# Course analysis (2012/13 period 1+2)
# DD2425 Robotics and Autonomous Systems, 9hp

**Course responsible and lecturer:** Patric Jensfelt
**Lab assistants:** Alper Aydemir, Andrzej Pronobis, Fernando Iglesias, John Folkesson (lab)
**Number of lectures:** 12 lectures (24 hours)
**Registered students:** 38
**"Prestationsgrad":** 99% (1 student have not passed TEN1)
**"Examinationgrad":** 98%  (1 student have not passed TEN1)

| Program | antal kurs.reg totalt | antal kurs.reg kvinnor | antal med sl.betyg | antal med sl.betyg kvinnor | medel-betyg | prest. Grad totalt | prest. Grad kvinnor | exam. Grad totalt | exam. Grad kvinnor | HST | HPR |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BILATERALT | 4 | 1 | 4 | 1 | 4 | 100% | 100% | 100% | 100% | 0.6 | 0.6 |
| CDATE | 1 | 0 | 1 | 0 | 3 | 100% | | 100% | | 0.15 | 0.15 |
| DD | 2 | 0 | 2 | 0 | 5 | 100% | | 100% | | 0.3 | 0.3 |
| DUALMASTER | 2 | 0 | 2 | 0 | 4 | 100% | | 100% | | 0.3 | 0.3 |
| ERASMUS | 7 | 2 | 7 | 2 | 4.14 | 100% | 100% | 100% | 100% | 1.05 | 1.05 |
| TCSCM (dat) | 16 | 0 | 16 | 0 | 4.19 | 100% | | 100% | | 2.4 | 2.4 |
| TEBSM | 4 | 0 | 3 | 0 | 3.67 | 92% | | 75% | | 0.6 | 0.55 |
| TMAIM | 5 | 0 | 5 | 0 | 4.8 | 100% | | 100% | | 0.75 | 0.75 |
| TSCRM | 8 | 0 | 8 | 0 | 4.62 | 100% | | 100% | | 1.2 | 1.2 |
| **Alla prog.** | **49** | **3** | **48** | **3** | **4.27** | **99%** | **100%** | **98%** | **100%** | **7.35** | **7.3** |

**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)
  ◦ Robot manipulator lab assignment completed in groups of two
- TEN1 3hp (end of first period)
  ◦ Written exam (re-exam Dec 2013)
- PRO1 5.5hp (whole second period)
  ◦ Project work
  ◦ Weekly status reports from the project group
  ◦ Weekly individual status reports
  ◦ 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 the students (70% very interesting and 27% interesting).

**Selection process:**
As always with this course there was total chaos in the registration and selection process. To reduce the suffering for the students that would otherwise have been the ones to pay the price 49 students were accepted.

**Grading:**
Grading is based on a weighted average of the score from the project (75%) and exam (25%) 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:**

**Lectures:**
- • Joakim Lilliesköld gave a lecture on project management

**Lab:** The lab was performed in the project group this time. The condition was that anyone in the group should be able to answer questions about the lab otherwise the entire group fails. The idea was to encourage communication within the group early on to make the project work later easier and smoother. The lab was considered less disconnected this year but we will consider removing it for next year to cut time.

**Group formation:** As previous year I used a skill test as input when forming groups. The tests (C++, Linux, Control, Computer vision) were given during the second half of the first lecture. The tests were modified a bit this year to better reflect C++ knowledge rather than C. The group were formed very early on because of this.

**Hardware:** Same hardware as last year. Some of the hardware seemed to reach the end of life by the end of the course. Some serializer boards and some of the custom made cards burnt at the end. There are no longer any spare custim power/IO boards. New hardware need to be acquired. It would be good if it is based on the 686 architecture or another architecture that supports recent Linux versions.

**Software**: We introduce ROS (Robot Operating System) this year as the basis for the robot software. ROS is now the standard software framework for esearch robots and provided the student groups with the means for communication and modularization out of the box. We provided a virtual machine (VirtualBox) to everyone during period 1 where prototyping could be made in ROS.

**Project work documentation:** We kept the idea of documenting progress by uploading videos of completed milestone requirements. Would be good to combine this with spending the night of the deadline in the lab to see most of the robots in action live as well (as almost every group passed each milestone hours or minutes before the deadline).

**Planned changes:**
- Acquire new hardware where ideally everything is off-the-shelf for easier maintenance and the possibility for students to buy their own setup.
- Make the lecture on manipulators more hands-on and scrap the lab as it was before.
- Let LAB1 instead be about learning ROS so that everyone has to show that they know ROS before the main part of the project starts. This allows us to identify students that might be in trouble early on and deal with this in the groups.
- Modify the task
- Introduce a requirement to submit a project plan and rough system solution by the end of the period one which is reviewed by the teachers and then feedback is provided to the groups. This is to identify problems (typically over optimistic plans) earlier.
- Schedule project meetings from second half of period 1 twice a week so that the groups have scheduled hours to meet and discuss the project.

# Survey results

| | |
|---|---|
| **Survey:** | Course evaluation |
| **Status:** | open |
| **Date:** | 2013-01-27 16:55:39 |
| **Group:** | Activated participants (DD2425 robot ht12) |
| **Answered by:** | 30(49) (61%) |

Did you find the course interesting and meaningful?
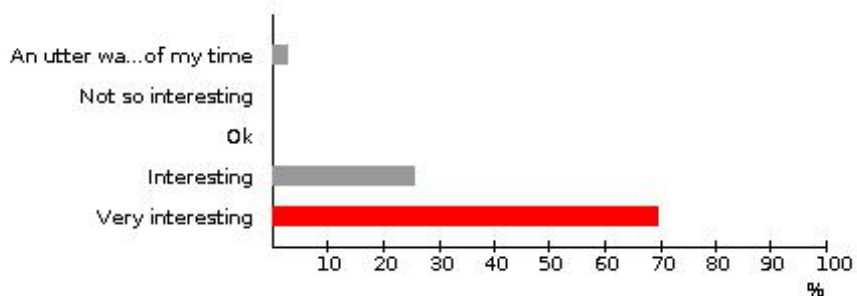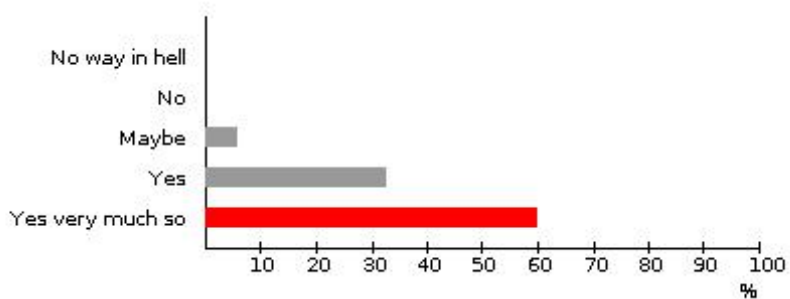


| number | distribution | answer choice |
|---|---|---|
| 1 | 3,3% | An utter waste of my time |
| 0 | 0% | Not so interesting |
| 0 | 0% | Ok |
| 8 | 26,7% | Interesting |
| 21 | 70% | Very interesting |

