

Course analysis (2014/15 period 1+2)

DD2425 Robotics and Autonomous Systems, 9hp

Course responsible and lecturer: Patric Jensfelt

Lab assistants: Francisco Vina and Rares Ambrus

Number of lectures: 12 lectures (24 hours)

Registered students: 39 (according to VIS report VG.5)

"Prestationsgrad": 92%

"Examinationgrad": 90%

Course material:

- Book: "Introduction to Autonomous Mobile Robots" by Roland Siegwart and Illah R. Nourbakhsh published by the MIT Press.
- Lecture notes: Available for download from BILDA

Examination requirements:

- LAB1 0.5hp (during first period)
 - Basis ROS assignment
- TEN1 3hp (after course)
 - Written examn
- PRO1 5.5hp (whole second period)
 - Project work
 - Weekly status reports from the project group
 - Presentation
 - Reflection on the work of oneself
 - Reflection on group work
 - Project report

General description:

The course runs over two periods with the first period providing an overview of the field of robotics and the second being entirely focus on a project. This year the project work was started already in the first period although at a lower pace. The project takes a lot of time. The course was appreciated by all students (87% very interesting and 13% interesting). The corresponding numbers last year were 71% very interesting and 29% interesting. In short, ALL students find the course interesting. 91.3% would recommend the course to others and 78.3% became more interested in robotics and robotics research after taking the course which I find great.

Grading:

Grading is based on a weighted average of the score from the project (50%) and exam (50%) which both give a score between 0 and 10 where 0 is just passing and 10 is the maximum score. The score in the project is individual but the group collects points together.

Relation to the previous years:

Lecture: Added a hands-on lecture on Scrum by Samuel Carlsson from Volumental AB. I think this turned out really well. Even though not everyone group ended up using Scrum or other agile methods in the project they got to see it and some groups did use it.

Lab: The individual lab on ROS was extended to give the basics about ROS as well. We managed to hand out the virtual machines with a Linux environment early on.

Hardware: Re-designed power and connection board. Worked quite well but needs some modification. Each group now had two NUCs for development. Most groups used one permanently on the robot and the other as a desktop.

Project: Changed the objects to detect/recognize to be simpler. We put wooden boards under the maze both in the lab and the contest area to make the conditions more similar.

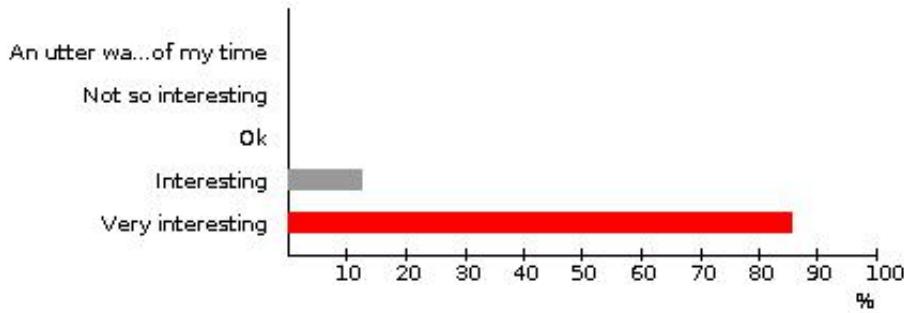
Planned changes:

- Small mods to the custom made board.
- More project meetings between groups and TAs
- Change the project tasks from mapping to localization

Survey results

Survey: Course evaluation
Status: open
Date: 2015-08-18 22:21:59
Group: Participants (DD2425 robot14)
Answered by: 23(38) (60%)

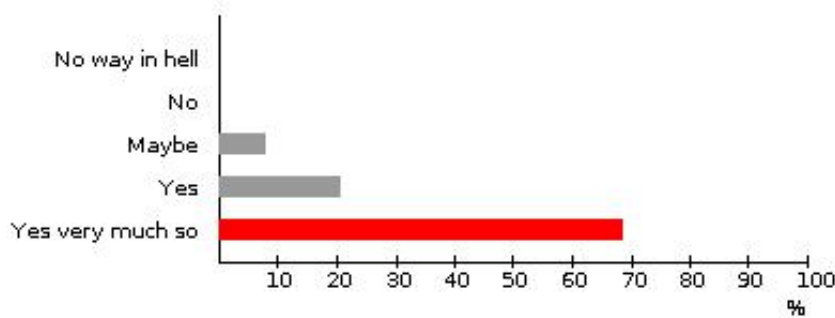
Did you find the course interesting and meaningful?



number	distribution	answer choice
0	0%	An utter waste of my time
0	0%	Not so interesting
0	0%	Ok
3	13%	Interesting
20	87%	Very interesting

23 has answered of 38 (60%)
Maximum number of choices: 1

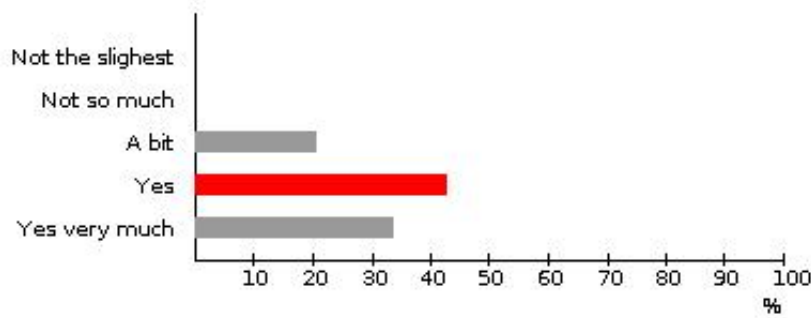
Would you recommend this course to a fellow student?



number	distribution	answer choice
0	0%	No way in hell
0	0%	No
2	8,7%	Maybe
5	21,7%	Yes
16	69,6%	Yes very much so

23 has answered of 38 (60%)
Maximum number of choices: 1

Did this course make you more interested in robotics and robotics research?



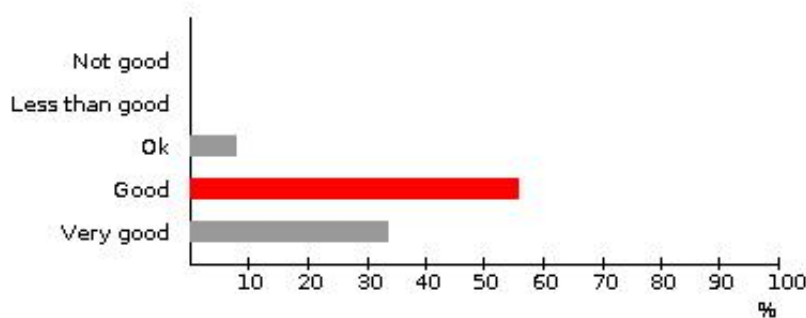
number	distribution	answer choice
0	0%	Not the slightest
0	0%	Not so much
5	21,7%	A bit
10	43,5%	Yes
8	34,8%	Yes very much

23 has answered of 38 (60%)
 Maximum number of choices: 1

Comment:

- The course was very interesting and extremely challenging. I would definitely recommend this to any student, as long as he/she has interest and a lot of TIME to put on the final project.
- Made me realize programming and CV are easy to get into.
- This kind of work is in my opinion the most fun way to learn and challenge yourself.
- I have learned more than I could dream of from this course. The way I think, see and solve problems are completely different now than before the course!
- The thing is, as a computer science student, the real-world stuff kinda put me off a bit. When working with solely digital applications, you can expect things to behave properly. With robots, there are plenty of practical problems arising, like motors and other equipment breaking down, changing outer conditions and so on. While this is exciting, it made it sometimes frustrating to work with. It's a completely new type of challenge, and I like for challenge's sake, but dislike the challenge itself.
- Made me realize what I like and don't like about robotics
- If there is an advanced course after this, we can learn more about robotics and gain more experience.
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- I feel I've learned enough to be able to regard problems from a roboticist's perspective to some extent, which I think is very valuable.

