TEAM JCBE
Neural Network AI Tag
12/1/2021

By: Jack Cordonnier and Ben Elfner

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Members

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Abstract

Our project is focused on developing a game of tag as a 2D platformer with specialized chaser and evader AI. The chaser AI(s) will work together to catch the evader. The game simulation will be written in a language conducive to quickly teach the AI through iterative learning. We will utilize neural networks to train and improve our AI's performance. This project idea is something that pushes the envelope when it comes to video game AI, since AI's tend to work alone and we are attempting to evolve that into a more collaborative AI approach.

Project Description

Our project, "Neural Network AI Tag", is based around a game of tag as a 2D platformer with chaser and evader AI. We are implementing the game itself and the controllers for the AI using Unity and C# and are tentatively considering using TensorFlow for the neural net. This project aims to challenge ourselves to dive into the concept of neural nets and figure out how we can get them to collaborate. Games such as Dota 2 have implemented collaborative AI's to accomplish tasks, our hope is to do this on a smaller scale. The project is being developed by Jack Cordonnier and Ben Elfner and will be completed in the Spring of 2022.

User Stories and Design Diagrams

User Stories
- As a player, **I want** to compete with AI in a game of 2d tag so that I can test my skills and enjoy a competitive experience.
- As a user, **I want** an AI that can learn from stimuli, so that it can improve its performance over time.
- As a chaser AI, **I want** other AI to be able to collaborate with me toward a shared goal so that I can catch the evader.
- As an evader AI, **I want** to be able to avoid the chasers, so that I can prevent being caught for as long as possible.

Design Diagrams
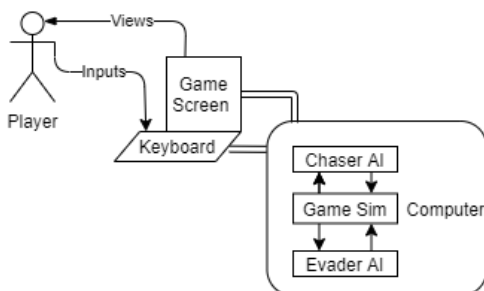
Design D0:

- Views: the Player watches the Game Screen
- Inputs: the Player sends the computer inputs by typing on a keyboard
- Both the Game Screen and the Keyboard are connected to the computer
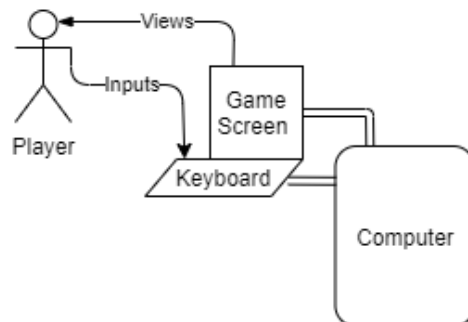
Design D1:

- The Chaser AI and Evader AI receives input from the Game Sim about the current game state
- Using that information the Chaser AI and Evader AI make decisions and send their input back to the Game Sim
- Depending on the game mode, the Chaser AI or the Evader AI can be replaced by the Player

🔗 Design D2:

- The Game Screen displays the Game Sim using the Game Sim graphics
- As time progresses The Game updates its Game State as it receives new input using the Level Design and Physics
- The Chaser AI and Evader AI pass information from the Game Sim's Game State to their Neural Networks that dictate their next move
- The Chaser AI also passes information about all Chaser agents to its Neural Network
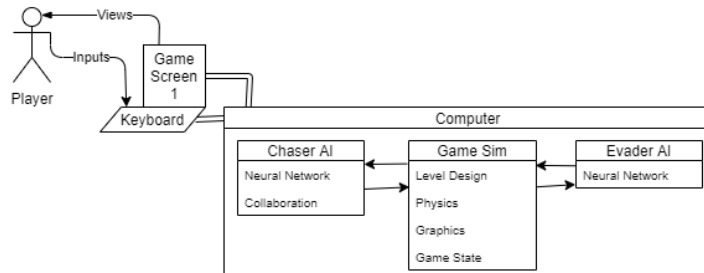
Project Tasks and Timeline

