Written exam Oct 25, 2016 (robot16)
DD2425 Robotics and Autonomous Systems

NOTE:
- **Fill in name and personnummer and nothing else!**
- **Copy "Exam id" to all other pages**

* Name:……………………………………………………...

* Personnummer:…………………………………

Exam id:

Summary of results Used by examiner only!!!!

Scoring: 1 for correct answer, 0 for wrong answer and blank for no answer.

Section A: Must have at least 7 correct to pass.

	1	2	3	4	5	6	7	8	9	10	Sum	P/F
A												

Result Section A:……. (either P or F)

Section B: Must have at least 3 correct in a subsection to pass. Must pass all subsections.

	1	2	3	4	Sum	P/F
B.1						
B.2						
B.3						
B.4						
B.5						

Result Section B: ………(either P or F)

Result overall exam: ……………(either P or F)

Date:…………………………..

Signature of examiner:………………………………

Exam id: …………….. (copy the exam id from the cover page)

Written exam Oct 25, 2016 (robot16)
DD2425 Robotics and Autonomous Systems

Lecturer: Patric Jensfelt

You are NOT allowed to use any books or calculators.

Hand in the exam no later than 15:45. Take your belongings and leave the room, **BUT return at 16:00 for an immediate feedback section**. Every student should give feedback on one other (anonymous) student's exam. The examiner will check the feedback, make modifications if needed and do the actual grading.

Requirements: To pass the exam you need to pass sections A and B. Passing section B requires passing all subsections in that part. You need at least 70% on each subsection to pass (7/10 on section A and 3/4 in subsections B.x).

Make sure to:

- ONLY write your name on the cover page! (to stay anonymous)
- Copy the "Exam id" from the cover page to all other pages
- DO NOT write in the square boxes next to the questions (these are for grading).
- Keep your answers short. It is not an essay!
- Write only on the pages provided to you. Use backside if needed but make it clear that you used it.
- **Return at 16:00 for the feedback session!!!!!**

The written exam is assessing your fulfillment of

ILO 1: recall basic concepts in robotics
The gist of this ILO is that the student is able to interact in a working environment where robotics is the domain. This means that basic nomenclature and concepts needs to be known. It is possible to learn the details about things while working but unless you know the basics you cannot even discuss about robotics.

ILO1 consists of two parts,
  A. Knows the basic nomenclature used in robotics
  B. Can recall basic concepts in the areas
      1. Locomotion and kinematics
      2. Manipulators
      3. Sensors and perception
      4. Navigation
      5. Mapping and localization

GOOD LUCK!

Section A

☐ A.1: What do you call the wheel configuration where you have two independently powered wheels, one on each side of the robot and typically a caster wheel to keep the balance?

………………………………………………………………………………………………….

☐ A.2: What do you call the wheel type with many small, freely moving, rollers along the periphery of the wheel that allow the wheel to slide in one direction?

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☐ A.3: We typically talk about two types of UAVs. Name one of them?

………………………………………………………………………………………………….

☐ A.4: Which of the following sensors are proprioceptive (can be more than one)? Sonar, gyro, camera, radar, encoder

………………………………………………………………………………………………….

☐ A.5: What does pose mean (as in "the pose of the robot" or "the pose of the object")?

………………………………………………………………………………………………….

Section A

☐ A.6: What does the acronym UWB stand for (e.g. used in radio based positioning)?

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☐ A.7: What does the C in C-Space stand for in the context of motion planning?

……

☐ A.8: What do you call the function that maps the Cartesian position to joint angles for a manipulator?

……

☐ A.9: What does RRT stand for in the context of motion planning?

……

☐ A.10: What does SLAM stand for?

……

Exam id: …………….. (copy the exam id from the cover page)

Section B.1 Locomotion and kinematics

B1.1: Consider a robot with kinematics described by
$dx/dt = v*\cos(\theta)$
$dy/dt = v*\sin(\theta)$
$d\theta/dt = \omega$

where you control v and ω. What geometric shape does the robot describe for a fixed input with none of the signal being 0 (keep it brief!!!!!!)?

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B1.2: Give 1 advantage and 1 disadvantage with having a holonomic car (keep it brief!!!!!!)?

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B1.3: Give 1 advantage and 1 disadvantage with skid steering (keep it brief!!!!!!)?

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B1.4: Give 1 advantage and 1 disadvantage of a legged robot over a wheeled robot (keep it brief!!!!!!)?

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………

Section B.1 Locomotion and kinematics

Section B.2 Manipulators

B2.1: What is a prismatic joint (keep it brief!!!!!)?

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B2.2: Give the forward kinematics for the arm in the image to the right. Focus on the center of the end effector, (x, y, θ), marked in the image.

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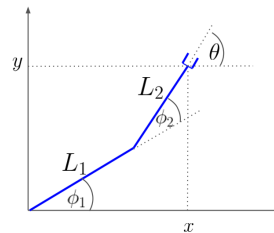
B2.3: Mentioned a challenge with motion planning for a manipulator (keep it brief!!!!!)?

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B2.4: Give 1 advantage and 1 disadvantage of using a suction cup instead of a dexterous hand for manipulating objects (keep it brief!!!!!)?

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Exam id: …………….. (copy the exam id from the cover page)

Section B.3 Sensors and perception

☐ B3.1: Motivate why sensor redundancy is considered important for many applications (keep it brief!!!!!)?

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……………………………………………………………………………………………………

☐ B3.2: Mention 1 advantage of using sound instead of laser light for measuring distances (keep it brief!!!!!)?

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……………………………………………………………………………………………………

☐ B3.3: What does the matrix typically decomposed as A[R T] where A, R and T are matrices describe in the context of a camera (keep it brief!!!!!)?

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☐ B3.4: Give 1 advantage and 1 disadvantage with fish eye lenses for cameras (keep it brief!!!!!)?

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……………………………………………………………………………………………………

……………………………………………………………………………………………………

Section B.4 Navigation

☐ B4.1: When you do path planning in an occupancy grid you typically start by expanding the obstacles by the size of the robot. Why? (keep it brief!!!!!)

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☐ B4.2: Outline how you could do path smoothing for a path generated from a grid map (keep it brief!!!!!)

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☐ B4.3: Give a **brief** description of the how RRTs work (keep it brief!!!!!)?

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☐ B4.4: Why do most robot systems have both global and local planners in the navigation system (keep it brief!!!!)?

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Section B.4 Navigation

Section B.5 Localization and mapping

B5.1: Assuming that you have a partial map of the environment why might SLAM not be needed (keep it brief!!!!!)?

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B5.2: Give 1 advantage and 1 disadvantage with using particle filters for localization (keep it brief!!!!!)?

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B5.3: Loop closures are important when doing SLAM. Why? (keep it brief!!!!!)

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B5.4: Grid maps are frequently used as a representation in robotics. Give 2 advantages with the representation (keep it brief!!!!)

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Exam id: …………….. (copy the exam id from the cover page)

Grading sheet for students

NOTE: This is ONLY to be used the other student when correcting your exam. Do not write on this page during the first part (when you answer questions)!!!

Name of grader:…………………………………………………

By signing this, I certify that I am NOT correcting my own exam, that I am NOT making any changes to the answers given by the other student and that I doing my best to make the corrections in a fair way.

Signature of grader:………………………………………..

Summary of results

Scoring: 1 for correct answer, 0 for wrong answer and blank for no answer.

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	1	2	3	4	5	6	7	8	9	10	Sum	P/F
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B.1						
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B.5						

Result Section B: ………(P/F)

Result overall exam: ……………(P/F)