Graduate Brochure

General Information and Description of Graduate Degree Programs
Department of Computer Science and Engineering
Texas A&M University

Last Updated December 19, 2008

This document is a summary description of the graduate programs of the Department. Current and prospective graduate students should be familiar with appropriate requirements in the latest version of this document and the current Texas A&M University graduate catalog. Links to other relevant information are included at the end of this document and on the graduate program web pages: `http://www.cse.tamu.edu/academics/graduate`.

The degree requirements and all other information are subject to change without notice. Students who enroll at Texas A&M University will be allowed to graduate under the degree requirements in effect during their first semester. Every effort will be made to honor such obligations, although reasonable perturbations and substitutions may sometimes be required.

1 GENERAL INFORMATION

1.1 College Station/Bryan

The College Station/Bryan area has a 2008 population of approximately 190,000. Five of the six largest cities in Texas (Houston, Dallas, San Antonio, Ft. Worth, and Austin) are within 175 miles of the area. The Department has significant industrial connections in each of these cities. This is complemented by a growing industrial base in the local area. The area is known for a good quality of life that includes strong public school systems, parks, performing arts, sporting activities, and excellent, affordable housing.

1.2 Texas A&M University

Texas A&M University was established in 1876 as the first public institution of higher education in Texas, and is one of the state's flagship universities. Texas A&M was the first university in the nation to receive land, sea and space grant designations. It has 2,500 faculty; 9,100 graduate and professional students; and more than 37,000 undergraduate students on a spacious campus. Recent rankings of Texas A&M:

- Fourth in new National Merit scholars, nationally.
- Sixth in total value of endowments, nationally.
- Eleventh in research funding nationally.

1.3 The College of Engineering

The Dwight Look College of Engineering is one of the nations largest and is consistently listed among the country's top 15 graduate schools. It has 12 academic departments and is dedicated to providing a quality educational experience for its students. The college's minority engineering, women's, and honors programs are focal points in efforts to attract and retain students for engineering and science careers.

1.4 The Department of Computer Science and Engineering

The computer science programs at Texas A&M began in 1962 and the department was formed in 1983. Today, the Department includes 39 tenured and tenure-track faculty, 5 lecturers, and approximately 300 graduate students and 600 undergraduate majors.

The Department offers undergraduate and graduate degrees in Computer Science and, jointly with the Department of Electrical and Computer Engineering, in Computer Engineering.

1.5 Graduate Program

Advanced study in computer science and computer engineering provides students with the skills to design and utilize modern computer systems. The Department encourages both fundamental research in computing and interdisciplinary research. Research projects in diverse areas offer students a wide range of opportunities to gain experience while completing requirements for advanced degrees. Significant computational facilities, networks, and other resources are available to support student research.

Graduate studies in the Department can lead to the following degrees:

- Master of Computer Science (MCS)
- Master of Engineering in Computer Engineering (MEN)
- Master of Science in Computer Science (MSCS)
- Master of Science in Computer Engineering (MSCE)
- Doctor of Philosophy in Computer Science (PhDCS)
- Doctor of Philosophy in Computer Engineering (PhDCE)

The graduate degree programs are described in Section 4.

2 ADMISSION

2.1 Application Process and Deadlines

Applications for graduate study should be completed on-line. Application fees, deadlines, required documentation, test scores,

and other requirements are explained in the materials associated with either application format.

The application target date for fall (August) admission is January 1 of that year, for full consideration for admission, and for all departmental fellowships and assistantships. The general application deadline is March 1 for fall (August) admission and August 1 for spring (January) admission. This applies to both international and U.S. applications.

Admission to the Department of Computer Science and Engineering is very competitive and there are a limited number of openings available each year. Applications are typically not processed until they are complete, so make sure that all materials (e.g. letters, test scores) are submitted soon after the target date.

There are a number of fellowships, scholarships and assistantships that are awarded by the Department and the University each year to the most competitive applicants. Applications received by January 1 or soon thereafter will receive full consideration for all such opportunities. There are relatively few fellowships and assistantships awarded for spring (January) admission.

Read the Texas A&M Admissions application instructions located at: `http://admissions.tamu.edu/graduate`. Also see the Department's frequently-asked questions (FAQ) at `http://www.cse.tamu.edu/academics/graduate/faq-admissions`. You then follow this process:

1. Create an application in the *ApplyTexas* system (`http://www.applytexas.org`).
    a. Choose the option **Texas A&M University** from the dropdown list. (You can also apply to other Texas public universities with this system).
    b. If you are applying to the computer engineering program, select "Computer Engineering (Computer Science)" as the major. If you are applying to the computer science program, select "Computer Science" as the major. In either case, select the appropriate degree. The degree program is not considered in the admission process, so if you select the wrong program, do not be concerned. This can be changed after admission.
    c. You will be required to pay the admission fee. The fee **CANNOT** be waived. Do not send us emails requesting a fee waiver.
    d. Do **NOT** enter names of recommenders or statement of purpose (SOP) even if you are prompted to do so. You will do this later.
2. Your application will be forwarded to Texas A&M Admissions. This may take several days, particularly during holidays.
    a. Admissions will send you your university identification number (UIN). (The UIN is sometimes referred to as a student identification number – SID). It can take as long as three weeks to receive your UIN. You must wait patiently for it before you can proceed to the next step. Do not email the department asking for your UIN.
    b. You use your UIN to create your official email account. Your user name for this account is referred to as your NetID. Email regarding admissions is sent to this account.
3. Have your test scores and official transcripts of previous degrees sent to TAMU Admissions. See their web site for the precise procedure. They will then be sent to the Department. **DO NOT SEND THEM DIRECTLY TO THE DEPARTMENT.** GRE and TOEFL (if needed) test scores must be sent directly from the Educational Testing Service to Texas A&M University (Code 6003, no department code); the scores must be from test dates that are within five years for the GRE and within two years for the TOEFL at the time of **application**. *You can upload unofficial scores to the department, but you cannot be admitted without official scores.*
4. With your NetID and password, you will be able to access the Applicant Information System (AIS), `http://applicant.tamu.edu`, and edit your application information. Do **NOT** enter names of recommenders or a statement of purpose into AIS. If you did enter recommenders into AIS, do not enter them into the Department admission system (`http://apply2.cse.tamu.edu`).
5. TAMU Admissions will electronically send your application data to the department. This may only occur every few weeks if it is long before the target date or application deadline, about once a week as the dates get closer. There are no transfers during the roughly two weeks of vacation just prior to January 1. If you submitted your application in late December, do not be concerned about this delay.
6. You will receive an email to start using the Department admission system (`http://apply2.cse.tamu.edu`). This will be the only admission system you use for the remainder of the application process. When you receive this email, do the following:
    a. Enter official email addresses of all your recommenders (i.e. university email address).
    b. Upload your statement of purpose.
    c. Select areas of research interest.
    d. Upload resume and other relevant documents.
7. Once the recommendations, test scores and transcripts are received by the Department, your application will be complete.

8. You will be informed about the application decision via email. Decisions for PhD students are typically made by the end of February, while MS student decisions are typically made by the end of March, for fall admissions.

2.2 Entrance Requirements

Applicants must fulfill the requirements for admission to graduate studies as specified in the graduate catalog and should hold a bachelor's degree in computer science, computer engineering, or a related field, or equivalent experience. Undergraduate preparation should include:

- Data structures and analysis of algorithms.
- Operating systems, compilers, and database systems.
- Digital design and computer systems architecture.
- Several high-level programming languages.
- Mathematics including calculus, linear algebra, and discrete mathematics.

Students are responsible for all course prerequisites. While most undergraduate courses cannot be applied toward graduate degrees, graduate students may take them to ensure they have the appropriate preparation. Students are encouraged to discuss their background with the Graduate Advisor if they have questions.

