter of the total marks. The method of project assessment is outlined below.

1.5.3 Method of assessment

All written examinations are marked anonymously (without knowing the candidate’s name); this is almost always done by those who set the questions. The External Examiner is asked to check the marking on a number of scripts at random and may comment and recommend further action.

Assessed exercises are assessed by a demonstrator, who will conduct a five to ten minute interview with each student; this suffices to detect any work which been copied, and more positively allows the demonstrator to offer critical comments. In the case of Part IB, two of the assessed exercises are for the group project, in which the size of each group is about six. Each group is monitored by an external “client” at a series of meetings throughout the Lent term. An overall project report is prepared, and each member of the group writes a personal report including a short appraisal of the contribution of all the other members. The meetings and reports are used to determine whether each group member has contributed significantly, and if so the ticks are awarded.

Each individual project dissertation in Part II is read by three assessors. These are the internal Examiners, plus a fourth member of the teaching staff who shares the load. It is unrealistic to mark dissertations anonymously. Each project, with its three independent markings, is discussed. If there is significant discrepancy one or more experts may be consulted, and thereby a marking agreed. The External Examiner may read a representative sample.

1.6 Syllabus design and modification

The Teaching Committee coordinates all design and modification of courses. The Department’s firm belief is that a course programme should be as little as possible subjected to abrupt large change; if such change occurs frequently it damages the polished quality which comes from internal evolution of the programme.

For design and modification within each course the Committee largely relies upon the individual lecturer; only this will ensure detailed quality and internal coherence

for that course. For overall coherence of the programme, the Committee continually reviews the consistency and continuity between courses in the same subject area (for example, in operating systems), and also the degree of relevance existing, and precedence required, between courses in different areas. They are assisted in this by the detailed syllabus [7], aims and objectives with which each course is provided. For the coherence of courses in a particular subject area they will, when appropriate, co-opt an expert in that area for assistance in re-designing that part of the programme. After consultation with individual lecturers this may result in the transferral of material between courses, sometimes between one year and the next, and also in the increase and decrease of material.

New material often enters the Tripos from experimental courses in Part II. Part II courses are of two broad kinds: those which go more deeply into material already encountered in earlier years, and experimental courses which present new topics, arising from research in the Department or elsewhere. After a number of years, an experimental course may be dropped, may continue, or may serve as the basis for a new course in Part IA or IB. Another motive for introducing new material is external influence from, for example, academic review or an assessment by a professional accreditation body (Chapter 6).

In managing this evolution, the Teaching Committee will also use information from many internal sources of feedback (§1.3): from the Staff–Student Consultative Committee, the Directors of Studies forum, the student questionnaires on each course, the performance of students on each topic in examinations which is preserved on record by the Teaching Administrator, and of course from internal discussion of the whole teaching programme.

1.7 Guest lecturers and substitute teaching

Lectures are generally given by University Teaching Officers (UTOs), although in some circumstances other people are used. UTOs can use external lecturers to cover material on up to 15% of the lectures on a course, with no need to seek prior permission. This is on the understanding that the external lecturer will *not* be paid. If a Lecturer wishes to use external lecturers on more than 15% of a course or use external lecturers who expect to be paid then he or she *must* seek permission, well in advance, from the Teaching Committee. The Laboratory will accept no liability for paying external lecturers who have not been approved in advance.

The circumstances in which the Laboratory is willing to pay people are:

1. To cover parental/sick/compassionate leave where there is no UTO able to provide the cover. Such substitute teaching must be agreed by the Faculty Board on the advice of the Teaching Committee.
2. To cover sabbatical leave where there is no UTO able to provide the cover. Such substitute teaching must be agreed by the Faculty Board on the advice of the Teaching Committee. It must be agreed in sufficient time for the Board to make application for central funding to cover the cost (i.e. the application must be made in the financial year prior to expenditure).

3. To cover situations where it is desirable for a non-UTO to be paid for lecturing owing to special expertise. In this case the arrangement must be approved *in advance* by the Head of Department on recommendation from the Teaching Committee.

In general, the Laboratory is unwilling to pay non-UTOs who give lectures in courses which are nominally lectured by UTOs. This includes research students or RAs giving lectures for experience.

1.8 Sabbatical leave

Lecturers wishing to apply for leave of absence, including sabbatical leave, must complete a form [2] supplied by the University Personnel Office. Before making application they are expected to discuss their plans with the Head of Department, and *must* discuss arrangements for substitute teaching with the Head of Teaching. Lecturers are expected to suggest how their teaching will be covered in their absence. The Head of Department will not give his approval unless suitable arrangements for substitute teaching have been put in place.

