MOBILE ROBOTS
Introduction to the Projects

Prof. Francesco Mondada

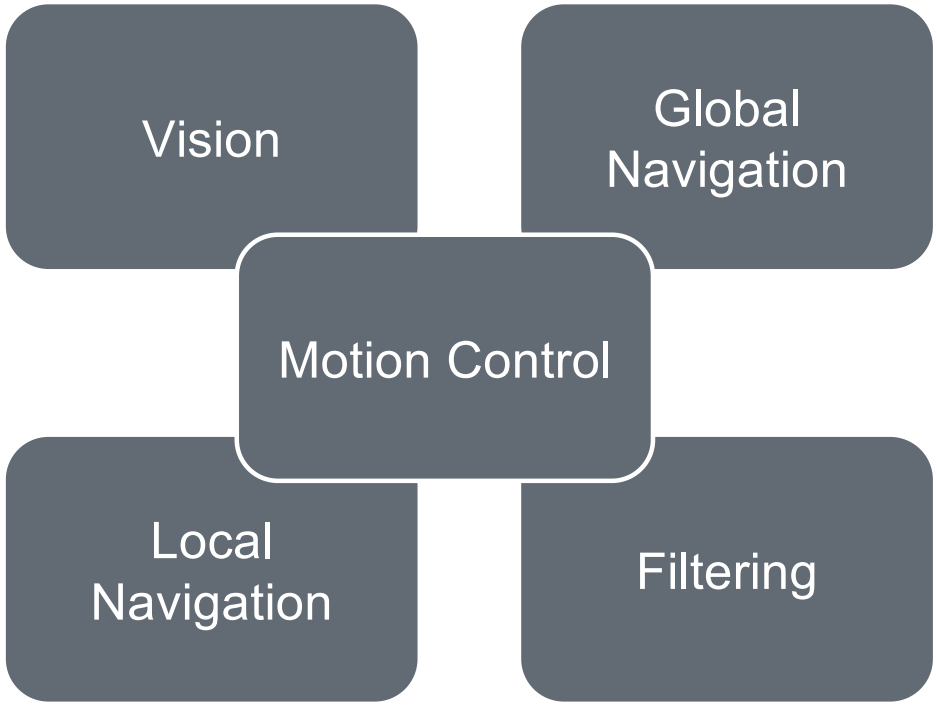
Course Topics (with project)

Week 1	Components of a mobile robot	**Week 8**	Uncertainties (+ team building)
Week 2	Vision	**Week 9**	Localisation 2 + Project week 1
Week 3	Vision & ANN & ML	**Week 10**	Project week 2
Week 4	Navigation	**Week 11**	Project week 3 + group work check
Week 5	Navigation + chatbot	**Week 12**	Project week 4 + Project presentations
Week 6	Localisation 1 (+ team survey)	**Week 13**	Project presentations + group debriefing
Week 7	Uncertainties + chatbot	**Week 14**	Project presentations + Conclusion + Mock Exam

Week of holidays between week 6 and 7

Project Information

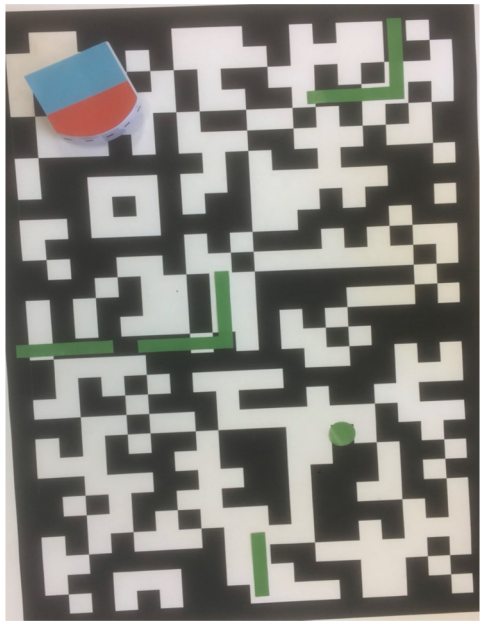
- Groups of 4 students
- Presentations weeks 12-13-14
- 4 weeks without exercise sessions (weeks 9-12) to work on it, note that there is a full lecture week 9 (today) and a case study week 10.
- TAs available from 16:15 to 19 on Tuesdays during the project, in the exercice room / online.
- Please use the forum, to allow everybody to benefit from the response.
- Training / development of group working skills

