Course analysis (2015/16 period 1+2)
DD2425 Robotics and Autonomous Systems, 9hp

Course responsible and lecturer: Patric Jensfelt
Lab assistants: Francisco Vina, Rares Ambrus and Diogo Almeida
Number of lectures: 12 lectures (24 hours)
Registered students: 38 (according to VIS report VG.6)
"Prestationsgrad": 89% (92% last year)
"Examinationgrad": 87% (90% last year)

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 exam
- 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 evaluation was not completed by more than 7 students. I forgot to remind people about it this year so the statistics is not very reliable to say the least.

The course was appreciated by all students students that answered the survey (43% interesting and 57% very interesting course). This is a bit lower than last year when 87% said very interesting and 13% interesting. However, since so few answered it is hard to tell what the cause for that is. The number of student that would recommend he course is also down a bit from 91.3% last year to 71% this year.

Grading:
We made use of a criteria based system for the first time. It worked well in most regards except that the criteria for ILO2 put to much stress on the individual contribution to a certain component in the system. This worked against team work in some cases.

Relation to the previous years:

Project: The biggest change from previous year was that each group had an assigned TA that communicated with the group in regular meetings and who was the first point of contact for the group. It seems to have worked quite well viewed both from the teaching staff's and from the students' perspective so it is a keeper.

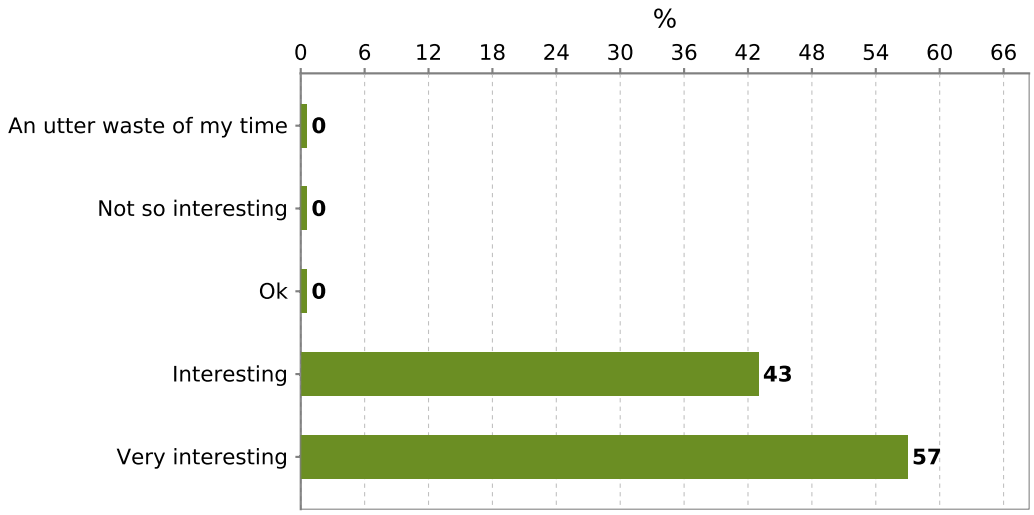
Planned changes:

- Complete change of hardware. There were quite a number of issues with the old sensors and motor control in terms of reliability, which resulted in a some unnecessarily lost time for some groups. Another aim here is to bring the projects closer to the work done in robotics research. This means switching from simpler IR sensors to a laser scanner for example. We also plan to add an arm to the robot to make the task more concrete.
- Harder milestones from the start to make problem surface earlier.
- Secure evidence of progress earlier in the course so that we can offer better support and also feedback on performance in term of grades earlier. It was not until the last week or maybe two weeks that we had collected enough evidence to really give any feedback. This also connects to the previous bullet.

Survey results

Survey	Course evaluation
Event	DD2425 robot15
Status	open
Date	2016-08-30 20:51
Group	Participants
Answered by	7(35) (20%)

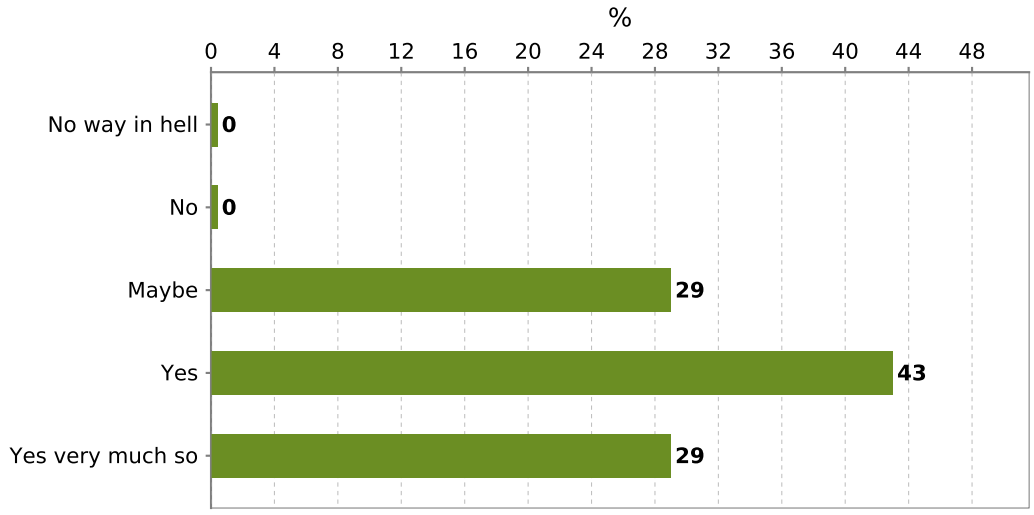
Did you find the course interesting and meaningful?



Number	Distribution	Answer choice
0	0%	An utter waste of my time
0	0%	Not so interesting
0	0%	Ok
3	42,9%	Interesting
4	57,1%	Very interesting

7 have answered of 35 (20%)
Maximum number of choices: 1

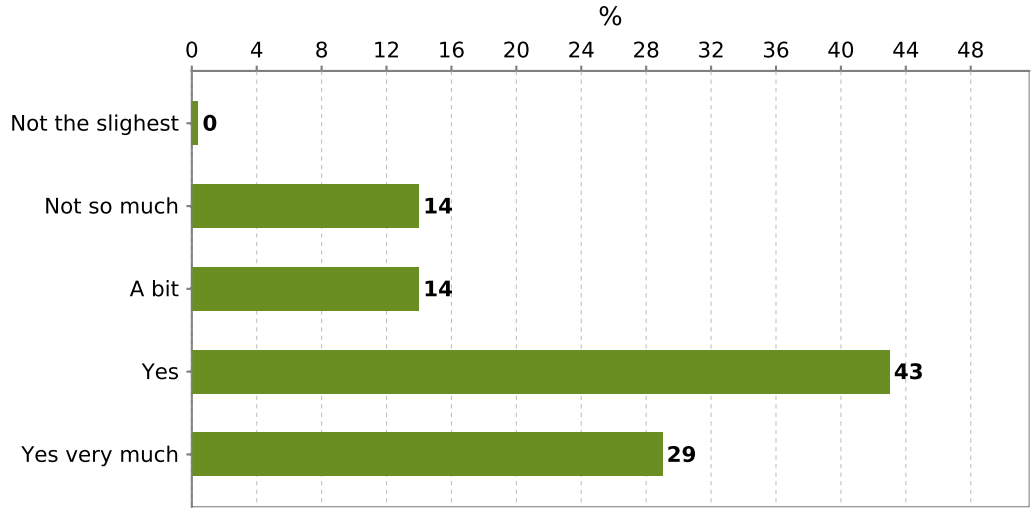
Would you recommend this course to a fellow student?



