MONASH UNIVERSITY
SCHOOL OF COMPUTER SCIENCE AND SOFTWARE ENGINEERING

INTRODUCTION TO DIGITAL SYSTEMS HONOURS 2004

`http://www.csse.monash.edu.au/hons/`

1 General Matters

Welcome to the Honours course in Digital Systems! We hope that you will have a successful and enjoyable year in your course. If you are having any problems related to this course, or if you need course-related or general advice you should talk to the coordinator:

- Nandita Bhattacharjee
  (Rm 189, Bldg 75, Nandita.Bhattacharjee@infotech.monash.edu.au)

Other people you may need to deal with include

- Karen Fenwick
  (G62, Building 75, Clayton, Karen.Fenwick@infotech.monash.edu.au):
  day to day Honours administration such as changes of unit registration.
- Technical Services Unit
  (TSU, Bldg 75, tech@help.csse.monash.edu.au):
  any questions related to computing accounts.
- Susan Saunders
  (Rm 156, Bldg 75, Susan.Saunders@csse.monash.edu.au):
  room keys, proximity cards, etc.

Important Note: Please be aware that if you want to contact any of us by email you have to make sure that your mail originates from one of the Monash domains for your student account (`student.monash.edu, csse.monash.edu.au, infotech.monash.edu.au`). Due to the amount of spam floolding the university mail system we need to use spam filters. As these systems sometimes generate false positives there is a chance that your mail will not arrive if you send it from accounts such as hotmail, gmx or yahoo.

Library Orientation

There will be a library orientation session at the start of the semester on **Thursday March 18, 10 am**. The focus of this session will be on using the library as a research resource and will include a hands-on session with electronic databases. Please meet Ms Sara Miranda at the Information Desk, Hargrave-Andrew Library; the session will be conducted in the IT training room.

Information resources

Information and handouts are available on the web at: `http://www.csse.monash.edu.au/hons/` where you will also find links to the subject homepages. It is necessary that you read the email sent to your student account regularly as many important announcements are distributed in this way.

2 Course structure

Each Honours student must undertake coursework units and a substantial individual research project which together add up to 48 points.

CSE417 Communication and Research Skills

All students must take the compulsory unit, CSE417 Communication and Research Skills. This unit is intended to improve the oral and written presentation skills of students and to teach skills required for the critical analysis of research. CSE417 will take place over both semesters. You will receive a separate handout for this unit in your first class. The first session takes place **11-12.30noon, Thursday 4 March, Room G55 (Seminar Room), Building 75**.

Seminars

School seminars are held regularly throughout the year (typically once a week). Information on CSSE seminars is available at: `http://www.csse.monash.edu.au/seminars/`.

We consider these to be part of CSE417 Communication and Research Skills. You are required to attend at least 5 seminars each semester and fill out a seminar evaluation sheet (available in separate handout and for download) for each seminar you attend and submit it immediately after the seminar to the Honours coordinator. Also, attendance at the interim and end of year honours project symposia is mandatory.

Coursework Units

The units offered this year to Digital Systems students are detailed in the appendix and on the Web. A total of 24 coursework points must be taken (this does not count the Communications and Research Skills Training unit CSE 417, which is considered part of the research training). You may select 4 units (each counting 6 points) from the following list of recommended units:

- Semester 1
  - CSE4881 - Internet architecture and protocols
  - CSE4882 - Digital communication technology
  - CSE4892 - Information security
  - CSE5805 - Advanced network design
- Semester 2
  - CSE4884 - Network design and management
  - CSE4891 - Public telecommunications networks
  - CSE5301 - Neuro-fuzzy computing
  - CSE5302 - Video coding and compression
  - CSE5803 - Advanced internet protocols and applications

Students may also enrol in any of following units:

- CSE4601 - Advanced Topics in Intelligent Information Processing
- CSE4602 - Advanced Topics in Software Engineering
- CSE4603 - Advanced Topics in Algorithms and Complexity
- CSE4604 - Advanced Topics in Computational Languages
- CSE4605 - Advanced Topics in Computational Science
- CSE4606 - Advanced Topics in Computer Networking
- CSE4607 - Advanced Topics in Graphics and Visualisation
- CSE4608 - Advanced Topics in Computer Architecture and Systems
- CSE4610/11 - Individual Study Unit in Computer Science
- CSE4333 - Parallel systems

As you can see from the title these units cover rather broad topic areas. Some of these are in fact flexible "framework" units in which you can specialise in different directions. Each of these framework units is worth 6 points for which you must elect one or two modules within the unit (some modules are worth 3 points, other ones six points).

