EVOLUTIONARY MULTI-ACTIONS UTILITYAI USING BÉZIER CURVES FOR RACING GAMES

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PROBLEM

After one year of development for our game KartMania, a 3D racing game, we felt the need to add some challenge for the players. The best way was to add an AI the player could race against. However, since we expect to let the players create their own circuits, share them and play on the circuits created by the community, we couldn't rely on classical neural network like a MLP. Indeed, allowing the player such creative possibilities, would mean that we would need a huge dataset in order to train our AI to run smoothly on every level created. Moreover, a MLP is quite opaque and doesn't allow for manual tweakings for the development team.

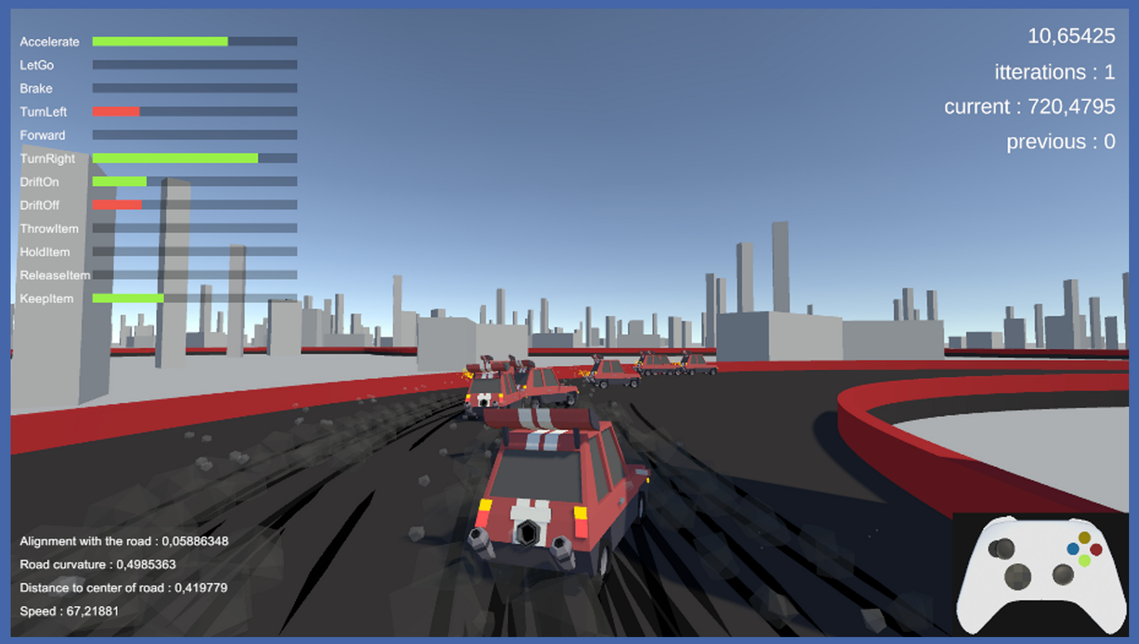
METHOD

We wanted to address this problem with an innovative approach. That's why we decided to focus our research around UtilityAI, analgorithm used to choose actions based on its utility. Its main advantage is that it can be edited easily by a someone and its parameters can be understood, unlike the weights of a neuron

vantage is that as it is a simpler structure, on the runtime, UtilityAI tends to be faster to compute when it is well optimised. However, we needed to be able to select multiple actions at the same time (i.e accelerating, drifting and turning right), therefore, we've modified the algorithm's structure in order for it to handle that. In addition, as a complex UtilityAI algorithm can require quite a lot of parameters, we've used a evolutionary algorithm to tweak them for us after setting it manually for the first time.

RESULTS

As a result, our algorithm produces an efficient racing AI capable of driving on any race track without having learned it before. Likewise, as UtilityAI is modular, if we want to include more behaviours like throwing an item, the structure allows us to do so without breaking the already trained AI and without the need to retrain from scratch.



THANKS TO OUR MODIFIED UTILITYAI ALGORITHM THAT CAN HANDLE MULTIPLE ACTIONS AND AN EVOLUTIONARY ALGORITHM, WE'VE MANAGED TO CREATE A CHALENGING AI THAT CAN ADAPT TO ANY SITUATION.

