

# Ubiquitous Computing ID2012 - course PM VT20

## Learning outcomes

The student is able to recognize and competently discuss:

- the origins and history of ubiquitous computing (UC)
- technologies and devices for UC
- interfaces and modes of interactions between people and UC devices, applications or environments
- infrastructures and architectures for supporting UC applications
- new applications and evaluation methodologies for UC
- social issues and general implications of UC
- the relation between ubiquitous computing and the Internet of Things (IoT)

## Contents

The course contains 8 lectures [see below], literature from selected articles, and a project.

Students are examined on an article review, a 5000 word essay, and the project.

The Canvas LMS is the primary means of communication and information.

- Due to the concerns regarding the Corona virus, the spring 2020 physical lectures are withheld (until further notice) and converted into literature. See Canvas for slides and notes.
- The project presentation seminar is converted into individual appointments with the examiner, using video, skype, or some other arrangement.
- For general information from KTH regarding the Corona virus situation, check <https://kth.se/corona-eng> daily.

## Recommended prerequisite skills

The course requires apart from basic skills in mathematics and computer science, knowledge in human computer interaction and programming of distributed systems.

## Course literature

### A collection of articles:

- The Computer of the 21st Century, Weiser, 1995.  
<http://www.cs.chalmers.se/idc/ituniv/kurser/07/uc/papers/weiser-computer-21st-century.pdf>
- The coming of age of calm technology, Weiser and Brown, Xerox PARC, October 5, 1996.  
<http://www.johnseelybrown.com/calmtech.pdf>

- Internet of Intelligent Things: Bringing Artificial Intelligence into Things and Communication Networks, A. Arsénio, H. Serra, R. Francisco, F. Nabais, J. Andrade, E. Serrano, 2014.  
[https://link.springer.com/chapter/10.1007/978-3-642-35016-0\\_1](https://link.springer.com/chapter/10.1007/978-3-642-35016-0_1)
- Beyond Weiser: From Ubiquitous to Collective Computing, G. D. Abowd, 2016  
<https://ieeexplore.ieee.org/document/7383147>

### Older articles:

- Charting past, present and future research in ubiquitous computing, Abowd and Mynatt, 2000.  
<http://www.cc.gatech.edu/fce/pubs/tochi-millennium.pdf>
- The human experience, Abowd, Mynatt and Rodden, 2002.  
[http://ieeexplore.ieee.org/xpls/abs\\_all.jsp?arnumber=993144](http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=993144)
- Pervasive Computing: vision and challenges, Satyanarayanan, 2001.  
<http://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=44C8B696D5DE7011AF98A5E8F7FE6E49?doi=10.1.1.24.6338&rep=rep1&type=pdf>
- *Further or alternative articles may be introduced during the course.*

### Examination and grading

- SEM1 (A-F) 3 hp – A 5000 word essay
- INLA (P/F) 1.5 hp – An article review
- LABA (A-F) 3 hp – A programming project

### Essay

Each student individually prepares an essay according to the format given below. You are most welcome to study the grading criteria and use them to argue why you think your essay merits a certain grade.

The size of the report should be around 5000 words.

There should be a section "Introduction on the Character of Ubiquitous Computing" on 500-1000 words.

The rest of the report should be a critical view of some idea for a Ubiquitous Computing system or element of such a system. The essay must be analytic and not just purely descriptive. Delimit the scope of your essay for your own benefit.

The idea can be yours or someone else's. It can be something which exists, has been proposed, or which realistically or speculatively could exist. In all cases, this part should connect to the mandatory introduction.

The essay should be grounded in the literature. You are expected to refer to the literature presented on the course, but there is no requirement to use all of it, only the ones that are relevant to your essay. You are also most welcome to refer to additional literature.

The report should be well written in good English, have a proper layout and format, and correctly use credits, notations and references.

## Essay grading

The essay is graded A-F. Please consult the document [EssayGradingCriteria.pdf](#) for details.

## On writing

Please mind the following guidelines to good academic writing:

### *Proper layout and format*

There are many possible formats available, but a long paper format for a conference would be suitable. Templates for Ms Word or LaTeX can usually be found on conference sites. Important to include are:

- a title page with the title of the essay,
- your name,
- the course for which it is written,
- and the date of the version.

Please make sure the pages are numbered.

### *Credits, notations and references*

Always credit other work, i.e. work that you have not created yourself. Always make it obvious to the reader which is your own work, and which is someone else's. This means that you must not copy text, images, graphics or other work so that it appears to be created by you. Since the essay will be submitted for examination, 'other work' in this case includes earlier work created by you which has already been submitted for examination of another grade.