Task List

Research project language for neural network, game environment and how they will interface - {Ben, **Jack**}
Research game engines within which the project will be based in - {Jack}
Research libraries to be used for neural networks - {Ben}
Research methods to train two networks in tandem - {Ben}
Determine environmental input for the agent to digest - {Jack, **Ben**}
Design the agents' neural network - {Ben}
Design game environment - {Jack}
Refine controls to give the users and AI fluid, precise movement - {Jack}
Implement the agents into the game - {**Jack**, Ben}
Train the agents - {Ben}
Establish the Game's rules set and objectives of the agents/players - {Jack}

Bold indicates teammate with primary responsibility

Timeline

Task	Person Assigned	Start Date	End Date
Research project language for neural network, game environment and how they will interface	Ben, **Jack**	OCT 1	NOV 1
Research game engines within which the project will be based in	Jack	NOV 1	NOV 15
Research libraries to be used for neural networks	Ben	NOV 1	NOV 15
Research methods to train two networks in tandem	Ben	NOV 16	NOV 23
Determine environmental input for the agent to digest	Jack, **Ben**	NOV 23	DEC 10
Design the agents' neural network	Ben	DEC 10	DEC 31
Design game environment	Jack	DEC 10	DEC 31
Refine controls to give the users and AI fluid, precise movement	Jack	JAN 20	JAN 30
Establish the Game's rules set and objectives of the agents/players	Jack	FEB 1	MAR 4
Train the agents	Ben	FEB 1	APR 10

Effort Matrix

Task	JACK (%)	BEN (%)
Research project language for neural network, game environment and how they will interface	50	50
Research game engines within which the project will be based in	90	10
Research libraries to be used for neural networks	10	90
Research methods to train two networks in tandem	100	0
Determine environmental input for the agent to digest	45	55
Design the agents' neural network	70	30
Design game environment	85	15
Refine controls to give the users and AI fluid, precise movement	60	40
Establish the Game's rules set and objectives of the agents/players	100	0
Train the agents	20	80

PPT Slideshow

Slideshow of work

NOTE: Our team has talked about it and we do not have any ABET concerns. Also, we had a hard time figuring out what they even were since they were never discussed in any assignment. More clarity in this area would be appreciated.

Self-Assessment Essays

Ben Elfner

Individual Capstone Assessment

Benjamin Elfner

Our project is about exploring how an AI could learn to play a game of tag. The focus is on how common machine learning practices such as neural networks and adversarial networks can be tailored to fit this problem. Other tools I have learned from school can also be applied such as optimization and modeling. The biggest problem will be trying to determine how this game can be modeled such that there are inputs and outputs for the AI to control. These inputs and outputs must be useful enough for the AI to perform its task successfully. Once the AI can play against itself, there will also be the opportunity to determine how a person will perform against it.

Using the knowledge from Python Programming (CS 2021) our project will be primarily written in Python. Python is a very flexible language which will be useful as our project evolves as well as providing ease of implementing our ideas. Using knowledge from Design and Analysis of Algorithms (CS 4071), I will be able to create optimized routines for training the AI and for the design of the game itself. I will be able to navigate Microsoft Azure or AWS so we can train the AI using their tools faster than if we did so on our personal computers using knowledge from Cloud Computing (CS 5165). I will use the techniques from Software Engineering (EECE 3093C) such as the UML diagrams to guide our projects development structure and organization. All written documents will be influenced by the things I learned in Technical Writing (ENGL 4092) such as organization and presentation.

The co-op role that will guide my experiences the most is my job at Kinetic Vision as a machine learning developer. At Kinetic Vision all my programming work was in Python making it my strongest language by far. Also, at Kinetic Vision I was exposed to many new types of machine learning implementations. Not only will I be able to draw inspiration from them for this project, but I also know where to go on the internet for resources on machine learning. I also used Microsoft Azure to train AI models at Kinetic Vision giving me the information necessary to start on that aspect of this project. Two of my other co-op experiences, Sphaeric.ai and Simple Maps (Python-dev at both), will provide me with a more solid foundation in Python.

