Internship proposal: Automated Game Testing through Novelty Search and Quality Diversity, application to Space Engineers

Overview

- **Supervisors:** Stéphane DONCIEUX, Alexandre CONINX, Achkan SALEHI (ISIR AMAC Team)
- **Duration:** 6 months

Topic description

Industrial Need

The increasing complexity of modern video games has made Game Testing (GT) an essential component of the game development process. Currently, GT relies on intensive human labor, which results in high financial costs for game companies. This is mainly due to two factors. First, human testing is slow, and second, the discovery of complex/rare bugs requires creative gameplay that might not necessarily occur to developers and testers. Given these issues, automation of GT seems desirable.

The algorithmic and software tools developed during this internship will help in GT automation of Space Engineers [1], which has sold more than 3.5 million copies [2] as of this writing.

Internship goals and roadmap

Using the usual Reinforcement Learning terminology, we will define a game-playing agent as a policy function mapping game states (*e.g.* as given by the game's internal state, or RGB image sequences) to actions. The aim is to find policies that exhibit interesting behaviors in terms of GT, for example, policies that lead to a software crash, or to a state where the player's progress becomes inhibited by faulty game logic.

Creative exploration of diverse policy behaviors can be done through divergent exploration methods such as Novelty Search (NS) [7], which can help achieve a uniform coverage of the behavior descriptor space if the latter is bounded [6]. Furthermore, given some undesirable game state s_i, Quality/Diversity (QD) [3] methods can be leveraged to construct and maintain an archive $\mathcal{A}_i$ of diverse agents whose execution results in s_i.

The current roadmap for the intership is as follows:

1. Experiment with simple, navigation-only related actions and low-dimensional, trajectory based behavior descriptors in static environments.
2. Use the previously acquired policies to construct more complex actions [5] in order to build more complex behaviors, and design/learn more sophisticated behavior descriptor spaces [4] that capture plausible player behaviors.
3. Optionally, work on generalising the developed tools to dynamic environments.

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Candidate profile

The candidate should have a strong interest in machine learning and be enrolled in a MSc or engineering school program in computer science, machine learning or related fields. Familiarity with evolutionary methods is a plus. Good development skills and proficiency in Python are expected. Good development skills in C++ is appreciated. The project will require working in close cooperation with several researchers and engineers and requires good teamwork abilities. A working knowledge of English is required; knowledge of French is appreciated but not necessary.

How to apply

Send an e-mail to `stephane.doncieux@sorbonne-universite.fr`, `alexandre.coninx@sorbonne-universite.fr` and `salehi@isir.upmc.fr` with [Game test automation] in the topic along with a CV and motivation letter.

References

[1] `https://store.steampowered.com/app/244850/Space_Engineers/`.

[2] `https://en.wikipedia.org/wiki/Space_Engineers`.

[3] A. Cully and Y. Demiris. Quality and diversity optimization: A unifying modular framework. *IEEE Transactions on Evolutionary Computation*, 22(2):245–259, 2017.

[4] A. Cully and Y. Demiris. Hierarchical behavioral repertoires with unsupervised descriptors. In *Proceedings of the Genetic and Evolutionary Computation Conference*, pages 69–76, 2018.

[5] S. Doncieux, D. Filliat, N. Díaz-Rodríguez, T. Hospedales, R. Duro, A. Coninx, D. M. Roijers, B. Girard, N. Perrin, and O. Sigaud. Open-ended learning: a conceptual framework based on representational redescription. *Frontiers in neurorobotics*, 12:59, 2018.

[6] S. Doncieux, A. Laflaquière, and A. Coninx. Novelty search: a theoretical perspective. In *Proceedings of the Genetic and Evolutionary Computation Conference*, pages 99–106, 2019.

[7] J. Lehman and K. O. Stanley. Abandoning objectives: Evolution through the search for novelty alone. *Evolutionary computation*, 19(2):189–223, 2011.

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