Human-Computer Interaction (HCI) 2020-2022

Code: SCI3097

Extent: Long (60 credits) or compact (40 credits) major. Students taking a compact major also have to take a minor (20-25 cr). Students taking a long major may include an optional minor in their elective studies.

Responsible Professor: Antti Oulasvirta (homepage)

Other professors: Perttu Hämäläinen, Janne Lindqvist, Elisa Mekler, Marko Nieminen, Tapio Takala, Giulio Jacucci (University of Helsinki/Computer Science)

Abbreviation: HCI

School: School of Science (coordinator) and Electrical Engineering

Objectives

Human-computer interaction is a field concerned with the design and study of interactive computing systems for human use. Experts in the field study opportunities in computing technology to innovate novel ways to use it, they design user interfaces and engineer the enabling hardware and software, and they produce empirical knowledge to inform decision-making concerning technology.

Master’s studies in Human-Computer Interaction (HCI) prepare future experts and leaders who use advanced methodology and technology to innovate and improve information technology for the benefit of people. The aim of our new HCI major is unique in Europe: It combines rigorous courses in computational and engineering disciplines, such as AI and machine learning, with spearheads in user interface technology and interface design, yet building supporting competences in interaction design, empirical research, and entrepreneurship. Highlights of the curriculum include:

- Skill set recognized globally in competitive industry positions and PhD programmes, especially in areas cross-cutting design, interaction, and AI
- An interdisciplinary orientation with strong emphasis on computer science and engineering but including contributions from psychology and design
- Competences complementing exact and engineering sciences, in particular in creative design, prototyping, and evaluation of interactive systems using advanced technologies
- Interaction with world-class research faculty across departments at Aalto as well as in the University of Helsinki
- Learning to learn in the area of HCI; a life-long learning attitude
- Strong specialization on a technical topic and a capstone course supporting students to achieve their potential at internationally benchmarked level on realistic problems carried out with top players in the industry and academic
- Soft skills, including meta-cognitive skills, scientific literacy and writing skills, critical thinking, presentations, and teamwork.

The education builds on recognized research efforts on HCI in Aalto University and University of Helsinki and it ties to top education offered in the CCIS program. HCI research at Aalto University is globally recognized and ranked as #2 in Europe and #14 in the world (source: csrankings.org).

Learning Outcomes

With this degree, students can pursue careers where they lead design, research, or management. They are well-equipped to approach modern design problems including challenges in intelligent systems, concept creation, interface technologies, algorithms, data, modeling, and communications and networking. However, they are also knowledgeable about the human and social factors affecting the success of interactive systems. They know how to address them in practical interdisciplinary development processes in business context. They have technical skills to experiment and prototype innovative interactions as well as the metacognitive skills to drive visions of interactive technology, critically evaluate different approaches to interaction, and to develop competences further by following advanced research literature.

Structure and content

Overall structure:

- **Basics**: Design thinking and methods for engineering and computer science students; User-centered methods, user research, and strategic usability in software engineering
- **Computational and engineering specialization**: Analysis, modeling, and computational solution of design problems; Data-driven design using computational methods (e.g., AI, machine learning, control, optimization, logic); Novel forms of interactive technologies and media; Interactive applications and systems, especially development and design; Interactive visual computing, such as augmented and virtual reality
- **A capstone project** and (optional) research immersion including interaction with world-class faculty and companies.

The major covers four main topics: (1) empirical research, such as the study of user needs to elicit requirements for a product, (2) constructive research, such as the concept design, computational design, and prototyping techniques, (3) interface technology from algorithms to electrical engineering perspectives, and (4) analytical and modeling-oriented research, such as a model explaining how choices in user interface design affect user performance. It also educates methods in user-centered design, including those for user research, sketching and prototyping, and evaluation. The courses cover a wide range of technical topics including input devices, interactive media, interaction techniques, interface technologies, interactive applications, social media, and multimodal interactive systems. Students learn both design thinking and the scientific basis of HCI in modeling, theories, and methods. As the curriculum progresses, they learn to apply their skills to increasingly more realistic problems. They are introduced to human factors, social sciences, business, and design. A lot of emphasis is put on ‘learning to learn’, improving the student’s ability to read, apply, and critically discuss scientific research in this area.
Student Experience

During the first year, students learn core methodologies and techniques in the design, study, and analysis of interaction. During the second year, they start to specialize on a technical topic. Students can flexibly build their study plans consisting of core and elective courses. The core courses provide a strong foundation in design, empirical methods, and theories of HCI. The elective courses allow a student to organize studies around technical topics in HCI, such as interactive graphics, mixed reality, user-centered software engineering, user interface software technologies, interaction techniques, interactive machine learning, interactive visualizations, computational design, usable security, and user interface technology. A reading group and a research immersion on advanced topics is offered to final-year students. During the last year, they complete a capstone project with an external client (industry or academic) and write a Master's thesis for a company or an academic group.

