CT6GAMAI - Report

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# Introduction

Racing simulations in games are AD-HOC systems which simulate real life drivers based on factors created by the programming team such as personality, vehicle type, race track and more. These features are the primary focus of a development team when creating a single player racing game.

The problem this project focused on was creating a racing game where AD-HOC where Artificial Intelligence would race each other around a circuit and consider strategy based on their personality. The main problems would be steering behaviours, state machines and pathfinding.

Creating realistic Artificial Intelligence for racing games is important, you want the Artificial Intelligence to be able to race each other but in a fair manner on the player and themselves. The Artificial Intelligence that is raced against can either make or break a game.

Forza Horizon 4 (Turn 10 Studios, Playground Games, 2018) and F1 2019 (Codemasters, Swordfish Studios, 2019) are two of the most popular and state of the art racing games both having advanced racing Artificial Intelligence which can be considered to be state of the art. Forza Horizon 4 (Turn 10 Studios, Playground Games, 2018) even has a system in place where the driver profiles are built using a Learning Artificial Intelligence system.

Both of these games are considered to be state of the art as they successfully implement fun and challenging Artificial Intelligence system within their games which can react to the best of players and can be modified by the players within menus.

For my project I focused on getting the Artificial Intelligence to go around the track and be able to pit when they need fuel based on desires. With the 3 main systems being Steering Behaviours, Pathfinding and State Machines.

My project is a top down racing game which has pre-set roads or tiles that can be placed down to create a track.

# Analysis

## Pathfinding

Pathfinding can be done in multiple algorithms each used for different systems. These are Breadth First Search, Depth First Search, Dijkstra’s algorithm and A\*

For the pathfinding I decided to implement the A\* Search algorithm (Nillson, Hart, & Raphael). I choose this technique as it is the quickest way to search a graph speeding up Dijkstra’s algorithm (Buckland, 2004). It is also the standard within video games being the most optimal technique currently.

I choose to use this technique as it was a quick way to get the AI to find their way across the track and made them behave in a more realistic way choosing the optimal path to race on and worked on any track.

I implemented this in by having the AI ray cast down and get their source node, they would then get the next checkpoint they wanted to go to and ray cast to get the target node. From there the algorithm would search and find a route and return it. I abstracted the ASTAR method so that I couldn’t break the implementation and would only need to hand in the source and target node for it and it would be able to search my given graph. My implementation of A\* was inspired by the implementation in Programming Game AI by example (Buckland, 2004) and I adapted the systems from this book and modified it to work within my parameters and code

The Nav graph was generated by creating a grid, this grid was set by an area e.g. 100 x 100. The nodes would be placed, they would then be given a “Selector” which would look above it and see if there are any roads, if there isn’t it deletes its self, if there is it checks for an obstacle or wall on the road, if there is either of these obstacle’s it deletes its self. This implementation of the Nav Graph saves unnecessary checking for walkable tiles and instead only checking the tiles it can walk on and decreases the run time.

## Steering Behaviours

Steering behaviours are techniques to control the AIs movement in certain conditions. Techniques can include obstacle avoidance, wall avoidance, evade, seek, join, flock, wander and more.

These techniques calculate a velocity which is added to a velocity sum and returned to the AI. In a racing game these behaviours were crucial to get correct otherwise the

## State Machines

# Reflection

# Conclusion

# References

Turn 10 Studios, Playground Games. (2018, September 2018). Forza Horizon 4. *Forza Horizon 4*. Redmond, Washington, United States Of America: Xbox Game Studios.