

Graduate HCI Programs at The University of British Columbia

K. S. Booth, S.S. Fels, and B.D. Fisher

Media and Graphics Interdisciplinary Centre

University of British Columbia

ksbooth@cs.ubc.ca, ssfels@ece.ubc.ca, fisher@cs.ubc.ca

ABSTRACT

The Media and Graphics Interdisciplinary Centre (MAGIC) at The University of British Columbia (UBC) recently introduced a masters level Specialization in the field of Human Computer Interaction. To receive a Specialization in HCI, students from any department in the university take: one course in each of three competencies, 1. Foundations of HCI, 2. Empirical Methods and 3. Design and Evaluation; one HCI elective course typically from their main discipline; and complete an HCI related capstone project such as a thesis. Students are required to fulfill the master degree requirements of their main department, however, the Specialization is structured to minimize extra courses needed by students. The program is built upon the philosophy of an HCI researcher or practitioner having at least one main discipline that is specialized in HCI working within a multidisciplinary team.

Author Keywords

Human-computer interaction, graduate education, specialization, multidisciplinary.

INTRODUCTION

The Media and Graphics Interdisciplinary Centre at The University of British Columbia (UBC) recently introduced a Specialization in the field of Human Computer Interaction that allows graduate students in a variety of disciplines to take courses in and focus their research on topics related to human-computer interaction. Master's students in departments that participate in the specialization who complete the additional requirements for the specialization have this noted on the degree they earn in their discipline.

The specialization builds on a decade of multidisciplinary collaboration fostered by the Media and Graphics Interdisciplinary Centre as part of its mandate within the Faculty of Graduate Studies. Initially only a single

introductory graduate course was available (1992 was the first offering), but over the years more specialized graduate courses have been developed as well as undergraduate courses that provide a grounding in the basics of the field. This developed hand-in-hand with an increasing emphasis on human-computer interaction as a distinct research area. Many master's and PhD students received degrees from faculties and departments where HCI research was being conducted: Commerce, Computer Science, Education, Electrical and Computer Engineering, Psychology, and the Individual Interdisciplinary Graduate Studies Program administered by the Faculty of Graduate Studies. In the Fall of 2004 the specialization was approved by the University's Senate and the first two students graduated that same term.

Although we have no comparable program at the doctoral level, we think this is fine. There is sufficient flexibility for individual students to customize their doctoral studies that it is not necessary to have a special program once students have received adequate preparation at the master's level. So, at least for now, we see the master's specialization as the cornerstone of our efforts to increase the multidisciplinary commitment to HCI in graduate programs at our university.

In the sections that follow we briefly describe the philosophy behind the program, the structure of the program and course descriptions, the current enrollment in what is effectively the first year the program has been officially offered, and our experience and lessons learned with the program to date including some of the pitfalls we encountered navigating through the academic red tape required to mount the program.

PROGRAM PHILOSOPHY

There has long been recognition of the "interdisciplinary" nature of human-computer interaction. In our experience the prefix "inter-" has implications of "not fitting within any academic discipline" and, even worse, of "not relying on any academic discipline". For this reason we prefer the term "multidisciplinary", with its clear connotation of the necessity for collaboration across disciplines rather than some notion of abandoning the collected wisdom of established disciplines and setting out to build HCI from the ground up. Indeed, the first course that we offered used a draft version of the second edition of the collection of readings edited by Baecker and Buxton whose first edition

(1987) had “multidisciplinary” in its subtitle. We continue to believe this is a sound basis for HCI, and shy away from newer terms such as “transdisciplinary” that again seem to suggest that traditional disciplines are no longer relevant.

With this respect for the inherent worth of the various disciplines that have contributed to the emergence of HCI as a core value, the Media and Graphics Interdisciplinary Centre set out to design a Specialization in the field of Human Computer Interaction. The program is called the “MAGIC Applied Graphics and Usability Studies” program, or MAGUS. Both top-down and bottom-up perspectives shaped the program.