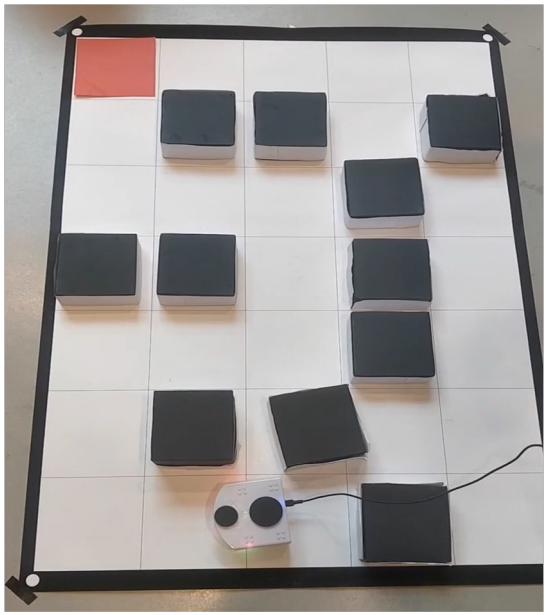


Components that are required for the project

Project Description - 1. Create an Environment

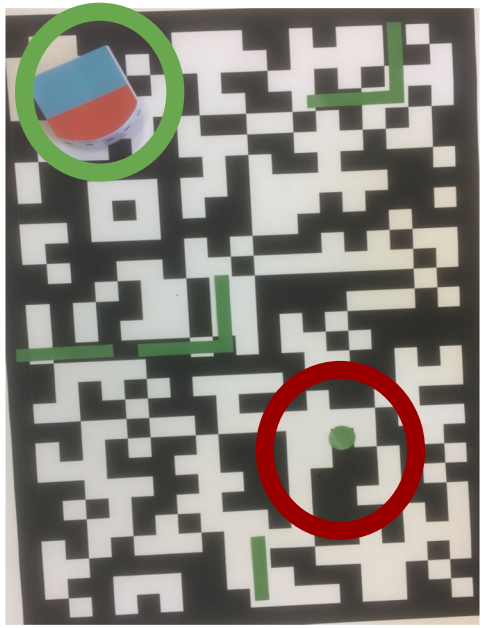
Your environment has to contain a set of obstacles that the Thymio avoids through **global navigation**. That is to say, the Thymio should avoid these obstacles without using the sensors to detect them.