30 has answered of 49 (61%)
Maximum number of choices: 1

Would you recommend this course to a fellow student?
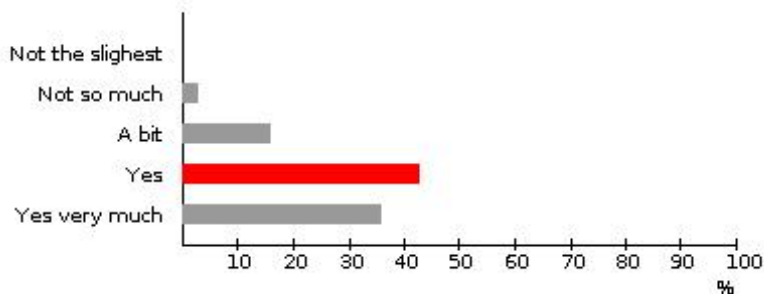


| number | distribution | answer choice |
|---|---|---|
| 0 | 0% | No way in hell |
| 0 | 0% | No |
| 2 | 6,7% | Maybe |
| 10 | 33,3% | Yes |
| 18 | 60% | Yes very much so |

30 has answered of 49 (61%)
Maximum number of choices: 1

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



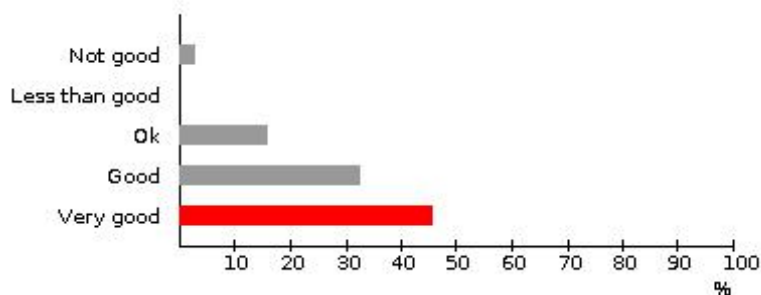| number | distribution | answer choice |
|--------|--------------|---------------|
| 0 | 0% | Not the slighest |
| 1 | 3,3% | Not so much |
| 5 | 16,7% | A bit |
| 13 | 43,3% | Yes |
| 11 | 36,7% | Yes very much |

30 has answered of 49 (61%)
Maximum number of choices: 1

**Comment:**

-I was already interested in the field. This course did not increase that interest.
-I was already very interested :)
-There is an upper limit to how much interested one can be, of course.
-Was already interested. No change, maybe a bit more encouraged.

What do you think about Patric's lectures?



| number | distribution | answer choice |
|--------|--------------|---------------|
| 1 | 3,3% | Not good |
| 0 | 0% | Less than good |
| 5 | 16,7% | Ok |
| 10 | 33,3% | Good |
| 14 | 46,7% | Very good |

30 has answered of 49 (61%)
Maximum number of choices: 1

**Comment:**

-Sometimes a bit too much overview. Would also have been good to have a lecture on Computer Vision with examples on possible algorithms that can be used in the robot.

Patric said he wanted us to read the theory in the book before the lectures but sometimes it was quite unclear before the

lecture what it was going to be about and what you were supposed to read.
-They provided a good general overview. A bit more depth, especially regarding SLAM, would have been interesting.
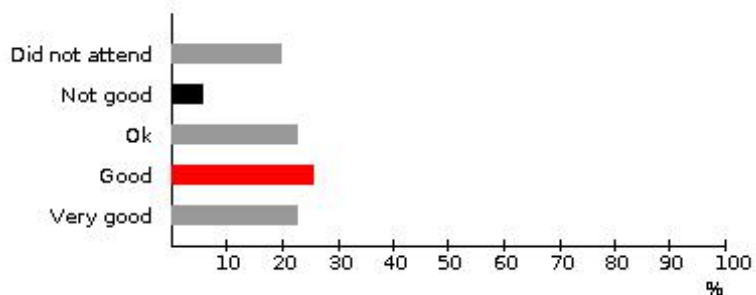-Just awesome. Clear, a lot of usefull information.
-Really nice system to interact with the entire class
-Good idea to do a group discussion at the end, but when you don't know the subject it's difficult to understand things in the first 45min...
-Your happy smile when lecturing always brightens my day!

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What do you think about Joakim's lecture on project management?



| number | distribution | answer choice |
|---|---|---|
| 6 | 20% | Did not attend |
| 2 | 6,7% | Not good |
| 7 | 23,3% | Ok |
| 8 | 26,7% | Good |
| 7 | 23,3% | Very good |

30 has answered of 49 (61%)
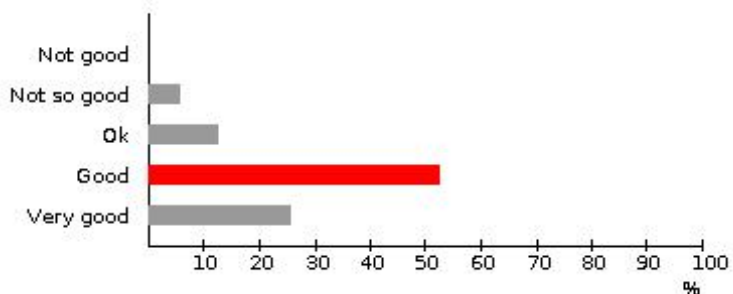Maximum number of choices: 1

**Comment:**

-Very much needed for this course, and get the groups start thinking about the management of the project, instead of just starting to work on it without a good plan.
-I was taking his course in project management at the same time.
-Wait, there was a lecture on project management?
-If I recall correctly it contained a lot of "obvious" or stuff that's been well heard before. I also remember that it wasn't very well targeted at our situation.

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How did you like the lectures in general?



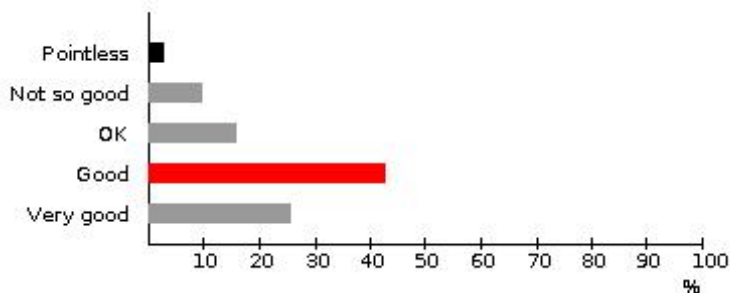| number | distribution | answer choice |
|---|---|---|
| 0 | 0% | Not good |
| 2 | 6,7% | Not so good |
| 4 | 13,3% | Ok |
| 16 | 53,3% | Good |

| 8 | 26,7% | Very good |

30 has answered of 49 (61%)
Maximum number of choices: 1

**Comment:**

-would be nice to have more peolpe from industry comming and tell whats out there. Like the guy from FOI.
-The only thing I would change, was either extend the lectures on kinematics, or drop them. Seemed a bit of an "aside" point, like you thought it was something we should know, without actually needing it later.

