# Evolving Neural Networks

15-48 EC masters' thesis project

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| For: | Master Students that know how to program - and are interested.<br>If you've ever done a course in heuristics, it is a pre. |
| Load: | 15 - 48 EC, depending on blocks (see below) |
| Period (approx.): | From September 2021 onward |
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| Introduction video: | https://bit.ly/3DWGFrG |

**About the project**

Weight-agnostic neural networks (WANNs) are networks with fixed weights, capable of performing tasks such as bipedal movement and race car driving [1][2]. These networks don't learn by themselves, but evolve thei neural structure, and that's exactly what we will do, but better (hopefully). Or at least learn something useful in the process.

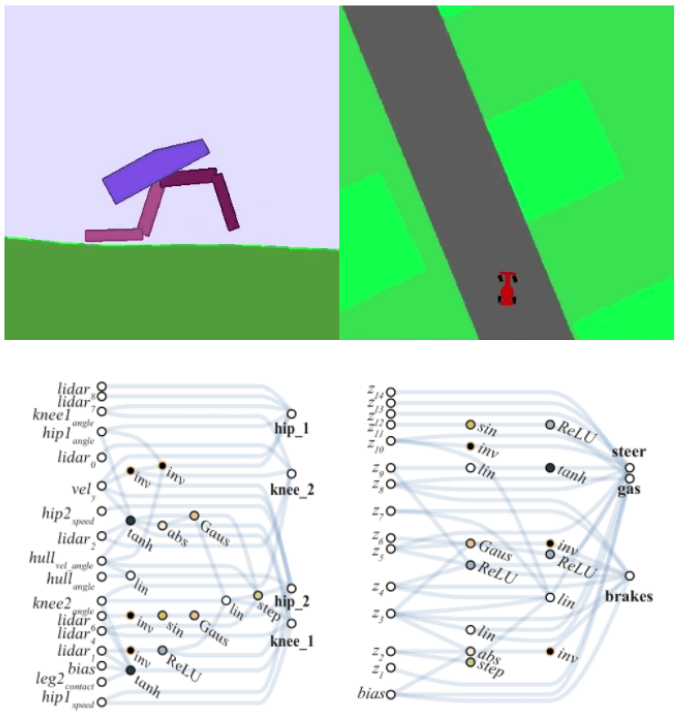


*Figure 1 Two weight-agnostic neural networks which have evolved to their task of bipedal movement and racecar driving. (source:[1]).*

The authors provide a very nice interactive online paper, as well as an arXiv-publication, which is possibly not peer reviewed, and a NeurIPS-publication. The goal of this project is rather conservative to make it succeed, but can still give some spectacular results.

Each block is about 15-18 EC's worth. You can choose blocks to your liking, though there is a strong recommendation for doing Block #1 first. Generally, we can adapt blocks as we go along, but once a block is finished, we're not going back, only forward.

**Block #1**
Choose one of the tasks of Gaier&Ha, and try to replicate their research up to the point that an evolved WANN can either perform the task with significantly improving accuracy through evolution, or conclude that replication is not possible. In the second case, we'll propabaly have to find out why, and none of the future blocks could be applicable. In that case we'll make new plans to keep your project managable and succesful.

**Block #2**
Let's try some new algorithms. How about the Plant Propagation Algorithm, or Simulated Annealing [3]-[8]? Other algorithms are also thinkable.

**Block #3**
Let's try a different task than the original ones. A very simple game, a pac-man simulation or an optimization problem such as traveling salesman, or rectangle packing.

**Block #4**
If we evolve very often for some task, how similar are the network structures we find? Also, if we restrict certain nodes or certain connective properties, does the network still evolve to a well performing entity? How well, and how structurally similar are the results?

**References**

[1] https://weightagnostic.github.io/

[2] Gaier, Adam, and David Ha. "Weight agnostic neural networks." arXiv preprint arXiv:1906.04358 (2019).

[3] https://bit.ly/3r2fc1D

[4] https://bit.ly/36qLTMQ

[5] https://bit.ly/3e4b4Jg

[6] https://bit.ly/36qNXEr

[7] https://bit.ly/3jH1Eqe

[8] https://bit.ly/3yHtF5A