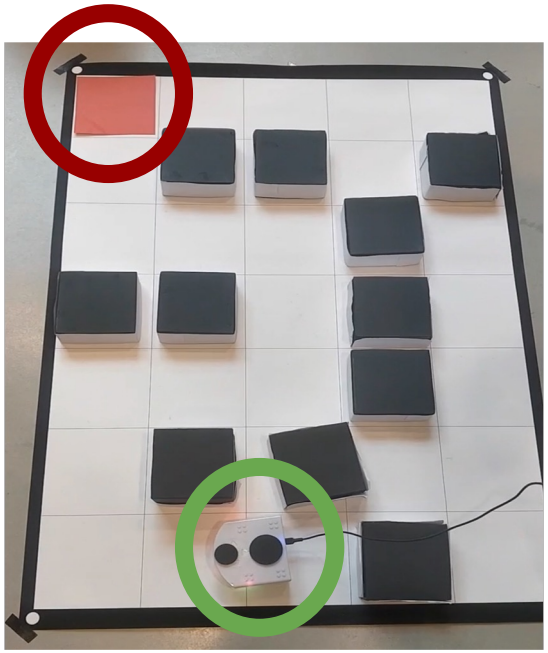




Project Description - 2. Find the best path

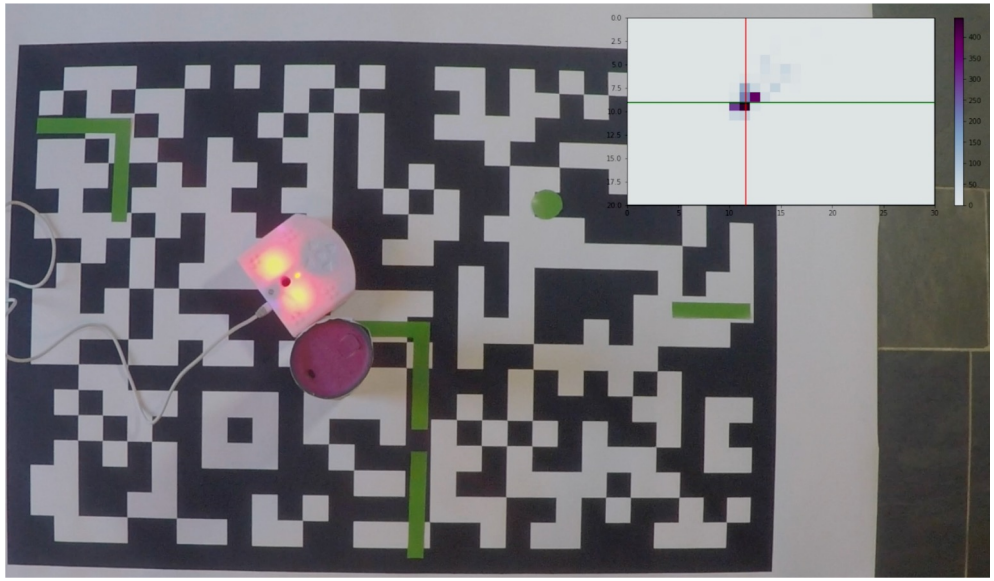
The objective is that the Thymio goes from **an arbitrary position** in the map **to a target that can be placed anywhere in the environment**. These will be changed during the demo to see how your system performs.