More detailed descriptions of the CSE5/4XXX units and the modules within them can be obtained from the handbook and the courseware web pages.

All 6 point units comprise of 2 hours of lectures each week through out the semester. In addition to the lectures some units have 1 or 2 hours of tutorials which may also include practical laboratory work each week.

Modules typically comprise 36 or 24 hours of lectures over 12 weeks and include some practical work. Some modules are taught for a whole semester, while others are taught during only one half of a semester. Modules start dates are Week 1, Semester 1; Week 8, Semester 1; Week 1, Semester 2; Week 8 Semester 2.

The number of lecture hours is not necessarily the same for all 3 point modules or for all 6 point modules. The variation of lecture hours is balanced by, e.g., more/less reading or more/less assignments, so that the overall workload of a six point unit will be independent of the module selection.

Assessment for each unit/module may be based on assignments, an examination, or both, and will be clearly specified by the lecturer at the start of the unit/module.

Unit and Module Selection

Note that you **cannot** directly enroll in the CSE5/4XXX units above without approval from the honours coordinator. This is a safeguard to ensure that your module selection is consistent with your unit selection.

Note that your enrollment with the faculty only concerns the individual 6 point units or framework units. Your selection of modules that you wish to count towards these units is done with the school.

On your day of enrollment (or before) pick up a **Honours Unit Selection Form** from the general office. This form clearly indicates which modules can be counted towards which units.

You must select four CSE 5/4XXX units. For each unit you must select modules that count for a total of 6 points, if appropriate.

Note that the CSE460X units are full year units.

After you have made your selection, you must have your **Honours Unit Selection Form** checked and approved by the coordinator who will also approve your unit selection form so that you can formally enroll into these units with the faculty.

You must also enroll into CSE 4650, which is the 24 point research component of the course.

If you later need to *change a unit* you can do so until the second week of Semester 1.

If you intend to *change a module* later in the year, you must formally notify your intention to do so by sending an email to Karen Fenwick (karen@csse.monash.edu.au). You will receive email

approving (or not) the change. All changes must be approved. Under most circumstances only module changes that do not require a change in the unit selection can be approved.

Should you fail to formally notify the School of module changes or fail to get approval, marks for the original modules will be used to calculate your course work component.

Final Grade

The final grade (H1, H2A, H2B, H3 or fail) for the Honours course is computed by combining the project mark and coursework marks weighted in accordance with their point value. The coursework mark includes the CSE417 (Communication and Research Skills) unit marks and the best possible combination of modules/units that constitute 24 points. At most one free elective (non CSE 5/4XXX) can be counted towards the final mark.In summary:

24 points of units	24 points
Honours thesis & CSE417	24 points
Total	48 points

Prizes

Two prizes of A$500 each for the best students in the categories best coursework and best project have generously been donated by ManageSoft (`http://www.managesoft.com`).

3 Projects

The core of the Honours programme is an individual research project which is worth 20 points. Two important parts of the project work are written and verbal presentations of the project.

For many Honours students the Honours project is unlike anything they have done before. Sometimes it is hard to know what you should be doing and when and how you should be doing it. Here are some general guidelines. However, they are not applicable to all projects and your supervisor will be able to – and should – provide more project specific guidelines and goals.

The Research Project is designed to take about 500 hours for the average student. A Research Project may be concerned with theory, program development, hardware development, evaluating and improving on a new technique, analysing performance - in fact anything associated with computing which involves a reasonable amount of intellectual and practical effort. The student is expected to read the relevant literature and carefully analyse the problem posed, to formulate a solution or proposals for a solution, and where appropriate, to implement and prove, evaluate or test the validity of their results and proposals. The project solution will usually require creative and original thinking. Typically, a project is designed for a problem in some area associated with a research programme being carried out by a member of staff. The Research Project involves substantial mentoring by a staff member, and is designed to teach research skills. These skills are particularly important if the student wishes to undertake a post-graduate research degree.