All applicants are required to take the general Graduate Record Examination (GRE) and they are encouraged to take the GRE subject test in computer science, particularly if they do not have a traditional background.

Applicants whose native language is not English are required to submit proof of English proficiency, which is satisfied by:

- A minimum Test of English as a Foreign Language (TOEFL) score of:
    - 550 for paper-based testing (p-BT),
    - 213 computer-based testing (c-BT),
    - 80 internet-based testing (i-BT), or
- A minimum IELTS score of 6.0 overall band, or
- Completing all years of a Bachelor's degree or all years of an MS or PhD degree at a U.S. accredited university.

2.3 Evaluation Criteria

All applications are reviewed by the Department's Graduate Admissions Committee. The criteria used in evaluation of applicants for admission to graduate study in computer science include:

- academic performance on previous degrees,
- GRE scores and, if applicable, TOEFL scores,
- relevant background,
- letters of recommendation,
- the applicant's statement of purpose, and
- other relevant information.

The Admissions Committee is primarily interested in determining your potential to perform research.

2.4 Your Application

Be sure that you select your desired degree program correctly. There are separate options on the application for Computer Science and Computer Engineering; if you are applying to Computer Engineering, then you also need to select the department, Computer Science (CPSC) or Electrical and Computer Engineering (ECEN). You must then select your degree objective: doctor of philosophy (PhD), research masters with thesis (MS), or professional, terminal coursework only masters (MCS or MEN). Note that it is possible to enter the PhD program without first obtaining a masters degree.

Statement of Purpose: The department does not have any specific requirements for the one page statement of purpose. However, the committee would like to see a discussion of the following issues: why you want to pursue graduate studies in CS, why you are interested in Texas A&M, and most importantly, your research interests, your background for working in this area, and a description of your research plan (if any). You should not recall your earliest remembrances of exposure to a computer.

Letters of Recommendation: The preferred source of letters of recommendation is the faculty who advised you in research projects and who taught your most advanced computing courses. We are most interested in assessments of your research potential and scholarly aptitude, and your rank and performance in the courses they taught you. If you cannot obtain enough letters from your current or previous professors, then you may also include letters from employers. However, you should understand that in most cases such a letter will not be given the same weight as letters from your professors.

Other Items: We recommend that you include a brief resume (curriculum vitae) addressing university academics and closely related professional activities. If you are applying before graduating from your current degree program, indicate current and planned courses for which grades will not be on your transcripts.

If you have peer-reviewed technical publications in international conferences and journals, then you may include them with your application materials.

Things to Avoid: Please do not include information about secondary school performance, testing, or other pre-university studies. Do not submit copies of class projects or publications that did not appear in peer-reviewed international venues. If you feel you have additional material that is very important, then please place it on a webpage and submit the URL. You may include URLs that enable access to descriptions of your university programs but please do not include syllabi. Do not contact Department faculty until you have carefully studied their Web site and read their papers, so you can explain in detail why you think there is a good potential research match.

3 FINANCIAL SUPPORT

There are a number of fellowships, scholarships, and assistantships available within the Department of Computer

Science and Engineering. PhD students receive the highest priority for Departmental assistantships, fellowships and scholarships. Most faculty award their research assistantships similarly. Assistantship positions require an average of 20 hours of work per week. Assistantships include 9 credit-hours of tuition and fees. Students with assistantships are eligible for University health insurance coverage and a portion of their monthly premium is paid by the employer. Information on health insurance premiums and coverage is available at `http://ogs.tamu.edu/current/graduate-insurance` and `http://www.tamuinsurance.com`.

Unless they are a sponsored student, all applicants are automatically considered for university and departmental fellowships, scholarships and assistantships. You do not need to separately apply for financial support with your application. Students who are not admitted with financial support can apply for it at `http://apply2.cse.tamu.edu`. Applications for financial support are reviewed by the Department's Assistantship and Awards Committee. Note that international applicants do not need to submit financial support data to International Student Services until after they are admitted.

Research assistantships are offered by faculty. Inquiries about these opportunities may be initiated by individual faculty members or by students. If you intend to contact a faculty member, first study their web site and read their research publications, so that you can be certain there is mutual research interest.

Additional positions are available in other campus departments where students can work as programmers, systems analysts, web developers and computer operators. Some of these positions are graduate assistantships that qualify for the same benefits (such as in-state tuition) as Departmental assistantships. Arrangements with other departments are made by the student. See `http://jobsforaggies.tamu.edu` for postings of jobs outside the Department.

4 DEGREE PROGRAMS

This section describes the graduate degrees offered by the Department in Computer Science (Section 4.1) and in Computer Engineering (Section 4.2). The major steps and deadlines that should be completed for the various degrees are outlined in Section 4.3, and some restrictions and clarifications regarding degree requirements are given in Section 4.4. For additional information, please see the Department's graduate program web pages: `http://www.cse.tamu.edu/academics/graduate`.

Graduate students will be advised by the Graduate Advisor until they have formed an Advisory Committee and have an approved degree plan. Advisory Committee details are included with the description of each degree in this section. Appointments with the Graduate Advisor can be made by calling +1-979-845-4087 or sending email to: `grad-advisor@cse.tamu.edu`.

Degree plans are filed on the Office of Graduate Studies Degree Plan Submission System, `http://ogsdpss.tamu.edu`.

4.1 Computer Science

The Department of Computer Science and Engineering offers the following degrees in Computer Science: a professional masters degree (MCS), a masters degree with thesis (MSCS), and a PhD degree (PhDCS).

4.1.1 Master of Computer Science (MCS)

The Master of Computer Science (MCS) should be thought of as a professional, terminal degree. This degree does not include a thesis, project, or final examination.

Advisory Committee: MCS students will have a default advisory committee consisting solely of the Graduate Advisor as chair.

Degree Plan: The degree plan requirements for the MCS include:

- At least 18 credit hours of graded CPSC graduate coursework (excluding CPSC 681, 684, 685, 691).
- Three breadth CPSC courses, one selected from each of these sets: Theory (627, 629), Systems (605, 613, 614) and Software (604, 606, 655). These must be passed with a grade of B or better. These count toward the requirement of 18 hours of graded CPSC graduate coursework.
- At most one approved three-credit 400–level CPSC undergraduate course. See Section 4.4. This course does **NOT** count towards the 18 hours of CPSC graded graduate coursework.
- Up to 6 credit hours of non-CPSC graded graduate coursework (excluding 681, 684, 685, 691).
- 1 credit hour of CPSC 681 (Graduate Seminar).
- Up to 3 credit hours of CPSC 685 (Directed Studies).
- A total of at least 30 credit hours satisfying the above requirements.

The major steps, and deadlines for completing them, required for the MCS degree is outlined in Section 4.3. Section 4.4 lists restrictions on the courses that can be used on the degree plan, as well as other common questions/issues. For additional information and clarification, please see the graduate catalog and the Department's graduate program web pages.

4.1.2 Master of Science in Computer Science (MSCS)

The Master of Science in Computer Science (MSCS) is a research degree. A thesis and final examination (thesis defense) are required. Students who complete the MSCS may file a Letter of Intent requesting admission to the PhD program.

Advisory Committee The student must select an Advisory Committee Chair from the Department's graduate faculty. If a student wishes to have a Chair who does not have an appointment with the Department, then the committee must have two Co-Chairs, including one who is a member of the Department's graduate faculty. (A committee has either one Chair or two Co-Chairs.)

The Chair and the student work together to select the remainder of the Advisory Committee. The Advisory Committee for the

Master of Science in Computer Science (MSCS) consists of at least three members from the Texas A&M graduate faculty (the Chair count as a member). There must be at least one member from another department and there must be a majority from the Department. Note that all faculty members with full joint appointments in the Department will be considered as Departmental faculty when evaluating the composition of the committee. Faculty who hold courtesy appointments will count as outside members of the committee.