Quotes should in general be used sparingly, but if you feel you need to quote text, make sure it is visibly laid out differently from your own. Use citation marks at the start and at the beginning of the quote. Inline quotes, are usually short enough to fit inside one line of text. For example:

Bertram and Jones [9] said that “small devices are good” but ...

For longer quotes, unless the format you are using specifies something else, use vertical space above and below, and use wider margins around the quote. Try to preserve emphasis (italics, bold) used in the original. If you insert your own emphasis, you should indicate that. For example:

As we move on to the subject of embedded devices, it has long been known that VLSI design sooner or later will be back up against the laws of physics. Gruber, in his 2015 paper [12] has the following comment to make:

“As the design process approach the picometer scale, quantum effects can no longer be avoided, and we are essentially no longer dealing with traditional physics, but with a beast of uncompromising complexity and proportion.”

Gruber may lead us to believe that...

For a primer on citing and referencing you may want to see:

<https://www.monash.edu/rlo/research-writing-assignments/referencing-and-academic-integrity/citing-and-referencing>

Computer science often use the IEEE style, which basically is a numbered footnote into the reference list, like this: [8]. This compact format is suitable for short papers and conference papers.

(<http://libguides.murdoch.edu.au/IEEE>)

The Harvard System is also popular in essays, theses and books:

([http://libweb.anglia.ac.uk/referencing/harvard.htm?harvard\\_id=63#63](http://libweb.anglia.ac.uk/referencing/harvard.htm?harvard_id=63#63))

There is also the Oxford referencing system:

<https://www.ub.umu.se/en/write/references/citing-references-oxford>

<https://www.ub.umu.se/en/write/references/writing-references-oxford#>

You are free to use another style, but make sure you stick to *one* style throughout the essay.

The reference list is there to help the reader find the text you are referring to. Make sure to include all the necessary information that may aid the reader. Avoid putting in just a URL to a web source. Include also the title, the author(s), the year (if you can), and the organization, because web links change but the article or page can usually be found elsewhere. As for URLs it is a good practice to mention when you last accessed them successfully.

If you are referring to a book, include the significant page numbers, or chapter numbers, and the edition. Otherwise it will be a needle in a haystack to find the spot you are referring to (unless you are indeed referring to the whole book).

Wikipedia is generally not a good reference. The reason is that it is not a stable (as in archive) source. What is there today can be gone tomorrow. Larger Wikipedia articles usually have sources listed at the bottom. Follow up on them instead, until you find something which appears solid.

When using images, you of course cite the source of the image. You also need to have permission to reproduce the image, and state close to the image, or in a list of images/figures, that you have that permission. The need to state that includes sources that are free to copy, like Creative Commons and the like. Again, the reader must be able to see what you have created and what was created elsewhere.

Make sure that:

- All references in the reference list are used in your text.
- All references used in the text are present in the reference list.

### *How to cite and reference*

**Do not use a numbered reference as a noun.**

Using the reference as a noun is commonly seen in short papers where space is at a premium and each word precious. For example, you might see something like:

A discrete solution to the Monk's problem can be found in [12], while [13] took the Bayesian approach further, to be finally completed by [14].

This compact and ambiguous style is only defensible when writing for an audience who can be expected to recognize the work being referred to, such as visitors at a conference or workshop.

### **Motivate your references to the reader.**

References to sources should be motivated by the text. Do not put on the reader the burden of figuring out what connects your words and the reference. Here is an example of how *not* to do:

The blue connector cannot be attached to the red port [22].

Why is there a reference to [22] at that point, the reader wonders. What will be found in that source? The only way to find out is to track it down, which detracts from the reading flow. Here are some alternatives which helps the reader to decide if the source is interesting:

As described in the service manual [22], the blue connector cannot be attached to the red port.

Or:

The blue connector cannot be attached to the red port, a design flaw originally discovered and documented by Adams et al [22].

### **Explain the scope of the reference.**

A common form of hasty writing, especially when describing something, is to find a source, rewrite the important information in a paragraph, and then end it with a reference. The reference becomes a sort of token protection against arguments of plagiarism or paraphrasing, and the whole thing is both confusing and somewhat unethical. For example:

The upper compartment of the rotary speaker houses a treble driver loudspeaker element and a two-pronged Bakelite horn, mounted on a ball bearing over the emission hole. Only one of the horns allows sound to escape (the other is plugged) but both are needed to achieve symmetrical air-drag [42].

The reader cannot easily know how the reference relates to the many concepts presented in the paragraph. If it indeed covers the whole description, then perhaps a direct quote would have been more appropriate.

A better way of writing is to synthesize your own description from different and independent sources (which you refer to, of course):

Several people have analyzed the Leslie speaker system over the years; Smith and Jones [42], Angar et al, [43], and the very extensive treatment by Dobbs [44]. The joint picture from these works reveal that ...