Project Registration Procedure

A list of projects will be handed out separately and is also available on the Web. It contains a brief outline of each project and the name of the supervisor. Supervisors can individually provide further information about a project and are willing to discuss what is involved.

If you have a project in mind that you would like to do you are encouraged to approach a relevant member of the academic staff to suggest this project. Most supervisors appreciate this sort of initiative and will be happy to supervise such a project if it is well-defined and in their area of research. However, students do not have a right to insist on their own project, and in the great majority of cases they will do projects from the published list. Students may not always be able to do the project of their choice, either due to the popularity of a project or because each staff member is restricted to supervising a maximum of three projects.

During the first week of the semester there will be some project presentation session in which individual groups of supervisors present potential projects. Each such session will be dedicated to projects that are grouped around a common research area. The timetable for these sessions is available at `http://www.csse.monash.edu.au/ berndm/Honours/2004/ProjectIntros.html` and in hard copy on a separate handout. Make sure to attend these sessions if you have some interest in their topics (and even if you don't know what they are about), but be aware that not all projects are represented in these events.

Project registration and allocation will be done in the first week of Semester 1. Please fill in the **Project Allocation Form** which you receive in the introductory session. Give at least 6 preferences in ranked order. **Your preferences must be supervised by at least 3 different supervisors.** Hand your completed form in to the Enquiries Office by the end of the first week of Semester 1. The project allocation will be announced by email as soon as possible after this time.

Evaluation of Projects

The School takes the evaluation of projects very seriously, as they are a substantial contribution to the student's final mark. The following are part of the project assessment.

NOTE: Some of these items are part of the assessment for CSE417 Communication and Research Skills; see CSE417 handout for details of assessment weightings.

1. A **research proposal** is due by 12 noon **28.4.04**. By this time the student is expected to have read sufficient literature to be able to form a fairly good plan of how to attack the chosen problem. Thus, this report typically contains a description of the project and plans for the solution of the associated problems. The report should show evidence of the thinking the student has done about the project, and possibly some initial experiments which indicate that the suggested approach seems plausible. A time-table accompanies the said plans. A submission must be made by the due date and handed in to the Enquiries Office. Re-submission will be requested for unsatisfactory proposal.

2. A **symposium** on **3.6.04** will be organised which all academic staff and Honours students will attend. Each student will be given approximately 10 minutes to describe their project

and what they have done on the project so far. A short question and comment time will follow. This seminar is intended to give experience in such presentations and to provide for input from other academic staff concerning your plan and approaches.

3. A first **Draft of a Literature Review** is due by 12 noon **11.6.04**. You have roughly six weeks for revision of this draft after which you must submit the **Final literature review** (Submission Deadline 28.7.04).

4. A first **Draft of the Thesis** is due **8.9.04**, 12 noon so that the supervisor can provide comments before the final report is submitted. (You should of course get drafts to your supervisors before this date.)

5. The **Final Report** is due in the first week of November on **Melbourne Cup Day, 2.11.04**. This is followed by a School Cup Day gathering to which Honours students are invited. The final report provides the basis of the project assessment and is examined by at least two staff members, one of whom is usually the supervisor of the project in question. It may be appropriate to demonstrate your project to your examiners.

   Only under exceptional circumstances will an extension of the thesis submission deadline be granted by the Honours coordinator.

6. The **Final Talks** will be scheduled on one or two days during the last week of October. during the week of **25.10.04-29.10.04** (exact dates to be advised). You will typically be given 20 minutes time for your presentation with 5 minutes time for questions and comments. Examiners take the seminar presentation and fielding of questions into account when assessing a project. It is compulsory for you to attend all final talks.

7. A *Project Web Site* must be maintained during the semester to keep supervisors, fellow students informed about your project and to impress the rest of the world. Its final version has to be available for marking one week after the final talks (**11.11.04**).

The final project grade is determined from the marks assigned by the two examiners, although their recommendations are sometimes changed by consensus to ensure that all projects are fairly marked. The examiners take into account each of the above, with emphasis given to the final report. If the two examiners' marks differ significantly, then a third or even fourth detailed examination may be called for. The final grades for the project and overall grade for the year are determined at a staff meeting after all components of the assessment have been marked. An external assessor will also independently examine selected projects and will be present at the staff meeting so as to ensure objective marking.