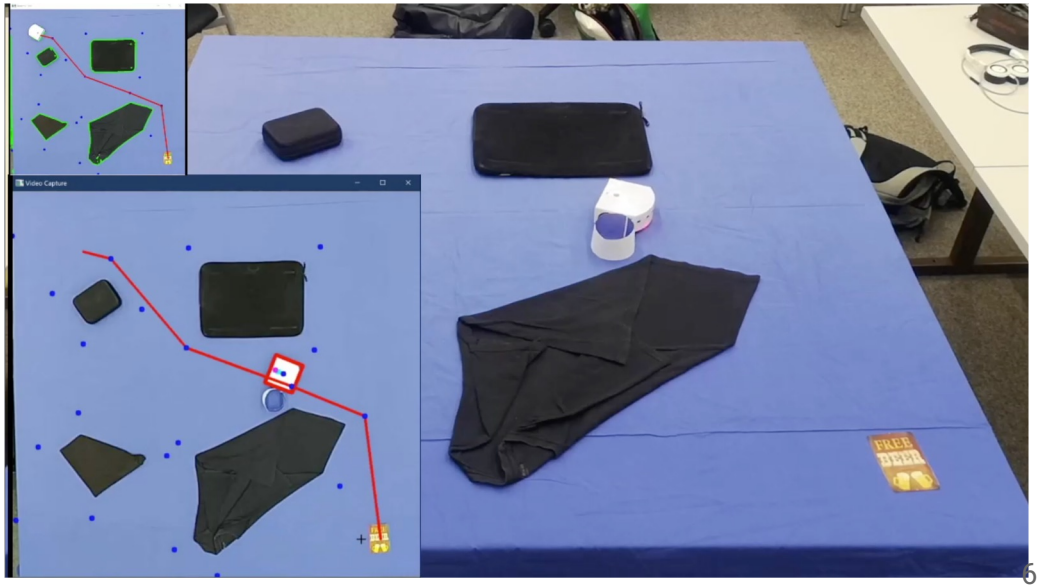




Project Description - 3. Motion Control & Pose est.

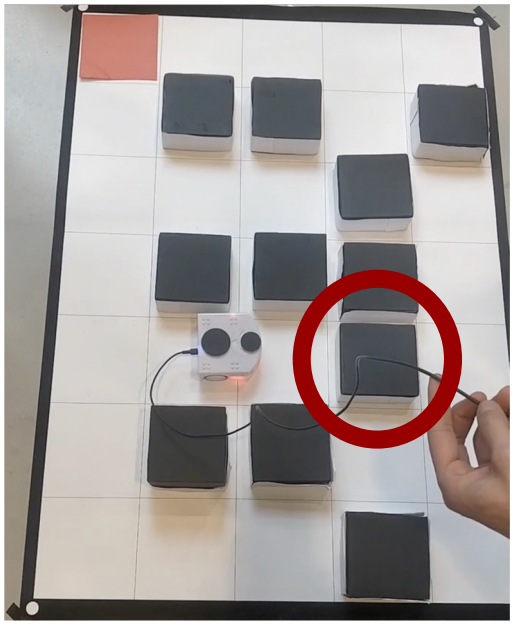
You will have to **control** the robot to help it move along the path. This requires an accurate estimate of the position of the robot which you will have to obtain through **bayesian filtering**.