What do you think about Patric's lectures?



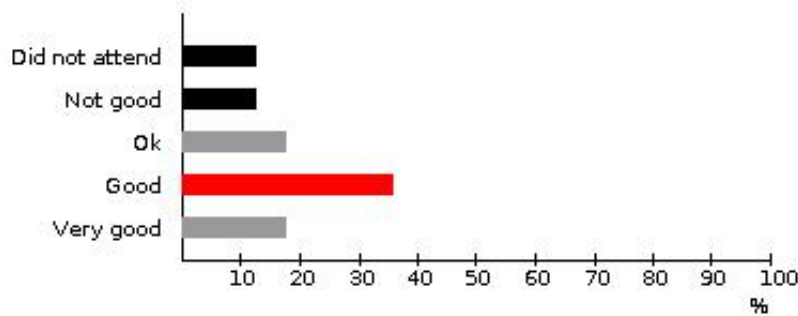
number	distribution	answer choice
0	0%	Not good
0	0%	Less than good
2	8,7%	Ok
13	56,5%	Good
8	34,8%	Very good

23 has answered of 38 (60%)
 Maximum number of choices: 1

Comment:

- Could be a bit more software oriented.
 - Cover the main areas briefly.
 - Quite nice, especially having videos and the final discussion session. We did learn a lot from them. Maybe it would have been nice to be able to apply some more concepts in the actual project, but it was OK anyway.
 - Interesting and entertaining
 - Good discussion and group bonding time. Content level is well adjusted to the needs of the course - not too theoretical.
 - Good mixture of listening and trying on minor tasks.
 - Loved them, very interesting, entertaining and contained lots of valuable information!
 - Entertaining but mostly with little depth (only exception being the kinematics stuff which was ridiculously heavy compared to everything else)
 - Serve as a decent introduction to the material but nothing more though,
 - He is so nice and patient when he gave the course. Also he focus on group training that is very impress.
 - the content was very basic and general, but way it was teach was good, Patric is good at giving lectures
 - Everything seems to be a little bit vague: we talk about a lot of things but never too deep into anything. Also, I think most groups would not complete the tasks in the end of the lectures, because we didn't have enough time to set up everything.
 - Didn't really catch everything during the lectures since we hadn't started the project yet, and therefore not started to think about the problems we were presented with possible solutions for.
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What do you think about Samuel's lecture on agile software development?



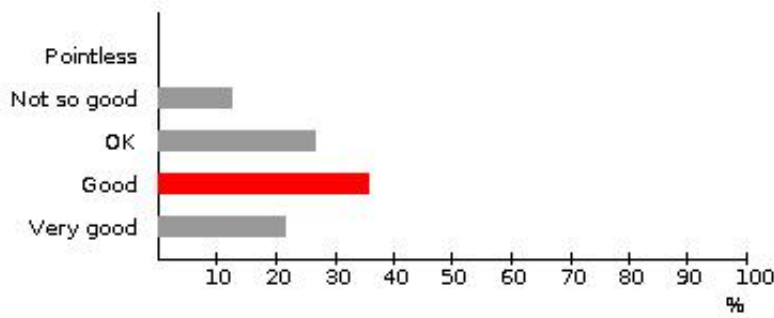
number	distribution	answer choice
3	13,6%	Did not attend
3	13,6%	Not good
4	18,2%	Ok
8	36,4%	Good
4	18,2%	Very good

22 has answered of 38 (57%)
Maximum number of choices: 1

Comment:

- Never heard about this.
 - I'm honestly surprised how such an stupid example could teach that much. I did learn by heart the basics of agile development in less than 2 hours. Congratulations!
 - Needed one bigger team assignment which mimics the team meetings later. The exercise in the lecture was pretty useless for me.
 - This I must have missed..
 - Pretty much a copy of a lecture on the same subject from the project management course, but it is useful for those who didn't take that course though.
 - There are lots of advice and lessons given on agile software development. Part of my career would work on programming. His lecture is very useful.
 - We didn't really use the method but I find it very useful for large scale projects involving many people
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How did you find the group discussions at the end of the lectures?



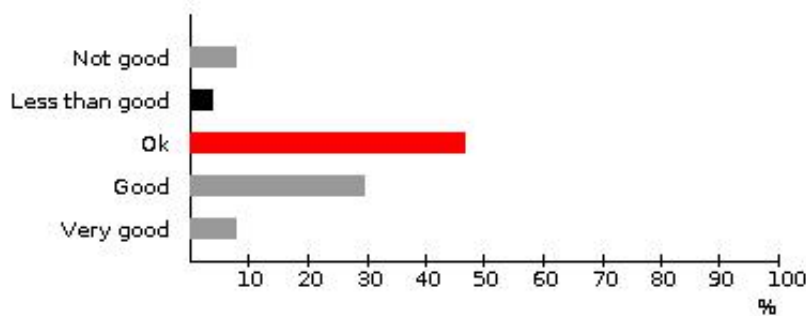
number	distribution	answer choice
0	0%	Pointless
3	13,6%	Not so good
6	27,3%	OK
8	36,4%	Good
5	22,7%	Very good

22 has answered of 38 (57%)
 Maximum number of choices: 1

Comment:

- Forces the groups to communicate which is good later in the project
- A key component of the lectures. That's where we actually learnt stuff. It also encouraged early discussions within the team about how to solve the different tasks of the project.
- They made you think about what have you learnt during the lectures
- It would be great if we have the answers to the discussed topics in the lecture slides so that we don't have to Google like crazy before the exam.
- Helped connecting further with the group
- Was very good for building group dynamics.
- Didn't really do so much for me
- The small game lets me know I should be more active on the group. I realized my shortness on group working.
- They were generally interesting but sometimes the time given was not right (some days we could finish them all in a few minutes and sometimes we could have needed way more, i.e. in the exercises)
- It was good, to get to know your group members before the project. The questions were not that useful for me.
- Commented above
- A bit forced

What do you think about the connection between the lectures and the project? Could you used what you learned in the lectures in the project?



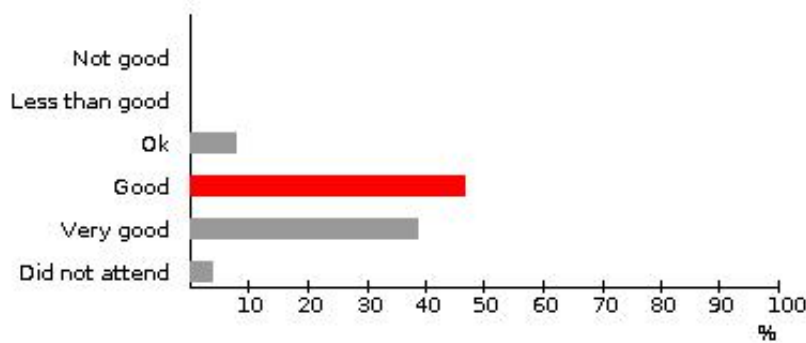
number	distribution	answer choice
2	8,7%	Not good
1	4,3%	Less than good
11	47,8%	Ok
7	30,4%	Good
2	8,7%	Very good

23 has answered of 38 (60%)
 Maximum number of choices: 1

Comment:

- Not really. We had to simplify all the content in the lecture for our project.
 - As I said before, we couldn't really use much of the contents from the lectures given the nature of the project. Maybe it's because of the fact that the lectures covered pretty much everything about robotics with not so much detail, so in the end the relevant information had to be looked up on the internet. But I think it was good to have a wide overview of Robotics; afterwards everyone can go and dig deeper on something.
 - They gave the best guidance they could - the project requires a lot of additional research anyway.
 - The lectures were mostly a completely different world from the project. Maybe they were relevant but it definitely did not feel that way during the project.
 - I don't like that all the lectures were held before the project started. The lectures and project should progress in parallel.
 - I guess, had seen most of it in other courses so the lectures did very little to extend on that knowledge
 - Lab2 needed a group work together. Although I realized I should be more active in a group, I did not well in the following lab's communication. I must change.
 - So-so, we used just a little bit
 - the lectures were very general, but the project was quite specific.
- I think I could have made the same project without attending the lectures
- I think it was ok, but most of the things you need to figure out by yourself. The lecture are good to give an idea of what needs to be done and how difficult it is.