I have always been fascinated by applying AI models to novel situations and I believe a game of tag is a good candidate since it provides a new environment in which two different AI will compete. It also lends to easy scaling of complexity which can be done by adding or removing restrictions to the AIs or the environment. First, the environment needs to be implemented and tweaked so that both the seekers and the evader are competitive with each other with no clear advantage. Next, the AIs will need to be built and trained on the environment. This will include any tuning of the AIs necessary for training to complete successfully. This stage will be the primary focus of the project since training AI can be a very complex and time-consuming task.

The expected results of this project are a game of tag and two AI that control the seekers and evader. The AI will be proficient in their respective tasks with the threshold of proficiency to be determined at a later date. Their proficiency will be what determines if the project has succeeded or failed. The project will be done when we have followed all parts of our determined path regardless of whether the project turns out to be a success or failure. I will self-evaluate my contributions in comparison to my teammates. If I feel we have done our parts with equal or similar quality and with that quality of a grade that I would feel proud to have my name on.

Jack Cordonnier

Individual Capstone Assesment

The senior design project that my team will be undertaking is focused on "AI Pursuance and avoidance in a 2d setting. We plan on developing a 2d platforming game in which we will develop 2 neural net/machine learning AI's. One of the Ais will learn to pursue a target by using pack mentality and pursuing algorithms (like wolves hunting) where they learn to work together. The other AI will be an avoidance AI that learns to hide and run away from adversaries and uses misdirection, hiding, and precise movement. The hope of this project is to push ourselves to learn more about AI, with a focus on how it can learn and adapt to changes and work as a cohesive unit. Academically I hope that my technical skills will be improved by using coding languages and frameworks we have not used before that are used in industry.

My college curriculum has touched on AI at multiple times, both in my Design and Analysis of Algorithms (CS 4071) and in AI Principles and Applications (CS 4033). In these courses, general AI practices and principles were covered so that going into this project I have enough background knowledge to know what I am getting into by developing an AI. In my Software Engineering course (CS 3093C), I developed a multiplayer board game called Tactus with gameplay similar to that of chess. I developed it with Python, more specifically a library called Pygame. My game development experience will allow the 2d game framework of this project to be quickly setup so the focus will be on developing the AIs since that is a much more complex topic. I hope to apply my skills from these courses to my project so that I put that knowledge to good use.

When it comes to my co-ops, I have a lot of development experience in software engineering. In my time working for Marathon Petroleum, I wore hats such as software developer, business analyst, and IT analyst. In these roles, I had extensive experience with developing full stack web applications. This development, while not exactly what this project will be about, still touched on and used coding languages similar what we plan to use here. For example, I had done some C++ work with Marathon, and we are tentatively planning on either using that or C for our project here. Additionally, my organizational skills that I gained from working at Marathon will translate well since I am used to having to work long on multiple different projects. For this project, I will be required to develop not only a video game, but also an AI, and possible even procedural generated environments. Balancing all of this work should be much more doable with my work experience. Another work experience that will translate well here is my time spent as a Software Engineer at GE Aviation. In my time working there, I did development work on an AGILE team where we touched base frequently on the work we were

doing. Being used to this quick moving, team based environment will help me since that is similar to what working on this project will be like.

The motivation for this project has three main prongs. The first one is the fact that I have extensive game development knowledge from classes but in excess from my own personal experience. I have developed videos game for fun for the past few years but have never dabbled in AI so this seems a natural evolution. The second reason for this project is the fact that AI is something that has been very interesting to me for the past few years, but I have never taken the time to implement it in any meaningful way. This will be an opportunity to learn a lot, especially if we use machine learning, to widen my knowledge base greatly. The last motivation for this specific project is the fact the project brings together the skillsets of my team and I. My team partner is very technically savvy with things related to AI and stuff of that nature while I am good at designing and implementing big picture ideas, so together, we think we can create something that showcases and challenges our skillsets.

For designing the solution, we are currently in the requirements creation phase where we hope to sift through different directions we can focus on and predict the feasibility of each of the ideas we have. We expect at the conclusion of the project (which was explained in the first paragraph) is to have a 2D platforming game of Tag that implements two unique AI's with the purposes of avoidance and pursuit, as well as bringing the AI's together to accomplish goals. As for expected results, we expect that we will be able to create a game that allows both players and AI's to compete. We will judge this project as a success based on the complexity and completeness of the AI's and how they interact with one another. The more complex and intricate the behavior, the more successful and the better of a job we will have done. Personally, my focus is delivering on all things that I will be responsible for as fully as I can, while also carrying my own weight in other areas of the project.