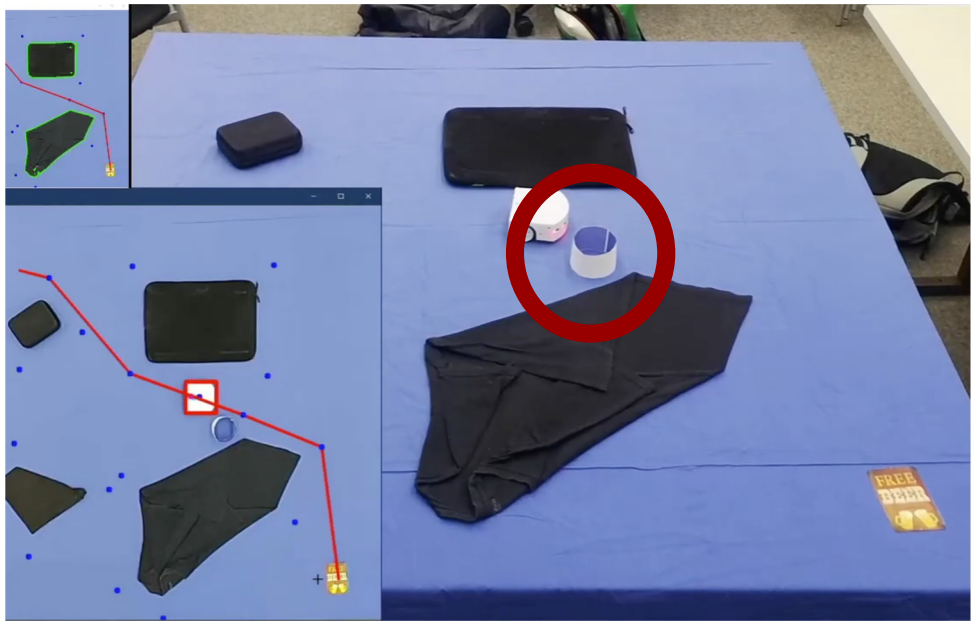




Project Description - 4. Avoid Obstacles

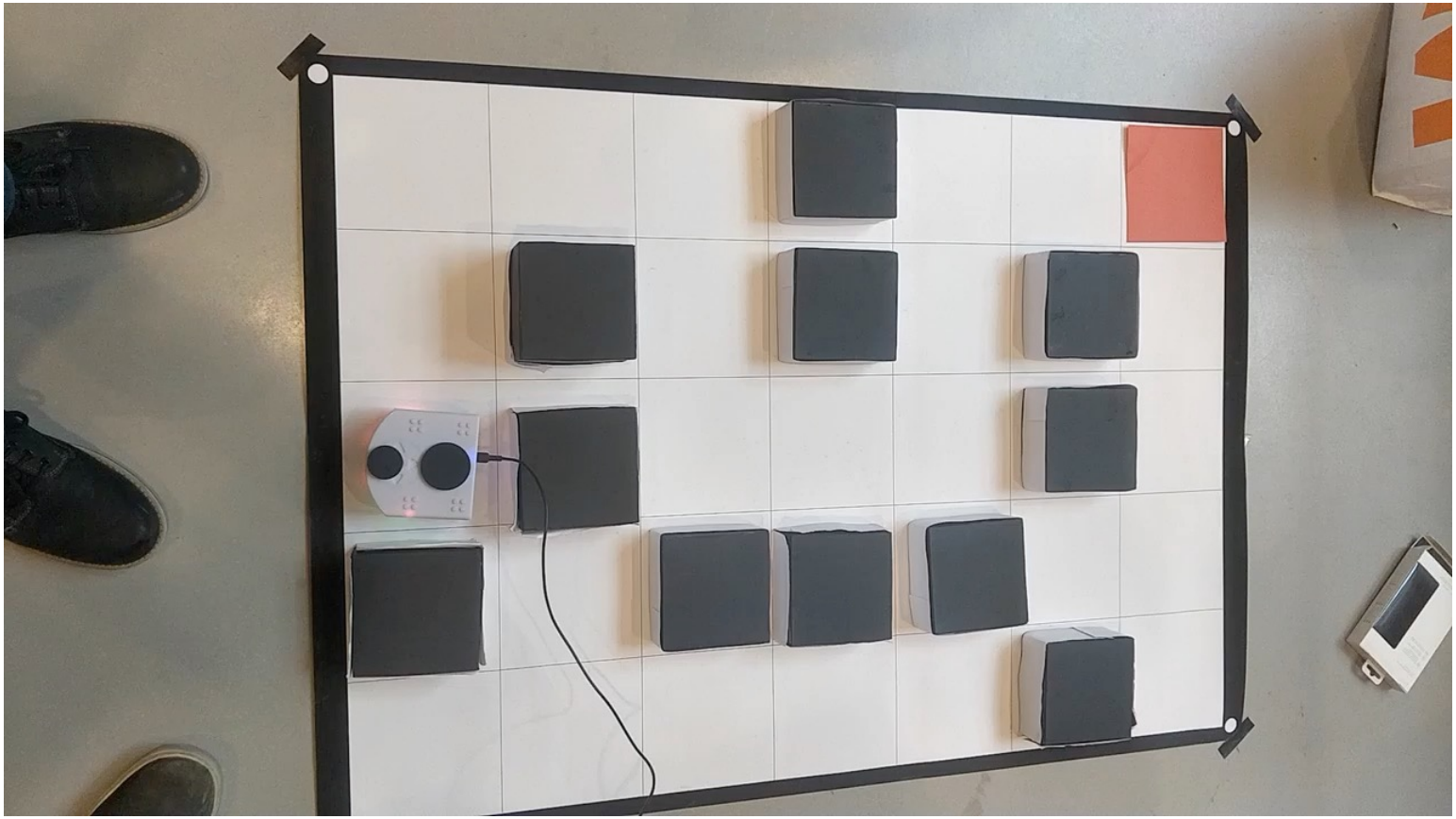
While navigating, the Thymio will have to use **local navigation** to avoid **physical obstacles that can be put in its path at any point in time**. You are free to choose what these physical objects are.