The Advisory Committee can have supplemental members who are not members of the Texas A&M graduate faculty (and hence do not count when evaluating the composition of the committee). Supplemental members are usually added because they have some special expertise that is relevant to the student's research topic. Such members are added by "special appointment" requests. Check with the Graduate Advising office for more information.

After the student and Chair agree on a tentative Advisory Committee, the student will then meet with each prospective committee member to determine whether this committee assignment is agreeable.

Degree Plan The degree plan should be completed by the student in consultation with the Chair and the Advisory Committee. The degree plan requirements for the MSCS include:

- At least 18 credit hours of graded CPSC graduate coursework (excluding CPSC 681, 684, 685, 691).
- Three breadth CPSC courses, one selected from each of these sets: Theory (627, 629), Systems (605, 613, 614) and Software (604, 606, 655). These must be passed with a grade of B or better. These count toward the requirement of 18 hours of graded CPSC graduate coursework.
- At most one approved three-credit 400–level CPSC undergraduate course. See Section 4.4. This course does **NOT** count towards the 18 hours of CPSC graded graduate coursework.
- At most 6 credit hours of non-CPSC graded graduate coursework (excluding 681, 684, 685, 691).
- 1 credit hour of CPSC681 (Graduate Seminar).
- 4 to 7 credit hours of CPSC 691 (Research). (A maximum of 7 credit hours of 685 and 691 combined.)
- A total of at least 32 credit hours.

The major steps, and deadlines for completing them, required for the MSCS degree is outlined in Section 4.3. Section 4.4 lists restrictions on the courses that can be used on the degree plan, as well as other common questions/issues. For additional information and clarification, please see the graduate catalog and the Department's graduate program web pages.

4.1.3 PhD in Computer Science (PhDCS)

Advisory Committee The PhD Advisory Committee is the same as the Master of Science in Computer Science (MSCS) degree except that it must have a minimum of four members, a majority from the Department and at least one from another department.

Degree Plan The degree plan should be completed by the student in consultation with the Chair and the Advisory Committee. The degree plan requirements for the PhD include:

- At least 30 credit hours of graded graduate coursework (excluding 681, 684, 685, and 691).
- Three breadth CPSC courses, one selected from each of these sets: Theory (627, 629), Systems (605, 613, 614) and Software (604, 606, 655). These must be passed with a grade of B or better. These count toward the requirement of 30 hours of graded graduate coursework.
- At most 6 credit hours of non-CPSC graded graduate coursework (excluding 681, 684, 685, 691). This counts towards the requirement of 30 hours of graded graduate coursework.
- 1 to 2 credit hours of CPSC681 (Graduate Seminar).
- At least 18 credit hours of CPSC 691 (Research). Normally the number of CPSC 691 hours will be increased to meet the required total number of credit hours.
- A total of at least 96 credit hours (or at least 64 credit hours if the student has a prior, approved and related masters degree).

The major steps, and deadlines for completing them, required for the PhDCS degree is outlined in Section 4.3. At most 32 credit hours from other graduate degree programs (e.g., an MSCS) can be applied to the PhD degree. Section 4.4 lists restrictions on the courses that can be used on the degree plan, as well as other common questions/issues. For additional information and clarification, please see the graduate catalog and the Department's graduate program web pages.

4.2 Computer Engineering

The Computer Engineering programs provide opportunities for students with interests in computer engineering to focus their studies more directly in this area. Degrees in computer engineering paralleling the computer science degrees are offered: a professional, terminal course-work only masters degree (MEN), a research masters degree (MSCE), and a PhD degree (PhDCE).

The Computer Engineering program is jointly administered by the Department of Computer Science and Engineering (CPSC) and by the Department of Electrical and Computer Engineering (ECEN). Each department has slightly different requirements for the various computer engineering degrees and hence students are cautioned to ensure that they are following the guidelines appropriate for their home department. Also, there are faculties in both departments that are designated as computer engineering faculty. See Section 7 for a listing of all computer engineering faculty in the Department of Computer Science and Engineering or see `http://ce.tamu.edu` for a listing of all computer engineering faculty in both departments.

4.2.1 Master of Engineering (MEN)

The Master of Engineering in Computer Engineering (MEN) should be thought of as a professional, terminal degree. This degree does not include a thesis, project, or final examination.

Advisory Committee: MEN students will have a default advisory committee consisting solely of the Graduate Advisor as chair.

Degree Plan The degree plan requirements for the MEN degree include:

- At least 12 credit hours of graded CPSC graduate coursework (excluding CPSC681, 684, 685, 691).
- At least 6 credit hours of graded ECEN graduate coursework that is not cross-listed with CPSC (excluding ECEN 681, 684, 685, 691).
- At least 6 credit hours of graded elective graduate coursework (excluding 681, 684, 685, and 691). This may include CPSC, ECEN, or other approved graduate courses.
- At most one approved three-credit 400–level CPSC undergraduate course. See Section 4.4. This course does **NOT** count towards the 12 hours of CPSC graded graduate coursework.
- 1 credit hour of CPSC 681 (Graduate Seminar).
- Up to 3 credit hours of CPSC 685 (Directed Studies).
- A total of at least 30 credit hours satisfying the above requirements.

The major steps, and deadlines for completing them, required for the MEN degree is outlined in Section 4.3. Section 4.4 lists restrictions on the courses that can be used on the degree plan, as well as other common questions/issues. For additional information and clarification, please see the graduate catalog and the Department's graduate program web pages.

4.2.2 Master of Science in Computer Engineering (MSCE)

The Master of Science in Computer Engineering (MSCE) is a research degree. A thesis and final examination (thesis defense) are required. Students who complete the MSCE may file a Letter of Intent requesting admission to the PhD program.

Advisory Committee The MSCE advisory committee is like that of the MSCS degree with the additional requirement that the Chair or a Co-Chair must be a member of the computer engineering faculty (see Section 7).

Degree Plan The degree plan should be completed by the student in consultation with the Chair and the Advisory Committee. The degree plan requirements for the MSCE degree include:

- At least 12 credit hours of graded CPSC graduate coursework (excluding CPSC 681, 684, 685, 691).
- At least 6 credit hours of graded ECEN graduate coursework that is not cross-listed with CPSC (excluding ECEN 681, 684, 685, 691).
- At least 6 credit hours of graded elective graduate coursework (excluding 681, 684, 685, and 691). This may include CPSC, ECEN, or other approved graduate courses.
- At most one approved three-credit 400–level CPSC undergraduate course. See Section 4.4. This course does **NOT** count towards the 12 hours of CPSC graded graduate coursework.
- 1 credit hour of CPSC 681 (Graduate Seminar).
- 4 to 7 credit hours of CPSC 691 (Research). (A maximum of 7 credit hours of 685 and 691 combined).
- A total of at least 32 credit hours.

The major steps, and deadlines for completing them, required for the MSCE degree is outlined in Section 4.3. Section 4.4 lists restrictions on the courses that can be used on the degree plan, as well as other common questions/issues. For additional information and clarification, please see the graduate catalog and the Department's graduate program web pages.

4.2.3 PhD in Computer Engineering (PhDCE)

Advisory Committee The PhDCE advisory committee is like that of the PhDCS degree with the additional requirement that the Chair or a Co-Chair must be a member of the computer engineering faculty.

Degree Plan The degree plan should be completed by the student in consultation with the Chair and the Advisory Committee. The degree plan requirements for the PhD include:

- At least 30 credit hours of graduated graduate coursework (excluding 681, 684, 685, 691).
- At least 12 credit hours of graded CPSC graduate coursework (excluding CPSC 681, 684, 685, 691).
- At least 6 credit hours of graded ECEN graduate coursework that is not cross-listed with CPSC (excluding ECEN 681, 684, 685, 691).
- At least 12 credit hours of graded elective graduate coursework (excluding 681, 684, 685, and 691). This may include CPSC, ECEN, or other approved graduate courses.
- 1 to 2 credit hours of CPSC681 (Graduate Seminar).
- At least 18 credit hours of CPSC 691 (Research). Normally the number of CPSC 691 hours will be increased to meet the required total number of credit hours.
- A total of at least 96 credit hours (or at least 64 credit hours if the student has a prior, approved and related masters degree).

