

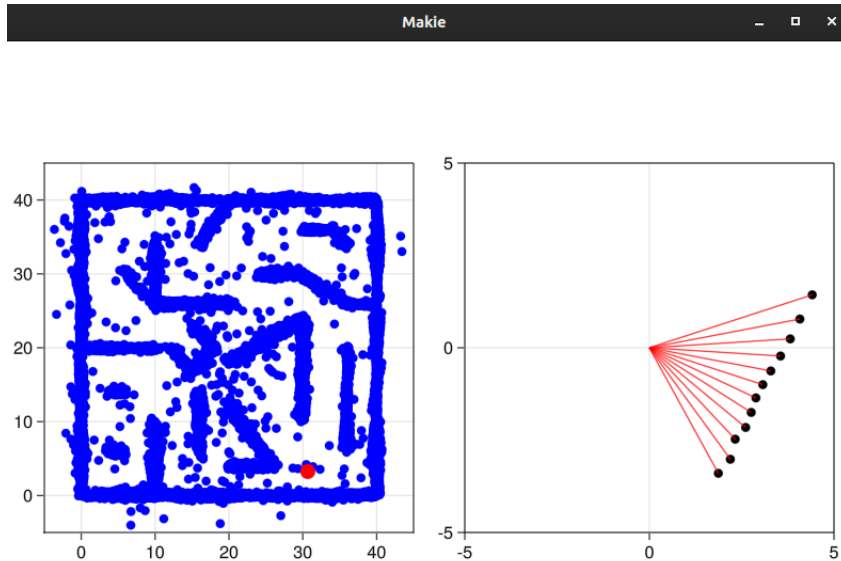
# HW3 Report

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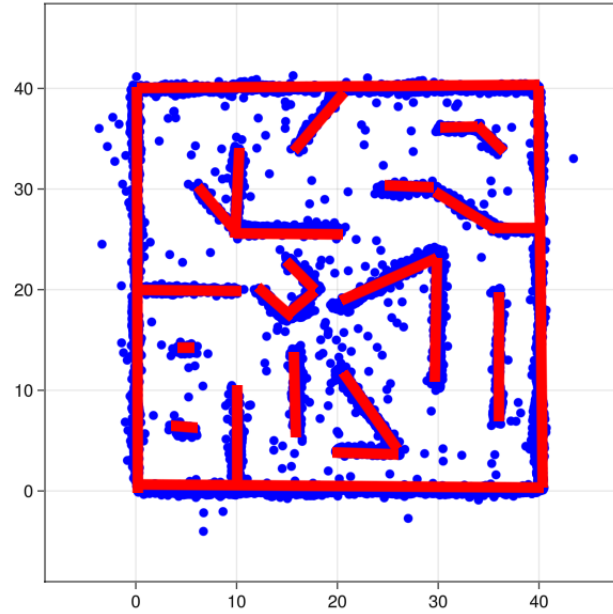
In order to run the Iterative closest point (ICP) process one should instantiate and run the following command to get started:

- `pkg instantiate` :- This instantiates all the packages inside the Julia project.
- using `Revise HW3` :- Compiles HW3 and Revise packages to be run.
- `manual.collection()` :- This function runs the Makie app which allows user to drive the vehicle around the map and obtain lidar-based data. At the end of mapping the entire map, the manually generated map looks like the following:

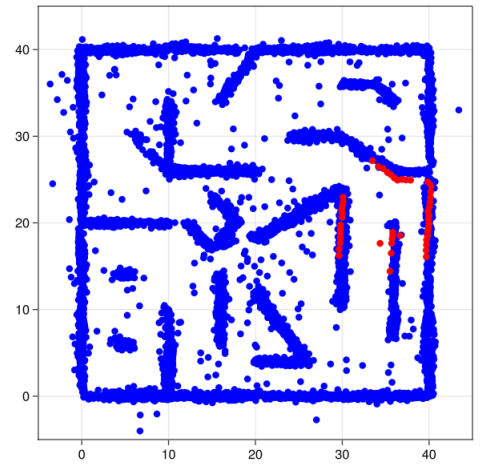
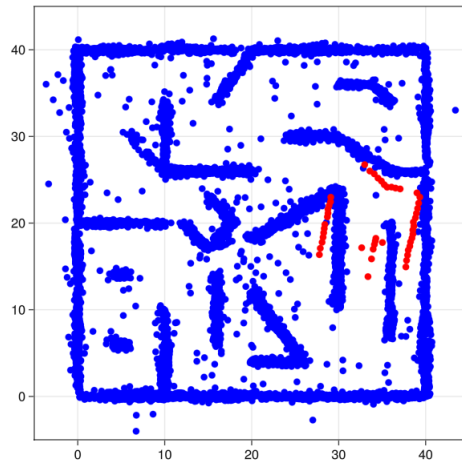


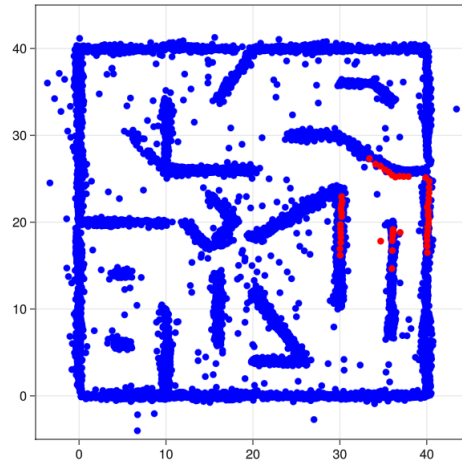
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- `label_generated_map()`:- This function runs the Makie to manually draw over the generated map retrieved from previous function (i.e., `manual.collection()`).

After calling the `label_generated_map` one can draw a line over the blue cloud points and achieve manually labelled semantic layer as shown in the figure below:



Once the ICP algorithm is implemented, it can be tested using the running `HW3.test_ICP(;visualization=true)`. Once ICP is iteratively tested, it will take one of the few point cloud and try to match it to the manually generated point cloud as shown in the following figures:





Sometimes ICP algorithm doesn't seem to provide a good alignment of point clouds. The reason behind ICP failures may be error in initial alignment since it requires a very good initial estimate of the transformation between the two point clouds to the correct alignment. If the initial alignment is far from correct, ICP may converge to a local minimum that is not the desired alignment. Another reason might be noise. ICP is very sensitive to noise in the point clouds, which can lead to incorrect correspondence between points and cause the algorithm to converge to an incorrect alignment.

To address some of the failures while using ICP, more advanced ICP algorithm should be used. For instance, a robust error metric ICP that is less sensitive to outliers, or use heuristics to estimate a better initial alignment.