Courses

Major compulsory courses (min. 35 cr for the long major, min. 25 cr for the compact major)

<table>
<thead>
<tr>
<th>CODE</th>
<th>NAME</th>
<th>CREDITS</th>
<th>PERIOD/YEAR</th>
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</thead>
<tbody>
<tr>
<td>CS-C3120</td>
<td>Human-Computer Interaction *</td>
<td>5</td>
<td>I-II</td>
</tr>
<tr>
<td>CS-E4200</td>
<td>Emergent User Interfaces</td>
<td>5</td>
<td>III</td>
</tr>
<tr>
<td>CS-E4840</td>
<td>Information Visualization *</td>
<td>5</td>
<td>IV</td>
</tr>
<tr>
<td>ELEC-E7890</td>
<td>User Research *</td>
<td>5</td>
<td>I</td>
</tr>
<tr>
<td>582666 (UH)</td>
<td>Designing Interactive Systems **</td>
<td>6</td>
<td>III-IV</td>
</tr>
<tr>
<td>CS-E5620</td>
<td>Social Media ***</td>
<td>5</td>
<td>III-IV</td>
</tr>
<tr>
<td>ELEC-E7260</td>
<td>Machine Learning for Mobile and Pervasive Systems</td>
<td>5</td>
<td>III-IV</td>
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<tr>
<td>ELEC-E7851</td>
<td>Computational User Interface Design</td>
<td>5</td>
<td>II</td>
</tr>
<tr>
<td>ELEC-D7010</td>
<td>Engineering for Humans (* (***)</td>
<td>5</td>
<td>V</td>
</tr>
<tr>
<td>CS-E5230</td>
<td>Collaborative Evaluation of Interactive Systems</td>
<td>5</td>
<td>IV-V</td>
</tr>
<tr>
<td>CS-E5220</td>
<td>User Interface Construction *</td>
<td>5</td>
<td>II</td>
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<tr>
<td>CS-E4350</td>
<td>Security Engineering</td>
<td>5</td>
<td>III-IV</td>
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*) You can omit this if you have a similar course in your previous studies.

**) Organized by the University of Helsinki. Students apply for this course through Flexible Study Right Agreement JOO.

***) You can replace this with something similar.

In-depth specialization

In-depth specialization is custom-tailored and approved via HOPS. The student choose a list of specialization courses with the following constraints:

- An HCI course should be accompanied by a matching technical course from the offerings of CCIS. For example, to specialize in interactive machine learning, we recommend an extracourse on information visualization with an in-depth course on machine learning.

Topics recommended for specialization include but are not limited to:

- Web technologies
- Speech recognition
- Robotics
- AR and VR
- CSCW and CMC
- Usable security
- Visual and interactive computing
- Machine learning and AI, including deep learning, reinforcement learning, probabilistic inference
- Interactive data analysis and visualization, including Bayesian data analysis
- Game design
- Ubiquitous computing
- Health technology
- Quality of Experience
- Neural and brain interfaces
- Accessibility
- User-centered software engineering

We also recommend the following in-depth seminar:

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<th>PERIOD/YEAR</th>
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<tbody>
<tr>
<td>ELEC-E7870</td>
<td>Advanced Topics in User Interfaces</td>
<td>3–5</td>
<td>II/2nd year</td>
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**Mandatory capstone course** for both long and short majors is chosen according to focus on industry (CS-E5200) or research (ELEC-E7861). (Choose one or the other.)

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<tr>
<td>ELEC-E7861</td>
<td>Research Project in HCI</td>
<td>5–10</td>
<td>2nd year</td>
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<tr>
<td>CS-E5250</td>
<td>Data-Driven Concept Design *</td>
<td>5</td>
<td>III</td>
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*) Note that CS-E4900 User-Centered Methods for Product and Service Design is a prerequisite for Data-Driven Concept Design.