The major steps, and deadlines for completing them, required for the PhDCE degree is outlined in Section 4.3. At most 32 credit hours from other graduate degree programs (e.g., an MSCE) can be applied to the PhD degree. Section 4.4 lists restrictions on the courses that can be used on the degree plan, as well as other common questions/issues. For additional information and clarification, please see the graduate catalog and the Department's graduate program web pages.

4.3 Requirements and Deadlines for Graduate Degrees

This section outlines the major steps, and deadlines for completing them, that should be completed for the various degrees:

- MCS and MEN (non-thesis masters degrees)
- MSCS and MSCE (thesis masters degrees)
- PhDCS and PhDCE

The Department has additional procedures or requirements that students are responsible for following and which are documented on the Department's graduate program web pages.

As noted below, many of the steps have associated OGS forms that need to be submitted. These forms are available on the OGS website `http://ogs.tamu.edu`. In all cases, the student is responsible for filling out the form before bringing it to the Graduate Advising office for Departmental approval. OGS forms are PDF templates, and students must **TYPE** in all entries before printing out the form (this includes the faculty member names, which appear below the signature line). Hand-written forms are not accepted. MS and PhD students should also obtain the signatures of their committee members (but not the Department Head) before bringing the forms to the advising office. The Graduate Advising staff will submit approved forms to the OGS.

4.3.1 MCS and MEN requirements and deadlines

This section lists the major steps that must be completed for the MCS and MEN degrees. Much of this information is taken from the 'Steps to Fulfill Masters Degree Requirements' on the Office of Graduate Studies (OGS) website.

Information about Departmental procedures and requirements for these steps is available on the graduate program web pages.

As noted above, many of the steps have associated OGS forms that need to be submitted. These forms are available on the OGS website. In all cases, the student is responsible for filling out the form before bringing it to the advising office for Departmental approval. The Graduate Advising office will obtain the signatures of the Graduate Advisor and the Department Head and submit the forms to the OGS.

- **Degree Plan.** MCS and MEN students must file an approved degree plan.
  *OGS Form***s**: Degree Plan. Degree plans are filed online at `http://ogsdpss.tamu.edu`.
  Departmental Procedures: No.
  Deadline: By the end of the first semester after the student has completed 9 credit hours (normally their second semester). Students are blocked from registration the week before early registration for the next semester, roughly the first week in November (if the student started in spring) and the first week in April (if the student started in fall).
- **Final Examination.** The oral final exam for the MCS and MEN is waived. Once the student files for graduation and appears on the graduation list, the department submits the Request for Exemption from Final Examination form to OGS. Students must file for graduation by the official deadline (typically the end of the second week of the semester) in order to ensure that the Final Exam exemption is filed on time. ***Failure to file for graduation on time will result in failure to graduate that semester.***

4.3.2 MSCS and MSCE

This section lists the major steps that must be completed for the MSCS and MSCE degrees. Much of this information is taken from the 'Steps to Fulfill Masters Degree Requirements' on the Office of Graduate Studies (OGS) website: `http://ogs.tamu.edu`. Information about Department procedures is available on the graduate program web pages: `http://www.cse.tamu.edu/academics/graduate`.

As noted above, many of the steps have associated OGS forms that need to be submitted. These forms are available on the OGS website. In all cases, the student is responsible for filling out the form and getting the signatures of all committee members (but **NOT** the Department Head) before bringing the form to the Graduate Advising office for Departmental approval. The Advising staff will submit the forms to the OGS.

- **Advisory Committee and Degree Plan**. MSCS and MSCE students must form an Advisory Committee and file an approved degree plan.
  OGS Forms: Degree Plan. Degree plans are filed online at `http://ogsdpss.tamu.edu`.
  Departmental Procedures: No.
  Deadline: By the end of the first semester after the student has completed 9 credit hours (normally their second semester), and no later than 120 days prior to submission of the Request for Final Examination (thesis defense) to OGS. Students are blocked from registration the week before early registration for the next semester, roughly the first week in November (if the student started in spring) and the first week in April (if the student started in fall).
- **Thesis Proposal**. The student must submit a Master of Science thesis proposal as described in the graduate catalog.
  OGS Forms: Proposal Title Page
  Departmental Procedures: Yes, documented on web pages.
  Deadline: The thesis proposal cannot be submitted before the degree plan and it must be submitted to OGS at least 15 calendar days before the Request for Final Examination (thesis defense) is submitted to OGS (or about 4 weeks before the defense). Precise submission deadlines for graduation in a particular semester are listed on the OGS calendar.
- **Final Examination**. The student must pass a final oral examination given by the Advisory Committee as described in the graduate catalog. The part of the final examination that is related to the presentation of the student's research is public (Thesis Defense).
  OGS Forms: Request for Final Examination, Report of Final Exam (sent to Advisory Committee Chair by OGS)
  Departmental Procedures: Yes, documented on web pages.

Deadlines: The Request for Final Examination must be received by OGS at least 10 working days before the exam. Final exam deadlines are listed on the OGS calendar (usually about 8 weeks before graduation).

- **Thesis**. The student must submit a Master of Science thesis as described in the graduate catalog and on the OGS website.
  OGS Forms: Thesis Approval Form
  Departmental Procedures: Yes, documented on web pages.
  Deadline: Thesis submission deadlines are listed on the OGS calendar (usually about 6 weeks before graduation).

4.3.3 PhDCS and PhDCE

This section lists the major steps that should be completed for the PhD in computer science or in computer engineering. Much of this information is taken from the 'Steps to Fulfill Preliminary Exam' and 'Steps to Fulfill Doctoral Degree Requirements' on the OGS website: `http://ogs.tamu.edu`. Information about Department procedures is available on the graduate program web pages.

As noted below, many of the steps have associated OGS forms that need to be submitted. These forms are available on the OGS website. In all cases, the student is responsible for filling out the form and getting the signatures of all committee members (but **NOT** the Department Head) before bringing the form to the advising office for Departmental approval. The Graduate Advising staff will submit the forms to the OGS.