Number	Distribution	Answer choice
0	0%	No way in hell
0	0%	No
2	28,6%	Maybe
3	42,9%	Yes
2	28,6%	Yes very much so

7 have answered of 35 (20%)
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 slighest
1	14,3%	Not so much
1	14,3%	A bit
3	42,9%	Yes
2	28,6%	Yes very much

7 have answered of 35 (20%)

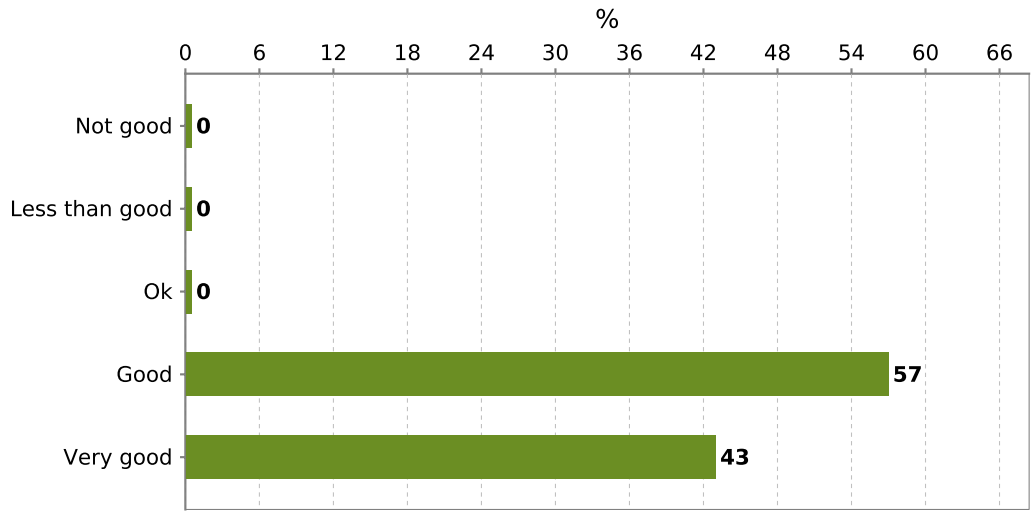
Maximum number of choices: 1

Respondents comments:

Discussing ongoing / latest research during lectures is a really good way to connect with the "outer world"!

Maybe not robotics research but research that enables robots do perform more complicated tasks (computer vision, for example).

What do you think about Patric's lectures?



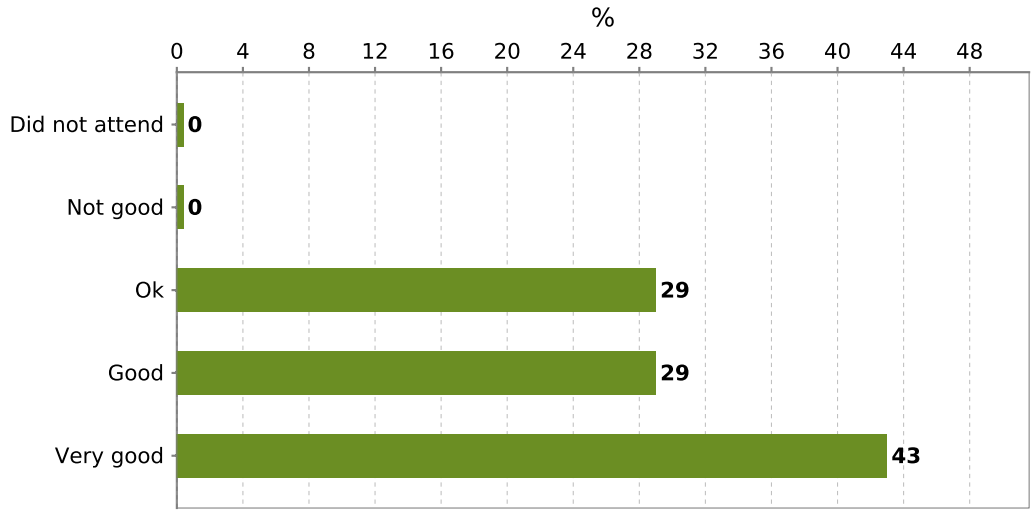
Number	Distribution	Answer choice
0	0%	Not good
0	0%	Less than good
0	0%	Ok
4	57,1%	Good
3	42,9%	Very good

7 have answered of 35 (20%)
Maximum number of choices: 1

Respondents comments:

I really enjoy the casual

What do you think about Samuel's lecture on agile software development?



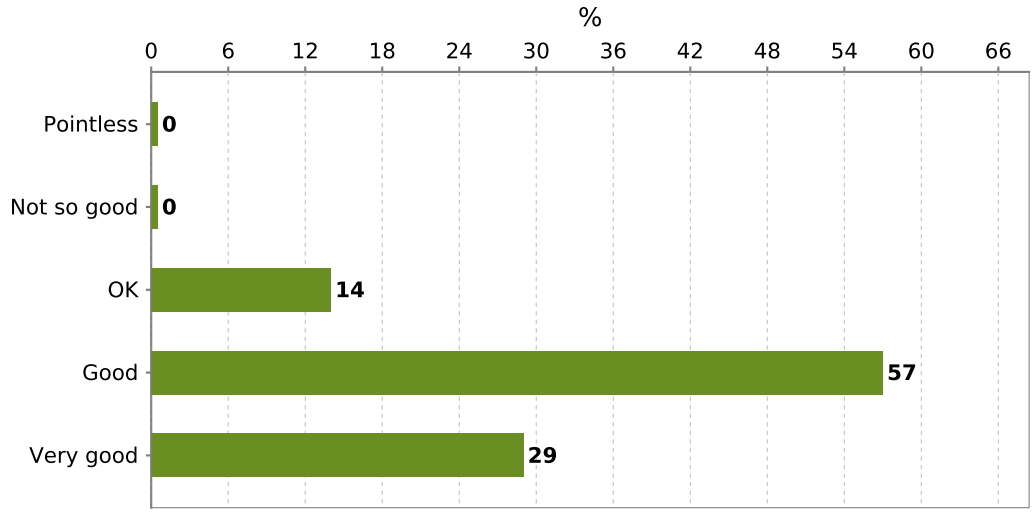
Number	Distribution	Answer choice
0	0%	Did not attend
0	0%	Not good
2	28,6%	Ok
2	28,6%	Good
3	42,9%	Very good

7 have answered of 35 (20%)
Maximum number of choices: 1

Respondents comments:

Still missing the slides?

How did you find the group discussions at the end of the lectures?



Number	Distribution	Answer choice
0	0%	Pointless
0	0%	Not so good
1	14,3%	OK
4	57,1%	Good

2	28,6%	Very good

7 have answered of 35 (20%)
Maximum number of choices: 1

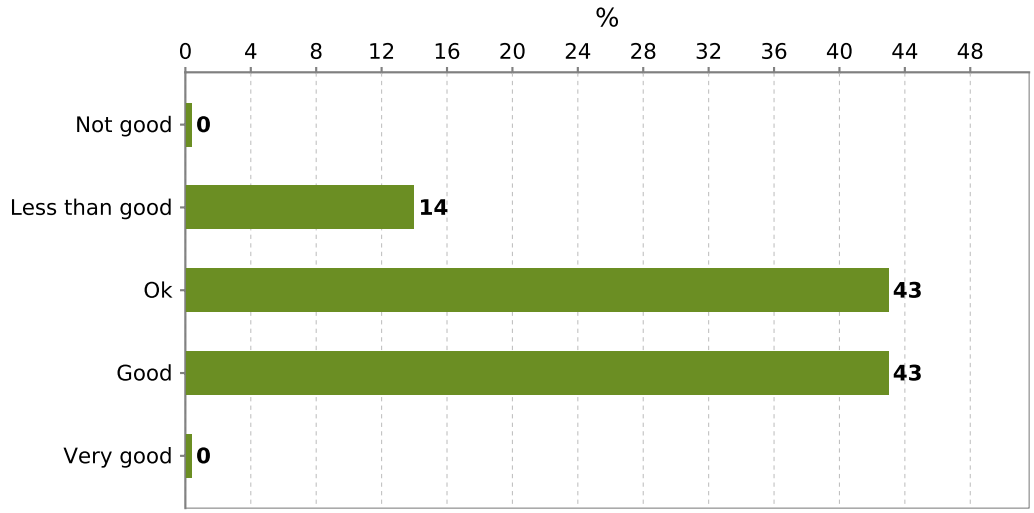
Respondents comments:

Often the best part of the lecture

Interesting. But I found it hard to keep everyone contributing.

Usually too little time to get something really going.

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
0	0%	Not good
1	14,3%	Less than good
3	42,9%	Ok
3	42,9%	Good
0	0%	Very good

7 have answered of 35 (20%)
Maximum number of choices: 1

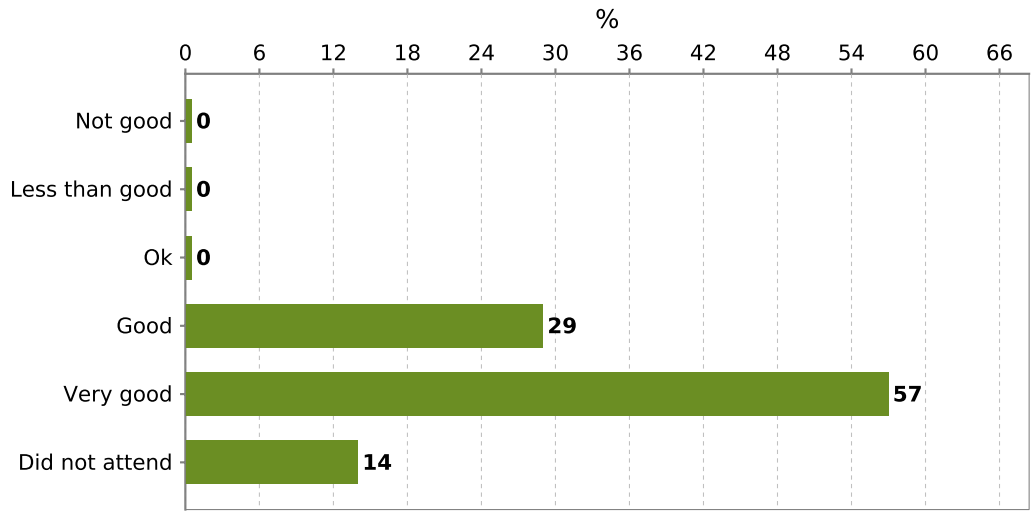
Respondents comments:

The lectures covered the exam more than the rest of the project.