From a top-down perspective, the program is inspired by some innovative approaches to teaching rhetoric and composition that arose from the “writing across the curriculum” concept. Paralleling how Rhetoric and Composition educators built customized writing-intensive courses in a range of departments, we argue that graduate students in any department need to not only be “computer literate” but also to have the training to actively participate in the design of those technologies as they impact their own discipline and domains of use. An “HCI across the curriculum” program should enable students in (for example) Forestry to be able to work in an multidisciplinary design team to build applications for their models of work and situations of use. A key element of the specialization is that students have a thorough grounding in at least one discipline in addition to knowledge and experience in HCI.

MAGUS is an interdisciplinary specialization for students in any UBC department or unit whose master’s-level graduate work is in the area of Human Computer Interaction. Students who meet the requirements for the Specialization have “Specialization in Human-Computer Interaction” added to their academic records and their diplomas for their master’s degrees. Course work includes both theoretical and applied aspects of HCI, with an equal emphasis on the design and evaluation components, and there is a required research activity that is either a thesis or major project, depending on the requirements and normal practice in the student’s home faculty or department.

From the bottom-up, over the years, students and their supervisors have discovered courses from different departments at UBC that provided a good grounding in HCI research and applied methods. With the instructor’s permissions, they enrolled in these courses while still completing their master’s in their home department. These students recognized the value of courses outside their own discipline, however, were not able to get official recognition of having additional specialization in HCI research and applied methods. As well, these students were at the mercy of the instructors to let them into the required courses. Thus, an additional goal of the development of the program was to coordinate the courses offered at UBC, provide guaranteed access to the courses, and form a coherent, identifiable HCI track for students from any

department on campus. Additionally, the Specialization on the student’s transcripts would form permanent recognition of their HCI study for use in applying for jobs.

STRUCTURE OF THE PROGRAM

The MAGUS program centers around three core competencies:

1. one Foundations of HCI course (e.g. CPSC 544 Human Computer Interaction),
2. one Empirical Methods and Analysis course (e.g. PSYC 546A Introduction to Graduate Statistics), and
3. one Design and Evaluation course (e.g. CPSC 543 Physical User Interface Design or EECE 596 Human Interface Technologies).

Students also need a minimum of 3 credits from at least one additional HCI theory and applications course approved by the MAGIC HCI Specialization Committee. Qualifying Courses are selected so as to provide an opportunity for cross-disciplinary studies as well as permitting students to satisfy the requirements for the Specialization using courses from within their own departments.

The final step in the program is the completion of a major “capstone” research project with an HCI focus (6 credit minimum). Depending upon the requirements of the candidate’s department this project may take the form of a thesis, studio project or major project. Research project proposals must be approved by the HCI Specialization Committee. The student chooses a MAGUS affiliate faculty member as project advisor. The role of the project advisor is to ensure that the project meets all requirements for the Specialization.

COURSE DESCRIPTIONS

Courses are divided into required courses and electives in addition to the capstone project. The courses are:

Required Courses

Foundations of HCI (select one course)

CPSC 544: Human-Computer Interaction. Overview of HCI - historical and intellectual perspective; emergence of graphical user interfaces; case studies. The Process of Developing Interactive Systems - design and evaluation; considering work contexts in design; software development environments; development tools. Interacting with Computers - vision, graphics design, and visual display; touch, gesture, and marking; speech, language, and audition. Psychology and Human Factors - human information processing; design ing to fit human capabilities. Research Frontiers in Human-Computer Interaction - groupware and computer-supported cooperative work; customizable systems and intelligent agents; hypertext and multimedia; virtual reality and cyberspace.

Empirical Methods and Analysis (select one course)

PSCY546A: Seminar in Psychological Problems – Introduction to Research Methodology. This course is designed to provide you with a good working knowledge of the statistical tools that most psychological scientists use to analyze quantitative data. The statistical procedures on which we'll spend most of our time are those that are most fundamental to testing hypotheses about relationships between variables. These include correlation, regression, and null hypothesis testing.