Most projects have a significant practical content, involving hardware and/or software development. It is crucial that by the time of the research proposal you have reached some agreement with your supervisor about the extent of this practical work. It is equally important that by the time you hand in your final report this practical work has been completed, as you are likely to lose marks for incomplete work. Your practical work will be judged for its quality in at least the following categories;

- correctness and completeness,
- sound, modular design,
- testing,
- ease of use,
- documentation.

Some projects will have a large theoretical component. Theoretical work will be judged for its quality in at least the following categories;

- formal correctness,
- problem understanding,
- innovative and independent problem solving,
- conceptual elegance and simplicity.

Guidelines for Carrying Out the Project

For most students, the hardest part of the Honours year is managing their time so as to work consistently on the project throughout the year amongst the short-term pressures of course work assignments and exams. Start your project **early** (that is, in March) and keep at it. Your project is worth almost half of your final marks for the year! Do not get bogged down spending a disproportionate amount of time on small course work assignments which are worth relatively little in your overall mark.

A rough timetable for your project should be:

- **1st week of semester**. Choose project and supervisor.
- **First 3 weeks of Semester 1**. Do background reading – typically 5 to 10 papers. Understand the problem and why it is important.
- **Weeks 4-6 of Semester 1**. Plan how to solve the problem. Write research proposal.
- **Rest of Semester 1** Undertake preliminary tests of your approach. Prepare interim presentation.
- **First 9 weeks of Semester 2**. Finish most of the implementation or proofs in your project work. First draft of your report.
- **Rest of Semester 2**. Write your report, and perform extra research suggested in the writing up stage.

The following hints may help your research and time management:

- You should have a regular weekly meeting time with your supervisor. Attend the meeting even if you have not completed anything.
- Keep a research diary where you write down your research ideas, progress on the project and a log of your meetings with your supervisor. This is a hurdle requirement for CSE417 Communication and Research Skills.
- Allocate 25% or 40% of your time to your project as appropriate. Regardless of course work requirements, spend at least one day a week on your project.
- Choose reasonable weekly and monthly goals in consultation with your supervisor.
- Read the background material critically – look for the underlying ideas, limitations and usefulness. Do not believe anything blindly just because it has been published.
- Start writing early. Do not leave it until the last weeks. Your research proposal and your literature review should form the basis of the first draft of your final report.
- Get help with your proposal, literature review, poster and final report:
  - your supervisor will help with structure and contents
  - you will receive help with your presentation in your CSE417 classes.
  - LLSU can provide help with ESL issues and scientific writing.
  - other students can help – form a self help group.
- Discuss your project with other Honours students. Communication is one of the keys to successful research.
- Practise your talks. In the final talk a **working** demonstration or video is often impressive.

4 Guidelines for the Final Report

The project report **must be typed** on A4 paper. It should typically be **no longer than 30 pages**, excluding the literature review, appendices and bibliography. Exceptions to this rule can be made if they are justified by the nature of the project. If you think your project constitutes such an exception you will have to discuss the case with your supervisor(s) and the coordinator and obtain their approval to exceed the page limit.

Draft printing must be kept to a minimum; use the postscript previewers or WYSIWYG packages on the Macintosh/PC computers. A quota of pages produced on the laser printers may be imposed for each Honours student. Three copies of the report must be submitted if you have one supervisor, four if you have two supervisors. Photocopying of the copies can be arranged through the Enquiries Office.

It is important that the report contain a complete account of the work done. In general, the report should contain:

- a clear description of the problem you have tackled and why it is important,
- a description of how your project relates to related published work,
- the approach taken (with ample justification), and also methods used to solve the problem,
- the results or conclusions obtained, and
- if appropriate, a detailed description of the software and/or hardware you have implemented.
- if required an appendix that details how the deliverables produced in the project deviate from the deliverables spelt out in the research proposal (see documentation for CSE417) and why this is the case.