It helped but there were still areas which required reading other materials (literature). I suggest writing and presenting a short list describing where to find which algorithms (nonlinear controller, particle filter, maybe also vision).

Could be a bit more hands-on. Particle filters weren't mentioned although there were present in every project.

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



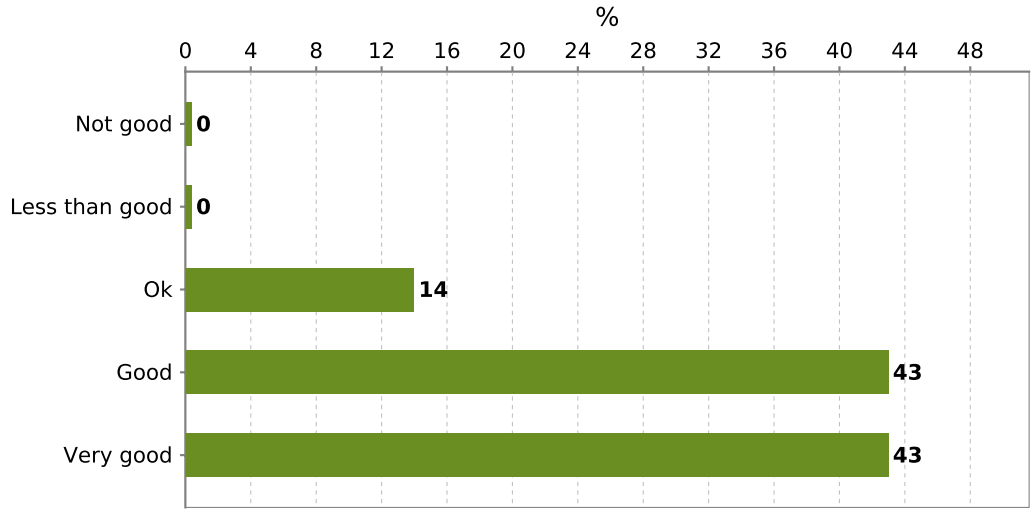
Number	Distribution	Answer choice
0	0%	Not good
0	0%	Less than good
0	0%	Ok
2	28,6%	Good
4	57,1%	Very good
1	14,3%	Did not attend

7 have answered of 35 (20%)
Maximum number of choices: 1

Respondents comments:

Stuff would be a whole lot harder without the lab.

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
1	14,3%	Ok
3	42,9%	Good
3	42,9%	Very good

7 have answered of 35 (20%)
Maximum number of choices: 1

Respondents comments:

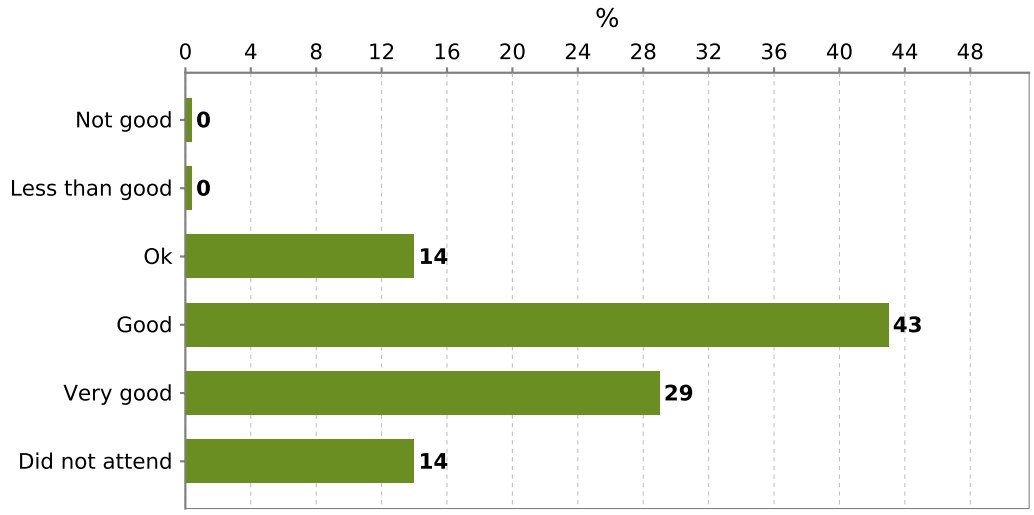
Didn't know ROS before, definately forced me to get started.

ROS topics covered well, I would add some ROS services too.

Maybe it could include one assignment on services (SRV).

Lab1?

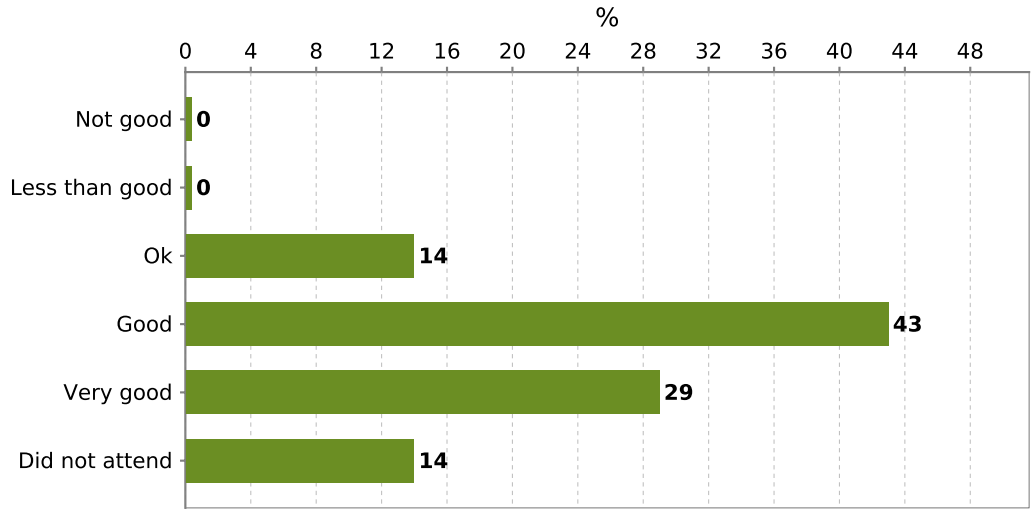
What do you think about the first introductory session in the robot lab?



Number	Distribution	Answer choice
0	0%	Not good
0	0%	Less than good
1	14,3%	Ok
3	42,9%	Good
2	28,6%	Very good
1	14,3%	Did not attend

7 have answered of 35 (20%)
Maximum number of choices: 1

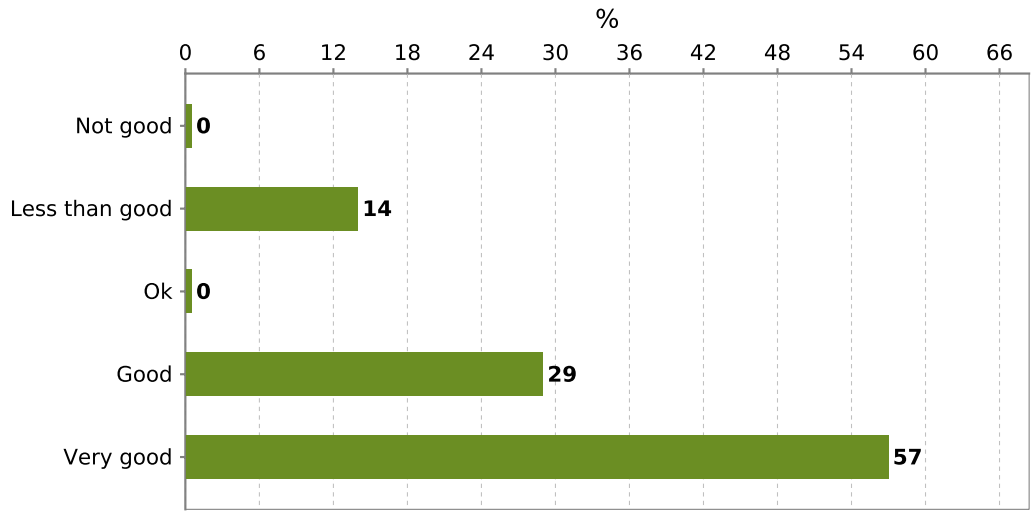
What did you think about the PCL and OpenCV tutorial?



