EDAN70/90: Project in Computer Science
Theme: Intelligent Systems

RSS group and friends

Dept. of Computer Science, Lund University, Sweden

March 21st, 2022

Plan for today

- Administrative stuff
- Projects, groups
- Planning for the rest of the term

Projects

- Define a study topic and an application in AI, machine learning, language processing or intelligent robotics.
- You may define them yourself or with the help of the instructor.
- Survey the relevant literature
- Define an implementation strategy and select algorithms
- Implement a prototype
- Evaluate it
- Write a project report
- Submit paper to a conference (optional). No guaranteed funding for conference fees and travel though.

About the course

- EDAN70: Project in Computer Science
  Theme: Intelligent Systems
- also EDAN90: Advanced Project in Computer Science
- `http://cs.lth.se/EDAN70`
- `http://cs.lth.se/EDAN70/projects-in-artificial-intelligence/`
- Serves as an announcement board as well!
- Teachers: We will see...
- Administrator: Ulrika Templing (expedition@cs.lth.se)

Contents

- 7,5 hp (ECTS)
- Grading: UG scale (pass/fail)
- Time span: 21/3–25/5–8/6
- Scheduled meetings: 2 (intro now and final presentation on 25th May)
- Supervision every week
- Home reading (textbook, papers, web, ...) and lab/home work
- You are assumed to have
  - AI background
  - programming experience

Evaluation

- Project performance: evaluated by the supervisor
- Result (code): evaluated by the supervisor (preferably in @git.cs.lth.se)
- Presentation during the last week
- Reports (to be filed in not later than 8th June, Wednesday).

End of the admin stuff

Questions? Comments?

Next: presentations of project proposals by potential supervisors.

Project Proposals (AH)

Identification of activation status of microglial cells using object classification

Microglial cells are part of the brains immune system. These cells change morphology/shape when they go from a resting to an activated state. We have recently developed an AI based algorithm to quantify these cells and the main part of the work would be to train the model to distinguish activated from resting cells using object classification.

Movement tracking in preclinical models of neurodegenerative diseases

Behavioural analysis of preclinical animal models of neurodegenerative diseases are imperative in order to develop and assess novel therapeutic interventions. These tests are quite labour and time intensive. Here we aim to track and score the movement of animals whilst they undergo different behavioural tasks.

AndréLab

Protein shape similary score

The shape of a protein is critical to its function and plays an essential role in drug discovery. By finding similarities in shape between proteins, scientists can infer function and relationships between proteins. Since the available protein dataset is increasing significantly every year, it is necessary to find a method that allows rapid scanning to retrieve those similar proteins given a desired target. Therefore, we propose a method in which an ANN model receives one “target” and one “candidate” protein 3D shape, and predicts a “similarity score” between the two. By this way, given a desired shape, we could quickly scan the available dataset of protein structures (up to 500,000) and rank them based on the predicted score. The developed program will be part of a pipeline for design of new proteins.

Autonomous Driving Systems

Evaluation of algorithms for generating critical scenarios for autonomous driving systems

Testing is essential to verify the safety and reliability of autonomous driving systems, yet identifying effective test scenarios for such systems is notoriously tricky, especially the critical scenarios that may cause a collision or near-collision consequences or situations. Recent research studies have explored many different algorithms in generating critical scenarios for testing autonomous driving systems, yet no such comparative studies have been conducted to evaluate the algorithms regarding their efficiency and effectiveness. In this project, we aim to evaluate the performance of different algorithms in generating critical scenarios and we do this in multiple steps:

Autonomous Driving Systems

1). explore and select an open-source project (e.g., from GitHub) that provides autonomous driving features, 2). explore and select a free, open-source simulator (e.g., CARLA) that runs the autonomous driving system from the previous step, 3). explore and identify typical algorithms (e.g., Bayesian, Genetic algorithm) for generating critical scenarios based on existing literature, 4). establish a reliable way (e.g., use tool modeFrontier) to run and compare how different algorithms perform in generating critical scenarios, and 5). report the evaluation results, and make observations and analyses of them.

Construction Robotics (MK)

Digital wall assessment of repointing needs

Robotics (MM, AD)

- Anomaly detection
- Safety constraints for RL
- RL bench
- Kinesthetic teaching
- Planners PDD, Temporal Planning, Logic Reasoning
- Reactive Planning with BTs

Roobotic Skill Knowledge Bases (JM)

1. Robot skill knowledge base (secure access, storage of big files, manipulation, plug-in reasoners) using triple store RDF4J (or some other SPARQL-enabled graph database of choice);
2. Graphical robot programming tool;
3.
4. Geometrical relations in the robot workspace (vocabulary, identification, planning, extraction from CAD files);
5. Reasoning about two-handed manipulation (parcel wrapping);
6. Knowledge base editing/visualisation (RDF4J, JavaScript, ???)