Machine Learning to the Rescue
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Workshop Goals

- Instruct how to use the MATLAB® Statistics and Machine Learning Toolbox™ through interactive applications to analyze and model disaster scenario data for developing more elaborated rescue decision-making algorithms.
- Demonstrate how to incorporate state-of-the-art machine learning algorithms into RoboCup Rescue competition code using the MATLAB® Engine API for Java.

Supervised Learning

Analysis of the disaster scenario could be used to learn associations between observable variables and hidden variables (part of a causal model of the world).
- Firefighters can optimize their decisions by estimating buildings’ danger of fire ignition (discrete state – classification).
- Ambulances can optimize their rescue operations by predicting more accurately the chance of potential victims to survive (continues state – regression).

Pre-Compute

Before the actual run, an agent of each type can do map reconnaissance. In this phase, agents can precompute the paths and segment the map into sectors.
- Path Planning with MATLAB®:
  - Shortest-path algorithms based on breadth-first, Dijkstra or A* [1].
  - The agents receive the possible path sorted on distance.
  - During the competition each agent can modify the unobstructed distances in its own copy of the graph based on observed or cleared blockades.
- RoboCup teams may divide the work of the agents over different sectors of the map [2].

Results

In Statistics and Machine Learning Toolbox™, data can be preprocessed with dimensionality reduction methods like principal component analysis (PCA) or singular-value decomposition (SVD), followed by classification methods, or linear/non-linear regression methods.

- In the regression, when the remaining hit points (HP) at the end of the scenario is estimated with the Gaussian Process Regression [4] the remaining root mean square error (RMSE) is the lowest, i.e., RMSE 1346.
- The best classification is estimated with the Ensemble Bagged Trees with PCA enabled and component reduction criterion set to 2 specific components out of 4, achieving accuracy of 75.5%.

Conclusion

By giving a workshop to the RoboCup teams on how to separate machine learning algorithms from the actual code to control the agents / robots, teams can concentrate on the learning aspect.

The algorithms implemented in the workshop are examples of common challenges in this competition, but the approach should extend to any algorithm available/developed in MATLAB®.

References