

# An Overview of the Carnegie Mellon HCI Institute Ph.D. Program

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## **ABSTRACT**

As a part of its mission to support the development and expansion of interdisciplinary work in HCI, the Human Computer Interaction Institute (HCII) at Carnegie Mellon offers a Ph.D. in HCI (as well as an undergraduate second major in HCI, and a professionally oriented Masters of HCI). This note describes the program, its context, rationale, goals and approach.

## **INTRODUCTION**

The HCI Institute at CMU was founded in 1994 with a mission of doing world class research in Human Computer Interaction. As a part of that mission, it has sought to foster the creation of a new discipline of HCI. We believe that this new discipline will emerge from interdisciplinary collaboration between researchers drawn from its roots in the behavioral sciences, Computer Science, and Design. Over time, we expect that this will happen in much the same way that Computer Science emerged as a separate endeavor from its origins in Mathematics and Electrical Engineering.

A critical part of any discipline is a steady supply of well trained and highly qualified researchers who are versed in the background and methods of the discipline. To help meet this need, in 2000 we began a new Ph.D. program in HCI. This program has grown to a current 34 students. We expect the first student to complete the full program in the summer or fall of 2005, and foresee an eventual steady state supporting about 45 students.

## **Context**

The HCI Institute is a departmental unit in the School of Computer Science (SCS) at CMU. It is not directly associated with the Computer Science Department, but instead is a peer unit within the School, as are the Robotics Institute, the Language Technology Institute, the Center for Advanced Learning and Discovery, and

the Institute for Software Research International. Each of these units acts as a department. Each has a department head, maintains independent budget, faculty appointments, degree programs, and tenure and promotion process. As a part of this structure our degree program is not a specialization in HCI within CS (or some other program), but rather offers a Ph.D. directly in HCI.

There are currently 49 tenure track faculty who list themselves as associated with the Institute, of which 40 are on the teaching track, and the remainder are on the research track (although many of these also teach and all are the subject of a rigorous “up or out” tenure review). Of these faculty, 27 are considered “core faculty” (who are given a vote on matters such as hiring and tenure), 22 of those have at least a partial appointment in the Institute, and 13 have a 100% appointment in the Institute. Of the core faculty 11 would roughly speaking be considered to have a behavioral science background, 12 CS, and four Design.

The work done in the HCI Institute is highly interdisciplinary. Whereas in most departments interdisciplinary work is the exception, in the HCII it is the rule – almost without exception all work done is interdisciplinary in nature. This is driven both by the mission of the Institute, and the diversity of its faculty, and we believe it represents a significant advantage for us and our students.

## **Students and Admissions**

There are currently 34 students from five incoming classes enrolled in the HCII Ph.D. program. Historically, two students have been removed from the program as part of our evaluation process, one student has transferred to a different SCS Ph.D. program, and one student transferred in from another CMU Ph.D. program that was ending, and graduated after one year with us. Although many come from, and are pursuing, interdisciplinary research directions,

roughly speaking 16 of our students could be classified as behavioral, 14 technological, and four design-oriented. 35% of our students are female, and 24% are non-US citizens. All students are required to study full time.

The strength of any program ultimately lies with its students. We are fortunate to have a group of students who we feel are on average extremely talented and hard working. To maintain this we have an admissions philosophy which includes:

- *Small and highly selective admissions.* Overall we have been very selective in admitting students, admitting between 6-10% of applicants each year. As a point of comparison, Harvard undergraduate which is often thought of as the gold standard for “hard to get into” admits about 11% each year. This means that we turn away many very good applicants each year.
- *“Best athlete” basis for admission.* We look at areas of background and expressed interest in order to try to maintain a balance with respect to faculty interest. However, we do not admit students specifically to work with any particular faculty member, and overall try to maintain a “best athlete” criteria – selecting on the basis of quality as the first criteria, and other factors as secondary.
- *Full support for all students.* We expect that the caliber of students we are seeking will be in high demand, and so try to make an attractive offer to all of them. Specifically, we offer full stipend and tuition support for all our students for as long as they are in good standing. This support must ultimately be provided by the advisor via research grants. However, the department guarantees this funding independent of advisors, and so takes the risk of funding gaps, etc. away from the students and places it on the faculty as a whole. (We currently support two of our 34 students from departmental funds which, is probably about what we expect in steady state.)

Note that although we have an active Masters of HCI program, this program is *not* designed to teach about HCI research or to serve as a feeder program for our Ph.D. Instead this program is a *professional* masters which is intended to impart advanced job skills for usability professionals. However, explicit training in HCI at an undergrad and masters level is still comparatively rare, and so in looking for students with HCI backgrounds we have in fact admitted a

significant number of students from our own MHCI program (five).

Admission to our program is without respect to advisors. However, for both financial and pedagogical reasons (see “*research from day one*” below), students are strongly encouraged to find a mutually agreeable advising relationship very quickly – normally within the first month of the program.