What do you think about the tutorial with introduction to ROS and the programming lab (LAB1)?



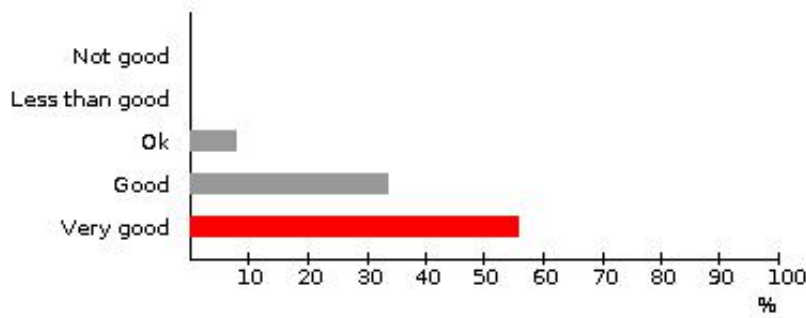
number	distribution	answer choice
0	0%	Not good
0	0%	Less than good
2	8,7%	Ok
11	47,8%	Good
9	39,1%	Very good
1	4,3%	Did not attend

23 has answered of 38 (60%)
 Maximum number of choices: 1

Comment:

- Maybe a bit easy.
- Quite good: it explained all the basics of ROS. However, it would have been better to combine it with some practical demos; otherwise there were too many concepts to be learnt just by looking at the slides.
- Very good to get an introduction to the environment you are going to use during the course and necessary.
- A must for everyone who is not experienced like me. Also, helped me get back to my old Linux habits and I haven't used Windows ever since.
- It was good to force everyone to become familiar with ROS before the project started, to not have to waste time on figuring out ROS basics during the project.
- don't remember it that well
- Those tutorials are very important part of the course for me. It helps me build a basic idea about the system step by step. If you can provide more examples on following lab programming would be better.
- Alright, it would have been interesting to see a "hello world" type of code and explain it a little bit since we finished quite ahead of time.
- I think it was very good to get used to ROS.
- I would say doing the ROS tutorials is almost necessary to understand ros well enough to complete the project. A great deal of emphasis should be put on doing the tutorials before the lab assignment. (I don't remember if this was done to an extent great enough.)

What do you think of the ROS programming assignment? Did it help you get started? Did it help peope in teh group to know ROS?



number	distribution	answer choice
0	0%	Not good
0	0%	Less than good
2	8,7%	Ok
8	34,8%	Good
13	56,5%	Very good

23 has answered of 38 (60%)
 Maximum number of choices: 1

Comment:

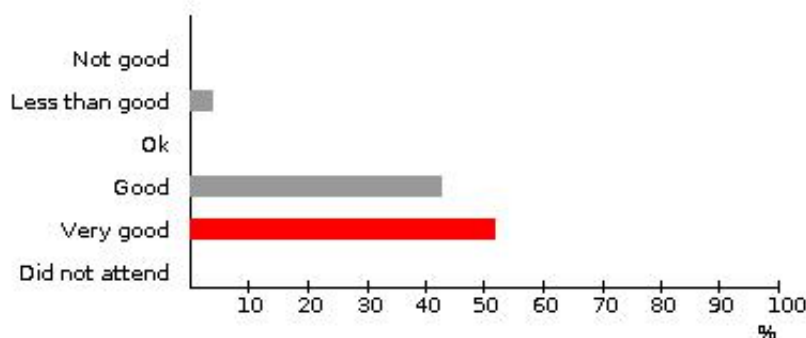
- The assignment is very well developed I think. It makes you cover all the main areas to get a good start in understanding ROS and how to use it. Without this assignment a lot of groups would waste much more time to try to learn it.
- Excellent introduction to ROS and basic motion control. It was easier to make the robot move after that. It definitely helped other people in the group to warm up and start coding.
- Most crucial part of the course. It was judged just right - not too difficult, not too shallow.

What was missing is the requirement for class implementation, which I think is fundamental for the later work. When you say "recommended", students hear "meh, optional." So it need to be mandatory in my opinion.

"From 0 to ROS in 3 days." - Unnamed

- It was a good start, I would'nt have minded a few more tasks in the assignment.
- Should add a little bit introduction to C++, was very hard for me but I did get a lot of help from my fellow teammates.
- Good difficulty on the assignment. Complex enough to have to understand ROS but not too difficult that it took too much time to do.
- very helpful and fun, forces you to read through the ROS tutorial to learn early which is very much needed.
- If I just read the tutorial, I might can not well understand ROS. But after the assignment, It helps a lot to understand ROS. I think more assignment or examples should be better for me to start lab2. I found most of students like me actually not good at c++ or programming. More assignment or examples about localization, path generating, navigation would help students understand more about robot.
- Very important that the other group members also know ROS
- Very good and definitely useful
- i was a good introduction, but i think people not familiar with ROS or C++ would benefit with more programming assignments
- I think it was a very good idea, since i didn't know ROS before. with that assignment it was just enough to be able to do the project. For some people I don't think it was enough, especially if they were not used to programming.
- Learned everything needed to get started

What do you think about the first introductory session in the robot lab?



number	distribution	answer choice
0	0%	Not good

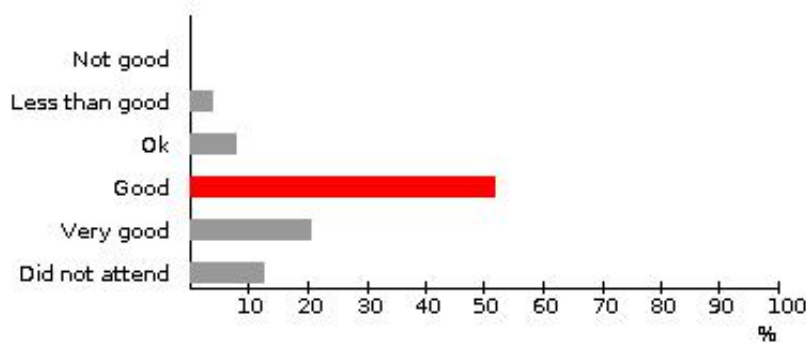
1	4,3%	Less than good
0	0%	Ok
10	43,5%	Good
12	52,2%	Very good
0	0%	Did not attend

23 has answered of 38 (60%)
Maximum number of choices: 1

Comment:

- Very nice introduction to test all the components and check that everything is OK.
- Needed in order to not be completely lost at the beginning
- Important and as fun as the lectures (I thought of it as a lecture). Needs to be compulsory (if it isn't already)
- Very informative, very good
- Forgot most things an hour after. Only used the slides for the openni launch command until I memorized it.
- Very useful and well planned
- I was really useful to get familiar with all the equipment. maybe should start earlier in the course.
- I think it was an important session.

What did you think about the PCL and OpenCV tutorial?



