



**Due date: 09/08/2022, 11:00am, before class starts. There will be mandatory assignments based on topics discussed in class. Problems will be either theoretical or implementation-based. The programming exercises will include Python/C++ and Matlab. The due dates will be available on the course web page and the assignment itself.**

### Exercise 1.1 (5 points)

Reading material: Recent advances in AI technology led to new markets and opportunities in important areas such as health, education, transportation, the environment etcetera. Machines have outperformed humans in the past decade with regard to certain specific tasks such as some facets of image recognition or the ability to win against humans in games like Jeopardy or Go. AI researchers expect further, even accelerated progress in some areas of artificial intelligence, e.g. in self-driving car technology. All this progress has been made in areas known to AI researchers as weak or narrow AI. Significant progress in General AI where machines will demonstrate broadly-applicable intelligence comparable to humans in the coming years or even decades is unlikely according to a recent AI study.

Renowned AI researchers composed a recent study on artificial intelligence, published in September 2016. The study was produced by a panel of 18 mostly American scholars and experts. The authors looked at how specialized applications of AI might affect life in a typical North American city by the year 2030. It is called "Artificial Intelligence and Life in 2030" and may be seen as a new landmark report as it is the first of a series of reports that will be produced every five years as part of the "One 100 year study on artificial intelligence (AI100)".

Read the following two reports for a discussion in class:

1. AI 100 report: <https://tinyurl.com/4sxnt45s>
2. White house report: <https://tinyurl.com/mrbx6twa>

### Exercise 1.2 (15 points) Implementation

Get to know ROS by inspecting the simulation of a HSR robot. You will get to know one of the environments on our machines in the teaching lab. The goal of this part of the assignment is to make the HSR robot move in an empty environment by using the TMC (Toyota Motor Company) commands e.g., `omni_base(X,Y, $\theta$ )`. Please follow these steps:

1. Login to one of the computers in our classroom with your login credentials (first row computers only).<sup>1</sup>
2. From your home directory: do the following:
  - `cp -r /home/graph/visser/csc752/ .`
  - `chmod 755 .`
  - `mkdir .gitconfig`

This will take a while, you are copying an 8GB file.

3. We are using Docker images for this class. That way, we have less hassle with admin rights and installations. `cd` into the folder `./csc752/assignment1` and load the tar-file to your docker images: `docker load < csc752-assignment-1.tar`. Be patient, the first terminal feedback will take a while.
4. `docker image list` should show the image in the list of your images. You should see something like this:

REPOSITORY	TAG	IMAGE ID	CREATED	SIZE
devrt/ros-devcontainer-vscode	noetic-desktop-tmc	1da44794b4eb	2 days ago	8.4GB

<sup>1</sup>You can also use your own computer but there are a series of installations necessary and that will take a while (e.g. docker, nvidia drivers, environmental variable setting). You also need a special hardware and OS (GPUs, the faster the better, AMD 64 Ubuntu 20)

5. Run the following command to start the image: `./start.sh`.
6. Open a browser (preferably Chrome).
7. Edit `localhost:3001`. The workspace will load inside the browser.
8. Open a terminal inside that workspace. You will have the VSCode environment to do so.
9. Run `roslaunch hsr_b_gazebo_launch hsr_b_empty_world.launch` to start an empty simulation.
10. Open another tab in the browser and edit `localhost:3000`. You should see the robot. Start the simulator (bottom left).
11. Open another terminal and inspect the created nodes and their topics using:  

```
rostopic list  
rostopic list  
rostopic echo [TOPIC] // Choose a topic with translation/rotation messages, not an image.  
rostopic hz [TOPIC]
```

For more information take a look at the slides or:  
<http://wiki.ros.org/rostopic>  
<http://wiki.ros.org/rosnode>
12. Open another terminal. Invoke the command `i_hsr_b`. Your task is to create a series of commands that make the robot move (e.g., going forward a few meters, turn 90°, look at the floor and go back to the origin). Be inventive, this is the fun part of the assignment. Use `Ctrl-D` to stop the interactive shell.
13. Refer to `hsr.io` (Development manual for HSR) for eligible commands, e.g. `omni_base`. You will get the credentials for that document in class.
14. Show what your robot can do in class. Remember: every command you run inside the docker image might be lost once you stop the image. You might want to copy the commands or remember them for next time.