#### **PROGRAM GOALS, PRINCIPLES, AND STRATEGIES**

A central goal of our program is to support development of HCI as a new discipline by providing a steady stream of young, high quality researchers who “eat, drink, and breath” HCI. More specifically, we seek to provide each student with depth in some aspect of HCI research, but also with the capability to do what most of us now manage only rarely – smoothly integrate the methods and knowledge from the underlying disciplines as called for by the work, rather than as dictated by our training.

In structuring and administering our program we have three guiding principles:

- *Quality first.* We seek quality in everything we do. That is almost a cliché, but taken seriously, it means that we maintain very high expectations for our students, and communicate that to them early and often. It also means that when there are conflicts between the best education for a particular student and the official rules, or what precedent might be set, we try hard to opt for the best education for that student. This leads to our stated meta-rule: “No rule is so important in and of itself that it should keep a student from getting the best education”. We occasionally bend or break the rules on this basis. Students are told this up front, and told not to expect exceptions for one to imply exceptions for all.
- *Research from day one.* We consider the primary goal of our program to be creating world class researchers and we feel it is important that students clearly focus on research from the beginning. To accomplish this we “clear the path” of some of the non-research activities that often occur early in programs. In particular, we do not have exams and typically do not allow our students to do TA work early. We also structure other requirements to motivate them to produce research results early.
- *A minimum of rules and the reasonable person principle.* We believe that quality does not come

from rules and structure, but from high standards and a vigorous and exciting environment. Consequently we have a bare minimum of rules and requirements for the program. Instead we use another meta-rule: the “reasonable person principle”. This states that we should all operate under the assumption that we are reasonable and intelligent adults in a cooperative community, and that we will operate in all situations as a reasonable person would. In particular, everyone is expected to know that the lack of a specific rule is not a license to “game the system”, subvert its intent, or do something outside what any reasonable person would see as right. Also, when something is not clear, a reasonable person asks first.

These principles are supported by a series of strategies which in turn play out in the curriculum and requirements for the program. These include at least:

- *Highly individualized education.* Although it is our goal to create a new discipline of HCI, at present our students will need to get jobs (particularly on the academic side) in the framework of the existing disciplines. Across the breadth of our program this means that they will need to know different things and present themselves differently (while still at the core all undertaking problems and questions in the places where people meet technology). To accommodate this, and to allow each student to maximize their own talents and interests, many of our requirements are individualized. Most notably, within an overall loose framework, the courses taken by each student are proposed by the student and advisor to meet the student’s needs.
- *Continuous evaluation.* Our program has no preliminary, qualifying, or other traditional exams except the dissertation proposal and defense. Instead, every student is evaluated by the full faculty each semester (in a day long meeting). These evaluations have been successful in maintaining high standards for student performance – the faculty has demonstrated its willingness to make tough decisions in these evaluations, and they are taken seriously by all parties. In addition, these meetings serve as a means for our diverse faculty to compare notes, stay abreast of the activities of the full student body, and create more uniformity in an otherwise fairly unstructured curriculum (although we are still struggling to achieve consensus on several

important issues). Additional motivation for this approach comes from the “research from day one” principle – we want our students’ attention placed firmly on research from the outset, rather than feeling that their first task is to pass an exam.

- *Interdisciplinary cohort building.* Finally, several aspects of our program are structured to attempt to promote the development of a strong cohort among the students which transcends disciplinary boundaries. First we house our students in larger mixed shared spaces rather than in advisors’ lab spaces. This has been in part due to necessity, since we have very limited lab space. However, it has been an important factor in developing a feeling of cohesion and in promoting cross-disciplinary work.

We also require participation in an interdisciplinary project in the first semester introductory course which every student takes. This project has resulted in several long standing interdisciplinary collaborations among the students which are independent of their advisors’ collaborations.

Finally, the students themselves have organized substantial group activities including an independent seminar series. Most notable among these activities was an instance where a group of interested students, at their own initiative, developed a new undergraduate HCI course for CS majors. They created an excellent design for the course which was accepted by the faculty with only small modifications. The course is now regularly taught by three Ph.D. students under the supervision of a faculty coordinator.

## **REQUIREMENTS AND CURRICULUM**

Based on our guiding principles and strategies, the HCII Ph.D. program uses a set of requirements which is fairly loosely structured, especially with respect to coursework. There are six requirements for graduation: the traditional proposal and defense of a dissertation, a communications requirement, a teaching requirement, coursework, and a usability skills requirement. As indicated above, there are no exams, nor is there a minor requirement.

The dissertation proposal and defense requirements, along with the written dissertation, are much like most other Ph.D. programs in the United States. The committee which judges these activities is required to be interdisciplinary and must contain at least one

external member (who either comes from within the University but outside HCI, or more commonly from outside the University but within HCI).

The communications requirement is designed to ensure that our students can communicate research results well in both written and verbal form. It is also structured to strongly reinforce the notion of “research from day one”. Students are required in both their first and second year to produce a paper suitable for publication, and present this work to an Institute-wide audience at the beginning of their second and third years. The faculty as a whole evaluates this presentation and the student must be designated as passing the oral communication requirement once (they must make two presentations, but may make more if needed to receive a “pass”). This presentation is done as part of the orientation program for new students. As a result, each new student knows clearly that “I must stand up there in 12 months” and so is very motivated to start working with their advisor on a research project immediately.