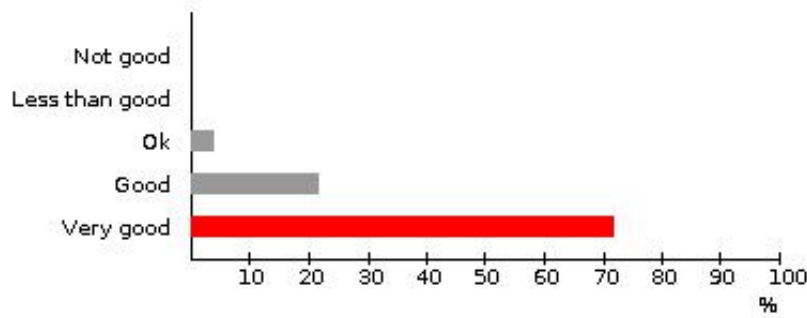
number	distribution	answer choice
0	0%	Not good
1	4,3%	Less than good
2	8,7%	Ok
12	52,2%	Good
5	21,7%	Very good
3	13%	Did not attend

23 has answered of 38 (60%)
Maximum number of choices: 1

Comment:

- Nice overview of the different techniques that could be applied to the project. Not too specific in order not to give away too much information. Maybe a combination with practical exercises would have been nice.
- Very happy with the tutorial. Would have been nice to have an implementation assignment with guidelines!
- Very good and useful
- It was good to get an overview of possible techniques to use, but it was way too late in the project.
- good overview of the most helpful features.
- A very good overview of the course. It lets me well schedule my time.
- It was so late, that we already looked up all the information by our self, so that we could not learn more.
-
- Didn't read

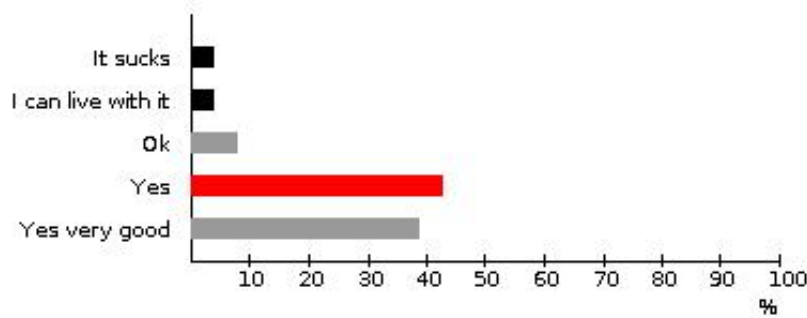
How did you like the project?



number	distribution	answer choice
0	0%	Not good
0	0%	Less than good
1	4,5%	Ok
5	22,7%	Good
16	72,7%	Very good

22 has answered of 38 (57%)
 Maximum number of choices: 1

You were divided into groups partly based on your skills and NOT knowing one another before. Do you think that this is a good way to do it?



number	distribution	answer choice
1	4,3%	It sucks
1	4,3%	I can live with it
2	8,7%	Ok
10	43,5%	Yes
9	39,1%	Yes very good

23 has answered of 38 (60%)
 Maximum number of choices: 1

Comment:

-If the argument is that we should practice to work in groups of different disciplines and culture: This course is about robotics, not communication. The project is tough enough.
 If the argument is that we need different knowledge to be able to build a good robot: Nope. The hardware and tuning is so basic (in this project) that anyone can do it (this was the first time for me). It takes maximum one week and then it's done. What the project needs is dedicated people with good programming skills. The CV part I understand that it might be good to have people that have studied it. But having people in the group that know how to process static 2D images in Matlab doesn't really help the project.
 If the argument is that every group should have a chance of building a good robot (and therefore spreading out the "skilled" people): I think this sucks. This means that there are people taking this course that shouldn't take this course. If you cannot program and are not willing to learn you don't belong in this course.

I think it would be much more interesting if groups could be divided by ambition and skill. I think a lot of the frustration would go away. It would take away a lot of stress for the less skilled folks while making the skilled ones more happy.
 -I think it is good since that is probably what it will be like when working in the industry. You need to be able to work with new people and not only with your friends. It is also good in the sense that you will get people with different knowledge and experiences.
 -It's good and bad at the same time. On the one hand, you exercise your team-work and communication skills when you

work with people you don't know. However, that might take some time, which we clearly lacked in the course. In addition, people might have different levels of ambitions, availability and knowledge. It's quite stressful to try to make such a diverse group work well in such a short period of time, but it's a good exercise to prepare us for a future working environment.

-It will be a more diverse group this way and also avoids the preoccupation of finding partners for the project.

-Not perfect, but the only correct way in my opinion. Some teams had soap-opera levels of drama, but that's due to people's personalities, not skills. I think the selection system should stay this way.

-Different ambition levels can be a problem, however I don't really have a good solution around that problem.

-Adds variety and you get new friends!

-Maybe I'm biased because I got placed in a great group but I enjoyed working with new people.

-Some people had lacking programming skills, we didn't deal with this in a good way. Perhaps some thorough mandatory discussion (guided, i.e. with discussion points) at the start of the course to assess this would have been beneficial.

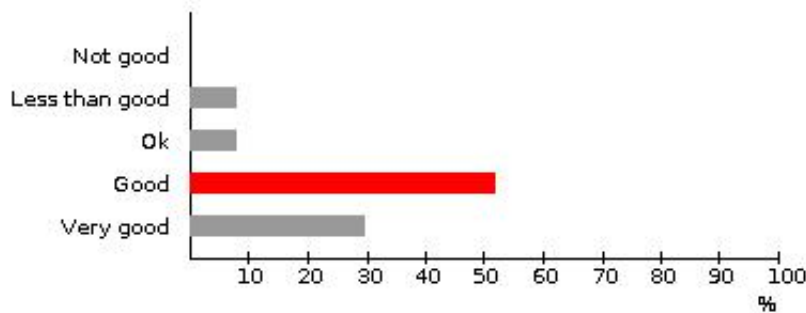
-The teams need a wide background to be able to solve this successfully.

-It is good to be divided by our background. It is important to have a member who is good at programming. But there are some frictions like before the deadline. If you can give a small group assignment about programming in Lab1, it might help.

-I think it is the best way to do it but that it didn't work perfectly. Everyone should be able to contribute with something and that doesn't always happen.

-Working together with people you don't know beforehand is a good experience, and having to match members with certain tasks is, too.

How did your group work together?



number	distribution	answer choice
0	0%	Not good
2	8,7%	Less than good
2	8,7%	Ok
12	52,2%	Good
7	30,4%	Very good

23 has answered of 38 (60%)

Maximum number of choices: 1

Comment:

-I was very happy with my group. I believe we were the happiest group, with no conflicts and good teamwork. I still hold on to my statement about forced groups though.

-Only two people did most of the work, for several reasons. We could definitely have achieved better results and especially have had a less stressful time if everyone had put an equal amount of effort in the project.

-My group was excellent, but this was due to coincidental match of characters of the team members. The only thing I didn't like is that we didn't have an assigned leader and we were too polite and democratic for our own sake.

-I felt that we had good communication and had the same end vision with the robot.

-Extraordinary, although we could have had better planning

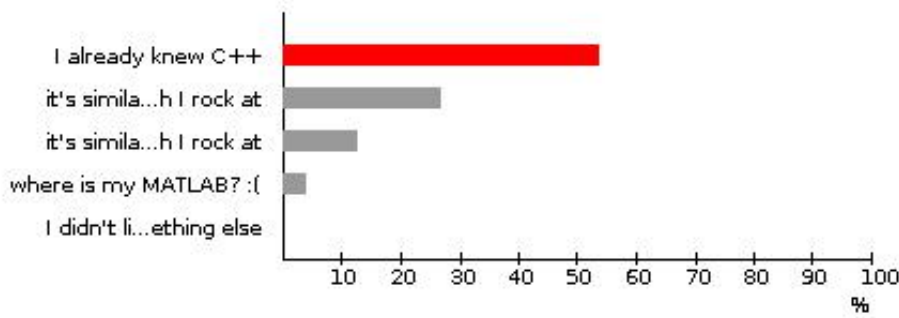
-Some people couldn't/didn't want to spend time on the project which was also frustrating. Not sure how to deal with that. Perhaps be clear with that grades will be individual based on contribution from the start.

-The team I got was really good so I am happy

-Most of the time we worked together, communication is super important!