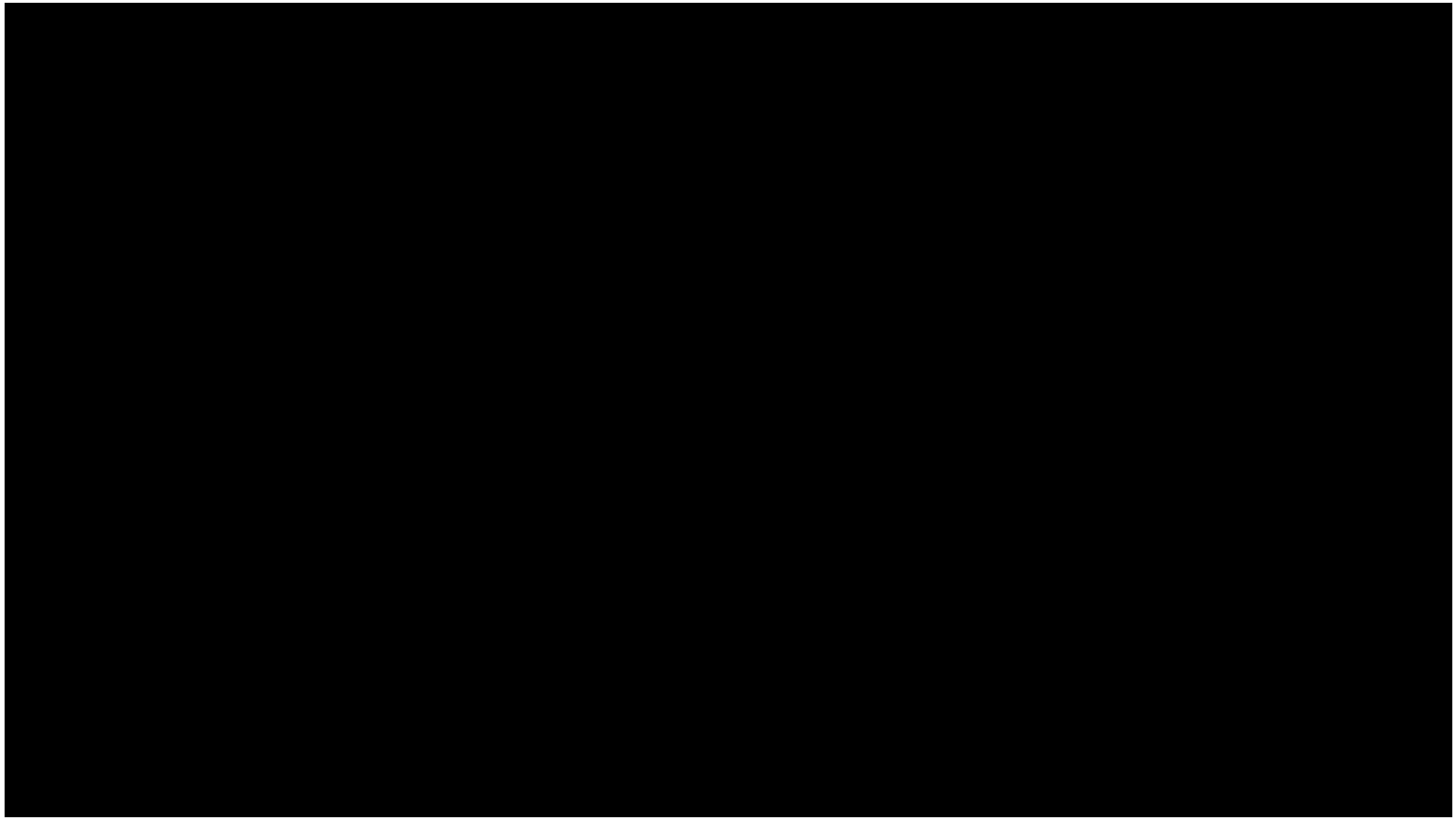
Examples from Autumn 2019-2020

Examples from Autumn 2019-2020



Examples from Autumn 2019-2020

Examples from Autumn 2020-2021



Deliverables

A Jupyter notebook which serves as a **report**. This must contain the information regarding :

- The members of the group, it's helpful to know who you are when we go over the report.
- An introduction to your environment and to the choices you made.
- Sections that go into a bit more detail regarding the implementation and are **accompanied by the code** required to execute the different modules independently. What is important is not to **simply describe the code**, which should be readable, but describe what is **not** in the code: the theory behind, the choices made, the measurements, the choice of parameters etc. Do not forget to cite your sources ! You can of course show how certain modules work in simulation here, or with pre-recorded data.
- A section which is used to run the overall project and where we can see the path chosen, where the system believes the robot is along the path before and after filtering etc… This can also be done in a .py file if you prefer. Just make sure to reference it in the report so we can easily have a look at it.
- Conclusion

The **code** used to execute the overall project. Do not hesitate to make use of .py files that you import in the notebook. The whole body of code does not have to be in the Jupyter notebook, on the contrary! Make sure the code **clean and well documented**. Somebody who starts to browse through it should easily understand what you are doing.

Deliverables

- A live (ZOOM!) **demonstration** preceded by a **short presentation** to explain what you did and why:
  - Deliver a clear and concise presentation (3 minutes) and then VERIFY with zoom etc… to be prepared for the live demo (3 minutes of demo) and then to delve into the questions.
  - For the demo, please include real-time (live) visualizations to effectively illustrate the mapping, path planning, navigation, filtering, etc.
  - During the demo we may request you to either hide the camera or place the Thymio at a different starting position. It would be also nice to see the impact of kidnapping on your pose estimation evolution.
- A backup video of your project at a stage where the modules were working is always a good idea. You never know what may go wrong during the presentation. We of course expect a live demo that works.

Tips

- **At the start of the project take the time to think through the choice of environment, obstacles, algorithms and how the modules interconnect. Groups that took more time to plan in the beginning made better choices which helped them save time in the long run. TIP: Write this down today**
- We will ask you to do some team buiding to explore the skills you have in the team and use them well
- We will ask you to define the project and then organize your work.
- Do a schedule and stick to it. Take note of the amount of time you think you will need and how much time you actually took. This will help you in future projects.
- Do not underestimate the time it will take to put the different modules together. Many groups waited until the last weekend to do so and struggled with the submission.
- Do not hesitate to use libraries for certain portions of the project. Just make sure you understand how the libraries and the underlying algorithms work. You will be asked questions in the presentation regarding the different modules.