The application form states that two terms' notice must be given when applying for sabbatical leave, and that any applications submitted earlier than the Easter Term in the academical year 2 years before the academical year for which the leave is proposed will not be considered (e.g. applications for Michaelmas Term 2009 will not be considered until the beginning of Easter Term 2008). In the Computer Laboratory, because of the requirement to examine all of the courses in Easter Term, *three* terms' notice are required *if* the leave is to be taken during an Easter Term.

Chapter 2

Documentation and Records

2.1 The Student Administration Office

The Student Administrators student-admin@cl.cam.ac.uk have particular responsibility for undergraduate and postgraduate students. Their offices are near the reception area of the Gates building. They can supply copies of various documents:

- lecture notes
- supervision guides
- syllabus booklets and reading lists*
- structure of examinations*
- Form and Conduct of Examinations Notices*
- the Lecture List and related schedules*
- information on practical work*
- the Department's research handbook*

The items labelled with an asterisk are also available via the Laboratory's Web page. Most of these documents are updated annually at the start of Michaelmas Term.

2.2 Lecture notes and supervision guides

Lecturing staff submit master copies of their lecture notes to the Student Administrator, who arranges for sufficient numbers to be reproduced by the Computing Service print room. Notes are delivered to the lecture theatre. Spare copies are returned to the Student Administration Office, where they are available to supervisors and students.

To assist supervisors, lecturing staff are asked to produce a *supervision guide* for each course [15]. The guide outlines the course contents and suggests reading and exercises (or past examination questions) relevant to each section of the course. These guides, along with solution notes for past Tripos questions, are kept in the Student Administration Office.

2.3 Undergraduate practical work

All practical work, project proposals and reports are submitted to the Student Administrator. The “Tick Lists” for each year are placed on the Web, and the Part IA “Tick Lists” are pinned on a noticeboard in Cockcroft 4. The Student Administrator also keeps records of Part IB practical work and of Part II project work. All undergraduates other than Part II students must submit a portfolio of written work before their examinations. In the case of Part IA students, the exercises are returned to the students who look after them and submit them in the form of a portfolio to the Student Administrator in May. Exercises completed by Part IB students are retained by the Student Administrator and given to the Examiners shortly before the examinations.

2.4 Student records

The Student Administrator holds records relating to teaching and examining of undergraduate students. She also holds graduate student records and processes applications for MPhil and PhD study. Archive material can be retrieved if necessary. The Department keeps no personal records on undergraduates.

Records relating to the Degree Committee and the Board of Graduate Studies are held by the Secretary of the Degree Committee in room GC06 of the Gates building.

2.5 Course Prospectuses

The University’s *Undergraduate Prospectus* [17] is published annually by the Cambridge Admissions Office, from which copies are available on request.

The *Graduate Studies Prospectus* [16] is published annually by the Board of Graduate Studies. Copies are available from the Board and also from the Student Administrator.

2.6 Accreditation reports

After an accreditation visit (§6.2), the accrediting body (BCS or IET) writes a report which specifies the nature of the accreditation: this is normally full or partial fulfilment of the requirements for corporate membership of the body (MBCS or MIET) and full or partial fulfilment for chartered status (CEng, CSci, CITP). The reports indicate how the Department measured up to the requirements of the accrediting body. The reports are presented to the Faculty Board and are filed with its Secretary.

2.7 Tripos Examinations

The following items are also available:

- *Class Lists* and *Order of Merit* tables are filed with the Student Administrator.

- *Chairmen of Examiners' reports* (one for Part IA and another for the other Parts of the Tripos; these are presented to the Faculty Board and subsequently placed on the Web.
- *External Examiners' reports*; these are presented to the Faculty Board and to the Vice-Chancellor.
- *Assessors' comments* on answers to individual questions: these short reports are presented to the Faculty Board and and subsequently placed on the Web.
- Part II (and Diploma) dissertations from past years are stored in the Library.
- Past Examination papers are filed in the Library and are available on the Web [6].

Chapter 3

Departmental Organization for Teaching

3.1 Faculty Board of Computer Science and Technology

This committee, hereafter called ‘the Faculty Board’, oversees the work of the Computer Laboratory and is responsible for ensuring the provision of facilities for research, for preparing the teaching programme and for ensuring that the teaching given is of a high standard.