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How hard was it to get used to C++?



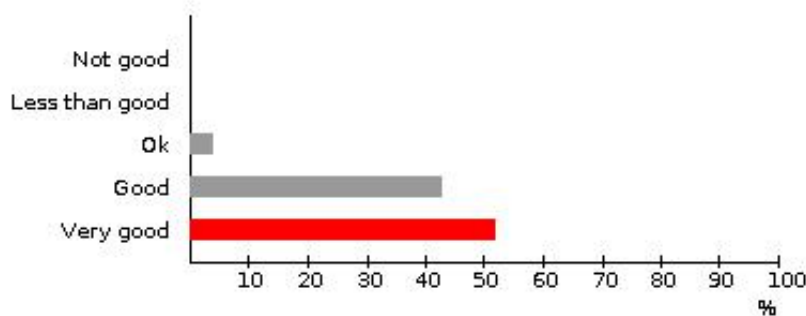
number	distribution	answer choice
12	54,5%	I already knew C++
6	27,3%	it's similar to C which I rock at
3	13,6%	it's similar to Java which I rock at
1	4,5%	where is my MATLAB? :(
0	0%	I didn't like it -- I prefer something else

22 has answered of 38 (57%)
 Maximum number of choices: 1

Comment:

- No problems since I took the C++ course (DD2387)
- There is a steep learning curve with the classes and I think this should be REQUIRED in the intro assignment.
- Barely knew C++ but its awesome! This made me prefer C++ over MATLAB tbh!
- Since some members of the group were very fluent in C++, it was hard to understand their code and hence, hard to code integrated into it.
- I had done some c++, c and java.
- In the beginning, I can write a project by c++ and feel that is difficult. In the course, I learned from webs and our group. It is a very happy experience for me. It did has different grammar compared with matlab. But they have the same logic and mathematics. I feel I become more powerful in c++ and thanks to the course.
- I "kinda" knew C++. I think it's very good for this project even if small Python modules might help
- I knew C and Java before, so it was ok to learn, and i am glad, that i know another programming language now.
- Those who weren't very good at programming had problems contributing to the project.

What did you think about ROS?



number	distribution	answer choice
0	0%	Not good
0	0%	Less than good
1	4,3%	Ok
10	43,5%	Good
12	52,2%	Very good

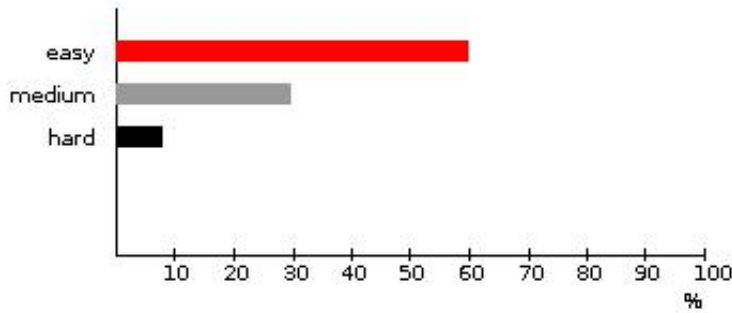
23 has answered of 38 (60%)
 Maximum number of choices: 1

Comment:

- Some rough parts. I wish we would have got some more information about best practices.
- Excellent framework. It allows to handle multiple threads as nodes really easily. Super simple interface with the hardware (Arduino, camera, IMU)... Lots of packages and very active community. Easy to install, very clear instructions.

- I don't know about other robot OS's, but this one amazed me. I'm not qualified to say if it is actually good because I wouldn't know :) But it worked very well!
- A bit buggy but otherwise very helpful! Will definitely use it lateron!
- Good interface for programming, good tutorials online. Was a bit hard to resolve problems sometimes though because of cryptic error messages (was partly CMake and c++ though)
- interesting to say the least
- helped us a lot to use it
- ROS is very good, but I am not good at ROS. I will keep on learning after this course. Let's see how far I could go!
- Generally very good and helping but unreliable sometimes, when messages would get lost in the communication and make debug very hard.
- It's messy but it makes sense once you get used to it

How hard was Milestone 0?



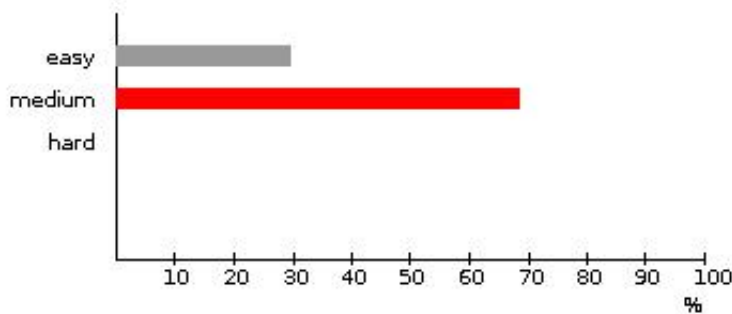
number	distribution	answer choice
14	60,9%	easy
7	30,4%	medium
2	8,7%	hard

23 has answered of 38 (60%)
Maximum number of choices: 3

Comment:

- The hardest part was to tune the PID controller for the motors.
- It was fun and a good intro.
- cake
- At first, we though it was easy and we finished well. But now I find actually we changed most things that we got in milestone 0.
- Easy, finished it and started working on M1 quite ahead of the deadline. I still think that the hand following might be changed to something else since people might waste a lot of time coding that feature that won't be part of the final project.
- we didn't have much time.
- Deadline should be earlier, to allow for more work with the later deadlines. It should give a decent reflection of when one is expected to be a which stage in the project, assuming the work is somewhat equally distributed over time.

How hard was Milestone 1?



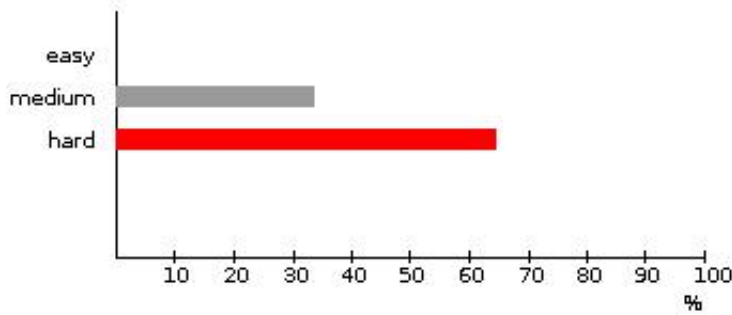
number	distribution	answer choice
7	30,4%	easy
16	69,6%	medium
0	0%	hard

23 has answered of 38 (60%)
Maximum number of choices: 1

Comment:

- Didn't work until we increased the publish rate.
 - Last one we managed to properly plan, but couldn't execute well.
 - cake
 - A lot of time
 - Still quite easy and finished in advance
 - Deadline should be earlier, to allow for more work with the later deadlines. It should give a decent reflection of when one is expected to be a which stage in the project, assuming the work is somewhat equally distributed over time.
-

How hard was Milestone 2?