Professional Biographies

Jack Cordonnier

Professional Biography
Name: Jack Cordonnier
Phone Number: 513-274-3613 | Email: cordonjk@mail.uc.edu
Co-op Work Experience
Digital Technology Developer GE Aviation: Cincinnati, OH - Spring 2020, Summer 2021
- Worked with a diverse team using the AGILE methodology
- Developed greenfield web applications using Vue.js
- Navigated between both remote and in person work
- Developed automated unit testing for new releases

Application Developer Marathon Petroleum: Detroit, MI - Fall 2020
- Developed a long-term scheduling application for refinery optimization
- Revealed savings opportunities of over 8 figures/yr
- Distributed for analysis/use at all 16 refineries
- Collaborated with 4 teams to supply the application data

- Created a refinery wide quarterly dashboard (PowerBI), seen by all refinery employees

Application Developer Marathon Petroleum: Findlay, OH - Fall 2018, Summer 2019
- Supported the Oil Refining Operations across the US
- Wrote the front-end and back-end for 20+ webpages (C#)
- Upgraded security and ORM for an application, ~200 work hours saved per year

National Accounts Intern/IT Intern: Cintas Mason, OH - Summer 2017, Summer 2018
- Worked on a team of 6 other interns on data from customers such as Walmart, Boeing, and GE
- Assisted with the data migration for clients as part of a 2-billion-dollar acquisition
- Commended by department head for exceptional efficiency and attention to detail

Skills
- Video Game Developer: cultivating coding and problem-solving skills
  - Moving towards publishing first commercial game: "Torched"
  - Over 1,500 hours invested
  - Torched Gameplay Trailer: https://youtu.be/AvpXCcjz7bU
- Languages: Python, C#, C, C++, SQL, Java, MATLAB, Web Development (HTML, JS, CSS), VBA
- Software: PowerBI, Visual Studio, Azure, SQL Server Manager, Unity, Git, Microsoft Office
- Operating Systems: Windows, basic Linux and Mac

Areas of Interest
- Embedded Systems
- Visualizations
- Simulations
- Game Design
- AI
- Data processing

Project Sought
- Visualization in a medical or healthcare field
- Psychology related study/test/game to document/study human behavior
- Video manipulation or editing software development or creation

Benjamin Elfner

elfnerbm@mail.uc.edu

Co-op Experience
- IT, City of Cincinnati, Cincinnati, Ohio. (1 quarter):
  - Streamlined rollout of new software to department 40 hrs/week
  - Automated setup of new PC's and installation of required software
  - Provided IT support for department staff
- Developer, Sphaeric Ai, Cincinnati, Ohio. (1 quarter):
  - Worked as data analysis contractor for companies
  - Specialized in applying machine learning for data prediction with Python
  - Automated data gathering, analysis, predicting, and formatting
  - Web scraping and natural language processing
- Developer, Simple Maps, Cincinnati, Ohio. (1 quarter):
  - Automated processing of geographic data
- Developer, Kinetic Vision, Cincinnati, Ohio. (2 quarters):
  - Created and processing large amount of data
  - Trained a wide variety of neural networks for large companies

Skills
- Programming: MATLAB, Java, C++, Python
- Operating Systems: Windows, Linux
- Database Programming: MySQL
- Other Skills: Google Cloud Tools (GoogleAppEngine and other API's), natural language processing, QGIS

Areas of Interest
- Artificial Intelligence with a focus on Deep Learning
- Data Processing

Projects Sought
- Exploring new applications of Deep Learning

Budget

No expenses to date.

References

https://github.com/JCorndog/JCBE
Slideshow of work

Appendix

Figure: Total work to date

Work	Jack Hours	Ben Hours
Planning	12	12
Documentation	20	18
Research	11	9
Discussion	6	6
Prototyping	5	7
Total	52 hours	52 hours