It receives the minutes of the Teaching Committee and the Staff–Student Consultative Committee.

3.1.1 Membership

- (a)(i) Head of the Computer Laboratory
- (a)(ii) Four professors elected by the Faculty
- (b) Two members appointed by the Council after consultation with the General Board
- (c) Four members elected by the Faculty
- (d) Up to two co-opted members
- (e) The Departmental Secretary of the Computer Laboratory
- (f) Three student members elected under Scheme F

Observers:

- The Secretary or the Deputy Secretary of the School of Technology
- A representative from the Faculty of Mathematics
- The Head of Teaching in the Computer Laboratory unless he or she is a member of the Faculty Board in class (a) or (c)

3.1.2 Remit

The Faculty Board is responsible for ensuring the provision of appropriate instruction and adequate facilities for research in Computer Science, for preparing the teaching programme of the Laboratory, and for ensuring that the teaching given is of a high standard. In practice it delegates this work to the Departmental Committees and Head of Department.

3.1.3 Meetings

The Faculty Board meets twice in each Full Term. The Annual General Meeting of the Faculty is held annually in the Michaelmas Term: all members of the Faculty are entitled to attend.

3.2 Teaching Committee

This committee determines teaching policy and initiates new teaching procedures in liaison with the Faculty Board. It designs the syllabus and the general teaching programme.

3.2.1 Membership

- Head of Teaching (Chair)
- Three or four other members of the teaching staff
- Chair of the Staff–Student Consultative Committee
- MPhil in CSTIT representative
- Co-ordinator of the MPhil in Advanced Computer Science

Observers:

- Student Administrator (Secretary)
- Teaching Administrator

3.2.2 Remit

- To keep under review the taught courses and teaching procedures, in liaison with the Education Section of the University and the postgraduate course coordinators.
- To discuss and determine teaching policy including the introduction of new teaching programmes and to design the syllabus.
- To administer all teaching procedures including examination structure, Notices about assessed practical work, and any Departmental arrangements relating to supervisions.

- To consider external examiners' reports and cause appropriate action in response.
- To discuss, institute and monitor procedures to assure quality.
- To keep abreast (via the coordinators) of the requirements of accreditation bodies and of teaching quality assessment and to prepare submissions for associated visits and reviews.
- To receive and act on feedback from students.
- To liaise as necessary with the Head of Department, the Chairman of the Directors of Studies Forum, the Teaching Administrator and others.

3.2.3 Meetings

The Teaching Committee normally meets once a month in term, but also conducts much business outside meetings, for example by email and at Wednesday meetings. The minutes are passed to the Faculty Board.

For more information, see the section on Syllabus Design (§1.6).

3.3 Staff–Student Consultative Committee

3.3.1 Membership

- Representatives from each of
 - Part IA
 - Part IB
 - Part II
 - MPhil
 - Research
- Three members of the teaching staff
- Student Administrators
- Departmental Secretary
- Computer Officers' representative
- Librarian

3.3.2 Remit

The SSCOM discusses issues raised by the students.

When an issue is felt to be the concern of the Teaching Committee, the Teaching Committee Representative will normally handle the matter. Such cases will be noted in the SSCOM Minutes. These are seen by the Teaching Committee, who might choose to comment further; then the Teaching Committee Representative will report the comments to the SSCOM who shall minute these comments under Matters Arising.

Occasionally, the Teaching Committee Representative will report an important matter directly to the Teaching Committee, which will discuss the matter and minute the result in its termly Minuted Meeting. This Minute will be transmitted to the SSCOM for inclusion under Matters Arising.

3.3.3 Meetings

It holds regular meetings, approximately twice a term, minuted by one of the student representatives. Its minutes are publicly accessible on the Laboratory's Web site [5], and they are passed to the Faculty Board and the Teaching Committee.

3.4 Directors of Studies Forum

3.4.1 Membership

This body consists of the Directors of Studies for Computer Science in all the Colleges. They elect their own Chair.

3.4.2 Remit

The informal remit of this body (which is self-constituted, and not officially part of the Department's organization) is to discuss Departmental teaching procedures as they affect the Colleges, and pass feedback and suggestions to the Teaching Committee.

3.4.3 Meetings

The Directors of Studies normally meet twice a year, in early January and in July. Notes of their meetings are passed to the Teaching Committee, the Faculty Board and to the Senior Tutors' Committee.