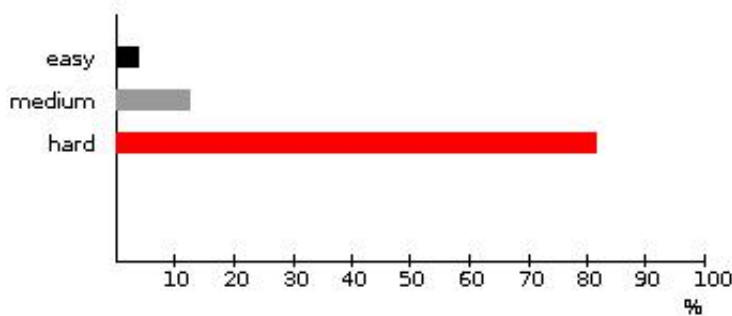
number	distribution	answer choice
0	0%	easy
8	34,8%	medium
15	65,2%	hard

23 has answered of 38 (60%)
Maximum number of choices: 1

Comment:

- Took a long time to get mapping and object recognition working successfully.
 - Difficulty: Very hard
 - Huge step from the previous milestone and way too little time.
 - suddenly soooo many pieces have to fit together
 - Medium time
 - much more difficult to do than the previous milestones, however well doable.
 - Quite hard to have a working reliable map, but I guess we had to accept some failures once in a while
 - The M0 and M1 deadlines being so late tricked me into thinking I wouldn't need as much time as it turned out.
-

How hard was Milestone 3?



number	distribution	answer choice
1	4,3%	easy
3	13%	medium
19	82,6%	hard

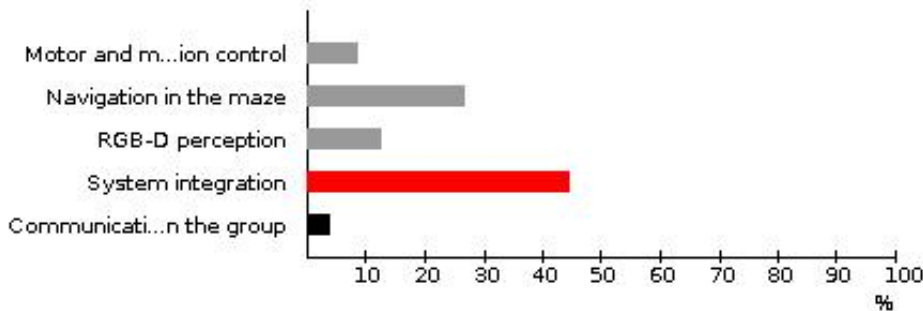
23 has answered of 38 (60%)

Maximum number of choices: 1

Comment:

- Didn't manage to get localization so we couldn't really demonstrate Phase 2 fully. Also, complete lack of time since we only had 1 week since the last milestone.
 - Difficulty: God - tier
 - We failed on every level due to previous mistakes.
 - If milestone 2 is done this would have been easy.
 - Little time
 - proved to be very difficult, especially following the map.
 - A nightmare, finished 5 minutes before the deadline with quite some luck.
 -
 - The M0 and M1 deadlines being so late tricked me into thinking I wouldn't need as much time as it turned out.
-

Which of the following do you think was the hardest part of the project. Write other below if you cannot find your choice



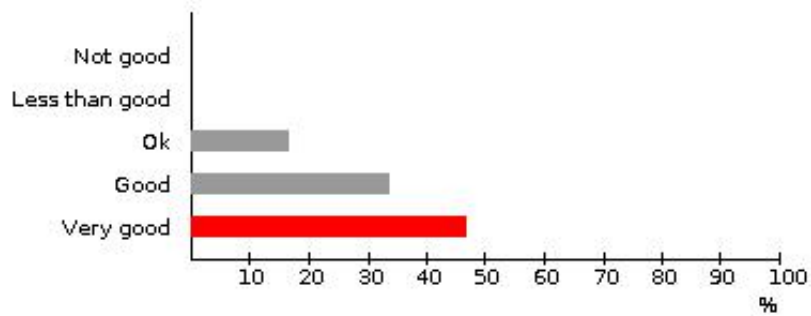
number	distribution	answer choice
2	9,1%	Motor and motion control
6	27,3%	Navigation in the maze
3	13,6%	RGB-D perception
10	45,5%	System integration
1	4,5%	Communication within the group

22 has answered of 38 (57%)
Maximum number of choices: 1

Comment:

- Components might work pretty well when they are run in an isolated controlled environment, but when you integrate them with the rest, you will be very likely to change a lot of what you did to achieve a good integration.
 - Navigation was difficult because we didn't really have a map.
 - And localization in the map in order to execute task 2 in a good manner.
 - If we had planned properly, everything would have turned out just OK
 - Well I worked pretty much only on the vision, and from what I felt it was the hardest.
 - atleast the one we had the most problem with
 - Fixing problems
 - Definitely integration, when the system becomes highly modular communication between nodes can become complex.
 - I think the hardest thing was to create a robust robot. When some sensors had a blackout, the robot total crash. The same when the robot touch a wall. So in our case was always a bit luck involved, whether we completed a task or not.
 -
 - We should have used more PIDs
-

How did you like the contest event at the end of the project?



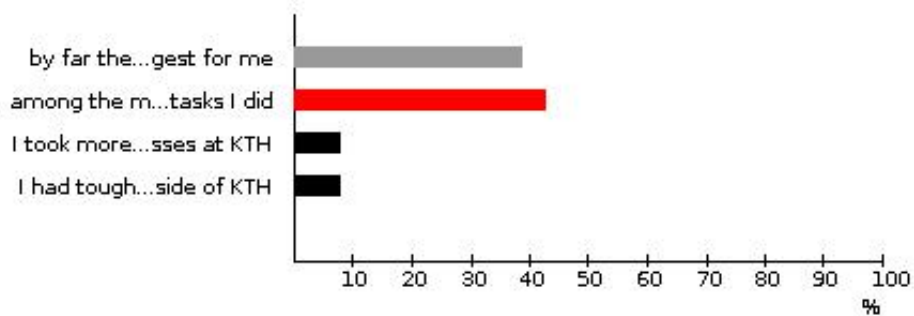
number	distribution	answer choice
0	0%	Not good
0	0%	Less than good
4	17,4%	Ok
8	34,8%	Good
11	47,8%	Very good

23 has answered of 38 (60%)
 Maximum number of choices: 1

Comment:

- It was nice and funny. I don't think the grading system was 100% fair: it only counted the object recognition accuracy. It would have been nice to also take into account things like mapping, motion control, exploration strategy/explored area, etc.
- Very interesting, motivating and funny
- I hate to lose. We lost. But organisation was nice and there was food, so it was nice!
- Very fun + free food is always welcome!
- free food!
- very fun way. i'm personally shy and so very nervous about the idea. but i do think it is a good idea
- was fun
- Would have some kind of bonus for doing navigation rather than exploration, but it was still very fun.
- There should be the possibility to do a testrun in the new enviroment. Nearly every group failed in the 1. round, and after everyone had changed some small things, the second round was much better.
- it's interesting and a fun way to end all the work.

How big of a software project was programming the robot for you?



number	distribution	answer choice
9	39,1%	by far the biggest for me
10	43,5%	among the more complicated programming tasks I did
2	8,7%	I took more demanding project classes at KTH
2	8,7%	I had tougher projects outside of KTH

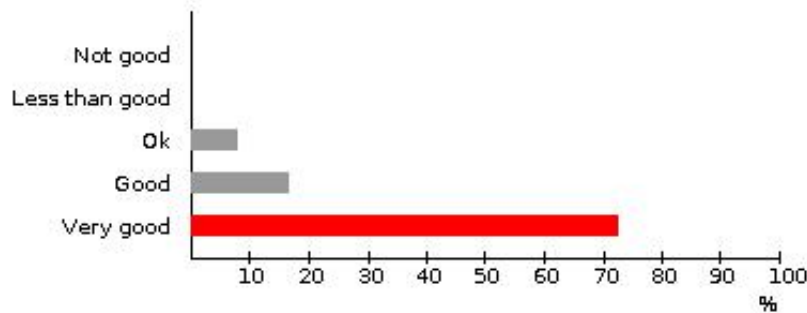
23 has answered of 38 (60%)
 Maximum number of choices: 1

Comment:

- Quite a big programming software, although I've written more lines before. This was more about integration and especially testing.
- The complexity and intricate details weren't sky-high, but the sheer volume of work and variety were a challenge.
- Hell of a big project but the best one I've ever done!