EPSE592: Experimental Designs and Analysis in Educational Research. Analysis of variance and covariance with one covariate, including various analyses via linear contrasts.

Design and Evaluation (select one course)

CPSC554: Physical User Interface Design & Evaluation. This is a graduate-level introduction to the inception, creation and evaluation of physical and multimodal human-computer interfaces, emphasizing control and/or display virtual environments through the sense of touch. It will begin with lectures, assignments, reading and discussion of current literature, and culminate in a design or evaluation project of the student's choice. Projects may employ available active-haptic display hardware ("active" means it can generate force), and/or prototyping of passive physical interfaces; they should focus on creative crafting of the interface to suit the application.

EECE 518: Human Interface Technologies. This course presents important developments in human interface technologies. The course begins with an overview of human sensation, perception, and kinetics. The remainder of the course is divided between a discussion of input technologies and output technologies. First, developments in input technologies are considered. Various input devices and metaphors will be studied along with methods for evaluating how successful they are. Second, developments in output technologies are studied. In addition to the specific technologies for various display techniques, emphasis is placed on the evaluation of the technologies as well as the interactions with various input devices will be covered. The course project involves the creation of a novel input device, a novel output device, a novel interaction technique or the evaluation of a current device.

Electives

Students select one additional course from a fairly extensive list from a wide variety of departments at UBC. The intent though is for students to choose a discipline oriented course that has a significant HCI related component to it. This facilitates students meeting their course requirements of their main discipline while at the same time specializing in HCI within their discipline. Some examples of courses from various departments are listed here.

Business Administration: Information Technology Management

BAIT 501: Survey of Information Technology Applications in Business

This course covers the general structure of information systems applications and their use by the various functional areas of business--production, human resources management, financial resources management, marketing, and logistics. Special emphasis is placed on emerging and innovative IT. Participating students will have an opportunity to select a project on a functional area and technology of interest.

BAIT 502: Fundamentals of e-Business Technology.

This is a hands-on course on IT application development for future managers. Students will be exposed to personal productivity tools that should prove useful in later careers. The goal of the course is to prepare students so that, faced with a managerial problem, they will be able to identify an appropriate software solution and apply it. The course will cover: decision support systems using advanced features of Excel, simple databases using Access, group support systems using Lotus Notes, and World Wide Web applications using one of a number of modern tools.

BAIT 513: Implementing e-Business in the Organization.

This course covers emerging information technologies, their application and impact, and the rapidly changing information technology industry including major players, trends and policy issues. Typical technologies discussed may include: the Internet, Groupware and Intranets, Client/Server Architecture, Workflow Automation, and Digital Documents. Industry segments covered include hardware, software, data communications, office products (e.g., document processing), and consulting.

BAIT 514: Technology and Development of e-Business Applications.

This course focuses on the technological infrastructure needed for implementing e-Business solutions, on the software components necessary, and on the ways to implement such applications. A major component of the module will be a hands-on project of developing an e-Business application.

Commerce

COMM 525: Introduction to Behavioural Research Methods for Business.

COMM 536: Analysis and Design of Information Systems

COMM 539: Technology Strategy and Policy.

COMM 636: Workshop in Management Information Systems

Computer Science

CPSC 502: Artificial Intelligence I. An introduction to AI emphasizing various approaches to the representation of

domain specific knowledge and methods of reasoning using these representations. Typical applications to be discussed include natural language understanding systems, problem solving, deductive question-answering, production based expert systems and machine vision.

CPSC 503: Computational Linguistics I. Formal models for natural language: phrase-structure grammars, context-free grammars, context-sensitive grammars, transformational grammars; syntactic analysis by computer.

CPSC 507: Software Engineering. Specification, design, implementation, and verification of large, multi-person software systems. Topics include: formal specification, modularization techniques, and software evolution.