Chapter 4

Transferable Skills

The University Education Section has identified a number of categories of transferable skills for undergraduate students, some that should be developed by all students, and others that are more course specific [18].

4.1 Skills to be developed by all students

The Colleges and the University have agreed that all undergraduate students should develop:

1. Intellectual skills
2. Communication skills
3. Organizational skills
4. Interpersonal skills

4.1.1 Intellectual skills

The Department undertakes to provide lecture courses, each with associated exercises and, where appropriate, practical work. The intention is that intellectual skills will be honed by analysing the material presented in lectures, working through exercises and formal practical classes, and undertaking other work under the guidance of supervisors.

4.1.2 Communication skills

Students develop oral communication skills *via* supervision work and by discussing assessed exercises with those responsible for the assessment. Part II students give a brief oral presentation on the progress of their projects. In the context of group projects, a formal briefing is provided to give guidance on presentation to an audience.

4.1.3 Organizational skills

Organizational skills include the ability to work independently, to take initiative and to manage time effectively. Supervisions, assessed exercises and other project work all develop these skills.

4.1.4 Interpersonal skills

Interpersonal skills are developed in the first year by working in pairs in hardware practical classes. In the second year, these skills are developed considerably further by working on Group Projects. See also the general remarks below (§4.3).

4.2 Skills which are more course specific

The General Board working party listed various skills under the heading above, of which three are relevant to Computer Science:

1. Research skills
2. Numeracy
3. Computer Literacy

4.2.1 Research skills

Undergraduate Computer Scientists are not formally required to undertake research but many aspects of Departmental teaching ensure that some research skills are developed.

In particular, practical work often involves an element of investigation and experiment. A good deal of use is made of the Department's library. Many aspects of working on Group Projects is akin to working in a research group and final-year projects often have a research element. Each year, the final-year examiners expect to identify a few dissertations that would count as reasonably serious research.

4.2.2 Numeracy

By the nature of the subject, Computer Science demands numerical skills of a high order. Even the weakest Computer Science undergraduate is likely to be fairly competent mathematically, and will have developed a range of Information Technology and data handling skills.

4.2.3 Computer literacy

No courses are provided on computer literacy as such, but most Computer Science undergraduates acquire exceptional skills in this area while undertaking assigned practical work.

4.3 General remarks about Transferable Skills

A proper hope that one has of undergraduates is that while working towards their degrees they mature in various ways and develop the ability to work by and for themselves.

Such self-reliance is not well fostered by teaching students in an environment where everything is totally defined by rule or formula. A good University provides many extra-curricular opportunities where students gain experience that contributes towards their becoming valuable to their future employers and to society at large.

In any given year, Computer Science undergraduates are involved in numerous University societies including music, sport, amateur dramatics and politics. Many serve on the organizing committees of such societies, not least because Computer Science undergraduates are well placed to maintain a society's World Wide Web page.

Chapter 5

Support and Guidance

5.1 The Colleges

In Cambridge, both the Departments and the Colleges contribute to education. Chapter 1 explains how lectures and supervisions are organized and defines the roles and interactions of the people involved.

Admission is carried out by Colleges and every undergraduate is a member of a College. Each College appoints a Director of Studies in Computer Science, who is responsible to the College's Senior Tutor and whose main concern is the student's academic development. As well as ensuring that courses are supervised (§1.4), this person will typically meet with students at the start and end of each term to discuss progress and offer advice.

Part of the contract between a supervisor and the employing College is that the supervisor reports to the College on the progress of each student. The Director of Studies receives a copy of these supervision reports at the end of each term and uses them as a basis for discussing progress. If a supervisor believes that a student has a serious academic problem, he or she is expected to notify the College immediately.

The Computer Science Tripos is unusual in timetabling courses so that a student can attend every course throughout the three years. The Director of Studies is the person with whom to discuss any specialization a student may wish to make. The Director of Studies also advises on final year projects and must appoint a suitable supervisor.

The Director of Studies is responsible for academic matters but is an obvious person to approach when a student has personal or financial difficulties. Some Colleges define a separate tutorial hierarchy and allocate each student a personal tutor as well as a Director of Studies. Other Colleges amalgamate the two roles but provide a number of tutors who may be visited at published times — or at any time in case of emergency.

In summary, students interact with many people in the Computer Laboratory and their Colleges. There are regular checkpoints for ensuring that all is well and both formal and informal procedures to ensure that any problems are handled in a timely fashion.