It is vital that the thesis contains a complete account of the work you have done: In particular, you should use an appendix to clarify your personal original contribution and to distinguish it from ideas and results that you have taken from the literature or that your supervisor has contributed. *Make clear what your own achievements and contributions are and how much time you spent on your project*. Your second reader will sometimes know your project only superficially, and your thesis is the best way for him or her to get to know it better.

With scientific writing, organisation and structure is half of the task, and so considerable effort should be invested in detailed outlines before any text is composed. Changing outlines is quick and easy; rewriting text is time consuming.

The supervisor will advise on all aspects of the preparation of the thesis, and will check through the draft at least once if received by the first draft deadline, but the student is reminded that it is not the supervisor's responsibility to write or re-write all or part of the work. Refer (with caution) to existing Honours theses of the School for an indication of the required format. Note that as a student you are being examined not only on research and organisation ability, but also on your ability to present and defend ideas. Conformity to conventions, both scientific and grammatical, is important.

A reasonable thesis structure is as follows:

- Title Page
- Declaration of Originality
- Thesis Abstract
- Acknowledgements
- Table of Contents
- List of Figures

- Introduction
- Main Body of thesis (Chapters or sections depend on topic)
- Conclusion and Further Research
- Appendix A: Revised Specification of Deliverables (if required)
- Appendix B: Clarification of Original Contribution (if required)
- Other appendices as required
- Bibliography

If you choose to use LaTeX, a suitable style file will be provided. The recommended font size is 11 point. Essential footnotes are normally placed at the foot of the page to which they refer. Number pages consecutively, including pages carrying diagrams, photographs, maps, etc. Diagrams should be computer drawn and included as postscript/latex graphic/etc files directly into the document, or at least photocopied onto the particular page. Photographs must be mounted with dry mounting tissue or spray adhesive, and where possible copied photographically as a whole page and included in the thesis in the normal manner. References must be referred to in the text, and listed in the bibliography following a standard and consistent format.

The "Declaration of Originality" must be on a separate page and contain the following wording:

> I <student name> declare that this thesis is my own work and has not been submitted in any form for another degree or diploma at any university or other institute of tertiary education. Information derived from the published and unpublished work of others has been acknowledged in the text and a list of references is given in the bibliography.
>
> _____
>
> (student signature)
>
> _____
>
> Date (day, month and year)

The Abstract on a separate page should not exceed 500 words.

Appendices are not intended as a means to 'pad-out' a sparse thesis with peripheral material, or to circumvent the page limit in an 'obese' thesis. They serve as a repository for useful products of the research (e.g., documentation including installation of a program and a detailed example run of the program) which are not an integral part of the main body of the thesis. Where the raw data of a thesis cannot be extracted directly from the test figures and tables, it is essential that they be tabulated in an appendix. In short, appendices preserve valuable information which might

otherwise be lost, but the thesis should be able to stand without them. Long, detailed program code should be put on a CD ROM or floppy disk in the back of the thesis, rather than listed in appendices.

In addition, student have to submit a copy of their thesis electronically to the coordinator (either PDF or HTML or Postscript).

Guidelines for the Research Proposal and Literature Review will be in the handout for CSE417 Research and Communication Skills.

5 Postgraduate Study

All Honours students should consider their potential and options for continuing into some form of research study. The Honours year can be seen against a number of backgrounds: employment advantages over 3 year degrees, ability to gather additional course material, even as a procrastination over career choices! But the original purpose of the Honours year is to provide training for students who wish to continue on to postgraduate study. This is still one of the main objectives of the degree, and an understanding of this will doubtless help you to make sense of much of the course work you do get. If you are interested in postgraduate study, make your interests and desires known to your lecturers and project supervisor. They will be only to happy to help you gain additional insights and perspectives on what is to them a fascinating field of study. Not only will they enjoy your interest, but you may find it gives you the additional impetus to do well in what may be your final year of formal examinations. Good luck in those examinations!

Scholarships are available to support you. They start at about $15,000 per annum (tax-free), and can be supplemented to higher figures in particular circumstances. There are a number of different types of scholarship, the main ones (roughly in order of prestige and amount) being:

- Australian Postgraduate Awards (APA).
- Monash Graduate Scholarships
- Faculty of Information Technology Scholarships
- School of Computer Science and Software Engineering Scholarships

Students intending to apply for scholarships are urged to talk to the Postgraduate Coordinator (Dr. Graham Farr). There are a number of options available to those who miss out on the very competitive APA

Usually only students with an H1 grade for Honours are successful in obtaining scholarships.