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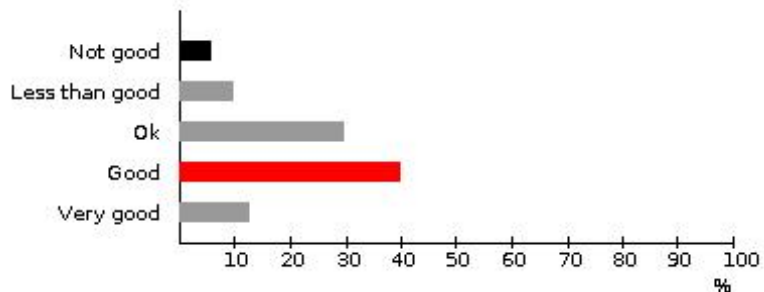


number distribution answer choice

| 1 | 3,3% | Pointless |
| 3 | 10% | Not so good |
| 5 | 16,7% | OK |
| 13 | 43,3% | Good |
| 8 | 26,7% | Very good |

30 has answered of 49 (61%)
Maximum number of choices: 1

**Comment:**

-Sometimes not as efficent as it could be. I really like the idea, wish more lecturers would do this.
-Good but sometimes the questions to discuss were a bit confusing.
-Answers were rushed over. Would have been better benefit in another session all together, such as a recitation.
-We often tended to talk more about how to use the sensors/concept discussed in the lecture in our robot, which I guess was the point. But some of the questions given were a bit unrelated to that, which made them feel forced.
-My groupmembers (including me) had a lot of schedule conflicts so sometimes we were sitting there alone.
-My group was rarely there...
-Sometimes not that easy if the other group members do not come to the lecture.
-Sometimes the tasks was a bit unclear
-It's a bit weird to ask what your group came up with, after half a dozen groups already said pretty much the same thing. There's only so many unique things you can think of.

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 | 6,7% | Not good |
| 3 | 10% | Less than good |
| 9 | 30% | Ok |
| 12 | 40% | Good |
| 4 | 13,3% | Very good |

30 has answered of 49 (61%)
Maximum number of choices: 1

**Comment:**

-Good, but could have been even better.
-Since the lectures provided more of an overview, it was sometimes hard to connect it directly to the project, which required a lot more technical details, but it gave us a good starting point - instead of being lost we knew where to start.
-The milestones forced us to work with some things but we would maybe done it a different way if there were no milestones...
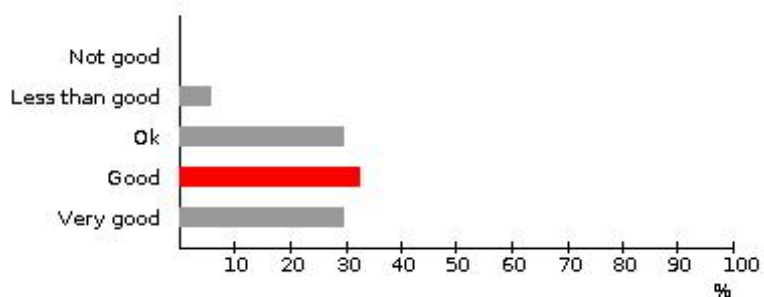-Yes!
-The lectures was a good place to start when thinking about how to solve some problem.
-You need to have a bigger background. What is expected of us in the lectures, for 3.5 credits, it's too much already.
-See note on reverse kinematics for example.

What do you think about the lab on manipulation? Did it help you understand the basics of controlling robot manipulators?



| number | distribution | answer choice |
|--------|--------------|---------------|
| 0 | 0% | Not good |
| 2 | 6,7% | Less than good |
| 9 | 30% | Ok |
| 10 | 33,3% | Good |
| 9 | 30% | Very good |

30 has answered of 49 (61%)
Maximum number of choices: 1

**Comment:**

-It felt quite basic, but I guess it's good to have a manipulator-part, since that's the by far largest commercial part of robotics today.

-yes, but this is the one thing that can be removed to save some workload for the students.
-The lab was good, but not so useful for the project. An introduction to ROS may be more useful.
-If by "understand" you mean "realise kinematics is a.. well.. dog of the female pursuasion".
-It was interesting and helped understanding the basics. However, it felt weird working on sth that had no connection to the later project.

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General feedback about the lecture/theory part of the course
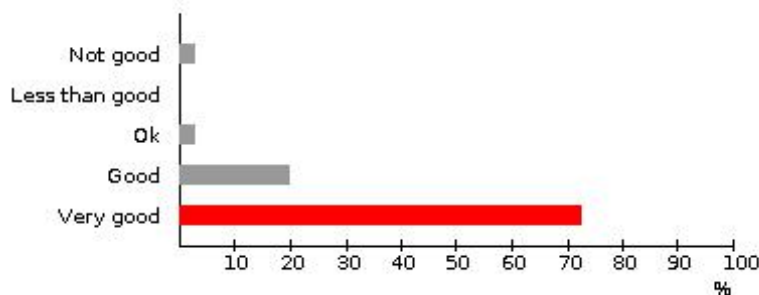
12 has answered of 49 (24%)

**Comment:**

-Good with lectures that makes you start to think about how to build the robot. The group discussions at the end of the lectures are very good. They give a good understanding of the subject.

-As already mentioned, a bit more technical details on SLAM algorithms would have been interesting.
-Still find the lab 1 with robot arm kinematics interresting, a bit too much complicated (i'm not a huge fan of maths) and a bit disconnected with the project.
-wider coverage of the field
less practical information
-In truth I did not attend at least half of the lectures. However, those that I did, I consider them quite general. Although the examples shown are extremely interesting and entertaining, they contribute little to acquire knowledge.
-It was good to begin with the theory part and finish it with an exam so that we (or at least I) had a good overview of how some stuff worked and to get familiar with some terminology.
-I really enjoyed it, we could even have more lecture about general robotic, such as medical robots, more about UAVs...
-The lecture part was useful to have done when the project started because then everyone knew the basics. It was a good place to start when looking for a way to solve something.
-It should have more credits and it should be more deep, or then, focused on the problem for the second period.
-Even knowing that the course is more a project course I think that in the lectures should be given more atention to what are the options we have in the project. For example we spent 4 classes talking about sensors (I'm not saying it's not important) and 1 talking about the camera or mapping. In the project the time spent choosing the sensors were of course a lot smaller than the one spent with the camera or mapping.
-Too short! Where was the discussion on control architectures? Where was the in-depth analysis of map-building? Of navigating a partially known world? Of localization through for example particle filters?

