# LCAV - Audiovisual Communications Laboratory Semester projects 2019, Fall semester Project description and planning

1. Project Description

This section is filled in by the project supervisor.

**1.1. Title:**

Learning-based multi-modal indoor localization

**1.2. Description (around half a page):**

Due to their aptitude in capturing complex dependencies, neural networks are a promising candidate for indoor localization. Omnipresent phenomena such as multi-path signal propagation, shadowing and device noise introduce non-linear effects in the data, and make conventional geometry-based methods fail even in simple environments.

We would like to create a neural network which is flexible to include any subset of available measurement modalities, thus the name “multi-modal”, and outputs a viable estimate of the user’s position in a room or corridor. Commonly used signals include WiFi (time of flight and/or signal strength), Bluetooth (signal strength and/or angle of arrival), images and audio, just to name a few.

The scope of this semester project is to investigate proposed solutions for indoor localization using machine learning, to develop a machine learning framework for indoor localization using PyTorch or tensorflow from scratch, and to validate the proposed framework on real and simulated data.

**1.3. Type of Work (e.g., theory, programming):**

Literature review / background reading (20%), programming in pytorch (50%), validation (30%)

**1.4. Prerequisites (e.g., signal processing for communications, C++):**

Basic knowledge of machine learning

**1.5. Supervisor:**

Frederike Dümbgen, Sepand Kashani

2. Student Information

This section is filled in by the student.

**2.1. Name:** Pedro Torres Da Cunha

**2.2. E-mail:** pedro.torresdacunha@epfl.ch

**2.3. School (e.g., I&C, STI):** IC

**2.4. Program (Comm. Sys., Comp. Science):** Data Science

**2.5. Cycle (B.Sc./M.Sc./EDIC):** M.Sc

**2.6. Semester (1, 2, 3, ...):** 3

3. Project Planning

This part is filled in by the student with the help (and the agreement) of his/her supervisor. It should be completed before the end of the 2nd week (hard deadline on Friday the 27th of September) and sent to the responsible person (adam.scholefield@epfl.ch). After the submission of the plan, a modification is still possible, but it should be motivated at the midterm or the final presentation.

**3.1. Deliverables:**

Explain in a few sentences the expected concrete outcome of the project (e.g., a C program that removes red eyes, a python simulation of sound propagation in a room, a subjective test on N persons of an algorithm).

A pytorch model that is able to predict indoor localization with as much accuracy as possible. The model would take as input any subset from a multitude of signals and output a (x, y(, z)) position estimate. It should work on simulated and real-world data. Basic and more advanced neural network architectures will be tested and evaluated while seeking for the best possible results.

**3.2. Timeline:**

Explain shortly (in a few sentences) what you plan to achieve for every week of the project in order to reach the final goal described in the previous section. Please remind that the students are supposed to spend 30 hours to prepare the required background before the beginning of the semester (e.g., reading papers, revising Matlab/C). The amount of work during the semester should correspond to 12 hours per week. After the end of the semester, 30 extra hours should be spent to complete report and presentation.

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| **Week of** | **Planned Work** |
| 16/09 | - Establish the project goals  - Schedule the plan for the semester |
| 23/09 | - Research on the subject, find adapted solutions to the problem  - Schedule the plan for the semester |
| Project description and planning is due on Friday the 27th of September. | |
| 30/09 | - Test basic neural network architectures  - Establish the general pipeline (training and evaluation procedures) |
| 07/10 | - Implement and evaluate recurrent neural network solution |
| 14/10 | - Implement and evaluate recurrent neural network solution |
| 21/10 | - Make it robust to the multi-modal setup:  → Handle the case when modalities are missing  → Modify the network to better suit the problem |
| 28/10 | - Make robust statistics/comparisons and prepare visualizations of the results so far |
| Midterm presentation. | |
| 04/11 | - Try more advanced/modern neural network sequence solutions: Long Short-Term Memory (LSTM) |
| 11/11 | - Try more advanced/modern neural network sequence solutions: Long Short-Term Memory (LSTM) |
| 18/11 | - Try more advanced/modern neural network sequence solutions: Gated Recurrent Unit (GRU) |
| 25/11 | - Try more advanced/modern neural network sequence solutions: Gated Recurrent Unit (GRU) |
| 02/12 | - Try more advanced/modern neural network sequence solutions: Temporal convolutional network (TCL) |
| 09/12 | - Try more advanced/modern neural network sequence solutions: Temporal convolutional network (TCL) |
| 16/12 | - Try more advanced/modern neural network sequence solutions: ??? |
| 10/01/20 | Final report submitted to lab. |
| Final presentation. | |
| 27/01/20 | Final grade is due at registar. |