Further announcements about Postgraduate Study will be made later in the year. Also see the Postgraduate Handbook on the School WWW entry.

6 Appendix A: Subjects offered

Note that the framework units as such have no further prerequisites if you have been admitted to the BDS Honours programme. However, individual modules that you wish to count towards these units may have additional prerequisites. Please check in the module descriptions in the appendix.

CSE5805 - Advanced network design

This subject mainly deals with Network performance modeling and analysis, Queueing theory, Network technologies, Analysis of network protocols, Traffic modelling, Circuit switching, Routing techniques, Mobile network design issues.

CSE4882 - Digital communication technology

This subject mainly deals with Local area networks; metropolitan area networks; satellite networks; ISDN; modem techniques; digital networks.

CSE4892 - Information security

This subject covers a broad range of security issues with emphasis on Internet and e-Commerce security. The course covers communications, computer, personnel and adminstrative security. Techonolgies covered include SSL, PKI, smart cards, biometrics, trusted systems and many other security matters.

CSE4881 - Internet architectures and protocols

This subject mainly deals with the structure, coordination and management of the Internet; Internet standards development process; Internet link layer protocols: SLIP, CSLIP, PPP, ARP, RARP, etc.; the IP (V4 and V6) and ICMP protocols; TCP and UDP; the Internet addressing structure, including domain naming and the DNS/LDAP systems and protocols; bridging systems and spanning-tree protocols; Internet packet routing techniques and protocols, e.g. Distance-vector, Bellman, SPF, and related IGP and EGP protocols; mobile IP; Real Time Protocols: RTP, RTCP, RTSP, SDP, RSVP; Security issues; Quality of Service (QoS) issues; the major common applications: FTP, Telnet, SNMP, SMTP, HTTP, etc.

CSE4884 - Network design and management

This subject covers Network strategy development; network design principals; Telecom services; network performance; network topologies; network implementation; case studies.

CSE4891 - Public telecommunications networks

This subject covers The basic components of the telephone network; principles of exchange operation; long-distance communication; SPC exchanges; digital telephony; digital networks; ISDN.

CSE5302 - Video coding and compression

This subject covers Fundamental concepts, theory and techniques of digital video signal coding and compression, waveform characterization and representation; human visual systems and vision modelling; transform coding, performance evaluation; motion compensated video coding techniques; hybrid coding algorithms sub-band and wavelet transform coding; vector quantization; run-length coding; variable-length coding techniques including Huffman, Sannon-Fano and Comma codes; fractal image/video compression; hierarchical coding; filtering in video systems; introduction to industrial coding/compression standards for image/video signals; implementations and applications of digital video coding systems.

CSE5803 - Advanced internet protocols and applications

This subject deals with In-depth coverage of the fundamental protocols to operate the Internet and intranets, and a selection of major applications, including implementations of protocols and systems. Topics covered include: Advanced Internet Addressing, subnetting, supernetting; TCP Performance and Enhancements, Multicasting - IGMP, DVMRP, MOSPF, etc.; Messaging systems - SMTP, POP3, etc.; World Wide Web systems, Real Time Protocols - RTP, RSVP, etc.; Security issues - VPNs, Firewall systems, Secure socket systems; Quality of Service issues; IP mobility issues; Management - SNMP, SNMP2,etc., Directories - DNS, X.500, LDAP, Remote File activities - FTP, NFS, xNFS. Advanced routing issues - BGP4, OSPF, etc.

CSE5301 - Neuro-fuzzy computing

This subject deals with theoretical background of fuzzy set, fuzzy logic and neural networks, applications in control, signal processing, image processing and communication networks. Topics include: fuzzy sets, fuzzy arithmetic and relations; fuzzy logic, membership functions; fuzzy inference and fuzzy systems; fuzzy logic controllers and predictors; fuzzy system applications in image processing, pattern recognition, communication networks and other areas; artificial neural network concepts; the perceptron and linear neural networks; multi-layer feedforward neural networks; self-organising systems, competitive learning, self-organising feature maps and recurrent neural networks.

