Assignment AE4350

In the course AE4350 on bio-inspired intelligence for aerospace applications, we introduce various bio-inspired algorithms in the lectures. The goal of the assignment is that students implement their own bio-inspired intelligence algorithm on a task they propose.

What type of task can be studied in the assignment?

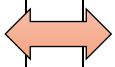
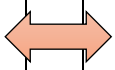
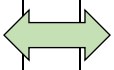
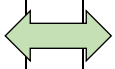
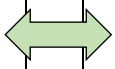
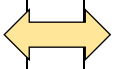
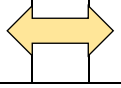
The following table shows per main topic some guidelines about the type of task that can be studied.

Reinforcement learning	Evolutionary Robotics	Insect (swarm) intelligence	Spiking neural networks	Physical interaction
Control of (simulated) (electro) mechanical systems: aerospace, robotics, automotive, etc.	Control of (simulated) (electro) mechanical systems: aerospace, robotics, automotive, etc.	Any swarming task in which a (preferably large) number of agents / robots perceives and acts locally, or a single agent task relevant to robots and insects (navigation, …)	Exploration / investigation of SNN learning / encoding / decoding / adaptation algorithms	Learning or design the control of a robot or robot arm that interacts with its environment.
Any type of game where a player (agent) interacts with the environment: Cardgame, boardgame, computer game etc.	Any type of game where a player (agent) interacts with the environment: computer / card / board game etc.	Make a combination with a learning method like ER	Tasks like classification, regression, ER, RL, navigation…	A combination of (automatically) designing a body and a controller for interaction with the environment.
Agent-based optimization of processes: scheduling, path planning, etc.	Agent-based optimization of processes: scheduling, path planning, etc.	Tasks like formation flight, foraging, construction, exploration, coverage, ...	Work with event-based datasets or encode traditional datasets in a spiking manner	Learning control for a robot that has compliance, comparing it with a rigid setup.

Students need to propose a task to the teachers (including "AE4350 assignment" in the mail's subject) and need a positive response before actually starting to work on them. We expect the students to first attend the lectures and make the exercises *before* choosing a task. However, the topic needs to be defined maximally two weeks after the last lecture. The "product" of the assignment is a report of maximally 10 pages (in TU Delft report style) together with a link to code on github (preferably public, but in case it is private, invite the teachers to the repo). The **deadline for the assignment report is August 31, 2023**, and the assignment has to be **handed in on Brightspace**.

What should the report be like?

The report should contain an introduction to the topic, with adequate references from the literature. For clarity: The methods studied in the assignment do not necessarily have to be novel with respect to the literature, although this is also not discouraged. The method followed by the student should be described, together with the results, and how those results depend on parameters of the algorithm. It is highly appreciated if the solution found by learning methods is analyzed to some extent. The rubric below is our guideline for assessing the assignment report.

	Sub-par (<=5)		**Excellent (9-10)**
Complexity of the method	Only 2-3 parameters		State-of-the-art method, continuous, high-dimensional problem
Environment / application complexity	Low number of states and actions, small dataset, few learning "runs"		Continuous, high-dimensional problem, real-world problems
Scientific reporting	Many elements missing (no references, no introduction, etc.), bad English, unreadable labels / captions / figures		All elements as required in a scientific report are present, incl. introduction of abbreviations, symbols, frames of reference, solid referencing to the literature, placing the work in context, etc.
Description of the method	Missing, basic elements unclear		Clear description, easily reproducible, all variables and parameters explained, open source code
Description of the results	Unclear, missing legends, axis labels, etc.		Very clear, informative graphs, descriptions, broader interpretation of the results, including statistics on multiple runs (uncertainty)
Sensitivity analysis	Just a single result, no sensitivity analysis		Varying multiple parameters in a sensible way, giving insight into the most vital parts of the learning process
Analysis of the found solution(s)	No analysis is performed of what the learning method has found		Profound analysis of the solution found by learning, clear explanation of the learned strategy

Each category (color) weighs equally in the determination of the grade.

Checklist report:

- Is it handed in on time? (before or on August 31)
- Does the report contain a link to github? If private, were teachers invited to the repo?
- Does the report have the elements in the rubric mentioned above?