Yes, these subjects were touched upon, but far too little to my liking.
-Since it is supposed to give a general introduction into robotics, I think it's good as it is.
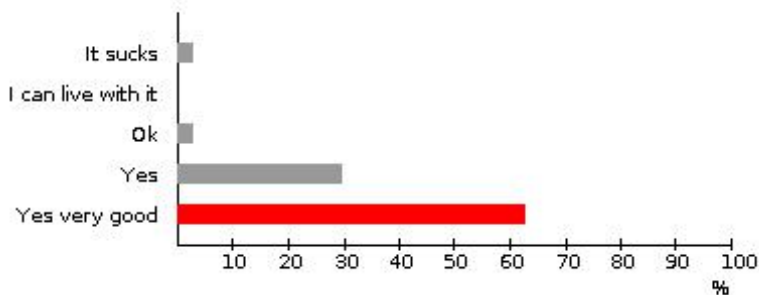
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How did you like the project?



| number | distribution | answer choice |
|---|---|---|
| 1 | 3,3% | Not good |
| 0 | 0% | Less than good |
| 1 | 3,3% | Ok |
| 6 | 20% | Good |
| 22 | 73,3% | Very good |

30 has answered of 49 (61%)
Maximum number of choices: 1

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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 | 3,3% | It sucks |
| 0 | 0% | I can live with it |
| 1 | 3,3% | Ok |
| 9 | 30% | Yes |
| 19 | 63,3% | Yes very good |

30 has answered of 49 (61%)
Maximum number of choices: 1

**Comment:**

-If I would've chosen the group myself, I would have ended up in a group where everyone knew computer vision, and some control, but no-one with more than basic C++-knowledge. Instead, we got a good pool of knowledge, and I met some new friends! :)
-I'm a exchange student and it would have been difficult for me to find a group by myself.
-It was AWESOME
-I disliked it totally. However it is how the real world works, so it is best practice.
-If we would choose groups ourselves the division of knowledge would not have been distributed in a good way.
-Its good to break up the old gangs!
-It is very good but did not work well for me. After the group is formed, it should be assessed at least 1 or 2 times, and then yes, the final decision on the groups would be made.
-Problems when people don't know programming at all... Except for that it was very good.
-A more uniform skill level would have been nice. It is hard to discuss the specifics of a particular kind of PF implementation while simultaneously reassuring another team member that "no, IR beams from the sensors can really cross without interfering".
-I didn't know anyone in the course before, so I actually think for me it was a lot better this way than if we had to find the groups ourselves. It would be interesting though to get the results of the skill test.

How did your group work together?
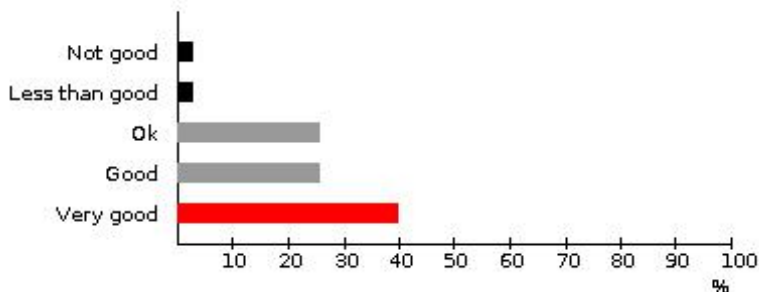


number distribution answer choice

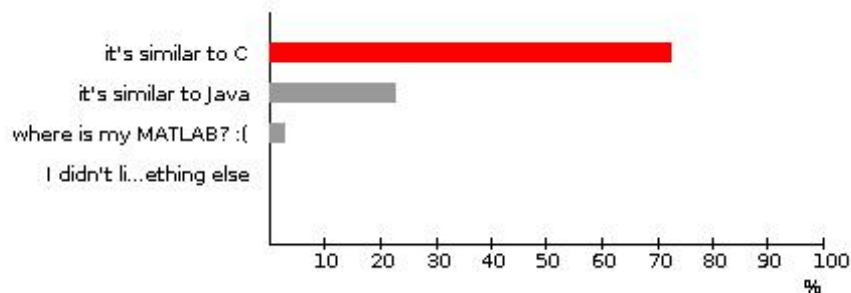|   |   |   |
|---|---|---|
| 1 | 3,3% | Not good |
| 1 | 3,3% | Less than good |
| 8 | 26,7% | Ok |
| 8 | 26,7% | Good |

| 12 | 40% | Very good |

30 has answered of 49 (61%)
Maximum number of choices: 1

**Comment:**

-There are amazing personalities in this world.
-Part terrible, part excellent.
-It was sometimes difficult to get more jobs to do, all tasks were occupied by others!

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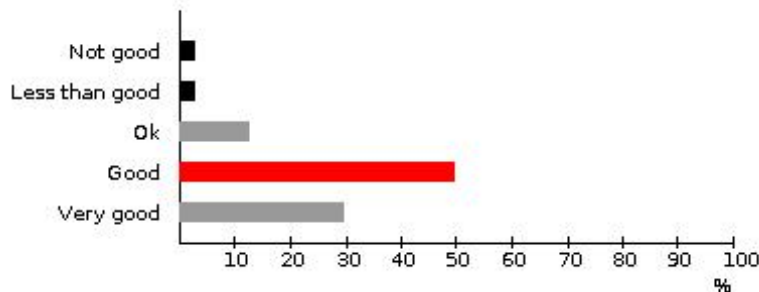


number distribution answer choice

| 22 | 73,3% | it's similar to C |
| 7 | 23,3% | it's similar to Java |
| 1 | 3,3% | where is my MATLAB? :( |
| 0 | 0% | I didn't like it -- I prefer something else |

30 has answered of 49 (61%)
Maximum number of choices: 1

**Comment:**

-It was a bit hard to get used to it in the beginning but I learned quickly
-Small knowledge jump
-Well, not that similar, maybe, but it's the best refernce-point for me. I found it valuable to learn some C++ by coding. On the same time, I feel we could have focused more on the application and algorithms if it would have been feasible to do it in a higher-level language, such as Python. But then the hardware would have had to be on another level, I guess.
-I knew C++ already.
-C++ for the win!
-It's easy but... put more credits on the first period please. I did not have time for learning it.
-I miss the option "I'm already used to C++". And, "It's similar to Java"? Really? Did anyone pick that option?
-lol, liked the option "where is my MATLAB", :D

-Which answer should I choose?
I knew C++ before. Didn't know Matlab before though, but it wasn't hard to learn enough for the lab.
-Missing alternative "not very hard"..
-Knew it before.

