Projects

Challenge levels and grades

Projects can be completed at three *Challenge levels*. The *Challenge level* determines the **best** grade that can be received to the project!

Challenge level	Best grade
Basic	3
Advanced	4
Epic	5

Tip

The projects are defined in a way that it is recommended to tart with the **Basic** level, and then gradually work

towards **Epic**.

The projects are graded based on the follwoing aspects:

- Proved to be the student's own work
- Running results valid output
- Usage of versioning, usage of GitHub/GitLab/other repository
- Launch files
- Completeness of the solution
- Proper ROS communication
- Proper structure of the program
- Quality of implementation
- Documentation quality

Schedule

Week	Date	Event
8.	April 18	Project lab I.
13.	May 23	Project lab II.
14.	May 30	Project presentations.

Grading

To pass the course, Tests and the Project must be passed (grade 2). One of the Test can be taken again.

Grade

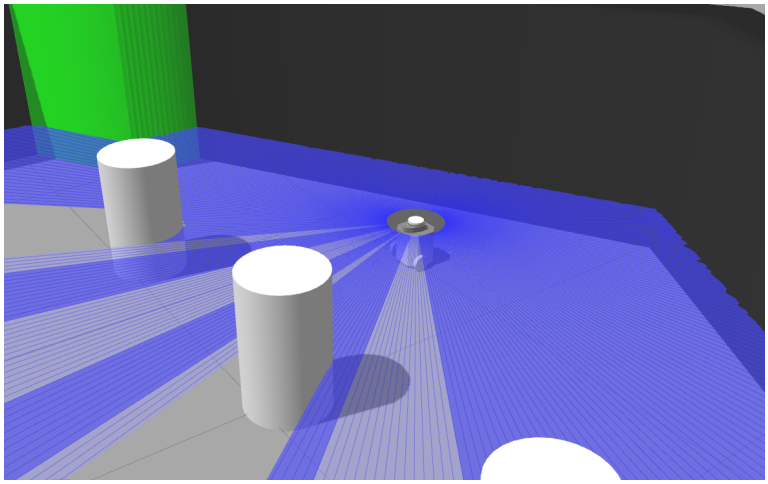
$Grade = (Test1 + Test2 + 2 \times Project) / 4$

Project topics

1. TurtleBot3

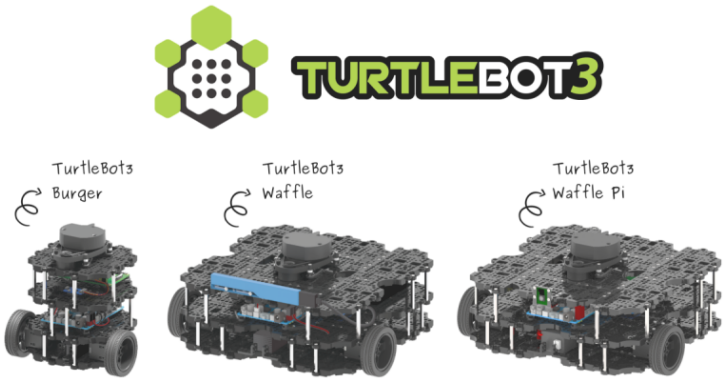
TurtleBot3 ROS tutorial

1.1. TurtleBot obstacle avoidance



- **Basic:** Simulator animation, SLAM testing. Implement ROS node/nodes to read sensor data and move the robot.
- **Advanced:** Implement ROS system to detect obstacle and plan and implement obstacle avoidance trajectory in simulated environment using any sensor.
- **Epic:** Impress me!

1.2. TurtleBot path following



- **Basic:** Simulator animation, SLAM testing. Implement ROS node/nodes to read sensor data and move the robot.
- **Advanced:** Implement ROS system for tracking in a simulated environment using any sensor (e.g. passing a wall at a given distance using LIDAR).
- **Epic:** Impress me!

Image source: https://robots.ros.org/turtlebot3/

1.3. TurtleBot object tracking/visual servoing

- **Basic:** Simulator animation, SLAM testing. Implement ROS node/nodes to read sensor data and move the robot.
- **Advanced:** Implement ROS system to find/recognize object and track/move it in simulated environment using any sensor (e.g. visual servoing).
- **Epic:** Impress me!

1.4. TurtleBot action library

- **Basic:** Simulator animation, SLAM testing. Implement ROS node/nodes to read sensor data and move the robot.
- **Advanced:** Implement a ROS action-based library of simple operations and a system to execute them (e.g. push object, move to object, turn around).
- **Epic:** Impress me!

2. YouBot

YouBot controller GitHub

2.1. YouBot ROS integration

- **Basic:** YouBot repo build, getting to know it
- **Advanced:** Moving a simulated robot in an articulated ROS environment
- **Epic:** Testing on real robot and/or impress me!

3. AMBF

AMBF GitHub

Building AMBF

Fork AMBF, then clone our fork:

```
cd ~/ros2_ws/src
git clone <MY_AMBF_FORK.git>
```

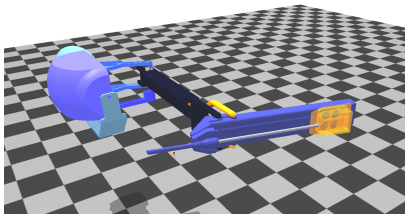
Don't use make as suggested in the AMBF documentation, use colcon:

```
cd ~/ros2_ws
colcon build --symlink-install
```

Launch the simulator:

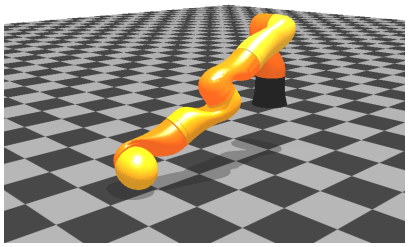
```
cd ~/ros2_ws/src/ambf/bin/lin-x86_64
./ambf_simulator -l 4
```

3.1. AMBF da Vinci ROS integration



- **Basic:** Simulator animation, robot control in joint space and task space (IK already implemented in AMBF) from ROS via CRTK topics
- **Advanced:** Object detection in *Peg transfer puzzle
- **Epic:** Autonomous manipulation in *Peg transfer* and/or impress me!

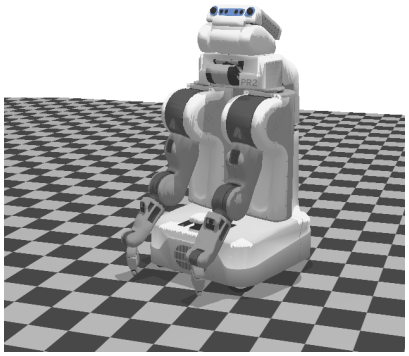
3.2. AMBF KUKA arm ROS integration



- **Basic:** Simulator animation, robot control in joint space from ROS
- **Advanced:** Generate trajectories in joint space

- **Epic:** Implement inverse kinematics and/or impress me!

3.3. AMBF PR2 humanoid ROS integration



- **Basic:** Simulator animation, robot control in joint space from ROS
- **Advanced:** Robot control in task space, IK?
- **Epic:** Trajectory planning/Navigation/Manipulation and/or impress me!

X. Own topic

By discussion.

Useful links

- TurtleBot3 Simulation
- TurtleBot3 Tutorial
- AMBF
- My fork of AMBF
- CRTK topics
- Navigation stack
- Paper on LiDAR SLAM
- Paper on vSLAM
- Paper on Visual Servoing Mobile Robot