- **Advisory Committee and Degree Plan**. PhD students must form an Advisory Committee and file an approved degree plan.
  OGS Forms: Degree Plan. Degree plans are filed online at `http://ogsdpss.tamu.edu`
  Departmental Procedures: No.
  Deadline: By the end of the student's third semester, and at least 90 days prior to the preliminary exam. The precise deadline prior to the preliminary exam is listed on the OGS calendar.
- **Preliminary Exam**. The student must pass the Preliminary Examination given by the Advisory Committee as described in the graduate catalog. The Preliminary Exam consists of written and oral portions. Each committee member is scheduled to administer a written exam during the 3 weeks prior to the common oral examination.
  OGS Forms: Preliminary Exam Checklist, Report of the Preliminary Exam
  Departmental Procedures: Yes, documented on web pages.
  Deadline: Eligibility requirements and deadlines for scheduling and reporting on PhD Preliminary Exams are documented on the graduate program web pages. Roughly, the Preliminary Exam is typically held at about the time that the degree plan coursework requirements are completed, and it cannot be taken in the same semester that the degree plan is filed or that the student plans to defend.
- **Dissertation Proposal**. The student must submit a PhD dissertation proposal as described in the graduate catalog. The dissertation proposal may be presented at the oral preliminary exam, or at a separate proposal presentation, at the discretion of the Advisory Committee.
  OGS Forms: Proposal Title Page
  Departmental Procedures: Yes, documented on web pages.
  Deadline: Typically the Preliminary Exam is passed before the approved proposal is submitted. The university requires that the proposal be submitted to OGS at least 15 calendar days before the Request for Final Examination is submitted to OGS (or about 4 weeks before the defense). Precise deadlines are listed on the OGS calendar.
- **Final Examination**. The student must pass the Final Examination (Dissertation Defense) given by the Advisory Committee as described in the graduate catalog. A final examination is required, which includes a public presentation of the candidate's research.
  OGS Forms: Request for Final Examination, Report of Final Exam (sent to Advisory Committee Chair by OGS)
  Departmental Procedures: Yes, documented on web pages.
  Deadlines: Eligibility requirements for scheduling and reporting on PhD Final Exams (Dissertation Defenses) are documented in the graduate catalog. The Final Examination cannot be held until all coursework on the degree plan has been completed and the Request for Final Examination must be received by OGS at least 10 working days before the exam. Final exam deadlines are listed on the OGS calendar (usually about 8 weeks before graduation).
- **Dissertation**. A PhD Dissertation as described in the graduate catalog and on the OGS website. The ability to perform independent research must be demonstrated by the dissertation. The dissertation must be the original work of the candidate. While acceptance of the dissertation is based primarily on its scholarly merit, it must also exhibit creditable literary workmanship. (Please see the graduate catalog for further details.) The Departments expects the student to submit a research paper to at least one refereed journal or conference prior to the dissertation defense.
  OGS Forms: No
  Departmental Procedures: Yes, documented on web pages.
  Deadline: The approved dissertation cannot be submitted until the Final Examination has been passed and it must be submitted within one year of the Final Examination. Dissertation submission deadlines are listed on the OGS calendar (usually about 6 weeks before graduation). See the Thesis Clerk web site (`http://thesis.tamu.edu`) for more details.

4.4 Degree Plan Restriction and Clarifications

There are some restrictions on the courses that can be used on degree plans. Some of the most common issues are noted below. Some of these are Office of Graduate Studies requirements and some are Departmental requirements. Unless otherwise noted, the restrictions apply to all graduate degrees offered by the Department. For additional information and clarification, please see the graduate catalog and the Department's graduate program web pages.

All Graduate Degrees

- Courses used for one degree cannot be used to reduce the number of credit hours required for another degree, and courses that are apparently the same cannot both be used for credit. An exception is that a previous related masters degree can be used to reduce the total number of hours required for the PhD degree from 96 to 64.
- Graded graduate courses used for a previous degree can be used to reduce the number of graded graduate courses that need to be taken for the current degree. Typically, the student replaces the credit hours that would have been used for the courses with CPSC 691 credit hours. For example, if a PhD student took 24 hours of graded graduate coursework as part a MS degree from our department, then they would file a 64 hour PhD degree plan and it would only need to have 6 credit hours (i.e., 2 courses) of graded graduate coursework on it to reach the 30 hours required of a PhD. Similarly, if a student took a graduate computer architecture course at another university, and received a grade of A or B, then this could be used to satisfy the Systems breadth requirement. The Graduate Advisor must approve any courses taken at another university that will be used to meet current degree requirements.
- Graduate service courses offered by the department cannot be used on degree plans for graduate credit. These include CPSC 601, 602, 603 and 612. CPSC 611 can be used on MS, MCS and MEN degree plans if it is taken in spring 2009 or later.
- All normally-graded courses on a degree plan must be taken for a letter grade, rather than S/U grade. Courses such as CPSC 681, 684 and 691, that are normally graded S/U, can be used on a degree plan as S/U.
- Due to their overlap in content, CPSC625 cannot be used on degree plans if the student has previously taken CPSC420.
- CPSC 684 (Professional Internship) does not count towards the total hours required on a degree plan. Any CPSC 684 hours must be in addition to the minimums required on the degree plan.
- At most 12 credit hours of courses taken in post baccalaureate non-degree (G6) status at Texas A&M can be used on the degree plan; this requires approval of the student's Graduate Advisory Committee, the Department Head, the college dean, and the Office of Graduate Studies.

Masters Degrees (MCS, MEN, MSCS, MSCE)

- The MCS, MEN, MSCS, and MSCE degrees allow at most one approved three-credit 400–level CPSC undergraduate course to be used on the degree plan. Courses that cannot be used include courses apparently the same as courses the student took for their own previous degree(s) and courses that are required for the CS or CE undergraduate degree at Texas A&M. Courses that are not permitted are: CPSC 420 (Artificial Intelligence), CPSC 431 (Software Engineering), CPSC 433 (Formal Languages), CPSC 462 (Microprocessor Systems), CPSC 482 (Senior Capstone Design) and CPSC 483 (Computer Systems Design). If CPSC 410 (Operating Systems) is stacked with CPSC 611, students must take CPSC 611, not CPSC 410. Only CPSC 410/611 taken in spring 2009 or later is permitted on a degree plan.
- At most 12 credit hours of transfer credit can be used on a degree plan. Transfer credit must be approved by the Graduate Advisor.

Doctoral Degrees (PhDCS and PhDCE)

- At least 6 credit hours of graded CPSC graduate coursework (excluding 681, 684, 685, and 691) must be taken at Texas A&M University in College Station. Thus, even if a student appears to satisfy all coursework requirements by a previous graduate degree or from transfer credit, they will still be required to take at least two graded graduate CPSC courses at Texas A&M.

5 PROGRAM REQUIREMENTS

Graduate students must fulfill the residence and scholastic requirements for graduate study as specified in the graduate catalog. In addition, the Department has these requirements:

5.1 Grade Point Requirements

Two grade point averages, or ratios (GPRs), are computed for graduate students at Texas A&M University, the GPR of all courses listed on the degree plan and the cumulative GPR. The cumulative GPR includes all graded graduate (600 level) and advanced undergraduate (300 and 400 level) course work completed at Texas A&M that has not been applied towards a prior graduate degree.

To be in good academic standing, both the degree plan GPR and the cumulative GPR must be at least 3.000. A student whose grades drop below this level is considered to be scholastically deficient and will be placed on departmental probation. Students that are scholastically deficient may be blocked from registration, and, by university regulations, will not be allowed to graduate, schedule final exams (defenses), preliminary exams, etc. Scholastic deficiency may also result in the loss of fellowships or scholarships.

Each graduate assistant funded by the Department must maintain a grade average of 3.25 in both the degree plan GPR and in the cumulative GPR. A graduate assistant whose grades drop below this level may lose their assistantship. PhD students who are rated Unsatisfactory in the annual PhD review are not eligible for departmental assistantships or scholarships.

5.2 Registration Requirements

The University and the Department both have registration requirements and students must satisfy them both. The number of hours that a student is required to be registered depends on the semester (e.g., usually fewer hours are required in the summer than in fall or spring semesters) and the student's individual situation including factors such as whether they have an assistantship, completion status, and (if applicable) visa status. These rules are subject to change and should be reviewed

before each registration. Updated information and clarifications can be found on the graduate program web pages.

6 COURSES

This section lists graduate courses offered by the Department of Computer Science and Engineering (CPSC) that appear in the 2008-2009 graduate catalog. Related courses are also offered by the Departments of Electrical and Computer Engineering (ECEN) and Mathematics (MATH), and Visualization (VIZA).

When determining the courses they plan to take for their degree programs, students need to be aware that not all of these courses are offered every year. The breadth courses (604, 605, 606, 613, 614, 627, 629 and 655) will normally be offered every year. In many cases, the more specialized graduate courses are offered every two years. However, there are some courses that are taught even less frequently than every two years. Few or no CPSC graduate courses are offered in the summer. There are usually several CPSC 689 Special Topics courses offered each fall and spring semester, and students are encouraged to be flexible in their course planning so that they can take advantage of these courses. An approximate two year schedule of graduate course offerings is available on the graduate program web pages.