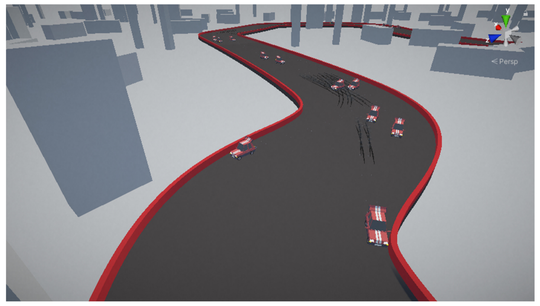


FIGURE 1 : MULTIPLE KARTS RACING DURING TRAINING OF THE AI.

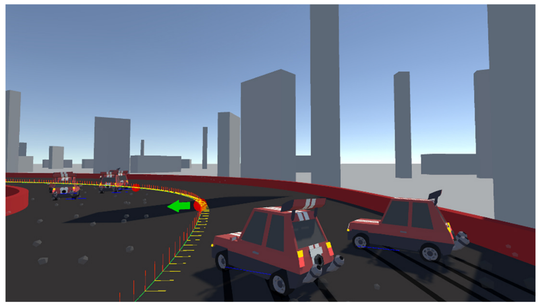


FIGURE 2 : THE TWO PROJECTED POSITIONS ON THE BÉZIER CURVE USED MEASURE THE CURVATURE OF THE ROAD INFRONT OF THE CAR.

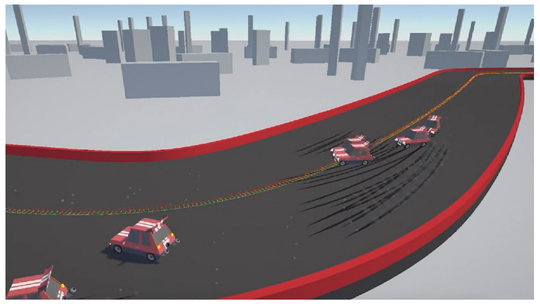


FIGURE 3 : THE AI LEARNED HOW TO DRIFT PROPERLY.

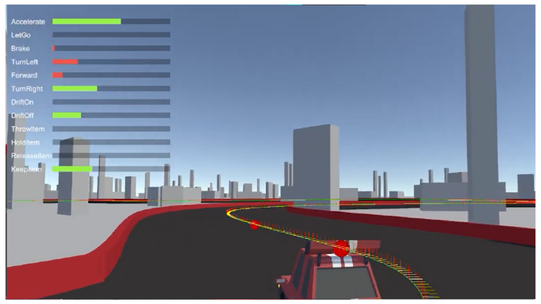


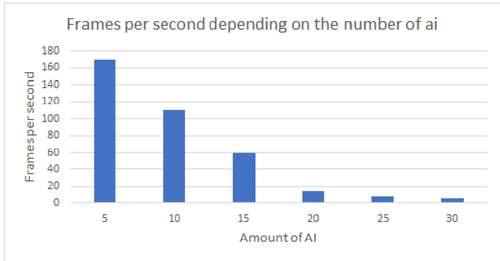
FIGURE 4 : ON THE TOP LEFT CORNER, YOU CAN SEE THAT THE AI IS PERFORMING MULTIPLE ACTIONS EACH FRAME.

OUR APPROACH

- Uses UtilityAI for smart action selection
- Altered UtilityAI's structure to choose multiple actions at once.
- It combines UtilityAI and evolutionary algorithm to get good results faster than a MLP
- It uses the power of bezier curves to get accurate measurements of the circuit.
- As it is modular, it allows to add new behaviour easily, without needing to retrain everything.

IMPROVEMENTS

- Add other parameters in the genome to improve its behaviour.
- Curently, our IA try to follow the center of the road as much as possible. An improvement would be to try to stay on the apex of the turn to have a better lap time.
- Using the Jobs System and Burst Compiler provided by Unity for our data computations. This would allow us to simulate faster but also with a bigger population. As you can see on the graph behind, our performances are quite acceptable but our final goal would be to run 20 AIs at 60fps and 15 AIs at 160fps.



RELATED WORKS

- Utility AI Theory :
[1] NORSTAD, John. An introduction to utility theory. Unpublished manuscript at http://homepage. mac. com/j. norstad, 1999.
- Other models of car AI :
[2] WANG, Jung-Ying et LIN, Yong-Bin. Game ai: Simulating car racing game by applying pathfinding algorithms. International Journal of Machine Learning and Computing, 2012, vol. 2, no 1, p. 13.
[3] CHILD, C. H. T. et TRUSLER, B. P. Implementing Racing AI using Q-Learning and Steering Behaviours. In : 15th International Conference on Intelligent Games and Simulation. 2014.

OUR VIDEO!