Organic NPCs through the use of neural networks

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Date submitted:

Module: UFCFS4-30-3 Creative Technologies Project

Screenshot/ image of the work (600 pixels high x 800 pixels wide .jpg @ 240 dpi)

Summary

This project uses neural networks to drive an NPC agent that behaves realistically in an RPG setting.

Using three neural networks, one for idle behaviour, one for combat behaviour and one final emotionally driven network, this project simulates a realistic bar brawl setting where NPCs can act on and react to in game events.

This project also includes a framework for developing additional behaviours through neural networks and training these networks to behave as expected.

Brief biography

I am a young and aspiring student currently studying Games Technology(Bsc).

I have always been interested in AI and wanted to use this project as a way learn more about the current practices used in the industry and how other methods could be applied to better effect. I chose neural networks as they employ machine learning, a skill I have always been infactuated with and one that many employers are seeking as they belive it is at the forefront of current technology.

How to access the project (not included in word count)

Please put down the URL and/or details of how to access your project, and the ***URL of your final video***. If we need to see any back end / administration interface please provide us with necessary passwords and URLs to access this. Basically, what we cannot access will not be considered for marking. You can change the passwords after you receive your mark.

We also want to be able to see source code, and the best way is to download it from your site or github. Please clearly comment code to show us what is your own and what has been used from frameworks, libraries, OSS or borrowed from elsewhere.

If there is some other method for providing access to your project you will need to provide instructions here. Also if there is anything we need to know about the work that will not be self-explanatory, then also provide brief instructions here.

Introduction 400

Briefly introduce the project in its professional context. Tell us what it was about, what problems it solved, why this is important, interesting or valuable. What were you seeking answers to, how did they arise, why were they worth investigating?

Also list your deliverables / project objectives.

This project set out to solve the issue of developing realistic NPCs that allow for greater player immersion as well as system optimization.

The objectives were as follows:

* AI that act ‘realistically’ or, as the player expects.
* AI that has a low overhead an impact on system performance.
* AI that is easy to develop and can be tweaked to the developer’s needs.

Development of AI systems are often restricted as they are less marketable than other game features such as graphical fidelity and gameplay content, therefore they are often lackluster and overly simplified to decrease their overhead and impact on system performance.

Using neural networks, this project has achieved an AI system that has a minimal impact on performance, is easily integrated into rapid development cycles and delivers an immersive experience for player.

Practice 1500

State the main outcomes of your practice. Insert graphs, screenshots, diagrams, short code snippets if necessary.

Reflection: How has your practice developed *after* the research phase, and in hindsight how successful was this developmental phase? How did your research impact on your practice and vice-versa? How did user/ peer/ tutor feedback impact on it?

Evaluate: How did you deal with problems you encountered along the way? Give us a few specific examples. These could be conceptual, technical, practical, legal (think copyright) or ethical (think user studies). Tell us how you succeeded, or at least how you exhausted every method within your grasp.

* Developing the neural network class
  + Modular
    - Created based on an inputted layout (no of Inputs, no of hidden layers and depth, no of outputs)
    - This allows networks to be created and tweaked easily in editor
  + Mutation based
    - Function call to mutate every weight in the network
    - Works well for rapid training
    - No need for back-propagation as training results were adequate
* Creating behavioral classes (Real time combat, queue-based needs, master network)
  + Behavioral scripts are inherited from a base behavior class allowing for rapid creation.
  + Master network controls what state the agent should be in based on their needs and emotions
  + Idle state driven by the needs network
    - Needs are evaluated by the nn and a prioritized list of actions are outputted
    - These actions are fed into a queue that the agent clears
    - Problems creating a system where queue items could be overridden
      * Overcome with the event system and manually inserting items to the queue outside of the networks control
    - Problems where some queue items weren’t possible, causing bots to idle (Introduction of priority system)
      * Created a priority system where all outputs were evaluated, not just the top. So that if the top action wasn’t available the next best would act.
  + Combat state driven by the combat network
    - Real-time inputs and outputs from the network
    - Little overhead produced as modern CPUs are good at floating point calculations
* Training the networks
  + Script developed to allow users to select the script to train, how long to train for etc.
  + Best network results are then evaluated and saved, loaded on next entry
  + Ran into major issues training the needs network as expected behavior was more abstract and there were lots of variables to consider. This was a massive downside to the project and cost a big heap of development time.
    - Problem was mitigated with the training script allowing for rapid training sessions and the network visualizer allowing a clear understanding of what the bot is ‘thinking’.
    - Different methods of adding fitness were explored such as on job completion, average of needs, weighted happiness function.
* Developing additional behaviors
  + Event system for crowd behavior
  + Relationship system for interpersonal behavior
* Evaluation user feedback

Discussion of outcomes 900

Reflection: What significance does your completed project have in a wider professional context? What can other professionals draw from your work? What does it improve on? Critically analyse what you have achieved and if necessary suggest different future approaches.

To what extent do the outcomes of your practice satisfy your original objectives, stated in your proposal?

What makes your project *original* in a professional sense; e.g. have you discovered any new methods as you went along? New models that might help others understand processes better? Developed a good protocol for implementing things? Streamlined some processes?

* Project proves neural networks can be used to create functional video game NPCs
* System allows for a streamlined creation process for neural network based behaviors
* Player immersion isn’t quantifiable based off one system, it is the collection of systems working in tandem that allow for player immersion.
* When isolated, the feedback proves that the NPC system created provides an immersive experience.
* Training the networks is still a major issue

Conclusion and recommendations 200

This section should not contain any new information. You should draw conclusions from the research and practical work you completed. Does your work have a longer-term future beyond UWE and if so what might it look like? Think about the impact you could achieve with it. How might it benefit users, professionals, society? Perhaps make some recommendations for further work.

* Future work should focus more heavily on effective ways to train neural networks and effectively communicate what the developer wants the network to achieve.

References (not included in word count)

Bibliography (not included in word count)

Appendixes: (not included in word count)

A Log sheets

B Project timeline

C If necessary, insert a list of interview questions, any larger tables, evidence of design development, longer code snippets or other relevant materials in here. This does not come under the wordcount. Nevertheless only insert useful materials here, please don’t bulk it up. Your report should be able to stand on its own, without relying on appendixes.