Number	Distribution	Answer choice
0	0%	Not good
0	0%	Less than good
1	14,3%	Ok
3	42,9%	Good
2	28,6%	Very good
1	14,3%	Did not attend

7 have answered of 35 (20%)
Maximum number of choices: 1

How did you like the project?

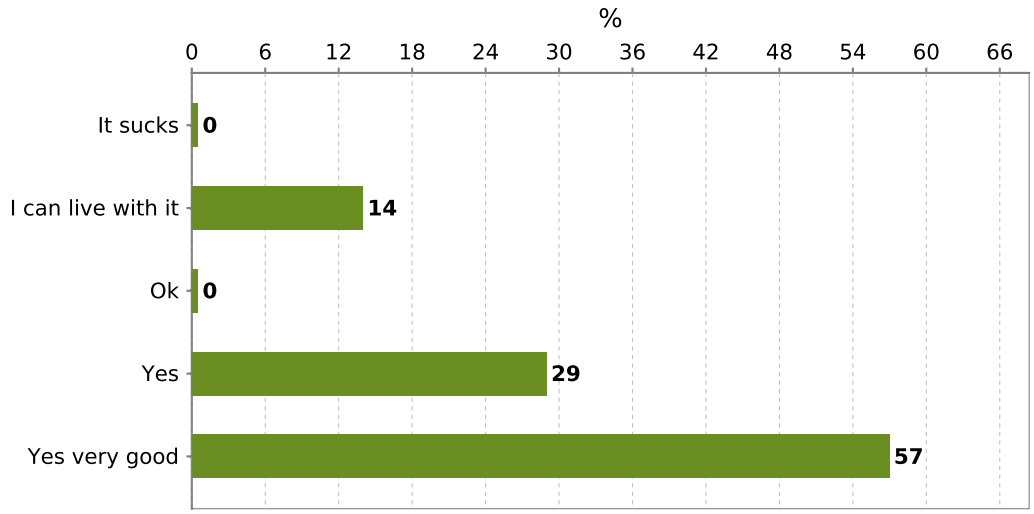


Number	Distribution	Answer choice
0	0%	Not good
1	14,3%	Less than good
0	0%	Ok
2	28,6%	Good

4	57,1%	Very good

7 have answered of 35 (20%)
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?



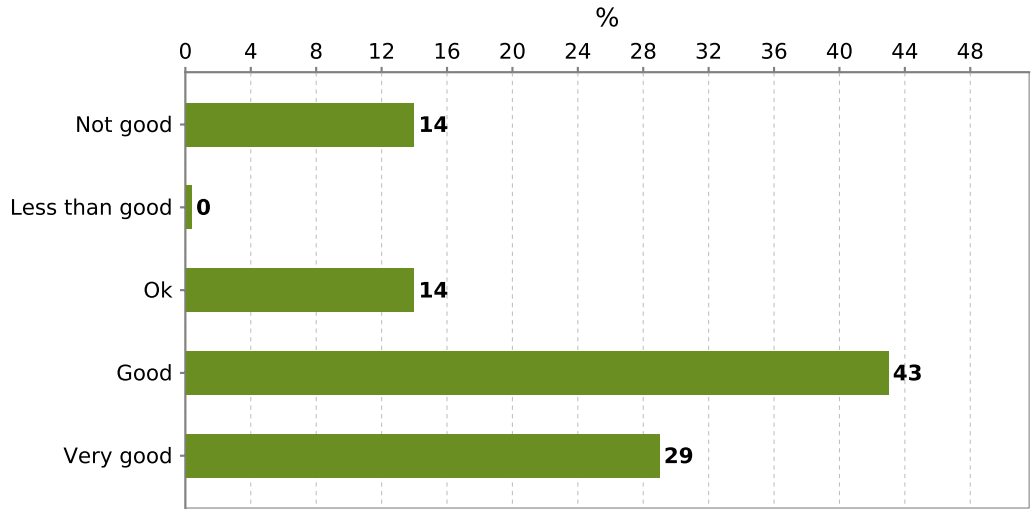
Number	Distribution	Answer choice
0	0%	It sucks
1	14,3%	I can live with it
0	0%	Ok
2	28,6%	Yes
4	57,1%	Yes very good

7 have answered of 35 (20%)
Maximum number of choices: 1

Respondents comments:

Competence was mostly spread good in our group.

How did your group work together?



Number	Distribution	Answer choice
1	14,3%	Not good
0	0%	Less than good
1	14,3%	Ok
3	42,9%	Good
2	28,6%	Very good

7 have answered of 35 (20%)
Maximum number of choices: 1

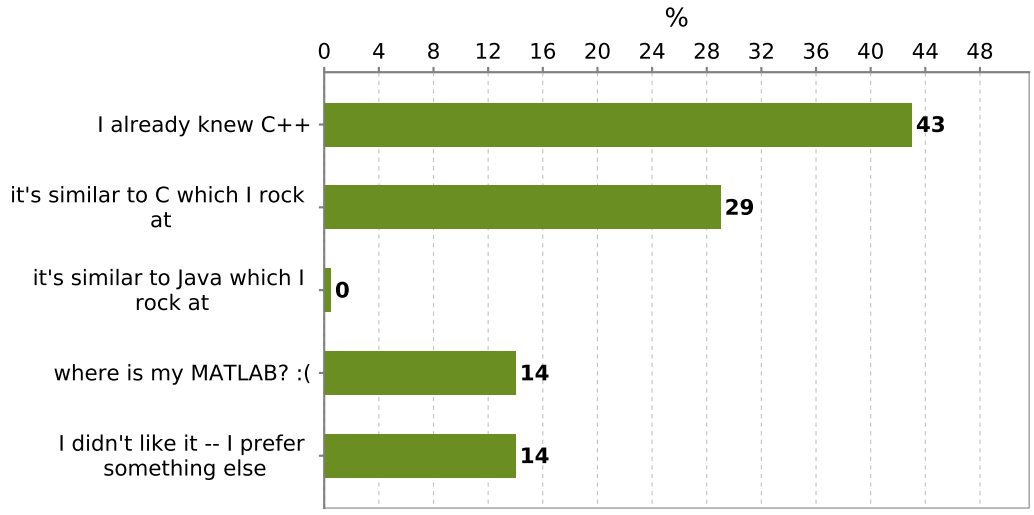
Respondents comments:

Cultural differences and language use were OK. Good planning and making progress was harder. I would make multiple different plans next time when planning and then choose the best plan (criterion: how likely it is to meet all milestones). I would like to learn how to help the less capable team members contribute with the right type of work to the project in the best way. What shall be the best response when someone fails to complete his/her work in time?

I will say very good because we got along really well. The output of our combined effort could have been better though.

Too little collaboration

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



Number	Distribution	Answer choice
3	42,9%	I already knew C++
2	28,6%	it's similar to C which I rock at
0	0%	it's similar to Java which I rock at
1	14,3%	where is my MATLAB? :(
1	14,3%	I didn't like it -- I prefer something else

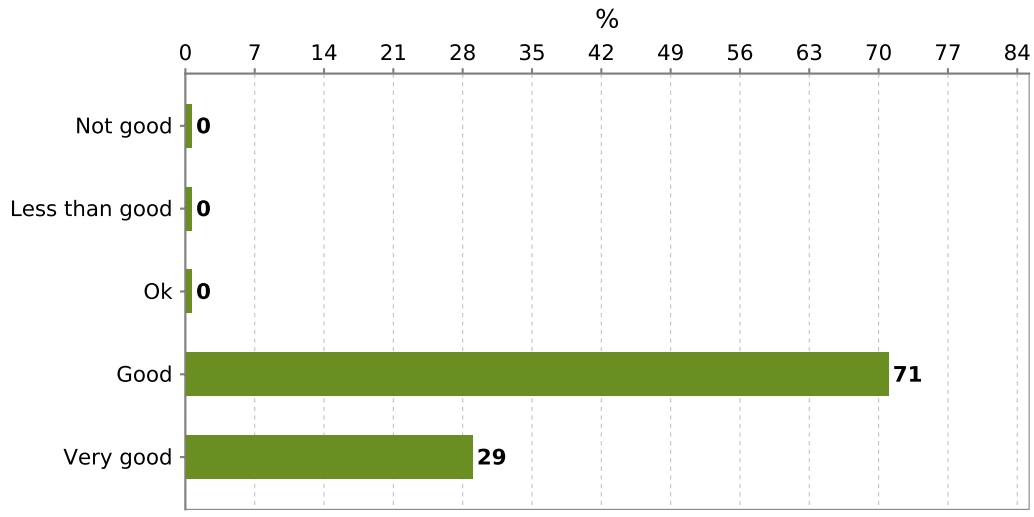
7 have answered of 35 (20%)
Maximum number of choices: 1

Respondents comments:

Knew some C++, but wouldn't say it helped me that much. The main task here was integration, and that is not purely C-related ;-)

I personally used lots of Python. Mostly for my own little scripts, not on the NUC.