5.2 The Department

Pastoral care in the Department is informal, supplementing the institutional College role. Any number of people may pick up problems and initiate action. This may occur in

connection with lectures, project work, practical classes, supervisions, the Staff–Student Consultative Committee meeting, student administration, etc. Since many staff have both Departmental and College connections, problems found in the Department can be relayed immediately to College authorities.

Students frequently approach Computer Laboratory staff for advice. Lecturers can be contacted by electronic mail to answer questions about their courses. The Librarian is an obvious source of information on course materials. The Student Administration Office (§2.1) can deal with a variety of issues, particularly those related to practical work.

For Part II projects, each student has two *overseers*. The overseers, who are drawn from the Laboratory’s teaching staff, scrutinize the student’s project proposal. They are responsible for ensuring that the student’s project meets specified criteria for subject area, significance and risk. Later, they read student progress reports and listen to the Part II oral reports. They interview any students who appear to be in the slightest difficulty, and if necessary write to the student’s Director of Studies. The Laboratory ensures that no student’s overseer is also his or her Director of Studies, since the two roles are complementary. The Director of Studies helps the student prepare the project proposal and find a supervisor, while the overseers verify that this has been done properly.

The Student Administrator warns the Director of Studies if any student appears to be falling seriously behind with his or her practical work: the assessed exercises of Part IA and Part IB.

Chapter 6

External Influence

The process by which the teaching programme evolves has been discussed above (§1.6). It evolves not only in content but in method. As far as content is concerned, much of this evolution arises from the Department's reflection upon its course material, on trends perceived by Department members in their wider role as members of the academic Computer Science community, and on opportunities created by research developments. Similarly, evolution of teaching methods arises from the Department's own perception of how well things are working, again drawing on experience of its members (for example, as external examiners) in the wider academic context.

In addition, the Department is (as are all Departments) subject to specific external influences. In this Chapter we describe three such influences, of different kinds. They are not confined to teaching matters, but can affect both course content and teaching procedures both directly and indirectly.

6.1 University Departmental reviews

Each Department in the University is considered at least every ten years for possible review. A review normally includes assessments of the Department's teaching programme, as well as of its research, its available resources, its future development and its relationship with cognate Departments. The review committee will contain at least one member of the General Board, representatives of cognate bodies, probably a representative from outside the subject, and normally two members from outside the University.

A review begins with a written submission from the Department, normally a self-assessment of all its activity and circumstances. As far as the teaching programme is concerned, the review committee will prepare a questionnaire for completion by the Department's students. On research, the review committee (or referees on its behalf) will study published work and work in progress. The review includes a site visit to the Department. The draft report of the review committee is made available to the Department for comment; it is then submitted to the General Board. Sometimes, as a second stage after an agreed interval, the committee will enquire into developments arising from the first stage of the review.

A full-scale review as described above is not set in motion automatically. In many cases the General Board conducts a preliminary review, with a minimum of extra

documentation, in order to determine whether a full review is needed. The preliminary review will specifically enquire into teaching; it will request a statement by the Head of Department on teaching, and will examine documentation on courses, as well as recent reports by external examiners. In the light of this information it will recommend to the General Board whether or not a full review should occur.

6.2 Accreditation bodies

The British Computer Society (BCS) and the Institution of Engineering & Technology (IET) are both affiliated members of the Engineering Council. They may accredit courses towards Chartered Engineer status (CEng) on behalf of the Engineering Council and towards their own corporate member status (MBCS and MIET). The BCS also accredits towards Chartered Scientist (CSci) and Chartered Information Technology Practitioner (CITP) status. For most of these, a degree is only partial fulfilment of the requirements; further professional experience is required before professional membership is granted.

The BCS and IET visit the Department at approximately five year intervals. Both bodies require a report from the Department prior to a visit and report back afterwards with its decision on accreditation (§2.6). It may specify conditions, for example “the Part II project must receive a mark of at least 40%.” Only those students who satisfy the conditions are accredited.

The Department’s report and the visit allow the professional body to determine whether their requirements for exemption and accreditation are met. They look at a wide range of factors. Of central concern is that a professional approach to design and development should be fostered by the course. A group project is deemed to be necessary as well as an individual project. The post-visit report covers all these aspects.

