

Advanced robotics (ARO)

Course Assignment 1

Total: 10 Marks

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28 September 2026 (homework handout)

This coursework counts for 10% of the final mark. Each point is equivalent to 1%.

Before starting, please consider the following points:

- This is a small programming assessment, but you are evaluated to the answers to the question and the videos submitted, not on the quality of the code.
- This should not take more than a few hours. If you feel like a question requires a disproportionate amount of research / work, you probably misunderstood it. This does not account for the bonus exercises.
- your report should be 2 pages maximum.
- You need to work alone on this homework. Collaboration is not allowed. You can ask for clarifications on EdStem, but any form of request for a solution will be sanctioned.

Consider the TIAGo robot from Tutorial 3. Throughout this coursework, Its task is now to carry a glass of water that must remain upright at all times to avoid spillage.

question 1 - Inverse Kinematics (4 pt): Identify the constraints relevant to satisfying this task, and implement a numerical inverse kinematics (IK) solver that drives the robot to a specified target while respecting them. You will define the starting configuration yourself, and specify different targets as 3D points of different heights. Attach a video of the trajectories obtained to your coursework.

question 2 - Motion Planning (4 pt): Design an environment that justifies the use of a sampling-based planner to reach a target. You will provide this justification in your report. Implement a sampling-based algorithm that produces feasible motions (dynamics are ignored — only geometry matters) to reach the task. Explain your reasoning and attach a video of the results. Explain what modifications to the canonical sampling algorithm were required.

question 3 - Bonus (2 pt): Add something extra to your setup to solve a more challenging problem. Explain what you did and attach a nice video.