CPSC 512: Architecture And Control In Artificial Intelligence. The interaction of computational architecture, control schemes and representational formalism in solving artificial intelligence problems. The concept of a virtual machine. Language constructs for representation and control, logic programming, concurrent systems, object-orientated methods. Serial machines, parallel and distributed machines, coarse-grain to fine-grain parallelism, SIMD/MIMD control. Applications to computational vision, robotics, reasoning and diagnosis.

CPSC 513: Integrated Systems Design. Integrating software with hardware. Software engineering aspects of real-time and distributed systems. Safety-critical systems. Reliability measures. System validation. Formal specification and verification. Cost estimation and scheduling. Students will undertake a programming project.

CPSC 524: Computer Graphics: Modeling and Rendering. Mathematical Tools - polynomial vector spaces and polynomial basis functions; elements of differential geometry; systems of linear equations. Curves and Surfaces - properties of curves and surfaces; formulations for curves and surfaces; implicit surfaces; parametric formulations; modeling and display. Local illumination - basic shading models, reflection, refraction, anisotropy, volume-based models. Global Illumination - ray-tracing; radiosity; hybrid techniques. Virtual Reality - Headtracked and stereo displays; sounds, haptic and other modalities.

CPSC 532: Topics in AI: User-Adaptive Systems and Intelligent Learning Environments. The objective of the course is to understand how Artificial Intelligence techniques can be used to design knowledge-based, adaptive systems that provide the user with individualized support for complex learning and reasoning tasks. Effectively tackling these challenges requires a strongly interdisciplinary effort that integrates research in different areas of Artificial Intelligence (e.g., knowledge representation, problem solving, natural language, planning and plan recognition, probabilistic reasoning and cognitive modelling) with research in Human Computer Interaction and Cognitive Science. During the course we will explore

major work in the field of intelligent interfaces and tutoring systems and we will learn how to build and evaluate one.

CPSC 532E: Perceptual Issues in Visual Interface Design. This course discusses and applies relevant work in perceptual psychology to the design of advanced visual interfaces and information visualization systems. Some applications to computer graphics (e.g., rendering and animation) are also covered. The focus of the course is on design constraints and guidelines rather than implementation. Basic methodology (design and analysis of experiments) is also introduced.

Computing Studies Education

CSED 508d: Review of Research in Computing Studies. Studies are made of recent research bearing on the applications of computers in education.

CSED 546: Seminar in the Teaching of Computing Studies. Curriculum, instruction and organization of computing studies courses in the secondary school. Prerequisite: CSED 314 or extensive experience with teaching computing studies in the schools.

CSED 565: Special Course in Subject Matter Field. Courses in various subject matter fields designed to bring teachers up to date in recent findings in each field.

Curriculum Studies

CUST 565B: Case Study Research and Cross Case Analysis. This advanced seminar examines case study research as a methodology that permits the study of complex human activities as they are embedded and bounded in some way by place and time. In this research-intensive seminar, we will discuss the ontological and epistemological status of case study research, as we explore the history of the case, its study, and the myths associated with this approach to research. Our seminar discussions will be informed by exemplary cases from the fields of education, history, medicine, commerce, and sociology. This is a transdisciplinary course.

Educational Psychology and Special Education

EPSE 503: Cultural Perspectives on Learning, Development and Media. Critical examination of current research and instructional design theories and exemplars, in which new and emerging concepts of learning, media, knowledge, facilitative environments, and instruction are being influenced by – and in turn, are influencing – educational technologies across age levels and across subject area boundaries. A major focus of the course will be hands-on exploration of online learning cultures, and practice in the design of digital learning cultures, artifacts, and instructional tools

EPSE 593: Design and Analysis of Research with Small Samples and Single Subjects. This is a course focusing on quantitative methods for analyzing research with 1 case or a small number of participants. Various single-subject

designs will be investigated, such as the ABAB and multiple baseline design. Various analytical techniques, including time-series analysis will be studied.