6.3 Teaching Quality Assessment

The Quality Assurance Agency (<http://www.qaa.ac.uk/>) carry out a Teaching Quality Assessment exercise of all universities, every few years, to monitor quality control of teaching. This exercise is coordinated by the University’s Education Section. The Computer Laboratory is sometimes asked to be an example department.

Chapter 7

Staff Development and Training

To a large extent academic staff members devise their own work programmes and mould their own careers. But there are a number of practices in the Department, and resources in the University, designed to assist academic staff to develop their powers to the maximum and thereby contribute best to the professional team they have joined. The Department, like others, has a Staff Development Liaison Officer whose job is to coordinate staff development in the Department and to bring development opportunities to their attention. This chapter describes how the coordination works.

7.1 Appointment

The appointment of a University Lecturer is initiated by a perceived need to fill a vacancy or for more staff in a particular subject area. Both teaching and research requirements are considered. The Head of Department, after internal consultation, presents a case to the Faculty Board; if approved it will go to the Council of the School of Technology, who regularly submit a prioritized list of such proposals to the General Board. If the General Board approves the proposal the post is advertised. Applications are considered by an *ad hoc* selection committee which draws up a short-list, conducts interviews as necessary, and makes a recommendation to the Appointments Committee of the Faculty Board. The Appointments Committee makes the appointment. Appointments are subject to confirmation on completion of an initial 5-year probationary period.

7.2 College membership

Many University teaching officers are also Fellows of Colleges, where often they serve as the Director of Studies for their subject (§5.1). Colleges form an important part of academic life at Cambridge. College teaching offers the opportunity to work with students as individuals rather than as a crowd of faces in the lecture theatre. Colleges handle admissions, and consequently look after their relationships with secondary schools. Colleges also offer a lively social life that brings together people from different disciplines.

University offices are not tied to College posts (unlike at Oxford). Typically, a College will approach the Head of Department when it is seeking to appoint a new

teaching Fellow. Through this and other mechanisms, most teaching officers who wish to have a College role eventually find one. A few choose to take on significant College responsibilities, such as becoming a Tutor. Lecturers should note that College teaching can be taken into account when applying for promotion to Senior Lecturer. Teaching staff are encouraged, but not required, to take on a College role.

Colleges take responsibility for training their Directors of Studies in the necessary skills, such as interviewing and pastoral support.

7.3 Mentoring

Each newly appointed University Lecturer is assigned a *mentor*: an experienced member of teaching staff who will assist him or her through the first two years of appointment [3]. Mentoring is also arranged for academic-related staff.

The mentor will help the newcomer develop his or her professional powers and activities as fruitfully as possible. Much of this help is in the form of advice: on achieving a balance between teaching, research and other work in the Laboratory; on developing contacts; on involvement with Colleges; on PhD supervision, research management and research funding.

Mentoring is not mainly about academic ideas, but about joining a community which promotes these ideas (in both teaching and research). Nor is it mainly about appraising performance; this is the job of the appraiser (§7.5). Mentoring involves experienced professionals helping the less experienced to organize and develop their professional activity.

The mentor and the newcomer maintain continuing contact. About once a term, they may meet specifically to identify opportunities for further assistance. The mentor will support the newcomer during the induction course (§??).

At the end of one year, the newcomer is asked by the Staff Development Liaison Officer to report briefly on the mentoring experience. If it has been unhelpful or unproductive, he or she will be invited to discuss alternative possible arrangements with the Head of Department. At the end of two years, the mentoring function is understood to be indistinguishable from a relationship between colleagues. Again the newcomer is invited to comment, and to draw attention to any further specific need for assistance.

Mentors do not report on individual mentoring relationships, but are invited each year to comment generally on the mentoring scheme. The Head of Department will sift such comments and may use them to extend the guidance to mentors.

7.4 Probation and teaching record

The probationary period is important, since in that period each newcomer establishes a profile. Academics vary widely in their aptitudes, and it would be wrong to subject each one to the same induction experience. The value of the mentor is in helping to adapt that experience to the individual.

As an additional focus, each new member is asked to complete over the first two years a Teaching Record card, recording a variety of activities such as lecturing on significantly different topics, setting and marking exams, supervising a Part II project, and so on.

When each item is done it should be initialled by the newcomer. When the record is complete it should be signed off by the mentor and by the Head of Department.

By the end of two years, the newcomer will have done a sufficient variety of different things to have become a well-rounded team member. At that time, the staff member is asked to lodge the completed form with the Departmental Secretary. It may be used as part of the Department's records submitted for external reviews of teaching.