This shows that you have done your homework and can give a general description which is shaped by the concepts that you, the author, feel are important to emphasize.

### ***Descriptive vs analytic writing***

It is usually easy to collect a number of examples of something from the available literature and describe them in various detail. While often needed, it will inevitably be just a description of things that exist if that is all there is. The really interesting part is when the author applies his or hers understanding and opinions to the topic, and provides some analysis (takes it apart into smaller

pieces) of the presented items. For example, the author may have opinions on, or answers to, one or more of the following questions:

- Why is X better than Y?
- What is the importance of Z?
- How are U and V different and similar?
- When will W not work?

## The article review

You are assigned a paper related to ubiquitous computing or IoT. Your task is to critically examine the paper and write a review report detailing your opinions and findings.

The review report is expected to be 2-3 pages.

In the review report, please do not forget to introduce the paper to the reader- you must not assume that the reader has read the paper you are working with. You may quote liberally (using proper techniques for indicating what is quoted) to illustrate and make clear your critique. You are also welcome to search for and refer to other works which you think are relevant, especially such that support or contradict the arguments in the paper under review.

Whatever your findings turn out to be, motivate your opinions. It is also valuable if you can propose improvements on the paper, as this helps to show that you have a good grasp on the topic area and the paper.

Do not forget to give your praise and agreement where you think it is due.

In writing your review you may be helped by the following questions. Select from the list where appropriate and motivate your choice. Do not simply answer each question with 'yes' or 'no'.

- Is the title clear and representative?
- Are the names of chapters and sections understandable and relevant?
- Is there a balance between the sections?
- Is the topic a good fit for the fields of ubiquitous computing or IoT?
- Is the topic described in a clear and understandable way?
- Are the arguments in the paper believable? Why? Why not?
- Is there any kind of evaluation or future evaluation strategy provided? If not, would it be meaningful to have one in the paper?
- Does the author(s) provide any conclusions? If not, should there be conclusions?
- Are the conclusions (if present) based on the preceding argumentation? Are they sound?

## Article review grading

The grading is PASS/FAIL. To achieve a pass, two out the following three criteria should be met:

- Background: The review can be read without having access to the original paper.
- Analysis: The review contains an analysis of the paper's vices and virtues.
- Priorities: The review discusses and prioritizes problems and benefits with the paper.

## Programming project

The programming project is performed in a group of one or two students. The group members should propose their selected topic to the course director (Fredrik Kilander) before starting work.

The programming project has a rather large degree of freedom. It should incorporate some kind of sensing mechanism, i.e. data captured from the real world in more than one dimension, classify the data according to some well-defined model, and update a context which is arguably useful for some purpose.

Sensing can be done using any number of modalities: light, temperature, sound, motion, weight, humidity. A modern laptop computer usually provides a microphone and a video camera. A cell phone can have both, and in addition a tactile screen, temperature, accelerometers, and humidity sensors (although how accessible they are from a user level program varies with the system). Other sensor alternatives include, but are not limited to, operating system statistics and hooks, on-line services with public API:s, equipment like MIDI or game controllers (Wii, Kinect, VR systems), general purpose input and output devices, and the full range of home automation gadgets available over the shelf in hardware stores.

Students are not expected to create or buy hardware, but are of course welcome to employ such resources that are available to them.

The project should generate a prototype capable of demonstrating some vital, illustrative or significant property of the idea. The demonstration is given to the examiner by appointment towards the end of the course. All group members should be prepared to answer any question regarding the project and its documentation.

The project should also produce a report which documents the following:

- The idea and purpose behind the project, and how it relates to the field of ubiquitous computing or IoT.
- The usage of sensor data, the classification model, the generated context, how it was used in the demonstrator, and could be used in a larger system.
- What has been implemented and what it demonstrates.
- Directions for future work.

## Project grading

The project is graded A-F after a demonstration has been held and a project report submitted, using the following guidelines:

E: The connection between the project and ubiquitous computing/IoT is *acceptable*. The choice of sensor data, classification model, and context is *recognizably* connected to its proposed purpose.

C: The connection between the project and ubiquitous computing/IoT is *well grounded*. The choice of sensor data, classification model, and context is *well* connected to its proposed purpose.

A: The connection between the project and ubiquitous computing/IoT is *indisputable*. The choice of sensor data, classification model, and context is *strongly* connected to its proposed purpose.

## **Course grade**

The course grade is based on the examinations in the following order of importance:

1. The essay (most important)
2. The project report and demonstration
3. The article review (least important)

The examiner reserves the option of adjusting the course grade based on an overall impression of the student's individual achievements.

## **Course director (kursansvarig), examiner, and teacher**

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