Practical Information

- **Deadline for the project submission on doodle:**
  Thursday December 5th, 23:00
- Presentation: 3 minutes of introduction, 3 minutes of demo, remaining 20 minutes of questions/answers
- Registration for the presentations slots (no worries, many available) will be open next week.

Team Development: Interpersonal Processes and Effectiveness

Prof. Francesco Mondada
Dr. Yousef Jalali

Schedule

- **now** Introduction and presentation on collaboration

Break

- **17:15 - 17:40** Team-Building Activity- Part A
- **17:40 - 17:55** Team-Building Activity- Part B
- **17:55 - 19:0** Project definition

Teamwork and Collaboration

Think about a **good team experience** you've had. What stands out about it? Pair up and discuss what you think made that experience good (2 min).

Teamwork and Collaboration

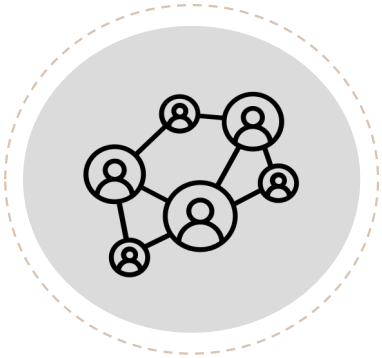
- Motivations and goals
- Surface-level diversity
- Deep-level diversity
- Prior interactions

- Communication
- Decision making
- Dealing with conflict
- Roles and responsibilities

- Team performance
- Satisfaction with membership

Your Team Project

Uncertainty



Interdependence

Potential for unsatisfactory performance

Creating Safe and Open Team Climate

Frame your work as team learning

Model curiosity

Acknowledge your vulnerability

Through Dialogue and Skillful Discussion

Edmondson (2018); Senge et al. (1994)

Increasing Team Effectiveness

Importance of Safe and Open Team Climate

- Google's teams
- Student teams
- Intensive care teams
- …

Duhigg (2016); Johnson and Avolio (2019); Nembhard and Edmondson (2006)

With a safe and open team climate, no one withholds their ideas, questions, and concerns. Discuss "among adults", in a professional way

Dialogue and Skillful Discussion

Surfacing and challenging assumptions

- What I'm thinking/feeling vs. what is said

Asking genuine questions

- "What other ideas could we generate?"
- "What might we be missing?"
- "Can you give me an example?"
- "What are your concerns?"

Be vulnerable

- "I don't know"
- "I need help"
- "I made a mistake"

Active and thoughtful listening

Genuine interest in others' perspectives

- Stop talking
- Imagine the other person's viewpoint
- Look, act, and be interested
- Observe nonverbal behavior
- Don't interrupt
- Listen for implicit as well as explicit meanings
- Rephrase what the other person told to ensure understanding
- Resist jumping in with evaluative, critical, or disparaging comment
- Offer constructive feedback without blaming

Team building: Tangible Activity- Part A

1. Using LEGO, build a *representation* of yourself as a member of this team. Please consider the following aspects. (10 minutes)
   - Areas of expertise and strengths
   - Skills that you think need improvement
   - What else can you offer to the group for creating a better team climate and improving team performance?

   Why LEGO??? Simpler to speak about a representation than about yourself… especially for critical subjects

Team building: Tangible Activity- Part A

2. Share your LEGO model and engage in a brief discussion. Please note the following steps. (16 minutes)

- Each team member present and share their models (1 minute)
- Other students in the team ask questions, one for each, and the presenter responds. (3 minutes)
- Repeat the process for all members.

Team building: Tangible Activity- Part B

Using mixed LEGO pieces, now create a group representation of what your team looks like. Build one agreed model which is representative of your team. What makes your team unique. Please address the following aspects. (15 minutes)

- Team goals
- Provisional roles
- Safe and open environment for team learning, i.e., activities by which you share, refine, or combine task-relevant knowledge through interaction with one another.
- Potential risks and uncertainties you envision.

Team meeting points