# Report - DD2423 - 2022-09-12

Respondents: 1
Answer Count: 1
Answer Frequency: 100.00%

**Please note that there is only one respondent to this form: the person that performs the course analysis.**

**Course analysis carried out by (name, e-mail):**

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**DESCRIPTION OF THE COURSE EVALUATION PROCESS**

**Describe the course evaluation process. Describe how all students have been given the possibility to give their opinions on the course. Describe how aspects regarding gender, and disabled students are investigated.**

The course is primarily evaluated through a questionnaire at the end of the course. The questionnaire is intentionally placed right after the results from the exam are published, giving the students an opportunity to comment on the exam correction. However, since this is almost two months after the final lecture, there is a risk though that students have forgotten some feedback they originally wanted to provide. Another possibility for computer science and machine learning students to provide feedback is through the program integration courses DD2300 and DD2301. The lecturer is a mentor in DD2300 for about 35 students in the autonomous systems and data science tracks, out of which many attend the course. Aspects related to gender are evaluated through the questionnaire, which includes average responses reported by gender. Students with disabilities who require individualized exam procedures are typically asked about the course in connection to the exam.

**DESCRIPTION OF MEETINGS WITH STUDENTS**

**Describe which meetings that has been arranged with students during the course and after its completion. (The outcomes of these meetings should be reported under 7, below.)**

Due to the COVID pandemic, the course round this year was run in hybrid mode, with lectures on campus, but broadcasted through Zoom for those who could not physically attend. Students met the lecturer and teaching assistants during 16 seminars (13 lectures and 3 exercise sessions), 3 individualized lab presentations and weekly lab help sessions. The only planned individual meetings are those related to the labs, which were all online in Zoom. However, students are always encouraged to ask questions related to the course either in Canvas, in direct connection to the lectures or after exams are corrected and returned. Many of these questions are later brought up during the lectures.

**COURSE DESIGN**

**Briefly describe the course design (learning activities, examinations) and any changes that have been implemented since the last course offering.**

The course is an introductory course in image analysis and computer vision. It covers mature areas such as image filtering, enhancement and reconstruction, feature detection and extraction, shape representation, image segmentation, object recognition, as well as stereo and motion analysis. It contains 16 seminars, out of which three are dedicated to exercises, repetition and open questions. Even if the course is heavy on theory, the focus is to make students learn how to do image analysis in practice, something that is done in three labs, one on image filtering, one on edge detection and line extraction, and the last one on image segmentation. Labs are examined by interviewing students individually, with directed questions assessing their understanding of the underlying concepts behind the labs, more than the results of the labs per se. The theoretical part of the material is examined through a final exam. Even if the lab course is worth more in terms of credit points, the exam has a higher influence on the final grade, given that grades are computed as an average of the lab and exam grade, but rounded towards the exam grade. The reason for that is the fact that theoretical aspects from the labs also end up on the exam and the exam is the last activity of the course. If a student misunderstands an important concept during the labs, the lab presentation can provide feedback in time for the exam. For students to get an idea of how much in-depth they are expected to study the material, the course also contains a weekly voluntary quiz. Since the course is introductory it spans the whole field of computer vision and the amount of available literature is vast. A second reason is to focus on essential concepts that are often misunderstood. Quiz questions are often phrased such that incorrect answers easily lead to cognitive dissonance when an explanation is given at the end. Finally, the quiz gives the lecturer feedback on what should be reiterated during lectures.

Due to the pandemic, the course was run in a hybrid format with lectures on campus but also broadcast in Zoom. Lectures were not recorded, but recordings from the previous year were instead used as supplementary material. Lab presentations and help sessions were also held online, which was both necessary due to the hybrid mode, but also something that turned out to work really well last year when the course was fully online. In earlier course rounds the labs have always been done in Matlab, but this year there was an option to instead use Python. While presentation sessions were densely scheduled during the last days of each lab week, help sessions were more sparsely spread over the whole period giving students and TAs more flexibility for more spontaneous meetings. To benefit fully from the availability of Zoom for spontaneous online meetings, Q&A sessions were introduced, during which students could ask any question related to the course. Besides the slight changes that are made for every course round, about half the lectures were updated this year in an attempt to show more recent examples of deep learning and its use for computer vision.

**THE STUDENTS' WORKLOAD**

**Does the students' workload correspond to the expected level (40 hours/1.5 credits)? If these is a significant deviation from the expected, what can be the reason?**

The reported course load was everything from 3 to 40 hours a week, which is a very large spread. This is possibly due to differences in levels of ambition and backgrounds of students. Students come from many different master's programs, many of which include less mathematics and programming than others. The median workload of 16 hours a week is closer to what one might expect.

**THE STUDENTS' RESULTS**

**How well have the students succeeded on the course? If there are significant differences compared to previous course offerings, what can be the reason?**

Most students successfully completed the course, but there are a number of students that, depending on background, find either the laboratory exercises or the mathematically oriented exercises on the exam difficult. Out of 156 (145) registered students, 120 (125) passed the lab course, 126 (129) passed the exam, while 117 (122) passed the course as a whole, based on numbers recorded in Ladok, which might vary from those in Canvas that include doctoral students and re-registered students that failed to complete the course during an earlier course round. The numbers in parentheses are from the previous course round. It should be noted since the course is an elective course for most students, the number of students passing the course might vary considerably from year to year, depending on the number of other alternative courses given in the same period. Due to the pandemic, this course round was attended by only a small number of exchange students, a group of students that has been fairly large over the years.