What did you think about ROS?



Number	Distribution	Answer choice
0	0%	Not good

0	0%	Less than good
0	0%	Ok
5	71,4%	Good
2	28,6%	Very good

7 have answered of 35 (20%)
Maximum number of choices: 1

Respondents comments:

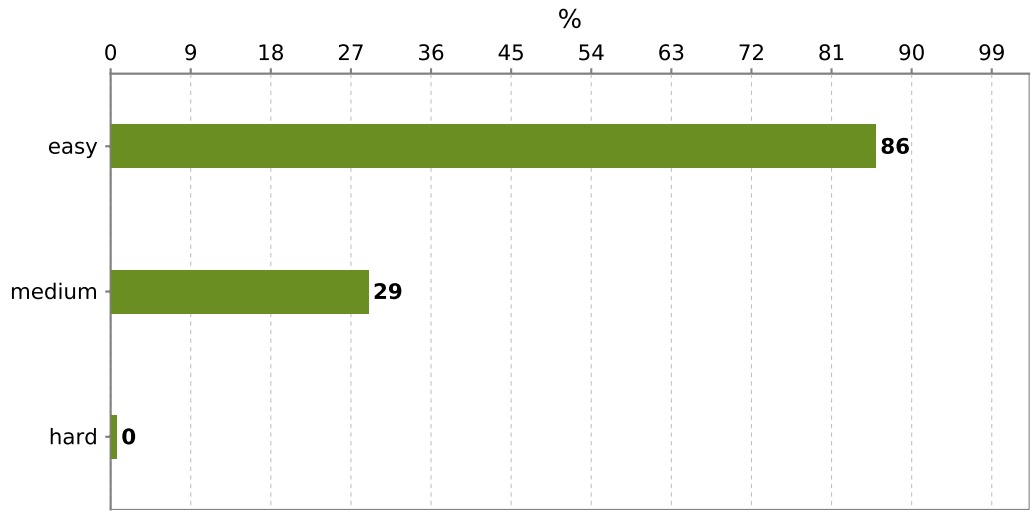
I can see why people use it, but it is kind of unstable and not the best performance wise.

ROS helps with connecting components together, with coordinate transforms (TF), data recording and playing (rosbag) so it is quite good. On the other hand, it seems to be relatively slow to me (waiting till everything starts, higher RViz CPU load) and less reliable (PrimeSense driver, Arduino connection).

Abstracts SO much stuff it's amazing. The tutorial they provide is really nice. If I'll do another robotics project in my life I will suggest using ROS.

Good to get familiar with, but boy what a learning curve. Super hard to debug.

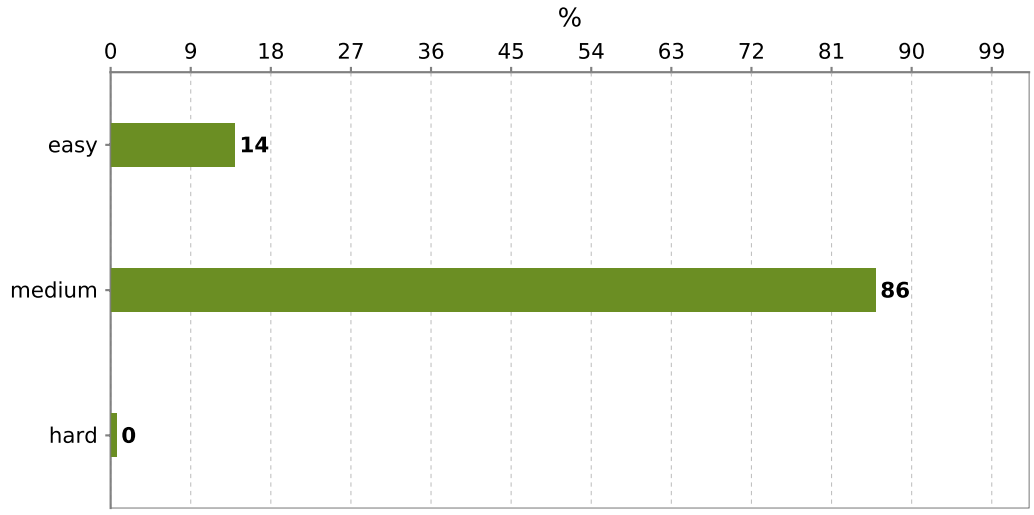
How hard was Milestone 0?



Number	Distribution	Answer choice
6	85,7%	easy
2	28,6%	medium
0	0%	hard

7 have answered of 35 (20%)
Maximum number of choices: 3

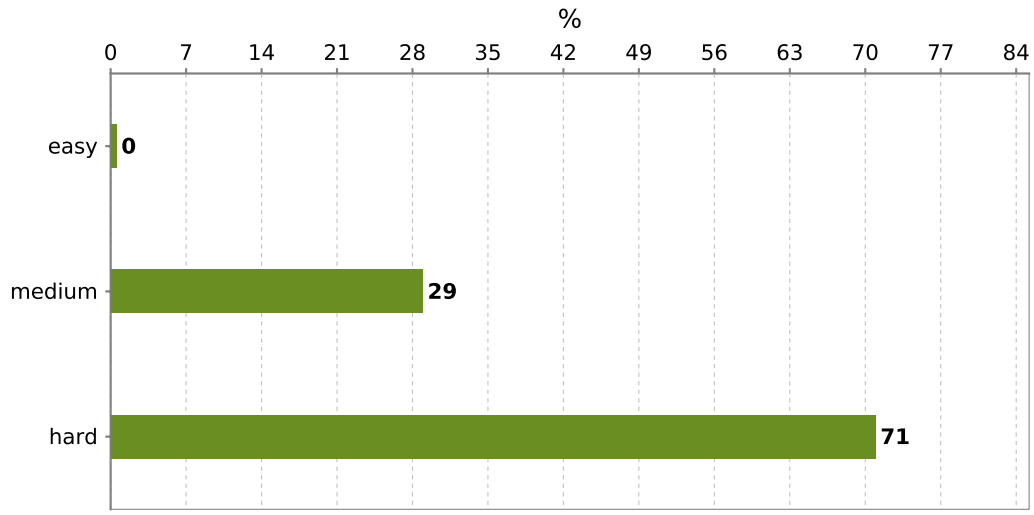
How hard was Milestone 1?



Number	Distribution	Answer choice
1	14,3%	easy
6	85,7%	medium
0	0%	hard

7 have answered of 35 (20%)
Maximum number of choices: 1

How hard was Milestone 2?



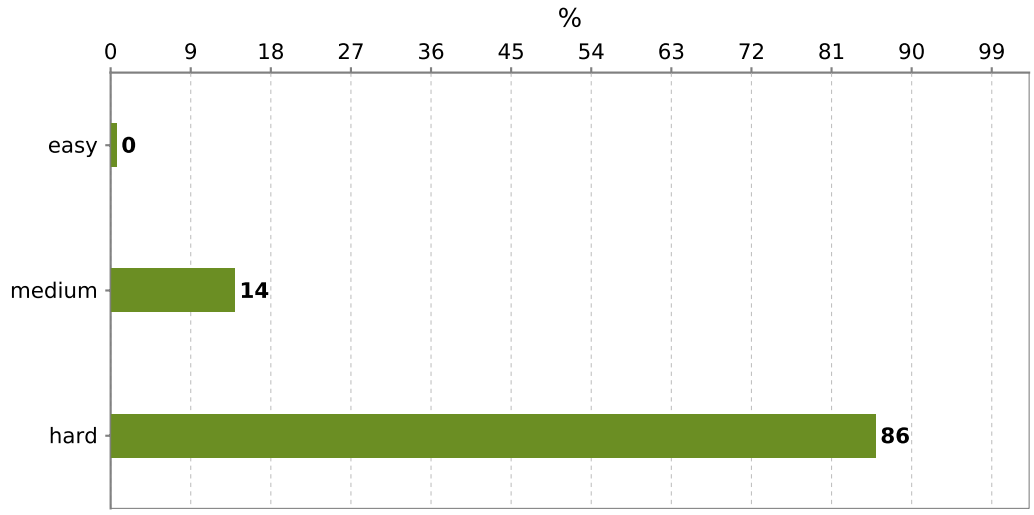
Number	Distribution	Answer choice
0	0%	easy
2	28,6%	medium
5	71,4%	hard

7 have answered of 35 (20%)
Maximum number of choices: 1

Respondents comments:

Not unreasonable hard, but we had HW issues.