- I have had one or two programming tasks of a similar scale, but I think this is the one I spent most time on.
- For c++ programming, this is the more and first programming tasks I did. Before this, I just use Matlab.
-
- No complex algorithms at all, all the time just went into getting something running

How would you rate the TA's help during the course?



number	distribution	answer choice
0	0%	Not good
0	0%	Less than good
2	8,7%	Ok
4	17,4%	Good
17	73,9%	Very good

23 has answered of 38 (60%)
 Maximum number of choices: 1

Comment:

- Always respond fast on emails. Very helpful people!
- Very nice and friendly, always willing to help and answering the emails super quickly. Maybe I missed a little more meetings or them showing up at the lab more often.
- Always responsive and helpful.
- Professional, super nice and very helpful!
- Did not really get much help from them. To be fair though we did not ask for it much. The help we got (answers to questions and such) was good.
- when we had problem, we could find them and solve the problem in a short time. Thanks!
- Always available, even for pre-contest panicking
- If there was a problem, they reacted quickly
- they were very helpful and were always ready to help
- Didn't ask for any help

Comments in general about the robot hardware (Arduino, NUC, motors, sensors, ...) and how it could be improved

14 has answered of 38 (36%)

Comment:

- The arduino was a bit glitchy.
- It was fine.
- I think the hardware worked well together. Was nice to have two NUC's.
- Quite good in general. Everything was ready to plug-and-play, so to say. Big computational power from the NUC. Some improvements:
- Increase the publish rate of the Arduino, or show us how to do it.
- A laser scanner would be awesome to replace the IR sensors, but I know it costs money :)
- Too easy to break the Arduino sandwich if you press too much or too little. A big project would be to create a single board integrating all the required components, but that takes quite a lot of time to design and build, and it would be less flexible.
- Incredible Arduino interface shield! Especially the indicator LED which was so powerful that messed with the color detection.
- The hardware in general was a very balanced and decent setup, no part of it was overkill or a bottleneck.
- Higher rate on IR-sensors and also a timestamp on the ADC message from arduino.
- NUC and arduino were pretty nice. everything else was crappy. The only thing I can think of is buying higher quality things but that might break budgets.
- Our IR sensors and one motor had some random problem. Sometimes our Arduino did not work too.
- Hardware problems all the time...
- Sometimes the sensor have been quite unreliable but generally not too bad

- The hardware would be very nice, if it works. The camera had sometimes blackouts, the same as the ir sensors.
- it is good and stable hardware, so we can focus on the integration and software development
-
- NUCs are useful, but if the battery life could be significantly improved without them, maybe that would be better.

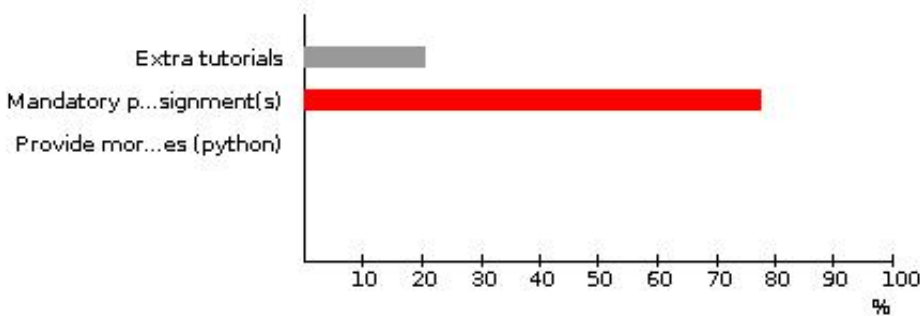
Comments in general about the project

9 has answered of 38 (23%)

Comment:

- Like the project. Unfortunately it is not possible to be part of all the different tasks which would be fun.
- Extremelly challenging and rewarding, despite the stress. We really got to see the difference between the controlled lab environment and real-life.
- We need a bigger room with ventilation. As a whole, everything is coherent and needs little adjustment. I guess longer time is not feasible.
- Best project ever!
- Would do it again.
- I really like the course. It is my first group course in kth. It is useful and helpful. I hope there is another advance course or workshop.
- Crazy amount of stress and work but also very fun and interesting
-
- The fun thing is that we are relatively free do approach the entire project however we want, which requires certain levels of skill from the group members.

Which of the following ways would be the preferred way to improve your ability to contribute to the programming of the robot?



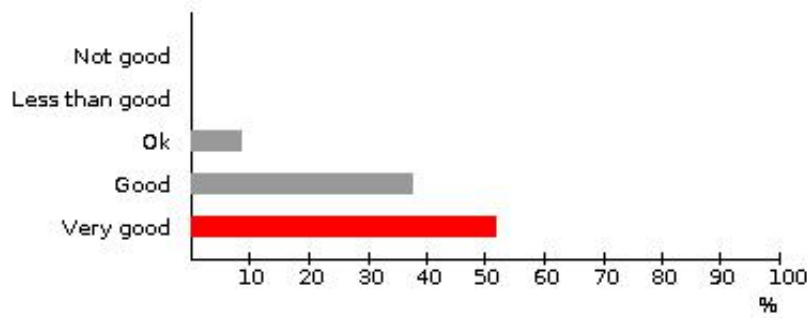
number	distribution	answer choice
4	21,1%	Extra tutorials
15	78,9%	Mandatory programming assignment(s)
0	0%	Provide more help for using other languages (python)

19 has answered of 38 (50%)
 Maximum number of choices: 1

Comment:

- Mandatory programming assignment(s) with guidance, like LAB1
- A bit more C++ assignments would definitely help and probably improve the results in the end.
- The only way to force people to learn is mandatory assignments. They cannot be too large though, as the project is enough work as it is...
- I am a lazy person, perhaps more early deadlines would have helped get me started.
- i answered extra tutorials in order not to take time away from the project. in another context i would say more mandatory programming assignments
- More focus on programming might have been good to help refresh C++ a little bit. Especially before the course start.
- i don't think anything would help
- Specifically, I would like to see more tutorials focusing on how to utilize RViz better, so that we can test the system in RViz instead of having to run the robot physically in a crowded maze all the time.
- Since I feel I already know what I need, adding more assignments would only take up more of my time. What I'd need is more experience in working with physical systems, but since this is the first course in which I built something physical that's not possible, but maybe allow us into the lab earlier in the course?

How did you like the debriefing session at the end of the course?



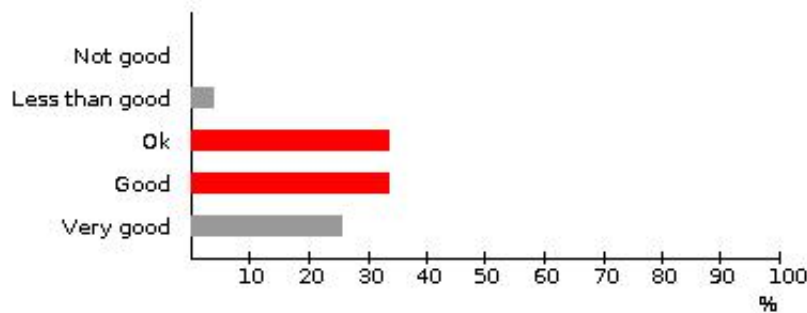
number	distribution	answer choice
0	0%	Not good
0	0%	Less than good
2	9,5%	Ok
8	38,1%	Good
11	52,4%	Very good

21 has answered of 38 (55%)
Maximum number of choices: 1

Comment:

- It was nice to hear from everyone in order to learn about other approaches to the same problem.
- Most of the project is senseless if you don't do it. In the debriefing session is where you will learn how can you improve in future projects.
- Good discussion
- We were informed about it the day before, not very good...
- did not attend
- did not attend
- Good to see how people look like after a proper sleep.
- it's good to discuss the project

What do you think about writing the self/group reflections?



number	distribution	answer choice
0	0%	Not good
1	4,3%	Less than good
8	34,8%	Ok
8	34,8%	Good
6	26,1%	Very good

23 has answered of 38 (60%)
Maximum number of choices: 1

Comment:

- Adds more personal perspective over the whole project
- Good to realize what we did wrong and learn this for further occasions.
- Non-confidential reflection is pointless because people are civil and kind in person (mostly)
- Personal reflection is useful due to the comparison with the expectations at the beginning of the course.
- necessary since not all group members work the same amount on the project
- Definitely good and helped to think about how to improve group works in the future

--

-It's good to to these reflections, and I think the scope (~1 page) is enough.