All graduate courses meet 2.5 hours per week and are 3 credits, unless otherwise noted. A listing of the courses annotated with appropriate faculty and a condensed catalog description follow. All courses assume the undergraduate degree as prerequisite. The instructor may also waive prerequisites.

601, 602, 603, 611 and 612. These courses are offered as service courses to the rest of the university community. Credit in these course may be used to satisfy prerequisites but not toward a graduate degree in Computer Science or Computer Engineering. CPSC 611 may be used if taken in spring 2009 or later and it is stacked with CPSC 410 (Operating Systems).

604 Programming Languages. Jarvi, Stroustrup. Study of the design space of programming languages, covering language processing, formalisms to describe semantics of programming languages, important concepts found in current programming languages and programming paradigms.

605 Compiler Design. Chen, Friesen, Furuta, Rauchwerger. Advanced topics in compiler writing; parser generators and compiler-compilers; dynamic storage and scope resolution; data flow analysis and code optimization. Prerequisite: CPSC 434.

606 Software Engineering. Lively, G. Williams. Development of advanced concepts in software engineering; software development environments as a mechanism for enhancing productivity and software quality; the classification, evaluation, and selection of methodologies for environments; rapid prototyping and re-usability concepts; artificial intelligence techniques applied to software engineering; transformational systems; maintenance environments. Prerequisite: CPSC 431.

608 Database Systems. Chen. Basic database models; concepts in database systems including knowledge representation and knowledge-based systems; database architectures, network and distributed databases; database design and performance measurements; query languages and natural language interfaces. Prerequisite: CPSC 310 or 603.

610 Hypertext/Hypermedia Systems. Furuta, Kerne, Leggett, Shipman. Comprehensive coverage of the area of hypertext/hypermedia systems. Course content: the history of hypertext, a survey of current hypertext systems, and research directions in hypertext. Appropriate database models, information retrieval models and user interface models are studied. Prerequisites: CPSC 310 or 603; CPSC 313.

613 Operating Systems. Pooch. Analysis of algorithms in operating systems; sequencing and control algorithms supporting concurrent processes; scheduling algorithms to minimize execution time and mean flow times; algorithms for allocating tasks to processors. Prerequisites: CPSC 313 or 611.

614 Computer Architecture. Kim, Liu, Mahapatra, Rauchwerger, Walker. von Neumann architecture and limitations; concepts of parallel computer structures and concurrent computation; analysis of pipeline computers, array processor machines and multiprocessor systems; control models for control-driven, data-driven and demand-driven machines. Discussion and analysis of intelligent interfaces, inference machines and knowledge-based systems. Prerequisite: CPSC 350.

617 Co-Design of Embedded Systems (CODES). Mahapatra. Co-design methodologies of hardware-software systems; models of computation (MOC), system specification, co-simulation, synthesis, and verification; hardware-software implementation; core-based systems and interfaces, performance analysis and optimization; system on chip, power aware design. Prerequisites: CPSC 462 or equivalent (CPSC 410).

619 Networks and Distributed Computing. Liu, Loguinov, Mahapatra, Pooch. Computer network concepts including network architecture, layering, protocols, packet switching and virtual circuits; performance evaluation and design considerations for local area networks; packet distributed networks; satellite networks; distributive processing including array, parallel and multiprocessor systems. Prerequisite: CPSC 463 or 612.

620 Computational Geometry. Amato, Chen, Friesen. Design and analysis of algorithms for solving geometrical problems. Includes convex hull problems, Voronoi diagrams, range searching, and proximity problems. Prerequisite: CPSC 311. Cross-listed with VIZA 670.

622 Generic Programming. Jarvi. The generic programming approach to design and systematic classification of software components, techniques for achieving correctness, efficiency, and generality of algorithms, data structures, and memory management, methods of structuring a library of generic software components for maximum usability are practiced in a significant design and implementation project. Prerequisite: CPSC 221.

625 Artificial Intelligence. Choe, Friesen, Gutierrez-Osuna, Ioerger, G. Williams. Basic concepts and methods of Artificial Intelligence. Heuristic search procedures for general graphs. Game playing strategies. Resolution and rule-based deduction systems. Knowledge representation. Reasoning with uncertainty. Prerequisite: CPSC 221.

626 Parallel Algorithm Design and Analysis. Amato, Chen, Friesen, Rauchwerger, Welch, T. Williams. Design of algorithms for use on highly parallel machines; area-time complexity of problems and general lower bound theory; application (of these concepts) to artificial intelligence, computer vision and VLSI design automation. Prerequisite: CPSC 221.

627 Theory of Computability. Chen, Friesen, Sze, Welch, T. Williams. Formal models of computation such as pushdown automata, Turing machines and recursive functions; unsolvability results; complexity of solvable results. Prerequisites: CPSC 433.

628 Computational Biology. Amato, Chen, Sze, T. Williams. Introduction to computational biology; formulations of biology problems as computational problems; computational approaches to solve problems in genomics and proteomics. Cross-listed with BICH 628.

629 Analysis of Algorithms. Amato, Chen, Friesen, Klappenecker, Welch. Concrete algorithm design and analysis; abstract models to analyze the complexity of problems; NP-completeness; approximation and probabilistic algorithms. Prerequisite: CPSC 411.

631 Intelligent Agents. Ioerger. On the design and implementation of Intelligent Agents and coordination mechanisms among multiple agents, ranging from theoretical principles to practical methods for implementation. Prerequisites: CPSC 420 or 625.

633 Machine Learning. Gutierrez-Osuna, Ioerger, Kerne. This course will survey machine learning techniques, which include induction from examples, conceptual clustering, explanation-based learning, exemplar learning and analogy, discovery, and genetic algorithms. Prerequisite: CPSC420 or 625.

634 Intelligent User Interfaces. Shipman. Intersection of artificial intelligence and computer-human interaction: emphasis on designing and evaluating systems that learn about and adapt to their users, tasks, and environments.

636 Neural Networks. Choe, Gutierrez-Osuna. Basic concepts of neural computing. Functional equivalence and convergence properties of neural network models: Cohen-Grossberg theorem. Associative memory models: bi-directional associative memories. Adaptation and learning in neural networks: associative, competitive and adaptive resonance models of learning. Models of category learning. Conditioning and attention models. Selective applications of neural networks to vision, speech, motor control and planning with relative emphasis varying year to year. Neural network modeling environments. Laboratory. Prerequisite: MATH 304 or 308.

637 Complexity Theory. Chen, Friesen, Welch. Deterministic, non-deterministic, alternating and probabilistic computations; reducibilities; P, NP, and other complexity classes; abstract complexity; time, space and parallel complexity; and relativized computation. Prerequisites: CPSC 627.

639 Fuzzy Logic and Intelligent Systems. Langari (MEEN). This course covers concepts and techniques in fuzzy logic as well as their applications for developing intelligent systems for control, decision making, and pattern recognition. Topics to be covered include fuzzy sets, fuzzy rule-based inference, fuzzy logic control, possibility theory and its relationship to probability theory, fuzzy expert systems, neurofuzzy systems, and fuzzy pattern recognition. Prerequisite: CPSC 625.

640 Quantum Algorithms. Klappenecker. Introduction to the design and analysis of quantum algorithms; basic principles of the quantum circuit model; gives a gentle introduction to basic quantum algorithms; reviews recent results in quantum information processing. Prerequisite: CPSC 629.

641 Computer Graphics. Chai, Keyser, Schaefer, G. Williams. Representation of 3D models; hidden edge/surface removal; shading models; transparency, intensity and color. Animation, surface patches and ray tracing; current topics in interactive graphics. Prerequisite: CPSC 441. Cross-listed with VIZA 671.

643 Seminar in Intelligent Systems and Robotics. Song. Problems, methods and recent developments in intelligent systems and robotics. This course may be taken at multiple times for credit as content varies.

