ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΕΙΡΑΙΩΣ
UNIVERSITY OF PIRAEUS

ΔΗΜΟΚΡΙΤΟΣ
DEMOKRITOS

Προτεινόμενα Θέματα Διπλωματικής Εργασίας

Από

Καθηγητή Γεώργιο Βούρο

A. Visualizations for explaining policies in human-agent collaborative settings

Abstract:

Interpretability (i.e. the provision of explanation content) and explainability (i.e. rendering this content using any – visual, textual etc – modalities) in deep reinforcement learning (drl) is a major challenge of great interest due to the need for agents to become accountable, trustable and collaborative. There are numerous techniques for interpretability / explainability of drl policies, although the field is still in its infancy.

This thesis aims at implementing and testing explainability and interpretability methods for drl in human-agent collaborative settings, using visual means.
The student must implement appropriate visualizations that will render explanation content as it is provided by specific methods explaining agents' actions and goals.

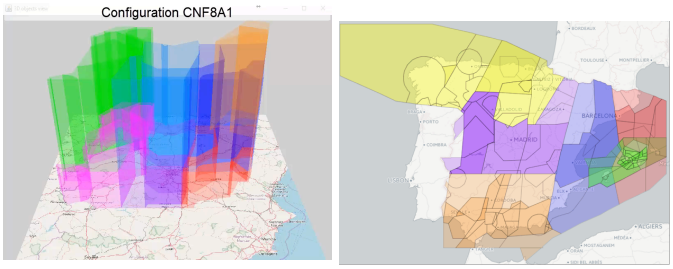
The contents include:

- Study of specific interpretability techniques for drl
- Implement explainable drl methods
- Design and implement visualizations for rendering explainability content in collaborative settings
- Test and evaluate the whole thing with human subjects.

We aim at high innovation which should result in an article publication.

B. Airspace Configuration Prediction

Abstract:



Sectorizations in Spnish airspace: Figures provided by VA group in IAIS Fraunhofer

This thesis aims at developing imitation learning methods for learning the course of active airspace configurations using predicted traffic conditions. Airspace configurations, as the figures in the left side show for the Spanish airspace, are specific segregations of the airspace, in sectors. Each sector is controlled by two humans (Air Traffic Controllers). This segregation is done for effective air traffic control and safety reasons. However, the segregation active at each time point depends on the traffic conditions (while 9 or 10 sectors may be active for Spain during the day, only one active sector may suffice during the night). The prediction of these active configurations is a major problem in the aviation domain, mainly for airlines' interest[1]. In this thesis we will explore solving this prediction problem using deep reinforcement learning - imitation learning techniques, which are highly promising in making predictions in high-dimensional state-action spaces.
The contents include:

- Study of specific imitation learning techniques.
- Implement imitation learning methods.
- Study data regarding airspace configurations and develop methods to extract features.
- Test and evaluate imitation learning methods for predicting airspace configurations.

We aim at high innovation which should result in an article publication.

[1] Y. Xu, X. Prats and D. Delahaye, "Synchronization of Traffic Flow and Sector Opening for Collaborative Demand and Capacity Balancing," 2018 IEEE/AIAA 37th Digital Avionics Systems Conference (DASC), London, 2018, pp. 1-10.

Γ. Predicting Human Behaviour
(σε συνεργασία με την κ.Μ.Δαγιόγλου)

Abstract:

As noted in the Directed Info-GAIL paper[2] "the use of imitation learning to learn a single policy for a complex task that has multiple modes or hierarchical structure can be challenging". This thesis will explore the use of directed info-GAIL algorithm, which is based on the generative adversarial imitation learning framework to model human behaviour and predict subsequent behaviour. This will be done through learning sub-task policies from unsegmented demonstrations of tasks.

The contents include:

- Study of specific imitation learning techniques.
- Implement imitation learning methods.
- Study data regarding human behaviour in specific settings and develop methods to extract features.
- Test and evaluate imitation learning methods for predicting human behaviour.

We aim at high innovation which should result in an article publication.

Δ. Explainable Deep Reinforcement Learning

(σε συνεργασία με την κ.Μ.Δαγιόγλου)

Abstract:

Interpretability (i.e. the provision of explanation content) and explainability (i.e. rendering this content using any – visual, textual etc – modalities) in deep reinforcement learning (drl) is a major challenge of great interest due to the need for agents to become accountable, trustable and collaborative. There are numerous techniques for interpretability / explainability of drl policies, although the field is still in its infancy.

This thesis aims to investigate the use of decision tree methods for inherently interpretable Q-Learning.

The contents include:

- Study of decision tree methods and drl methods.
- Design and implement the use of decision tree methods for interpretable drl.
- Test and evaluate the developed method in real-world settings for predicting behaviour/ trajectories.

We aim at high innovation which should result in an article publication.

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[2] Arjun Sharma∗ , Mohit Sharma∗ , Nicholas Rhinehart, Kris M. Kitani, "DIRECTED-INFO GAIL: LEARNING HIERARCHICAL POLICIES FROM UNSEGMENTED DEMONSTRATIONS USING DIRECTED INFORMATION", arXiv:1810.01266v2 [cs.LG] 12 Mar 2019