**STUDENTS´ANSWERS TO OPEN QUESTIONS**
**What does students say in response to the open questions?**

Given the large and diverse group of students, students have different opinions on the course, even if most students enjoy the course as a whole. Some find the labs too easy, while others find the programming parts difficult. The same is true for the more mathematically oriented exercises and exam questions. It is clear that most students enjoy the labs and appreciate that they can be done in either Matlab or Python. Most students also seem to like the lectures, but some students believe the content is too extensive.

**SUMMARY OF STUDENTS' OPINIONS**
**Summarize the outcome of the questionnaire, as well as opinions emerging at meetings with students.**

While students were in general quite positive in their comments, especially when it comes to the labs, they still had a number of recommendations for future course rounds. Some students believe more exercise sessions are needed to prepare for the mathematical problems on the exam. It is also questioned whether an exam is at all necessary given that the exam could possibly be replaced by more labs or projects. Even if more material on recent deep learning-based methods has been added to the course, while removing more traditional methods that are nowadays less common, there is an interest in even more deep learning.

**OVERALL IMPRESSION**
**Summarize the teachers' overall impressions of the course offering in relation to students' results and their evaluation of the course, as well as in relation to the changes implemented since last course offering.**

Computer vision is indeed a broad topic and includes a number of mathematical concepts that can be difficult to grasp. The question is how the understanding of these more mathematical concepts should be assessed. If they are not assessed, students will eventually learn to ignore them. In that case, it would be better to gradually let the course become a pure project course, in which students try to understand only those concepts that are needed for the individual projects. The course has so far used a final exam to assess both these mathematical concepts, as well as algorithms that are regarded as fundamental in computer vision. The exam could potentially be replaced by take-home exercises, but the question is how to then avoid students collaborating on these exercises so that the understanding of each individual student can be assessed.

There is an interest in seeing more examples of more recent deep learning-based methods in the course, which in practice would mean less coverage of more traditional methods. However, deep learning methods are not the only ones used in the industry. In medical image processing, for example, energy-based methods are still very common and will hardly be replaced by pure deep learning-based methods any time soon. In other areas that involve reasoning in 3D space, it is questionable whether deep learning will ever dominate, other than for solving subproblems such as feature learning and matching. The course should be updated with recent development in mind, but without sacrificing topics that are still of importance to professionals. It is also worth noting that our course already today has quite a lot about deep learning, compared to computer vision courses at other universities.

Exploiting the benefits of Zoom for more online lab assistance and Q&A sessions seems to have been a step in the right direction since they seem to have been much appreciated by the students, who had little negative to say about the support they got during the course.

**ANALYSIS**
**Is it possible to identify stronger and weaker areas in the learning environment based on the information you have gathered during the evaluation and analysis process? What can the reason for these be? Are there significant difference in experience between:**
**- students identifying as female and male?**
**- international and national students?**
**- students with or without disabilities?**

Compared to earlier years, the scores on the points in the questionnaire improved significantly, with a spread from 4.8 to 6.5 and a median of 6.1, where the maximum score is 7.0. The weakest point is "20. I had opportunities to influence the course activities" (4.8), but this is also the point that has improved the most, possibly due to the option of using either Python or Matlab for the labs. Similar changes should be considered in the future, changes that introduce options for the students, but without complicating the work for the TAs too much. Another weak point was "15. I could practice and receive feedback without being graded" (5.0). Both this and the previous point are hard to solve, given the size of the course and the diversity in backgrounds and interests of the students. Possibly due to the pandemic and the hybrid format "5. I felt togetherness with others on the course" (5.0) also showed to be a weak point. The highest scoring point was "6. The atmosphere on the course was open and inclusive" (6.5). There was no significant difference in assessment between the international students and students from KTH, but female students gave somewhat higher scores in general. One possible explanation is that the relative number of female students is higher among international students and that students are more likely to be well motivated if they came to KTH only for their master's education. No student with disabilities responded to the questionnaire.

**PRIORITIZED COURSE DEVELOPMENT**
**What aspects of the course should be developed primaily? How can these aspects be developed in short and long term?**

The course has no real trouble spot. Students view it as quite well organised, even if there is a bit too much content. It might be good to completely refresh all lectures, not least to better follow the current course book. Over the years bits and pieces have been added to the course, while less relevant topics have disappeared, but this means that the course lacks a bit in terms of a holistic view of the whole field. A complete refresh is no easy task, however, and might result in new issues popping up in a course that is already today quite streamlined. More important is to introduce more options for the students, especially in terms of assessment. Given that the student group is so diverse, one should preferably have two different courses, one in image processing and analysis, and one in computer vision for real-time systems. Since this is not possible with current teaching resources, alternative methods should instead be explored, such as alternative labs and optional exams for higher grades.