644 Cortical Networks. Choe. Architecture of the mammalian cerebral cortex; its modular organization and its network for distributed and parallel processing; cortical networks in perception and memory; neuronal microstructure and dynamical simulation of cortical networks; the cortical network as a proven paradigm for the design of cognitive machines. Prerequisites: CPSC 420 or 625 and 636.

645 Geometric Modeling. Keyser, Schaefer. Geometric and solid modeling concepts including free-form curves and surfaces (splines and Bezier) with relational, intersectional and global mathematical properties. Parametric solid representation; topology of closed curved surfaces; boundary concepts and set theoretic operators. Graphical construction and display of simple solid models. Prerequisite: CPSC 441 and 442. Cross-listed with VIZA 675.

646 The Digital Image. Credit 4. Akleman (VIZA), Keyser. Tools and techniques for generation, handling, and analysis of two dimensional digital images; image representation and storage; display, media conversion, painting and drawing; warping; color space operations, enhancement, filtering and manipulation. Prerequisite: VIZA 653. Cross-listed with VIZA654.

647 Image Synthesis. Credit 4. Akleman (VIZA), Keyser. Principles of image synthesis from 3-D scene descriptions; includes local and global illumination, shading, shadow determination, hidden surface elimination, texturing, raster graphics algorithms, transformations and projects. Prerequisites: VIZA 653. Cross-listed with VIZA 656.

648 Computer Aided Sculpting. Akleman (VIZA), Keyser. Mathematical and artistic principles of 3-D modeling and sculpting; includes proportions, skeletal foundation, expression and posture, line of action; curves, surfaces and volumes, interpolation and approximation, parametric and rational parametric polynomials, constructive solid geometry, and implicit representations. Cross-listed with VIZA 657.

649 Physically-Based Modeling. Akleman (VIZA), Keyser. Physical simulation as used in choreography, geometric modeling, and the creation of special effects in computer graphics; a variety of problems and techniques explored which may include particle-methods, modeling and simulation of flexible materials, kinematics and constraint systems. Cross-listed with VIZA 659.

653 Computer Methods in Applied Sciences. Sarin, G. Williams. Use of modern and classical algorithms in obtaining numerical solutions to problems from the physical sciences. Student development of a repertoire of computation techniques. Linear and nonlinear least squares, spectral analysis, solution of initial and boundary value problems in ordinary and partial differential equations. Prerequisite: CPSC 442 or MATH 417.

654 Supercomputing. Rauchwerger, Sarin, G. Williams. Principles of high-performance scientific computing systems, vectorization, programming supercomputers, numerical methods for supercomputers, performance measuring of supercomputers, multitasking. Prerequisite: CPSC 614.

655 Human Centered Systems and Information. Kerne. A foundation course in human centered systems and information; understanding and conceptualizing interaction; design and prototyping methodologies; evaluation frameworks; visual design using color, space, layering and media; information structuring and visualization; animation and games; individual and team programming projects.

659 Parallel/Distributed Numerical Algorithms and Applications. Sarin, G. Williams. A unified treatment of parallel and distributed numerical algorithms; parallel and distributed computation models, parallel computation of arithmetic expressions; fast algorithms for numerical linear algebra, partial differential equations and nonlinear optimization. Prerequisites: MATH 304, CPSC 653. Cross-listed with ECEN 659.

660 Computational Linear Algebra. Sarin, G. Williams. Techniques in matrix computations: elimination methods, matrix decomposition, generalized inverses, orthogonalization and least squares, eigenvalue problems and singular value decomposition, iterative methods and error analysis. Prerequisite: CPSC 442 or MATH 417. Cross-listed with MATH 660.

661 Integrated Systems Design Automation. Walker. VLSI design systems and their levels of abstracting; algorithms for general VLSI design and implementation; computer aided design tools and principles; physical and logical models.

662 Distributed Processing Systems. Bettati, Loguinov, Pooch, Welch. Principles and practices of distributed processing; protocols, remote procedure calls; file sharing; reliable system design; load balancing; distributed database systems; protection and security; implementation. Prerequisite: CPSC 313 or 463 or 611 or 612.

663 Real-Time Systems. Bettati. Taxonomy of real-time computer systems; scheduling algorithms for static and dynamic real-time tasks; hard real-time communications protocols; programming languages and environments for real-time systems; case studies of real-time operating systems. Prerequisites: CPSC 313 or 611, and CPSC 463 or 611.

665 Advanced Networking and Security. Pooch. Security aspects of various network protocols including investigation and tool development using "live" machines and networks.

667 Collaborative Systems and Models. Shipman. Collaborative systems support group activities over computer networks; emphasis on human factors, system design is different from traditional systems; overviews existing research efforts to address various design issues; state-of-the-art knowledge and how to implement collaborative applications. Prerequisites: CPSC 310 or 603, 313 or 611, a programming language (C++/JAVA) and CPSC 436 or 671 or 672.

668 Distributed Algorithms and Systems. Friesen, Welch. Study of algorithms for distributed computer systems, especially loosely-coupled and failure-prone systems; formal models, algorithm design and analysis, lower bounds and impossibility proofs. Prerequisite: CPSC 629.

669 Computational Optimization. Chen, Friesen. Combinatorial theory of polytopes as a tool for the solution of combinatorial optimization problems; applications to max flow, matching and matroids; geometric interpretation of the results indicating the profound role that polyhedral combinatorics plays in the design and complexity of approximation algorithms. Prerequisite: CPSC 629.

670 Information Storage and Retrieval. Caverlee, Furuta. Information retrieval deals with the representation, storage, and access to very large multimedia document collections. Fundamental data structures and algorithms of current information storage and retrieval systems and relates various techniques for the design and evaluation of complete retrieval systems. Algorithms for indexing, compressing, and querying large digital collections are studied. Prerequisite: CPSC 310 or 603.

671 Computer-Human Interaction. Furuta, Kerne, Shipman. Course content includes the history and importance of computer-human interaction (CHI), theories of CHI design, modeling of computer users and interfaces, empirical techniques for task analysis and interface design, styles of interaction and future directions of CHI.

672 Computer-Supported Collaborative Work. Furuta, Shipman. Design, implementation and use of technical systems that support people working cooperatively; current theoretical, practical, technical and social issues in CSCW and future directions of the field; theoretical models of cooperative work, computer-mediated communication, group decision support systems, situation theory, and technical innovations such as electronic meeting rooms, liveboards, shared editors, and

synchronous and asynchronous communication technologies. Prerequisite: CPSC 610 or 671.

673 Information, Secrecy, and Authentication I. Pooch, Blakley (MATH). Preliminaries: probability, information, entropy, signals, channels; group-theoretic view of messages; contemporary secrecy and digital signature systems; one-time pads, DES, RSA, DSS, wheels, LFSR-based systems; analog scramblers; key exchange, key management, secret sharing, access structures; measures of security. Cross-listed with MATH 673.

674 Information, Secrecy, and Authentication II. Pooch, Blakley (MATH). Classical and recent attacks; login, compression, error control, and genetic codes; finite and infinite codes; matrices, graphs, duals, groups, morphisms, composites, products, rates, and classification of codes; the confusion/ diffusion/arithmetic/calculus extension of Shannon's two design primitives. Prerequisites: MATH 673 or CPSC 673. Cross-listed with MATH 674.

675 Digital Libraries. Furuta. Surveys current research and practice in Digital Libraries, which seek to provide intellectual access to large-scale, distributed digital information repositories; current readings from the research literature which covers the breadth of this interdisciplinary area of study.

680 Testing and Diagnosis of Digital Systems. Walker. Theory and techniques of testing VLSI-based circuits and systems; design for testability; BIST and Boundary Scan; board level test and functional test. Prerequisites: CPSC 350, ECEN 248. Cross-listed with ECEN 680.

681 Graduate Seminar. Credit 1. Reports and discussion of current research and of selected published technical articles. May not be taken for credit more than once in masters degree program nor twice in PhD program.