EPSE 594: Meta-Analysis: Quantitative Research Synthesis. This is a course investigating quantitative methods for integrating a large number of published research studies on a single topic. Methods for estimating effect sizes from a wide variety of statistics presented by the original authors will be examined. Students will learn to integrate effect sizes to draw defensible conclusions summarizing a large body of research.

Electrical & Computer Engineering

EECE 519: Computer-Supported Collaborative Work. Technical and social perspectives on collaboration and teamwork. Communications theory and collaboration technologies including email, instant messaging, videoconferencing, hypertext, knowledge management, and digital libraries.

EECE 589: System Design for Robots and Teleoperators. Requirements and methods for computer control of manipulator systems; computer simulation of mechanical linkages and actuator systems. Computer architectures suitable for manipulator control in robots and teleoperators.

EECE 593: Advanced Computer Graphics. Geometric modelling, curves and surfaces (Bezier, B-splines). Solid modelling, representation schemes, CSG, B-rep Volumetric modelling, quadtrees and octrees.

Landscape Architecture

LARC 521: Design Thinking. Study of methods-theories of design knowledge. Includes design as reflective-iterative process, idea generation, visual-verbal and visual-verbal transformation, design criticism and project evaluation methods.

Library and Information Studies

LIBR 540: Foundations of Information Services. As part of the "core" of skills all librarians and information specialists must have in order to effectively identify, locate, and provide access to recorded information, this course provides students with the knowledge and expertise needed for determining the information needs of clients, formulating research strategies, and identifying pertinent materials. The course focuses on the various types of reference materials, both print and electronic, and students learn how they can be used selectively and efficiently. Students also learn of the various roles of reference librarians and information specialists in different institutional and non-institutional settings, and the diverse set of skills needed to perform effectively in these settings.

LIBR 553: User-Oriented Design of Information Retrieval Systems

LIBR 557: Advanced Information Retrieval. The primary focus of this course is on the techniques and strategies required to effectively and efficiently use online retrieval systems; it builds on the skills and techniques you learned in LIBR 500, 510, and 540. Current research in online searching is also covered.

LIBR 559: Topics in Computer-Based Information Systems. The goal of this course is to provide students with the theoretical and practical knowledge required to understand the processes and techniques involved in creating, organizing, presenting, and using information in digital environments.

Mechanical Engineering

MECH 505: Industrial Acoustics and Vibrations. Fundamentals of acoustics and vibrations, physiologic effects, measurement, instrumentation, interpretation of data, industrial standards and control. For students in Occupational and Environmental Hygiene; other graduate students may enroll with permission of the instructor.

MECH 520: Control Sensors and Actuators. Review of control, instrumentation and design. Performance specification of control components, component matching, error analysis. Operating principles, analysis, modelling, design considerations of control sensors and actuators such as analog sensors for motion measurement, digital transducers, stepper motors, DC motors, induction motors, synchronous motors, and hydraulic actuators. Control techniques pertaining to actuators. Applications.

Psychology

PSYC 578: Perceptual Processes I. An introduction to human perception from a multidisciplinary perspective. The major theme of the course varies from year to year. This year the focus will be on Visual Perception and the Visual Arts. Questions considered include: Is a science of art possible? What might a science of art look like? Is there a relation between what artists do and how the visual brain functions? Is it possible to 'diagnose the canvas'? What is the purpose of art from a neurobiological perspective? These questions arise from an emerging interest in the Cognitive Sciences in visual art and several recent and provocative theoretical pronouncements from Cognitive and Neuro scientists. They are also a useful 'hook,' providing an engaging opportunity to learn the basics of modern vision science. These topics include color, objects, attention, time, space, motion, imagination, and consciousness.

PSYC 582: Cognitive Processes I. This course is in cognitive processes that emphasizes a multidisciplinary approach to human consciousness.