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What did you think about ROS?

number distribution answer choice

| number | distribution | answer choice |
|---|---|---|
| 1 | 3,3% | Not good |
| 1 | 3,3% | Less than good |
| 4 | 13,3% | Ok |
| 15 | 50% | Good |
| 9 | 30% | Very good |

30 has answered of 49 (61%)
Maximum number of choices: 1

**Comment:**

-Quite a large difficulty curve for first time user
-As well as helping us with a lot of stuff, ROS also lead to some hard-to-find performance problems. I think you should continue to use ROS, and eventually you can give hints and guides on what to do/not to do based on experience from previous years, and then it will be very valuable.
-a bit dissapointed : maybe too high level, but with a different way of doing things. I still prefer Real Time OS with better synchronisation system and primitives (VxWorks or µC/OSII)
-It really helped and is a good catalyst for better design.
-Very abstracted low level, so very simple to use, but many things cannot be modified and controlled.
-Once we figured out what it was for and what was good and what was bad it was really helpful
-In the end, you could program your own C 133t interface, but it's quite ok.
-Using ROS or other system for robots is nice for people who wants to continue working in robotics...
-Aside from the huge overhead, ROS is awesome. It allowed me to work on parts of the project, while interacting with a module I had absolutely no knowledge about, simply by agreeing on a message format with my teammates.
-Made some things a lot easier. Others maybe harder. We had some problems with random time delays between receiving messages. We weren't always sure how fast and how exactly the messages were passed.
-Topics are good. Roslaunch is to slow and gave lag issues, same with roslogging. Should recommend which parts to use and which to avoid.

What do you think about the idea of usinga VirtualMachine for development and testing?



number distribution answer choice
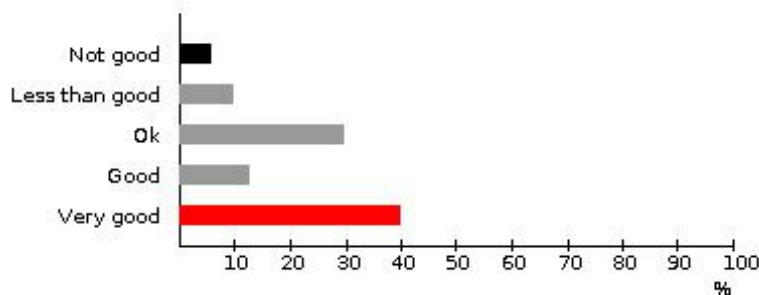
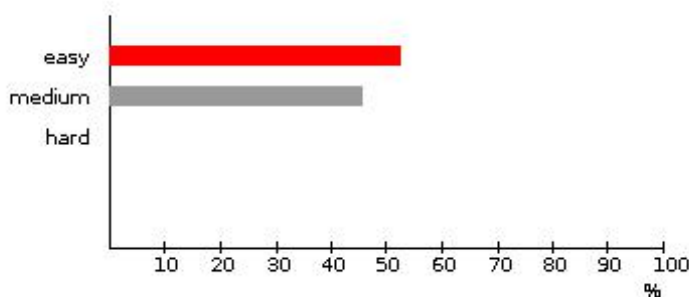| number | distribution | answer choice |
|---|---|---|
| 2 | 6,7% | Not good |
| 3 | 10% | Less than good |
| 9 | 30% | Ok |
| 4 | 13,3% | Good |
| 12 | 40% | Very good |

30 has answered of 49 (61%)
Maximum number of choices: 1

**Comment:**

-I like real machines better. Response time not comparable.
-Added more complication
-I didn't use it
-Had some problem with camera and 3D rendering performance.
-Really easy to install and we don't have to think about any weird installation problems.
-Sooooooo much simpler
-Slooooooowwww
-Very useful when you want to work from home.
-It didn't run on my laptop for example
-The only thing missing was a simulated world. Luckily, our group wrote our own.
-We never used it!
-It's nice to have a common environment. For developing and testing virtual machine isn't the best, however. My laptop gets to its limits running Chromium (Web browser) and Virtual Box at the same time. But anyhow, I think it is the best and cheapest way to have a common ground for everyone.
-VM ran a bit slow on my computer, and it was generally not super nice running through it. It's however a looot better than having to use the lab computer or robot hardware.

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How hard was Milestone 1?



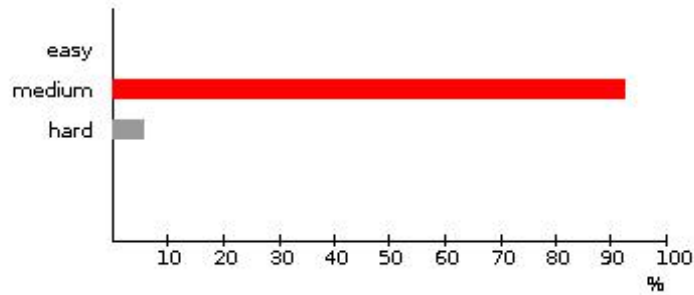| number | distribution | answer choice |
|--------|--------------|---------------|
| 16 | 53,3% | easy |
| 14 | 46,7% | medium |
| 0 | 0% | hard |

30 has answered of 49 (61%)
Maximum number of choices: 1

**Comment:**

-Too easy compared to the others.
-Good, maybe close to the exams.
Could add general ideas about importance of wall following (don't make the milestone more difficult but add some suggestions about what other things should the robot be able to do...)
-We lost quite a lot of time because we tried implementing control stuff in python. So due to that I think we experienced it to be a bit harder than it actually was.

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How hard was Milestone 2?

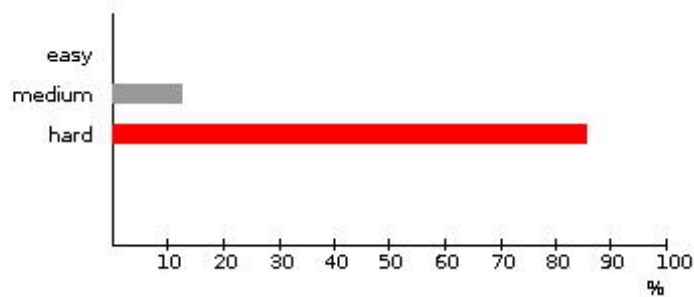| number | distribution | answer choice |
|--------|-------------|---------------|
| 0 | 0% | easy |
| 28 | 93,3% | medium |
| 2 | 6,7% | hard |

30 has answered of 49 (61%)
Maximum number of choices: 1

**Comment:**

-Good.
-It was fair that it wasn't required to create a map without any or with only very few errors.

How hard was Milestone 3?



| number | distribution | answer choice |
|--------|-------------|---------------|
| 0 | 0% | easy |
| 4 | 13,3% | medium |
| 26 | 86,7% | hard |

30 has answered of 49 (61%)
Maximum number of choices: 1

**Comment:**

-we focused on being able to follow the wall in the new maze so there was not enough time to make it planning paths.
-Soo much work to do !
-For the time given, scratching the impossible.
-Hard but good to select best groups.
-Required a LOT more than Milestone 2, while following fairly close behind. We were hard pressed for time, as were many other groups I think.
-We had the feeling to be good in time after milestone 2. But then the test maze was changed and we realized that our wall follower and our sensor installation weren't sufficient for the new maze. Fixing that took so much time that we didn't make the milestone in time anymore. We concentrated on the wall follower because on the one hand we felt that a stable wall follower was more important and on the other hand we weren't able to map the maze anymore.