How hard was Milestone 3?



Number	Distribution	Answer choice
0	0%	easy
1	14,3%	medium
6	85,7%	hard

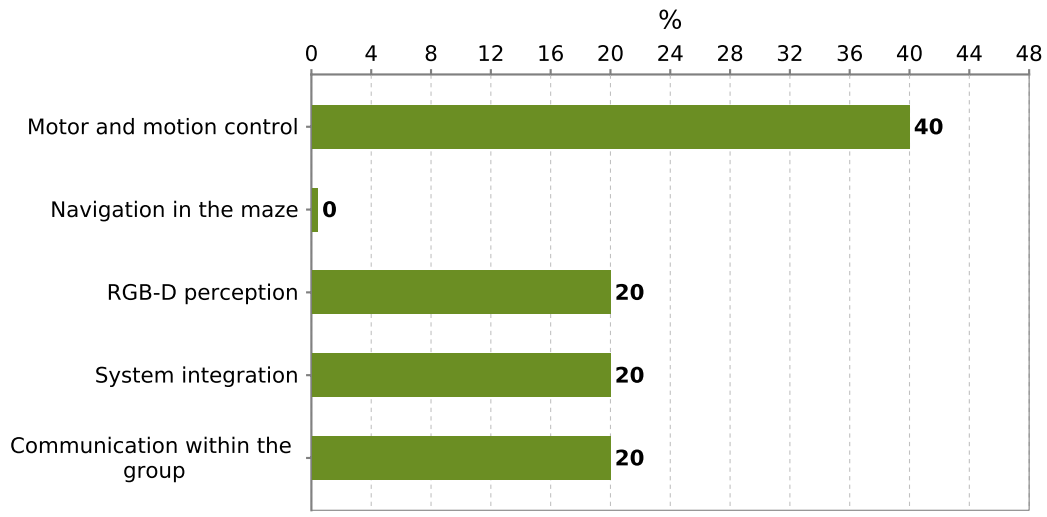
7 have answered of 35 (20%)
Maximum number of choices: 1

Respondents comments:

Robust global localization and recovery is not easy.

As a general comment for all milestones: bring the real deadlines back! Our group would have refocused on the essentials way earlier which would have saved our project result.

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	40%	Motor and motion control
0	0%	Navigation in the maze
1	20%	RGB-D perception
1	20%	System integration
1	20%	Communication within the group

5 have answered of 35 (14%)
Maximum number of choices: 1

Respondents comments:

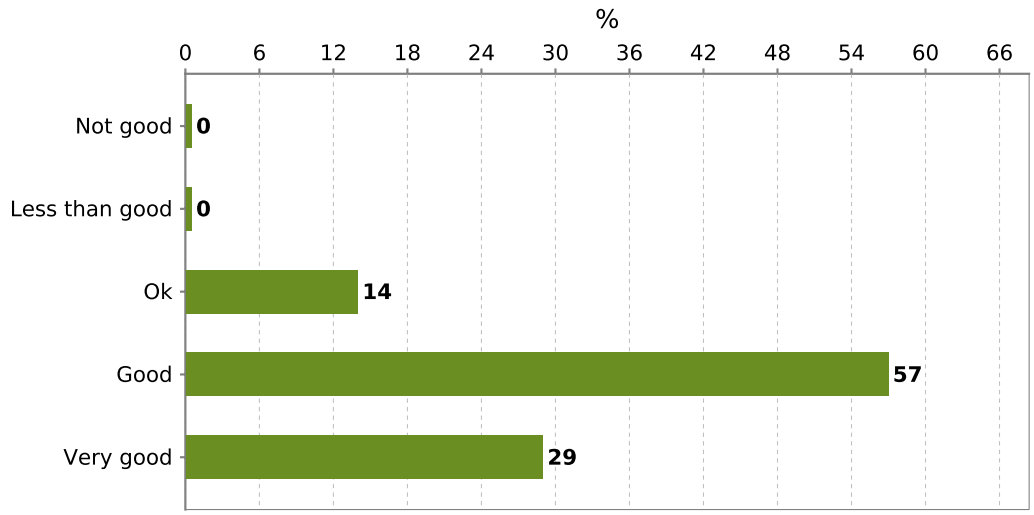
Very few groups achieved a robot system which moved really well. Some groups even couldn't run anything at the contest, due to this.

Each and every planning of the next set of project tasks, prioritizing. Dealing with unfinished or late work of some group members. (Perform a risk analysis when planning?)

I'd say none and all of the above. We've had problems with every single one of these throughout our project but what really hit us hard was time management. Seriously, this project is over before you know it. You think you have all the time in the world and all of a sudden it's contest week. If I would do it again I would take the following steps:
1. Mechanical design: get everybody on board for this and talk to other groups! Getting the mechanical design right from the beginning is crucial because people have conflicting interests!
2. Motor and motion control
3. Localization and mapping
4. Vision
Regard the above as tollgates, i.e. don't start with vision until 1, 2, and 3 are done, trust me. Occam's razor is essential for each topic as well, you can always get fancier if you have time in the end (which you probably don't).
Ideally, the milestones would also encourage this procedure! As far as I remember all milestones had vision integrated somehow...

"Everything" relied on good control which made everything else harder when it didn't work good.

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
1	14,3%	Ok
4	57,1%	Good
2	28,6%	Very good

7 have answered of 35 (20%)
Maximum number of choices: 1

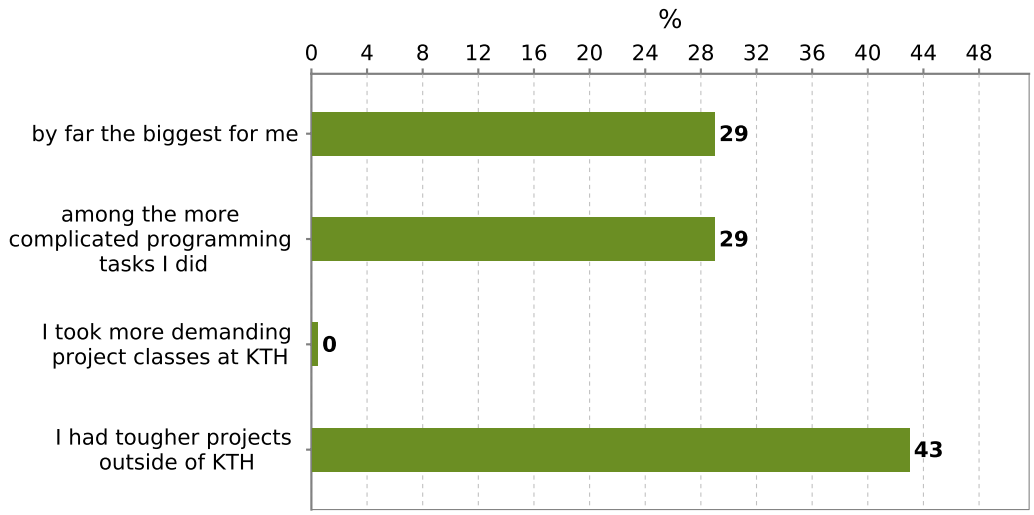
Respondents comments:

The scoring I am not a 100% sure about. Seemed a bit improvised. But I understand that it's a difficult thing to score.

Good to see other robots in action.

Give nerds some pizza & soda and they'll be happy :D

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



Number	Distribution	Answer choice
2	28,6%	by far the biggest for me
2	28,6%	among the more complicated programming tasks I did
0	0%	I took more demanding project classes at KTH
3	42,9%	I had tougher projects outside of KTH

7 have answered of 35 (20%)
Maximum number of choices: 1

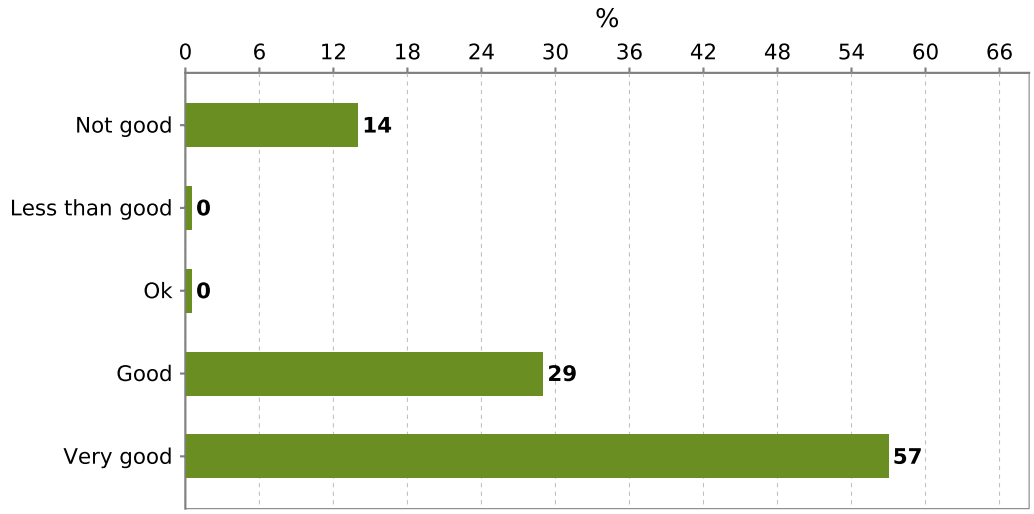
Respondents comments:

By far the most complicated at KTH, have however done similar projects outside KTH.