Statistics

STAT 534: Experimental Design and Quality Improvement. Graphical methods including Ishikawa's

methods and control charts. Deming and Taguchi philosophy and methods. Acceptance sampling. Robust parameter designs. Fractional factorial designs and orthogonal arrays. Response surface methodology. Special topics.

STAT 535: Statistical Computing. Numerical methods useful for statistical research, and numerical analysis useful for writing statistical software (e.g., numerical linear algebra, optimization, generation of pseudo-random numbers, statistical graphics). The statistical language and computing environments for data analysis. Special research topics.

STAT 536: Statistical Theory for the Design and Analysis of Clinical Studies. Theory for statistical problems commonly encountered in medical studies, including clinical trials, studies of agreement and diagnostic accuracy, rate, comparisons, and standardization.

STAT 544: Theory of Sampling. A comprehensive account of sampling theory as it has been developed for use in sample surveys. Topics include simple random sampling, stratified random sampling, ratio estimates, regression estimates, systematic sampling, cluster sampling, subsampling, double sampling, estimation of sample size, sources of errors in surveys.

Additional elective courses

As appropriate, proposals for courses in various schools, faculties and departments, such as (but not limited to) Anthropology and Sociology, Audiology and Speech Sciences, Commerce, Computer Science, Education, Engineering, Forestry, Human Kinetics, Library, Archival and Information Studies, Music, and Psychology are also considered by the specialization committee for credit towards the Specialization.

VITAL STATISTICS TO DATE

The program was formally approved for Fall 2004. Two students who completed degrees that term qualified for the specialization. They graduated with master's degrees in Computer Science with the HCI designation. There are currently about a dozen students approved for the program or being considered for it. In steady state we expect to have 25 students entering the program each year across the various departments. We are still in the process of getting all of the relevant departments to approve the specialization for their students.

LESSONS LEARNED

The program was initiated by MAGIC with the strong support of Computer Science Department and the Faculty of Graduate Studies. In the initial year only CS students were eligible. We are now working with colleagues in Electrical and Computer Engineering, Psychology,

Education, and Forestry to identify potential MAGUS candidates and to help to design or modify courses in their departments that would fulfill the three core requirements and the electives. In practice it seems that student interest is the main driver-- when there are a number of students who are interested in the specialization it opens the door to working with their department.

Numerous bureaucratic challenges had to be dealt with to get the necessary university calendar entries for the specialization to be recognized. It required nearly 1.5 years of massaging the text to meet the many competing demands beginning with instructors all the way through to the highest level of curriculum committee. Considerable "pre-consultation" with all the relevant stakeholders and enlisting a number of champions along the way helped to make the Specialization happen.

Questions for the Workshop:

1. What are the core topics that all HCI researchers and practitioners need to learn as part of an HCI curriculum? Are the ACM SIGCHI Curricula for HCI guidelines appropriate at the graduate level?
2. Are there job opportunities for students specializing in HCI? How can students find them?
3. Is HCI sufficiently defined as to constitute a discipline? Should it be?
4. Can the core HCI competencies be taught online so as to facilitate students crossing departmental boundaries and removing bottle-neck courses?
5. Is there funding available to foster HCI curriculum development and/or programs?

ACKNOWLEDGMENTS

Our appreciation goes to the members of the HCI@UBC group including: Izak Benbassat (Comm), Cristina Conati (CS), Elizabeth Croft (Mech), Vince DiLollo (Psych), Jim Enns (Psych), Bryan Gick (Linguistics), Tony Hodson (Mech), Holger Hoos (CS), Alan Kingstone (Psych), Karon Maclean (CS), Joanna McGrenere (CS), Mike Meitner (Forestry), Tamara Munzner (CS), Ron Rensink (Psych & CS), Tim Salcudean (ECE), Michiel van de Panne (CS), Lawrence Ward (Psych), and Carsen Woo (Comm).

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