CPSC 684 Professional Internship. Credit 1-16. Training under the supervision of practicing computer professionals in settings appropriate to the student's professional objectives, away from the Texas A&M University campus. Prerequisite: Approval of department head and one semester of graduate work completed.

CPSC 685 Directed Studies. Credit 1 to 12. Research problems of limited scope designed primarily to develop research technique. Prerequisite: Approval of instructor.

CPSC 689 Special Topics in .... Selected topics in an identified area of computer science. May be repeated for credit. Prerequisite: Approval of instructor.

CPSC 691. Research. Credit 1 or more. Research for thesis or dissertation. Prerequisite: Approval of instructor.

7 Graduate Faculty

This section lists the faculty in the Department that can serve on Advisory Committees for graduate degrees at Texas A&M University (i.e., the tenure-track and tenured faculty – assistant professors, associate professors and professors).

Faculty that are also designated computer engineering faculty are denoted with a '*' ; a listing of all computer engineering faculty from the Departments of Computer Science and Electrical and Computer Engineering can be found on `http://ce.tamu.edu`.

Nancy Amato,* Professor. B.S. Mathematical Sciences (1986), A.B. Economics (1986), Stanford University; MS Computer Science (1988), University of California, Berkeley; PhD Computer Science (1995), University of Illinois. Areas of interest: motion planning, computational biology, robotics, computational geometry, animation, CAD/VR, parallel and distributed computing, parallel algorithms, performance modeling and optimization.

Riccardo Bettati,* Professor. Diploma in Computer Science (1988), Swiss Federal Institute of Technology (ETH), Zurich, Switzerland; PhD Computer Science (1994), University of Illinois. Areas of interest: very large distributed real-time systems, real-time communication, distributed multimedia, intelligent networks.

James Caverlee, Assistant Professor. B.A. (magna cum laude) Economics (1996), Duke University; MS Engineering-Economic Systems and Operations Research (2000), Stanford University; MS Computer Science (2001), Stanford University; PhD Computer Science (2007), Georgia Institute of Technology. Areas of interest: Web, databases, information retrieval.

Jinxiang Chai, Assistant Professor. B.E. Electrical Engineering (1995), Xi'an Jiaotong University; MS Computer Engineering (1998), Chinese Academy of Sciences; PhD Computer Science (2006), Carnegie Mellon University. Areas of interest: computer animation, computer graphics, computer vision, interactions techniques for 3D graphics, video-based motion capture, image-based rendering and modeling, image and video processing. statistical learning.

Jianer Chen, Professor and Head of Graduate Admissions. B.S. Computer Science (1982), Central-South University, China; MS Computer Science (1984), PhD Computer Science (1987), New York University; M.A. Mathematics (1989), M.Phil. Mathematics (1990), PhD Mathematics (1990), Columbia University. Areas of interest: algorithms and complexity, computational biology, parallel processing, computer graphics.

S. Bart Childs,* Professor emeritus. B.S. Civil Engineering (1959), MS Civil Engineering (1960), PhD Civil Engineering (1966), Oklahoma State University. Areas of interest: computational science and engineering, literate programming, documentation, software engineering, and programming environments.

Yoonsuck Choe, Assistant Professor. B.S. Computer Science (1993), Yonsei University (Seoul, Korea); M.A. (1995) and PhD (2001) Computer Science, University of Texas at Austin. Areas of Interest: neural networks, computational neuroscience, human visual perception, computer vision, and artificial intelligence.

Gabriel Dos Reis, Assistant Professor. B.S. Mathematics (1997), University of Paris-VII; MS Mathematics and Computer

Science (1997), Ecole Normale Suprieure de Cachan, France; Advanced Studies in Mathematics (1997), University of Paris-VII; PhD Mathematics (2001), University of Paris-VII and Ecole Normale Suprieure de Cachan, France. Areas of interest: Computer Algebra, Computer Methods in Geometry, Mathematical Software, Programming Languages and Libraries, Compiler Construction, Generic Programming.

Donald K. Friesen, Professor and Associate Head for Academics. B.A. Mathematics (1963), Knox College, IL; M.A. Mathematics (1965), PhD Mathematics (1966), Dartmouth College; PhD Computer Science (1978), University of Illinois. Areas of interest: algorithm analysis, parallel algorithms, and artificial intelligence.

Richard Furuta, Professor and Undergraduate Advisor. B.A. (1974), Reed College; MS (1978), University of Oregon; PhD (1986), University of Washington. Areas of interest: interactive computer applications and computer-human interaction.

Guofei Gu,* Assistant Professor. B.E. Computer Science (2000), Nanjing University of Posts and Telecommunications; MS Computer Science (2003), Fudan University; PhD Computer Science (2008) Georgia Institute of Technology. Areas of interest: network security, system security, intrusion detection, malware detection, analysis, and defense.

Ricardo Gutierrez-Osuna,* Associate Professor. B.S. (1992), Polytechnic University of Madrid, Spain; MS Computer Engineering (1995), PhD Computer Engineering (1998), North Carolina State University. Areas of interest: pattern recognition, neural networks, robotics and sensor systems, computer vision, speech processing, artificial intelligence.

Tracy Hammond, Assistant Professor. B.A. Mathematics (1997), B.S. Applied Mathematics (1997), MS Computer Science (2000), M.A. Anthropology (2001), Columbia University; Finance Technology Option (2003), PhD Computer Science (2006), M.I.T. Areas of interest: sketch recognition, perception, cognitive behavior, computer human interaction, artificial intelligence, concept learning, computer graphics, psychology, anthropology, the gender gap in computer science

Thomas Ioerger, Associate Professor. B.S. Molecular and Cell Biology (1989), Pennsylvania State University; MS Computer Science (1992), PhD Computer Science (1996), University of Illinois. Areas of interest: artificial intelligence, machine learning, and bioinformatics.

Jaakko Järvi, Assistant Professor. MS Computer Science (1993), PhD Computer Science (2000), University of Turku, Finland; Areas of interest: programming languages, generic and generative programming, software library design.

Anxiao (Andrew) Jiang, Assistant Professor. B.E. Electronic Engineering (1999), Tsinghua University, Beijing, China; M.Sc. Electrical Engineering (2000), PhD Electrical Engineering (2004), California Institute of Technology. Areas of interest: algorithms, wireless ad hoc communication and sensor networks, file storage and retrieval, and distributed systems.

Andruid Kerne, Associate Professor. B.A. Applied Mathematics, Harvard (1982), MS Music Composition, Wesleyan (1993), PhD Computer Science (2001), New York University. Areas of interest: Recombinant knowledge spaces, interface ecosystems, augmentation of creative process, wearable affective computing, semiotics, time-based media, social interactivity, public installation, ambient media, sensor networks, cultural databases, information visualization, human computer interaction, visual hypertext, distributed and embedded real-time and internet architectures, machine learning.

John Keyser, Associate Professor. B.S. Applied Mathematics, B.S. Computer Science, B.S. Engineering Physics (1994), Abilene Christian University; PhD Computer Science (2000), University of North Carolina at Chapel Hill. Areas of interest: Geometric computing, graphics and visualization, simulation and modeling, and computer algebra.

Eun Jung Kim,* Assistant Professor. B.S. Korea Adv. Inst. Sci. Tech. (1992), MS CS&E, Pohang Univ. Sci. and Tech. (1994), PhD CS&E, Penn. State (2003). Research Interests: Computer Architecture, Power Efficient Systems, Parallel/Distributed Systems, Computer Networks, Cluster Computing, QoS Support in Cluster Networks and Internet, Performance Evaluation, and Fault-Tolerant Computing.

Andreas Klappenecker, Associate Professor. Diploma in Computer Science (1995), University of Karlsruhe; PhD Computer Science (1998), University of Karlsruhe. Areas of interest: Quantum computing, cryptography, and wavelets.

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