I had a tougher software project (also a mobile robot) but RAS has been a more complete software project. That means not writing lower level code but creating all higher software modules of the robot (localization, navigation, motion control, vision) and not using any of them ready made.

Tougher only because the teamwork did not work at all.

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



Number	Distribution	Answer choice
1	14,3%	Not good
0	0%	Less than good
0	0%	Ok
2	28,6%	Good
4	57,1%	Very good

7 have answered of 35 (20%)
Maximum number of choices: 1

Respondents comments:

The meetings with the TA were probably the most important, life changing feature of the course. They made the majority of the difference between a private, out of school enthusiastic students' project and a project course.

They all did a great job! Always helpful and patient. Special thanks to Diogo who was responsible for our group.

Didn't get any good, practical feedback, just hypothetical and "try this" which we usually already considered and tried or scrapped. Could probably easily have done as good without the TA. The TA was available and tried to help us with hardware when we asked about it, which I/we appreciated much.

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

Text answers:

-Robustness of the SCR board??
-Using a NUC for processing while the Arduino + shitty IR sensors completely messes up the end result. Another solution for low level signals?
-Small batteries useless, good that we got new ones.
-The lab room was to small and always chaotic. Would be nice to have a separate room with tables for programming, the lab

can then be used for testing.

The IR sensors were of a very different quality. That, or the ports on the arduino weren't of equal performance. At least we had a lot of problems with sensors, switching back and forth. Some short range were good for up to 25 cm, others up to 50 cm. I don't know how expensive they are. But maybe invest in something just ever so slightly more expensive, could be a good idea.

NUCs are fine, motors also. I suggest making the Arduino more reliable (encoder data publishing sometimes stopped out of the blue). Sensors are OK.

All the sensors were sub-optimal in some way or another. Let's say I'm surprised the world works as smoothly as it does while relying on sensors like these
You guys could go over the functionality of the sensors with us or give us pointers to what to expect, i.e. check the curve your sensor produces with our verified curve. This way hardware faults could be detected more easily.

The laser thing sounds awesome as an improvement. Furthermore I want to get mad at the motors, but in hindsight they probably weren't as bad as we made them out to be.

It was ok.

6 have answered of 35 (17%)

Comments in general about the project

Text answers:

Interesting project in the way that you get to experience how it is to work in a real project. Delays, things that should work but never do etc. However, very time consuming. This course should have more than 9 credits, the content is good though.

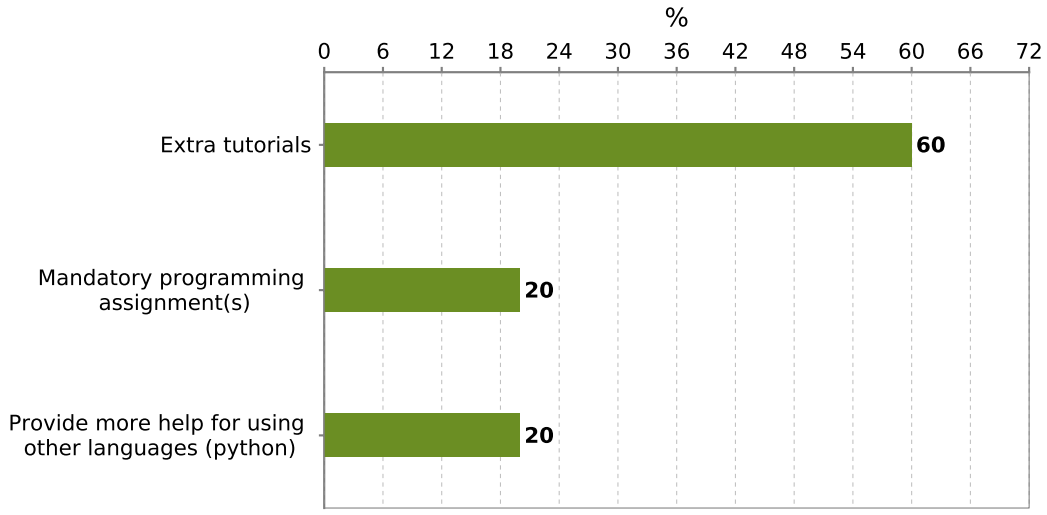
Very fun!
Maybe the TAs could have more individual meetings with students, in order to have more information to go on when deciding for a grade.

Spent way too much time, stopped being fun.

It is better to integrate frequently to have something working step by step.

4 have answered of 35 (11%)

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
3	60%	Extra tutorials
1	20%	Mandatory programming assignment(s)
1	20%	Provide more help for using other languages (python)

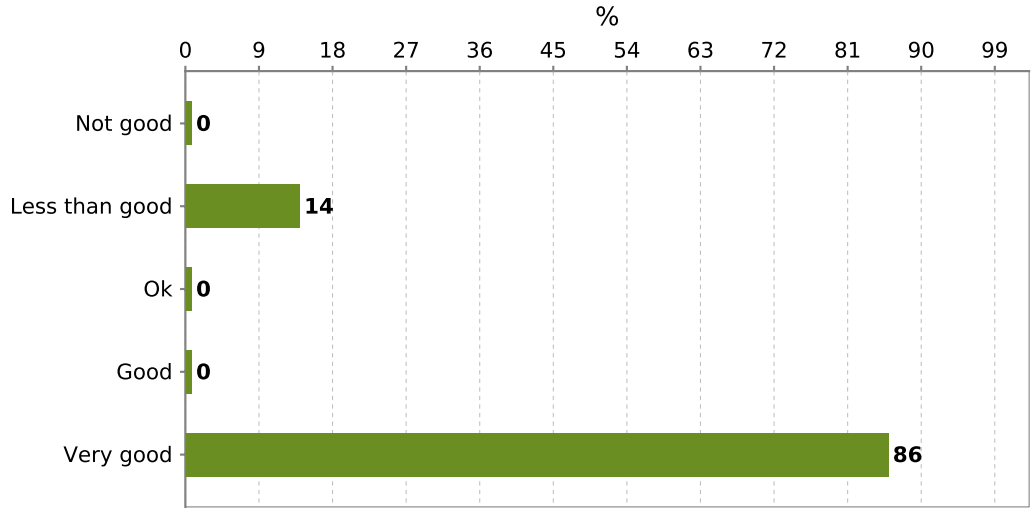
5 have answered of 35 (14%)
Maximum number of choices: 1

Respondents comments:

With follow up on alternative / better solutions,

I had no problems with contributing to the robot programming so I would not change anything here.

What do you think of the setup for the written exam with an immediate feedback session if you compare it to the standard way of conducting an exam?



Number	Distribution	Answer choice
0	0%	Not good
1	14,3%	Less than good
0	0%	Ok

0	0%	Good
6	85,7%	Very good

7 have answered of 35 (20%)
Maximum number of choices: 5

Respondents comments:

Enjoyable, only works for P/F exam though.
I was planning on leaving early for another event, would have been nice to be informed beforehand about the full exam time.

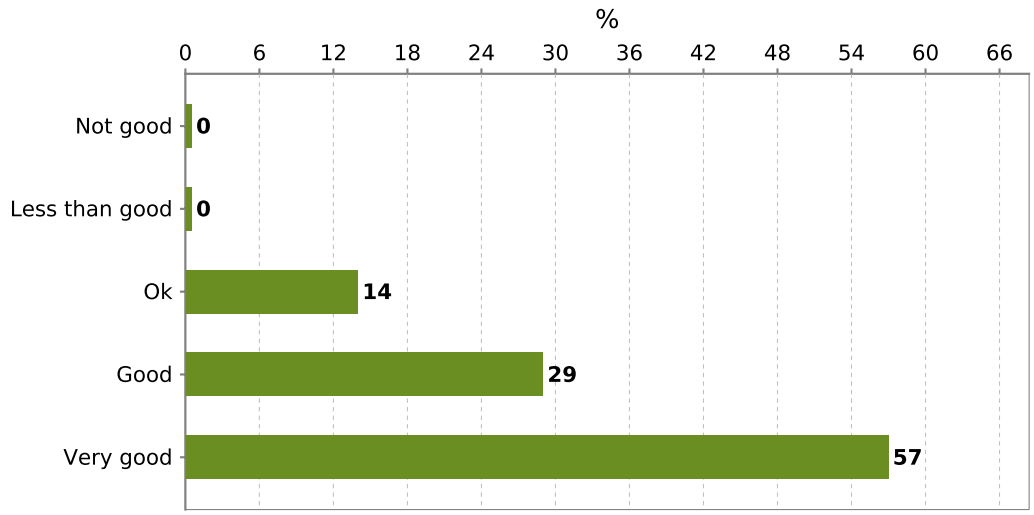
I might think that the requirement of 75-80% correct answers was a bit harsh. But other than that I think the questions were reasonably difficult, and the test was of adequate length.