CSE4601 - Advanced Topics in Intelligent Information Processing

Methods from Artificial Intelligence (AI) form the basis for many advanced information systems. These techniques address problems that are difficult to solve or not efficiently solvable with conventional techniques. Building on the undergraduate curriculum this unit introduces the student to

advanced AI methods and their applications in information systems. Within the framework of this unit, the student can choose between a variety of modules in the broad area of Intelligent Information Systems. Most modules relate directly to the school's research strengths and are taught by active researchers in the respective fields. Research fields covered include:

- Machine Learning
- Data Mining and Knowledge Discovery
- Automated Reasoning
- Knowledge-based Systems Search,
- Constraint Solving and Optimization
- Natural Language Processing
- Computer Vision and Pattern Recognition

Some of these topics may not be offered in every year.

CSE4602 - Advanced Topics in Software Engineering

Software engineering is concerned with all aspects of effectively building reliable software systems that satisfy the requirement. It addresses the entire software life cycle including requirement analysis and specification, design, construction, testing, and operation and maintenance.

The modules in the framework of this unit cover advanced issue in software engineering, particularly the use of formal methods, ie.

- Mathematical concepts behind formal methods,
- Executable specifications,
- Formal specification formalisms and their use in the software engineering process,
- Verification and testing.

CSE4603 - Advanced Topics in Algorithms and Complexity

Algorithms are the most fundamental area for all aspects of computer science and software engineering. Discrete structures, such as those treated in graph theory, set theory, combinatorics and symbolic logic form the mathematical underpinning of the study of algorithms. As well-designed algorithms and data structures are essential for the good performance of an information system, an in-depth understanding of the theoretical properties of algorithms is essential for any computer scientist. As importantly, the theoretical investigation of algorithms leads to a deeper understanding

of problem structures and classes of problems and the knowledge of a large variety of algorithm types enables the designer to approach a new problem from different angles.

Within the framework of this unit, the student can choose between a variety of specialisation modules in Algorithms and Discrete Structures. Most modules relate directly to the school's research strengths and are taught by active researchers in the respective fields. Research fields covered include:

- Computability and Complexity
- Automata Theory
- Advanced Analysis and Design of Algorithms
- Parallel and Distributed Algorithms
- Numerical Algorithms
- Cryptographic algorithms
- Spatial/geometric algorithms

Some of these topics may not be offered in every year.

CSE4604 - Advanced Topics in Computational Languages

Advanced working knowledge of programming languages is central to most activities in computer science. As students can expect to use many different languages and types of languages in their professional work, they should acquire knowledge of more than a single paradigm.

Modules in the framework of this unit

- introduce the student to different programming paradigms (such as logic programming, functional programming, agent-based programming)
- introduce specialized modelling/programming languages for particular types of problems (such as mathematical modelling languages, constraint languages and parallel languages)
- discuss formal concepts underlying programming languages, in particular (a) programming language semantics (b) type systems and calculi,
- discuss advanced issues in the implementation of programming languages

Some of these topics may not be offered in every year.

CSE4605 - Advanced Topics in Computational Science

All sciences are increasingly relying on computational support and the growth of many branches of science has only become possible due to the availability of efficient computational methods. The common basis of such methods are numerical methods and high performance computing.

Under the umbrella of this unit, the student can specialize in a particular areas of computational science by choosing from different modules including:

- Numerical Methods
- High Performance and Parallel Computing
- Optimization and Operations Research
- Bioinformatics
- Simulation, Visualization and Modelling

Some of these topics may not be offered in every year.

CSE4606 - Advanced Topics in Computer Networking

With the rapid growth of the internet and increasing use of company-internal networks, network-oriented computing has become a central field in the discipline. Within the framework of this unit, the student can choose between several modules which cover different advanced areas of network computing. Most of these modules relate directly to the school's research strength and are taught by active researchers in the respective fields. Topics covered include:

- Digital Communication Technologies: Local area networks; metropolitan area networks; satellite networks; ISDN; modem techniques; digital networks
- Network security
- Internet Protocols
- Advanced Network design and management
- Compression and Coding Methods
- Quality of Service

Some of these topics may not be offered in every year.