Which of the following do you think was the hardest part of the project. Write other below if you cannot find your choice
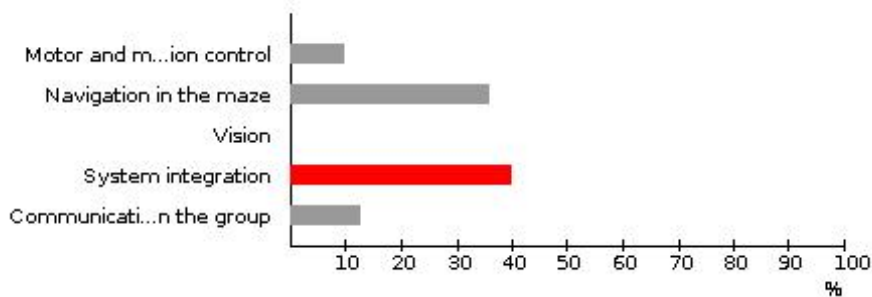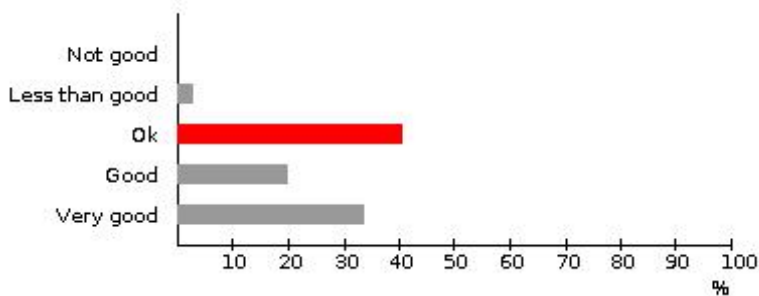
| number | distribution | answer choice |
|---|---|---|
| 3 | 10% | Motor and motion control |
| 11 | 36,7% | Navigation in the maze |
| 0 | 0% | Vision |
| 12 | 40% | System integration |
| 4 | 13,3% | Communication within the group |

30 has answered of 49 (61%)
Maximum number of choices: 1

**Comment:**

- / caused by system integration was hard
-Depending how the robot is built, the actual movement of the robot relies very heavily on system integration.
-I think it was hard to motivate myself with seeing that just half of the group was really working and thus the robot would not be finished in time.
-Path planning and following mostly
-People are difficult!
-I would say something between system integration and communication. They are intimately related. In the end, the technical stuff is just technical stuff and it gets done one way or another.
-I thought everything was easy to be honest; it just took a really, really, really long time to do everything.
-There are some wall constellations that are almost impossible to detect with the given sensors. It took us two or three days to build a sensor front that detects all obstacles in front of the robot.

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



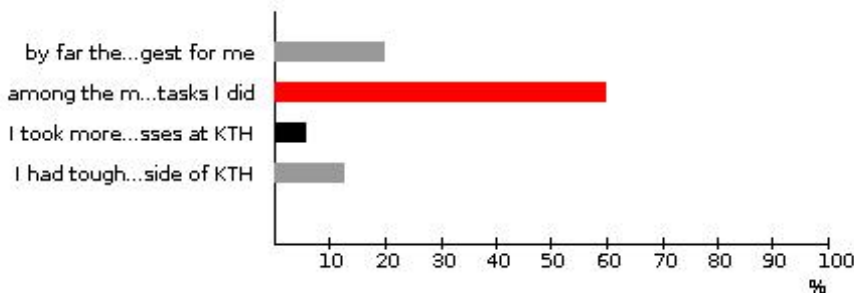| number | distribution | answer choice |
|---|---|---|
| 0 | 0% | Not good |
| 1 | 3,4% | Less than good |
| 12 | 41,4% | Ok |
| 6 | 20,7% | Good |
| 10 | 34,5% | Very good |

29 has answered of 49 (59%)
Maximum number of choices: 1

**Comment:**

-(something cant be bad if there is free pizza..) On a serious note, it was really fun and was one of the reasons people gave everything to make a good robot.
-It felt like the competition made us focus on the wrong things the last couple of days. Would be nice with a competition that tests what we can do, and not whether we can do the specifics of the competition. Maybe the winner should be the group that impresses a jury the most.
-Pizza! :D
-so much fun
-Delicious pizza!
-I was disappointed, because I thought we should run mapping/path planning in phase 2, but it turned out that many groups ran "path planning" in phase 2 and got better score!!
-I was disappointed that many groups (including us) were more or less just doing wall following. I think if the second test maze had been a bit easier more groups had concentrated more on higher level strategies for exploring and collecting. This way, however, it was hard enough just to get through the test maze without a collision. Since the maze in the contest was easier again, improving the wall follower felt a bit like a waste of time.

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



number distribution  answer choice

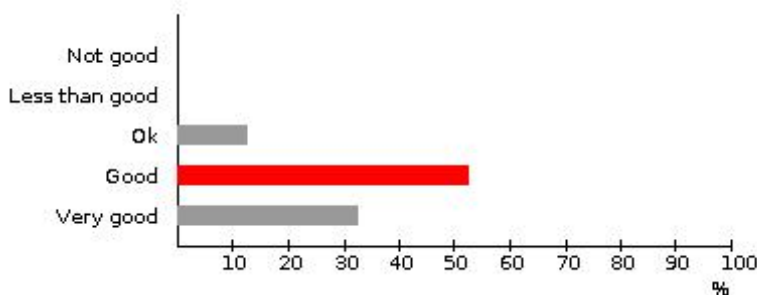| number | distribution | answer choice |
| --- | --- | --- |
| 6 | 20% | by far the biggest for me |
| 18 | 60% | among the more complicated programming tasks I did |
| 2 | 6,7% | I took more demanding project classes at KTH |
| 4 | 13,3% | I had tougher projects outside of KTH |

30 has answered of 49 (61%)
Maximum number of choices: 1

**Comment:**

-OS very simple
-I have worked continuously on an evolving software project for five years. A three month project? Peanuts.
-Comparable to other projects I did at my home university. But it was the same that you worked a lot more than you got credits for.

---

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



number distribution  answer choice

| number | distribution | answer choice |
| --- | --- | --- |
| 0 | 0% | Not good |

| 0 | 0% | Less than good |
|---|---|---|
| 4 | 13,3% | Ok |
| 16 | 53,3% | Good |
| 10 | 33,3% | Very good |

30 has answered of 49 (61%)
Maximum number of choices: 1

**Comment:**

-we were working at evening/night time so we didnt see him that often.
-Johan was always here to try to help us. Thanks !
-Except of course during the weeks where he had far greater things to do with his life ;) But yeah, in hindsight, I wish I had listened to more of his tips.
-I think in the last week before the contest he was less often in the lab although we had more questions than in some weeks before. But I'm not sure about that.