What would you to say to a potential student about the course in one sentence?

21 has answered of 38 (55%)

Comment:

- Incredibly hard project but definitely worth it
 - Very fun but crazy demanding course, I wish you'll end up in a nice group!
 - I would say that it is hard but very interesting course and he/she wont be disappointed with it.
 - Demanding course, but will give you a lot of experience.
 - Have interest, put effort, code, test, but especially learn and have fun with your team :)
 - Very interesting but also very demanding.
 - "Most important course in the program"
 - The course is time very consuming and you should be willing to give your best effort in order to fulfill all the requirements.
 - Hard and time consuming, but the reward is much bigger.
 - you build and program a robot from scratch, how cool is that?
 - a course with a very interesting approach to robotics that will allow you through hands-on work find out what are your likes and dislikes regarding the various branches of robotics that are needed in the project.
 - don't attend unless you have time to spend, sucks to have lazy groupmembers.
 - It takes times, but it worth!
 - Lots of work but lot of fun ;)
 - Robotics, living. Choose one.
 - Make sure, that you have time, and then take this course, you won't regret it.
 - you will learn depends how much you do
 - It's hard work but it's so so SO worth it :)
 - It is a time consuming but very fun course in which you have a lot of freedom in how you approach the project!
 - Good but time consuming course if you want to try/learn building physical systems.
 - It is demanding but it is definitely worth the time!
-

What would you liked to have seen changed if the contest was run again? Any rule changes? Anything else?

15 has answered of 38 (39%)

Comment:

- Maybe a bit more complex maze but smaller.
 - It was good
 - As said before, I would change the grading system so that it covers other things appart from computer vision (motion control, mapping, etc). Also, a smaller map, more time or better odometry; otherwise there is no way the robot can explore the whole maze and go map.
 - Maybe the mazes could be more similar since for instance, in the contest maze there were very big empty areas that can lead to failures during the contest if you did not expect the maze to be like that.
 - I'd give more time for the last 2 milestones and push the contest around the exam
 - Also, offer strong suggestions about possible methods to use for mapping, localisation, etc.
 - Points for percentage of the maze covered.
 - Allow for longer test runs in order to calibrate according to the new light conditions
 - Less big jump between milestones 1 and 2
 - think the maze was to big, didn't have time to explore it properly
 - More assignments in Lab1.
 - Maybe a bonus depending on the amount of area explored might have been interesting (i.e. 50% of the maze 50 points and 100% 100 points)
 - It would be nice to get a second chance, when the robot screws up (at least for hardware reasons). Maybe saving the map as well and giving not only points for the objects detected, instead extra points, when the objects are placed in the map correct.
 - maybe being able to run each round 3 times tops, being the last round the one that counts (if one group wants to stop after round 1 or 2 it should be accepted)
 - Maybe getting points for exploration somehow, although, the scoring scheme has to make sense. The time allocated for the contest seemed unnecessarily high.
 - I like the idea you discussed with group 6 to use a given map and focus more on localization.
-

Things you liked about the course?

15 has answered of 38 (39%)

Comment:

- Building the robot was great fun. Patric and the TA's were super nice also.
- To build the robot from scratch was really fun process
- It is great to have a course where you actually get to make use of your knowledge from previous courses into an actual system. Great assignment before the project.

- Complete freedom when designing the robot.
- Challenging task.
- Clear task specifications.
- Good materials, especially NUC and PrimeSense.
- Excellent support from Patric and the TAs.

- The close relation between teachers and students.
- Good work atmosphere
- Good materials and way too generous tool set
- Metal workshop size is enough, we had 0 problems with congestion
- Good tutorials and intro
- Fun contest

- The opportunity to actually work in the integration between hardware and software.
- Implementation of algorithms or solutions from computer vision, applied estimation and control on a physical system.
- Everything!
- Fun to work on a relatively large project about an interesting subject.
- Group working.
- Programming.
- Wiki tutorials.
- Nice to build an own robot :)
- The project work and the competitive but friendly environment in the lab
- The challenging tasks, where you could always see the result of some changes, additions.
- the project
- The freedom in approaching the project.
- Working with software and hardware and integration of those, in the same project.

Things that could be improved about the course

14 has answered of 38 (36%)

Comment:

- Either only programmers should take this course, or it should be changed to be more hardware/electrical demanding.
- Right now the electrical/hardware guys built the robot in a couple of days and then there was nothing left for them.
- I think that it is weird to have the same weight on the grade for the project and the exam. I spent sooo much time on the project but barely a day for studying on the exam.
- Either skip the exam or lower the weight I think.
- Maybe harder entry requirements. C++ clearly is a big requirement. A minimum dedication would be also required. I was thinking on having personal meetings with those students who have 2+ courses in P2, besides robotics, and make them understand what they are really getting themselves into. If they cannot commit themselves to a minimum of say 10 h/week then they should not be allowed, in my opinion, since that slows the whole group down.
- In the initial test, ask also the time one is willing to spend on the project, and make the groups accordingly after that. It don't think it was good to discuss this for the first time on a group meeting or through a written group assignment, because people in the group tend to answer according to what the others answered. This way we avoid false promisses and we can put more people in a group where people are willing to spend less time than others.
- More individual assessments to check that everyone is following.
- More lab space. It was next to impossible to work with lots of groups in the same room due to the noise, so we had to go elsewhere.
- Replace IR with laser scanner :)
- Wheels with better grip -> the robot can go faster without ruining odometry.
- Bad ventilation in the room, also cramped. But ventilation is the main issue.
- Course needs more control and guidance over group progress and methods used
- Report quality was a joke for most teams - there need to be very strict requirements for the reports, otherwise they are just a waste of time and an annoyance.
- Exam needs problem solving, especially for camera optics and parameters
- The weight on the final grade of the project and the exam. More weight to the project like 70% and 30% for the exam.
- Better wheels (Lego-like, for more traction)
- A couple more C++ assignments would benefit the contestants
- The schedule should be reworked. The project should start earlier, so there is more time for the latter milestones. Also as mentioned the lectures should be given in parallel with the project so every lecture is given when the content of that lecture is relevant in the project.

Alternatively, the exam could be in period 1, so that we are better prepared for the project before it starts.

Or even better, the exam could be removed. This course takes way too much time even without it. This course took almost all my time in p2, I barely touched other courses. And I didn't even carry my group, my contribution was valued to 1/5 ($=1/N$), I think it should have been higher though, the people who did the least were greatly overvalued in the evaluation.

I think the project should be more guided somehow to make work distribution work better.

I am not sure if I would take the course again in its current state, mainly because of the workload the last weeks and my experience with the group work. Although now afterwards I am glad that I got through it, because I learned a lot.

-I think that all the progress reports and paperworks required to hand in was a complete overkill and unnecessary, atleast in my group where the team worked well together.

Also don't really see the point of the final exam, the lectures don't really go into depth in anything and after spending all this time on this course (the most I have spent on any course) and only receiving 9 credits doing the project should be enough, then just put higher requirements on passing the project.

-If there was a simple lecture about arduino would be very interesting for me.

-All group members should have at least basic programming skills...

-More time to work on the project, reschedule the deadlines (more time for the later ones), more programming exercises early on

-Another lecture for ComputerVision early enough.

-more preparation for the exam

-Earlier deadlines for M0 and M1. Access to the lab closer to the start of the course. (Could mean earlier lab access, OR later course start).