7.5 Appraisal

Every member of teaching staff is assigned an *appraiser*, who is a more senior member of staff [3]. Appraisal is carried out for all staff, however experienced. For newcomers, the appraiser will not be the same person as the mentor. For teaching staff, appraisal interviews normally occur once every two years. The purpose is to appraise recent and future achievements and responsibilities, and discuss future development and ways of assisting it. The appraisal is concerned with teaching, research and administration. To this end, before the interview the appraisee writes a self-assessment which forms the basis of discussion, during which useful actions are identified. Then both parties make written comments and the whole record is lodged with the Head of Department. It is treated as confidential among appraisee, appraiser and Head, but may with the appraisee's consent be considered by a promotion or reappointment committee which requests it.

Shortly before each appraisal interview, the appraiser sits in on a lecture given by the appraisee and records an assessment of the lecturing style and technique, which is discussed at the appraisal; the appraisee completes the record with his/her own comments and the result is lodged confidentially along with the appraisal record.

Clearly the functions of mentor and appraiser overlap, but they have different emphasis. Mentoring is about induction and finding one's feet, while appraisal is about judgement. Both are concerned with planning. The mentor's job finishes when induction is complete; the appraiser's job is on a longer term (and where possible the appraiser is not changed unless the appraisee wishes so). Finally, it is no bad thing to have the attention of two more senior members.

7.6 The University programme

The Centre for Personal and Professional Development in the Human Resources Division of the University run a wide range of staff development activities, including induction courses for new staff, under the general headings of teaching and learning; research; administration and management; personal and career development. The course programme is circulated to all staff and is published in Reporter and on the University Web page [1]. All these courses are free of charge.

The annual Programme and Activities Handbook is filed with the Departmental Staff Development Liaison Officer (currently the Departmental Secretary) and the HoD's secretary.

In particular, the programme includes courses on giving supervisions to undergraduates. The Department organizes supervisions for Part II of the Tripos on behalf of the Colleges (§1.4). Those enlisted as supervisors are strongly encouraged to

attend courses, introductory and beyond, on supervising undergraduates. A course is generally arranged to be held in the Department in either October or November for new research students and staff.

Bibliography

- [1] Academic staff development programme.
<http://www.admin.cam.ac.uk/offices/hr/cppd/information/teaching.html>
- [2] Leave of absence application form.
<http://www.admin.cam.ac.uk/offices/hr/forms/chris67/>
- [3] Computer Laboratory staff development programme.
<http://www.cl.cam.ac.uk/local/policy/staffdevpolicy.html>
- [4] CST Part IB Group Projects.
<http://www.cl.cam.ac.uk/teaching/GroupProjects/>
- [5] Staff–Student Consultative Committee. Minutes.
<http://www.cl.cam.ac.uk/teaching/SSCOM/>
- [6] Computer Science past papers.
<http://www.cl.cam.ac.uk/teaching/exams/pastpapers/>
- [7] Computer Science Tripos Syllabus and Booklist.
<http://www.cl.cam.ac.uk/teaching/current/CST/>
- [8] Lecture course material. <http://www.cl.cam.ac.uk/teaching/current/>
- [9] Part II Supervisions arrangements.
<http://www.cl.cam.ac.uk/teaching/supervisions/>
- [10] Guide to Courses: Computer Science.
<http://www.cam.ac.uk/cambuniv/guide/ugcourses/compsci.html>
- [11] Marking scheme and classing convention, Computer Science Tripos. Computer Science.
<http://www.cl.cam.ac.uk/teaching/exams/classing.pdf>
- [12] Mentoring for new academic and academic-related staff.
<http://www.cl.cam.ac.uk/local/policy/staffdevpolicy.html>
- [13] Information on Tripos Projects. <http://www.cl.cam.ac.uk/teaching/projects/>
- [14] Review comments on Computer Science Courses.
<https://lecture-feedback.cl.cam.ac.uk/feedback/>
- [15] Supervisor support in the Computer Laboratory.
<http://www.cl.cam.ac.uk/teaching/supervisions/support.html>
- [16] *University of Cambridge Graduate Studies Prospectus*.
<http://www.admin.cam.ac.uk/univ/gspectus/>

- [17] *University of Cambridge Undergraduate Admissions.*
<http://www.cam.ac.uk/admissions/undergraduate/>
- [18] *Transferable Skills for Undergraduate Students.*
<http://www.skills.cam.ac.uk/undergrads/>