---

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

15 has answered of 49 (30%)

**Comment:**

-A faster processor would be nice to be able to have all the sensors that you would like and to be able to do image processing faster.
-it was hard to detect "evil walls". would be nice with a wide range sonar!
-battery power was not enough
-We had all we need.
-Really nice, the roboard is really quite good even though the servo/gpio API is a pa!n to use.
The serializer is.. immature.. but when you've found it's limitation it works quite well!
I'd really like to have faster motors with higher resolution encoders.
-The hardware was good in general. There were some problems with the IRs given to us in the beginning though.
-The sonar had not as wide angle as we hoped. Some IR-sensors were not so good and sometimes broken. But they were replaced fast enough so it didn't affect our progress that much.
-Maybe more explanation about the serializerboard, because we didnot find a lot on internet, so it was kind of try and fail method.
-The largest problem, which I guess your'e aware of was the SD card that was slow.
-good. The wiki is a good idea, but using directy the board documentation was a very good idea to know exactly what you can do with the board and the serializer (like onboard PID, GPIO, Servo commander,...).
-Serializer-board caused trouble...
-It's ok. But if you want to really dumb down the course just go for arduino. It would be cool some raspberry pi. But, the hardware was great, I would say.
-Fantastic! No worries about that...
-CPU: way too slow for image acquisition. Wait what? It's just a simple webcam, how on earth can that clog your pipes? Complete mystery to me.
Cameras: seem unsharp. Not sure why. Completely pointless to have cameras capable of 1600x1200 resolution images when the rest of the hardware cr*ps itself at anything above 800x600.
Long range IRs: fairly inaccurate. More than I would have expected. The short range IRs were great though.
Motors: big! 11cm is a long distance to press into a small robot. Large diameter as well, so your roboard either floats inches of the ground, or your castor wheel needs to be raised.
-Tell the students next year that the sonar does not have a wide opening angle ;)

When you connected the power cable the roboard crashed sometimes. No idea why.

---

Comments in general about the project

13 has answered of 49 (26%)

**Comment:**

-Very fun to get to do something in practice and make use of all the theoretical knowledge that you have.
-Nice that we go from idea to product! but i think i would have been more fun if there was no milestomes! then we could have choosen any way of designing the robot and there would be more variations in designs among the teams.
-enjoyable but demanding
-Probably the best course in the world™
-Great and interesting project. However extremely demanding in work hours and programming knowledge. Demands way more credits than given (if the student dedicates himself).
-I did not like the idea of "competition" in the group. Actually to be more correct, I hated it! ;)

-Awesome course!
-Hard but really fun.
-awesome
-Cool.
-Awesome! It should start earlier with easier tasks.
-- Task: suitable.
- Group size: either too small, or too big.
-Nice experience. A lot of work, but in the end it was worth it.

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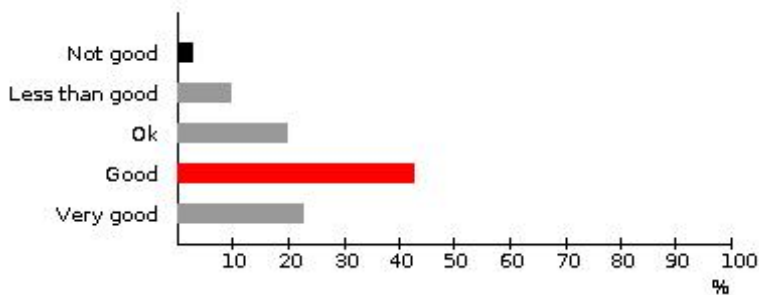


number distribution answer choice
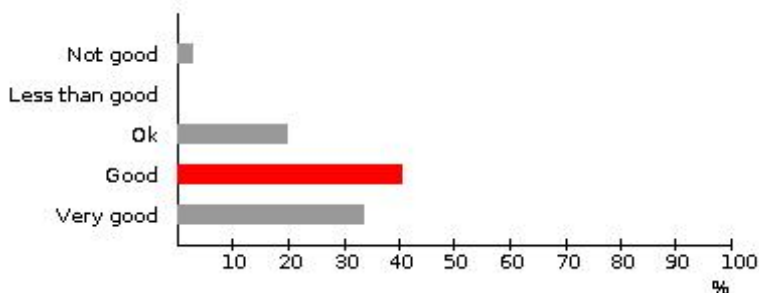
| number | distribution | answer choice |
| --- | --- | --- |
| 1 | 3,4% | Not good |
| 0 | 0% | Less than good |
| 6 | 20,7% | Ok |
| 12 | 41,4% | Good |
| 10 | 34,5% | Very good |

29 has answered of 49 (59%)
Maximum number of choices: 1

**Comment:**

-i wasnt there
-I have the feeling the real work division could not really get through even if we tried to make it clear without "blaming" the other group members.
-Teachers are excellent. They know how to listen. Not as some people that might get into your group.
-There is a word in French which describes the feeling of coming up with a good comeback the moment you walk down the stairs. Totally applicable here. Lot more I wanted to have discussed, and a few things that could have been put more eloquently.
-Nice and relaxed atmosphere

---

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



number distribution answer choice

| number | distribution | answer choice |
| --- | --- | --- |
| 1 | 3,3% | Not good |
| 3 | 10% | Less than good |

| 6 | 20% | Ok |
| 13 | 43,3% | Good |
| 7 | 23,3% | Very good |

30 has answered of 49 (61%)
Maximum number of choices: 1

**Comment:**

-good, but there was a lot of documents in the end, maybe too many.
-Opportunity to conclude a journey in the best way.
-Good, but boring.
-A nice way of keeping track. Not always easy though, if you work in the lab for ten, twenty hours on a single problem, and by the end of the week all you can write "fixed motor deviation bug". Doesn't quite seem to cover it.
-I would have done it (in my mind) even if it hadn't been an assignment. In the last week it was a bit stressful as I would have preferred learning for some exams instead.

---

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

26 has answered of 49 (53%)

**Comment:**

-Do not take other advanced courses in p2
-Take it!
-If you have the better part of a period to spend on the course, take it!
-Take it!
-The course will demand a lot of time, but it's woth it!
-Plan first!
-The course is very interesting, organize yourself early to get the most of it and not being in a rush.
-Don't over do it, brush up on c++ and have fun!
-Have fun!
-Extremely hard working and programming intensive. Rich in content but get ready to dedicate to it and little less else.
-Get prepared to get f****d!
-Try to involve the whole group into the work otherwise the robot will be hard to finish in time.
-Plan your work if you could, and do not underestimate the path planning/following part !
-Hard but fun course if you put in a lot of work.
-Testing the robot should be your longest task in the project, it make your robot reliable and robust.
-Fun and interesting but time consuming.
-Make sure you know programming and that you have a good team, and then, jump into it and have fun ;)
-Don't do it if you don't have time (or don't know anything about programming) !
-Be prepared to have a lot of fun and a lot of work!
-Take this course if you really want it and if you are sure you have time for it.
-It's a very fun project, but be prepared that it takes very much time.
-"Drop every other course during the second period"
-You should take this course!
NOTE: I already have find a PhD student who will take it next year :)
-You should only do this course if you have a lot of time in period 2 and you know how to program in C++ or at least Java or C.
-Be prepared, it will be bloody.
-Very fun but very time consuming.