Our students are each required to do two classes worth of teaching assistantships, and we attempt to give each student some substantive teaching experience as part of this. We generally encourage students to do TA work only after they have completed their course requirements. To emphasize the importance of teaching, we attempt to structure their TA work as something they are allowed to do once they are more knowledgeable, rather than as an activity they must do until they can graduate to research work.

Finally, course requirements are constructed very loosely in accordance with our strategy of individualized education. Each student must take eight courses: the first semester “HCI Process and Theory” course, four courses in a primary area, two courses in a secondary area, and one course in the third area (where areas are behavioral sciences, CS, and Design). At least one Design course must be a graduate studio course. The exact program of study is designed by the student and advisor(s). However, every program of study must be approved by the full faculty (as part of the semester evaluation meeting). This allows us to customize the coursework to each student, yet still maintain a comparable set of standards across the program.

It is interesting to note that every single student who has completed their course requirements has later taken additional courses.

The first semester “HCI Process and Theory” course is designed with several goals in mind. It is intended to give an introduction to interdisciplinary research (including an interdisciplinary research project), to explore the commonality and differences in methodology between the constituent disciplines, to help promote cohort formation among the students, and to provide background knowledge from each of constituent disciplines. We have found that these goals are too ambitious for the course in its present one semester form. In particular, the faculty currently feels that at least the background knowledge goal is not being adequately met, and the course is currently being substantially revised.

In addition to these specific course requirements, each student is required to meet a “usability skills” requirement. This requirement is designed to ensure that all our students have at least a basic knowledge of usability practice so that they could, for example, be called on to teach an introductory HCI course. This requirement can be met by passing the exam, taking, or TAing the master’s level “Introduction to HCI Methods” course, or by co-teaching our new undergraduate “HCI for CS Students” course.

To support our undergraduate second major, professional masters, and Ph.D. programs in HCI, we teach a wide variety of courses. There are about 35 courses listed or cross-listed with an HCI designation. Beyond these courses there are also numerous other HCI related or relevant courses taught in other parts of the university (particularly in CS, Robotics, Psychology, and Design, but also in the business school and several other departments). Additionally, our students may freely take courses at the nearby University of Pittsburgh, where additional relevant courses are taught. Since these courses are so numerous and diverse, we will not attempt to list them here.

#### **PROSPECTS AND ISSUES**

The true measure of the success of a Ph.D. program is the success of its graduates, so it will be a few more years before we can properly judge our efforts. However, we have overall been happy with most aspects of our program, and there are some objective signs of success. For example, one measure of the quality of students we have been able to attract is nationally competitive fellowships. In this regard, we are proud to note that *all* eligible students in our first entering class received nationally competitive (primary NSF and NDSEG) fellowships. Although

we clearly could not sustain that record, we have continued to have fairly good results in that regard. With respect to measures of continuing research quality, most of our students past course work publish one or two papers each year in top venues, and it is not unusual for the best students to publish four or even five papers in some years. There are also signs that we have been successful in our goal of fostering an interdisciplinary approach. As noted above, there have been several cases of interdisciplinary collaborations between students which have arisen independently from their advisors' collaborations. Anecdotally, it seems that many (but not all) of our students are comfortable with both activities of invention and activities of discovery, value both, and are able to apply appropriate methodologies to each.

Although we are mostly happy with our program to date, we do face some challenges. A number of these are related to interdisciplinary work. Interdisciplinary work is hard. Even in a unit which is dedicated to interdisciplinary work as its core, it is something that must be worked at constantly. For example, as we near the point of steadily producing graduates, we are currently facing a noticeable disagreement among the faculty about what expectations should be set as to the nominal pace of our students. The Psychology departments which represent the heritage of many of our faculty often push their students to complete their degree in four years. On the other hand, CS departments tend to average six or more years of study. These differences are in part due to the nature of the work in each area, but also represent some differences in culture and values which can be hard to resolve.

Another issue for us is how to properly integrate activities of Design into our program. We are

committed to the idea that Design should have an important place in HCI and we have worked hard to incorporate it in our culture – most notably by hiring Designers to the faculty. However, Design as a research discipline is still forming and it draws its work from much less analytical roots than the science and engineering roots of Psychology and CS.

Finally, we have still been struggling with our common introductory class. In particular, we are still working on how to manage its multiple goals without dramatically expanding it (and consequently pushing out some more depth oriented course work, and/or part of our emphasis on early research).

#### **Workshop Discussion Issues**

Based on our experiences and interests, we propose several possible workshop discussion questions:

- Can we enumerate specific (and preferably demonstrably successful) strategies to help promote the acceptance of interdisciplinary work – particularly in academic departments of our constituent disciplines?
- Will sufficient jobs for HCI background Ph.D.s be available to justify specialized HCI programs? Where will these jobs most likely be, and how can students best be prepared to contribute to the research community and get these jobs?
- Can we create a common core or base of knowledge which transcends disciplinary boundaries and yet is manageable in scope?
- How do we properly and fully accommodate the methodologies of Design into HCI programs?