Problems with unclear questions/answers are figured out right away, students can learn better from the exam. Maybe even results (pass/fail) are obtained faster. I think the "new exam style" is excellent.

I personally loved it - the experiment was a success :)

Very good in the sense that you immediately repeat and by that learn what you didn't know (I will probably never forget homogenous coordinates again). However, I sat on nails, sweating and chewing my nails from hearing some guy asking if my answer was OK and you tell them to set a question mark, but the pros (learning better, not having to wait 3 weeks for results) outweighed the cons (having to change my shirt)

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
1	14,3%	Ok
2	28,6%	Good
4	57,1%	Very good

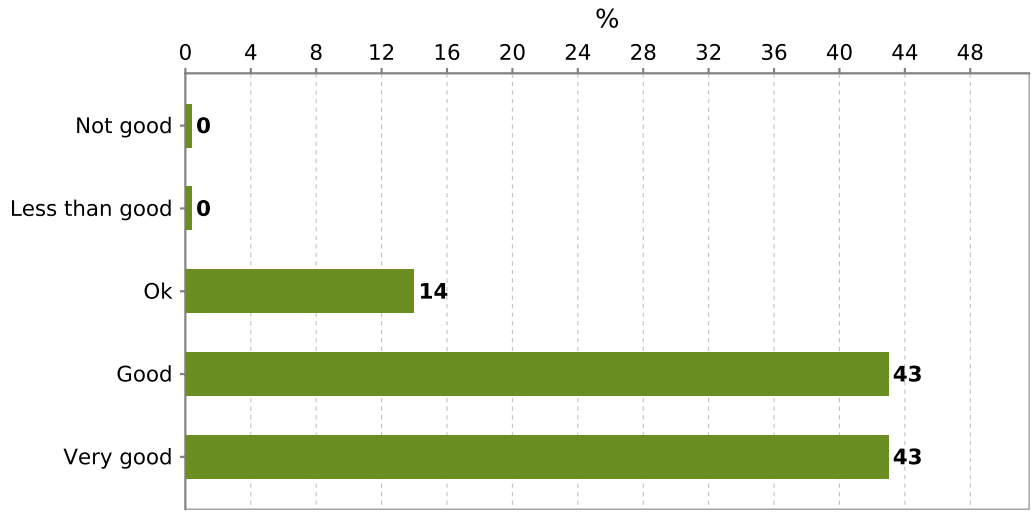
7 have answered of 35 (20%)
Maximum number of choices: 1

Respondents comments:

I think it is very important to reflect on the work done in order to learn something more.

Honestly don't remember this at all.

What did you think of the criteria based grading system?



Number	Distribution	Answer choice
0	0%	Not good
0	0%	Less than good
1	14,3%	Ok
3	42,9%	Good
3	42,9%	Very good

7 have answered of 35 (20%)
Maximum number of choices: 1

Respondents comments:

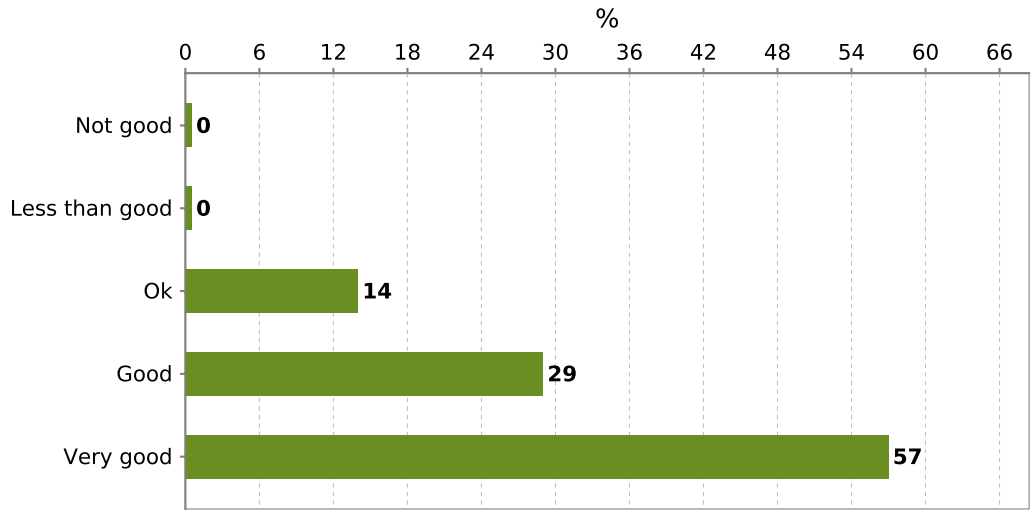
I think that one of the requirements for A was that you were supposed to have very deep knowledge of all the different parts of the robot. If you have a very good division of labor, combined with good communication between the group members, you might not gain this deep knowledge into all the different parts.
Perhaps it should then somehow be encouraged to work on other than your main part of the project. I mean if I'm the control-guy maybe I should spend a day with the computer vision-guy, to understand that part.

I was pleasantly surprised how well the TAs and the examiner were able to grade project work of each group member based on the criteria and regular meetings. However, the requirement of substantial individual contribution to at least one module might have motivated some people to work only on their module and neglect team cooperation.

I think the exam at the end was not necessary... You could think about a take home exam or another assignment. The course takes too much time as it is.

Less stressful than "OMG I need to get 10 points on this thing and that thing to get an A and if I miss a point in the beginning I'm screwed". I feel it reflects the overall quality of your work better, also.

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



Number	Distribution	Answer choice
0	0%	Not good
0	0%	Less than good
1	14,3%	Ok
2	28,6%	Good
4	57,1%	Very good

7 have answered of 35 (20%)
Maximum number of choices: 1

Respondents comments:

The real feedback session would have been to distribute the reflections within the group ;) As long as you don't know what the others think it is hard to improve.

I think it is very important to reflect on the work done in order to learn something more.

It was more useful than I thought!

Except if you're self-esteem and are disappointed with your performance.

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

Text answers:

Bring a sleeping bag.
Don't take other courses in parallel, and be ready to spend A LOT of time in period 2. And by that I mean giving up your life for 3 months.

Go from design to robot and think twice about the design choices, and get a robust driving at an early stage.

Learn by doing anything you wish from mobile robotics.

I cannot stress this enough: DO NOT TAKE PROGRAMMING UNDER PRESSURE SIMULTANEOUSLY! Just don't. That's all I have to say.

If you're OK with spending too much time, you will learn a bunch by implementing software on hardware.

Interesting but time consuming.

Programming is the most important part of this course.

7 have answered of 35 (20%)

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

Text answers:

Very few groups actually completed the entire task, perhaps adjust the maze accordingly?

Place more emphasis on giving points for localization or motion control. Robots with a good vision but bad localization (or motion control/planning) could have got quite high scores.

I feel the points weren't very fair. Some groups navigated (/drove around) really good but had a hard time detecting and classifying but got low points while some didn't but detected well and got a bunch.

Nothing.

Show the details of calculating the scores on the screen.

5 have answered of 35 (14%)

Things you liked about the course?

Text answers:

Described above

Fun to work in a group. And all the material that was provided to each group was of good quality, which made building the robot more fun. A great way to combine all the different parts aspects of autonomy.

That Patric is really honest about that it's a pain but usually rewarding. We get a bunch of resources (computers, space, sensors and stuff) that I wouldn't expect from any other course. Enjoyed the not so harsh atmosphere and that it was OK if things were hard.

A lot of aspects of the robotics, theoretically and concretely.

I learn more about robotic system by learning theories and also practical skills.

5 have answered of 35 (14%)

Things that could be improved about the course

Text answers:

No. of credits.

People spend too much time and are way stressed out over it. No idea what to change though so I shouldn't have written anything.

Give more credits because the course is really demanding.

During the lecture, there could be more discussions about implementation of the project.

4 have answered of 35 (11%)