---

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

19 has answered of 49 (38%)

**Comment:**

-I think the contest rules were fair.
-Se above.
-The group reflection where we as a group scored ourselves should be taken more seriously and not so easily overruled by the teacher. When 100 points are divided 5 ways (so the average is 20 points per student), taking 2 points from one student is 10% of their grade on the project, and is easily the difference between 1 letter grade (A to B or B to C)... This should be carefully considered before reassigning points the group members all established as fair.
-Smaller maze or longer run time for each robot.
-more knowledge about the complexity of the maze!
We were spending a lot of time on making the robot handle complex wall situations that were never seen in the competition maze.

-pointing system should be more intelligent
-More time or smaller maze, make it worth the time to use navigation!
-Nothing should be changed.
-Maye have some kind of maze that can demonstrate the different functionalities of the robots.
-The overall project this year felt too hard. In the end the maze in the contest was much simpler than was permitted but since a lot of effort was put into creating robots that had these extra features the maze did not test what should have been tested.

If the maze would have tested exactly what was permitted no robot would have succeeded at all in the competition but I think the project was harder than it should and the competition should match an easier project.
-More time in the first phase to be able to use exploration in the maze.
-Nothing
-More time so that the best groups can do exploration completely.
-No.
-The format of the competition could be more restricted so that we knew for sure that it would be easy, as it was. Or maybe the competition could be made so that we actually show each of the features, for example being able to win different categories, as best mapping, best planning, etc.
-The contest wasn't what I expected. The most successful robots didn't even use the information gathered during phase 1. Making only one phase and totally skip the first phase would have payed of for all groups. All this talk about mapping and pathfollowing, and then you can win by only doing wallfollowing one lap and classify whatever you pass by. Maybe some rule changes that makes the teams actually benefit from phase 1, or skip phase 1 :(.
-Maze opening on the *right* side instead of left.
-No rule changes.
-It was not possible to explore much with the current time limit, if you make the robot go close to max speed the localization is much harder. So a higher time limit, at least in phase one, alternatively a smaller maze. Also maybe some limits how the maze can be constructed so obstacle detection is simpler.

---

Things you liked about the course?

19 has answered of 49 (38%)

**Comment:**

-Almost everything, for example:
- To do something practical
- The contest (even though our result was bad). Motivates the group to build a good robot.
- Good to do a big work in group. You learn a lot from working in group in such a "large" project.
-Everything!
-doing something from scratch!

-group works
-Almost everything
-Seeing real life engineering applications.
-1. Free to build the robot as we wished.
2. Free to structure the code as we wished.
3. That we could access the lab when ever we wanted.
4. Software & hardware integration.
5. Patric & Johan were really fast on responding to our questions.
-using real hardware and ROS
Trying to create a whole robot from the scratch
-Lectures, lab, everything
-Creating a robot with almost no design restrictions

Getting a task and figuring out how to best succeed at the given task.

Working in a group where everyone took the project seriously
-The project is so awesome !
-Teachers, the environment, the richness of the lab, seeing people getting happy when they saw their robot actually move straight and in the end hitting a wall... and also, learning about robotics (sensor integration) and how hard it is to manage a team.
-The project group.
-How practical it is, and how close it is to a real project.
-Fun project
-- Building something from the ground up
- Working with some brilliant minds
- Being grouped with people with a completely different skill-set
- Getting to know all the good eating places around campus
- Robots! F*ck yeah!
- That feeling you get, when upon working on a hard problem for days, you finally see it work, and just for half a minute, it

actually seems to work perfectly, exactly as you always dreamed it would be but in practice never seemed to.

-I liked you as a teacher because:

du var engagerad!
man fick snabba/bra svar
mkt feedback
bästa kursen jag har tagit på kth utan tvekan!!!
-The mixed groups.
Open task, no one telling you how to do it.
A lot of different tasks.

Building a complete system, not only parts of it.
-The challenge, a hard to reach goal so there always is something to improve.

---

Things that could be improved about the course

18 has answered of 49 (36%)

**Comment:**

-- Faster processor in the robot
- Maybe one more feedback session with Patric and Johan in the middle of the project to make sure that the group is on the right track.
- The course should give more than 9 credits. Most people definitely puts a lot more effort than for a normal 5.5 credits project in this project.
- Bilda is a mess. Some things are found under "Documents", other under "Content". You had to search a lot to find what you were looking for. Please make it more structured.
- The first part of the course is a bit unstructured. Suddenly, there turns up a new lab time or something that you have to fit into your schedule.
-More guides / FAQs about the hardware and software framework (ros). Ie what we should avoid, common problems etc. I know it's an important lesson that stuff will go wrong, but I think there is enough possibilities of that without having to figure out that writing to disk makes everything lag, and then how to stop doing it. Instead we could have things go wrong at more interesting places :-)
-Milestones were affecting the architecture
this form was too long.
-the small lab room
-Less hand-ins, I think some of them were a good exercise but some of them just felt unnecessary and time-consuming.
-The laboratory installation is too small for the amount of groups. Maybe more lectures with more technical information?
-Maybe give us a "black list" of things that is not possible to implement (within the given amount of time). Or at least some warnings about walk could go wrong. (like coding some low level stuff in python or that there could be some defected sensors and cables)
-In the end I got the feeling that the grading was not as fair as I hoped it would be ( following my feeling for the divison )
The basic nodes that we got to read the Sensors and use the Motors were not really good we had a lot of trouble with them and realized to late that we should have maybe rewritten them like other groups
-Because I really like the robotic world, I would have liked to have more lecture about robotic in the real world, etc.
-Easier project. The project this year had so few restrictions that there were a lot of things that we had to consider. For example fake angular walls.

On the other hand the difficult project was part of what made the course so fun. We had to think about how the maze could be difficult and adjust the robot to cope with those difficulties.
-general documentation about the hardware (wiki)
-Some mandatory project management for the groups, during the robot construction. One P.M. should be appointed by group, after a few weeks later, together.
-More time between Milestone 2 and 3
-Start the project earlier!
-Maybe more focus needed on the systems engineering and management part.
-- That feeling when, once your robot has done something excellent for half a minute and you think you solved the problem once and for all, when it suddenly goes on a kamikaze-rampage trying to break down all the walls in the maze.
- Being grouped with people with a completely different skill-set.
- Evaluation as puzzle wrapped inside an enigma covered by a mystery. And then dropped down a well and lost. Exams you can learn for, but this?
- Time requirement. To do it right (and I'm looking at team discovery over here), you need to sink far more time in this course than a measly 6 credits for the practical part would hint at.
-I think the "Project Contribution" was a bad Idea, it creates conflicts! And I also think that you should divide tasks or at least don't let one get too many tasks to do!

-More time if somehow possible. Provide one representative test maze at the beginning and stick with it.

Better definitions of what to do in the contest's phases.
Especially about phase 2. For a long time we thought we were told a set of tags we had to collect. We weren't aware we were allowed to choose them by ourselves.

Clearly define how the robot can enter and leave the maze (how big is the entrance?, anywhere in the maze?).

Make the knowledge of C++, C (or Java) as a requirement for this course.