CSE4607 - Advanced Topics in Graphics and Visualisation

This unit covers advanced topics in computer graphics and visual interfaces. Within the framework of this unit, the student can choose between a variety of modules relating to these sub-fields. The topics relate directly to the school's research strength and are taught by active researchers in the respective fields. The fields covered include:

- Advanced image synthesis, including: polygonal rendering; local and global illumination models; hidden surface removal algorithms; parametric curve and surface representations; texturing; sampling and aliasing theory; and advanced lighting models.
- Advanced animation and modelling techniques, including: specification of models (mountain landscapes, plants, animals), their movements and high-level behaviour. Various means of giving "Artificial Life" to what are essentially sets of numbers are examined: dynamical systems including cellular automata and reaction-diffusion systems; explicitly, implicitly and aesthetically-directed genetic algorithms; virtual worlds and ecosystems; physical simulation.

Some of these topics may not be offered in every year.

CSE4608 - Advanced Topics in Computer Architecture and Systems

This unit covers topics in hardware architecture ranging from the gate level to processors and full computer architecture. Topics include

- Gate-level architecture
- VLSI design
- Hardware description languages and their application
- Hardware design specifications and methodology
- Software tools and packages for design, specification and
- Selected algorithms for digital design: Multipliers. Random Number Generators.
- FPGA, ASIC, etc.
- Machine organization
- Memory structures
- Architectures for parallel processing

Within the framework of this unit, students can select individual modules to specialise in a particular domain, such as VLSI design or parallel architectures. Some of these topics may not be offered in every year.

CSE4610 - Individual Study Unit in Computer Science / 0 point

This unit allows the student to study additional material and/or related fields pertaining to the topic of his/her chosen research project. Its contents is therefore individually defined. Please note that this is a 0 point unit, so you cannot count it towards fulfilling your degree requirements. However, the unit will appear on your transcripts so that your additional studies are documented.

CSE4611 - Individual Study Unit in Computer Science / 6 point

This unit covers advanced current research topics in computer, new emerging trends and research directions that are not covered in any other honours unit. Enrollment requires individual approval and it may not be offered in every year.

CSE4650 - Individual Honours Research Project

This subject introduces the student to independent research. Most projects are software-oriented, although some projects may be purely theoretical and others may involve hardware work.

A research project covers the whole process from initial problem analysis in a current research topic of computer science, literature study and evaluation of existing research and proposal of a research plan to carrying out the proposed research and presenting it in written and oral form. Where appropriate it includes the development of software (or hardware), from analysis through design to implementation and testing and documentation.

The project is conducted by the student in close cooperation with one or several staff members. The staff member will initially lead the project, help to formulate the initial research question and guide the student throughout the project. The staff member will arrange meetings with the student (typically weekly) in which intermediate results are reported and analysed and further directions for the project are decided on. The student is expected to read the relevant literature and carefully analyse the problem posed, to formulate a solution or proposals for a solution, and where appropriate, to implement and prove, evaluate or test the validity of their results and proposals.

The formal research skills training comprises weekly lectures as well as supervised literature study. Individual consultation is offered additionally for the improvement of presentation skills. Students also attend and evaluate regular school research seminars.

The research project is complemented by formal research training which is designed to improve the oral and written presentation skills and to teach the skills required for a critical analysis of current research. This component comprises lectures and seminars on presentation structuring, writing and editing, literature study, research methods, argument analysis and analysis of experiments and design and delivery of oral presentations.

ASSESSMENT: Project Evaluation by Supervisors and Additional Examiner(s) based on Deliverables, Final Report and Final Presentation (85%), Written Research Skills Assignment (5%), Presentations (10%): consisting of Initial Research Proposal (20%), First Seminar Presentation (mid-year interim presentation) (Hurdle), Literature Review (30%), Project Presentation as web site and/or poster (20%), Final Seminar Presentation (30%).

CSE4333 - Parallel system

Modern computer systems contain parallelism in both hardware andi software. This unit covers parallelism in both general purpose and application specific computer architectures and the programming paradigms that allow parallelism to be exploited in software. This unit examines both shared memory and message passing paradigms in both hardware and software; concurrency, multireading and synchronicity; parallel, clustered and distributed supercomputing models and languages.

7 Appendix B: Modules offered

Refer to the handbook or courseware web pages for details.