

In School

February 8, 2023 10:50 am - 11:31 am

Day #1

Nick and Josh

Today Josh and Nick started to research what they would need to create a chess game. They started to see that they would need to go down to technology and gain access to the command prompt for installing pygame and the chess libraries.

February 9, 2023 10:50 am - 11:31 am

Day #2

Nick and Josh

Nick and Josh went back down to technology to finish installing what they needed, but Mr. Jaw was not present today. Instead, one of the people in technology opened the command prompt for Josh and Nick which allowed them to install the packages they needed. This really helped them since they would be able to download any packages they needed later that they were not aware of now.

February 10, 2023 10:50 am - 11:31 am

Day #3

Nick and Josh

Nick and Josh started working on their projects today. Nick started creating his chess game before working on his engine. He used pygame in order to make a GUI for the game, but in order to do this he has to do some more research on pygame. Josh did some research today on how he would be able to go about coding a game in chess after he installed his libraries.

February 13, 2023 10:50 am - 11:31 am

Day #4

Nick and Josh

Nick continued researching pygame to make his GUI. He read about backgrounds and blitting images onto his background, which basically means turning the image and the background into one layer. Josh continued to do research today about how we could create his own GUI for his game. Josh was researching mainly how he could implement things into pygame. He did start to try and find some tutorials that would be helpful for him.

February 14, 2023 10:50 am - 11:31 am

Day #5

Nick and Josh

Nick finished most of his GUI at home yesterday. He was now implementing smaller features such as keeping a piece selected after clicking on it and then trying to make an illegal move. Josh continued to do research about this and found some tutorials that would help him create his basic chess game using pygame.

February 15, 2023 10:50 am - 11:31 am

Day #6

Nick and Josh

Nick completely finished his GUI today. He implemented promotion into the game, where the user will be prompted to enter what piece they would like to promote to when a pawn reaches a promotion square. Josh started to try and code a little bit of the game with the help of tutorials. He started to create the main file where the main variables would run.

February 16, 2023 10:50 am - 11:31 am

Day #7

Nick and Josh

Now that his GUI was done, Nick started working on his engine. He thought that he would first create a basic engine and then implement machine learning elements later. He first made a standard evaluation function to get the current value of the board. Josh finished coding the main for as much as he needed for the time being. He then started to code the next file so the game would start to work and even open a pygame blank space.

February 21, 2023 10:50 am - 11:31 am

Day #8

Nick

Nick started looking into mobility evaluation today. He learned about bitboards and how they can be used to represent the current state of the board. However, he was still unsure as to how billboards are used and what exactly they were.

February 22, 2023 10:50 am - 11:31 am

Day #9

Nick

Nick researched bitboards last night but he was still unsure about them in general. Therefore, he continued to research bitboards during class. He focused on looking into their operations such as union and intersection.

February 23, 2023 10:50 am - 11:31 am

Day #10

Nick

Nick continued implementing bitboards into his evaluation function that he started last night. He used the bitboards to represent the position of a piece of a certain type and the square they attacked. He used the union function to get the squares that would not be safe to move to and removed them from the potential moves list.

February 24, 2023 10:50 am - 11:31 am

Day #11

Nick and Josh

Nick began looking for Deep Q-Learning articles that he could read in order to develop a better understanding of the process as a whole since he did not have much knowledge on the subject. Today Josh was looking at his code for his chess engine. He realized that with all the errors he was getting that just creating the chess game too complex. He decided today he would actually switch to creating a checkers AI.

February 27, 2023 10:50 am - 11:31 am

Day #12

Nick and Josh

After researching machine learning as a whole over the weekend and today, Nick came to the conclusion that the evaluation function he was currently using was pretty much useless. The way games would be scored using a reward system would not be based on an evaluation function, but rather on whether a game was lost or won. Today Josh understood more about how he would now create a checkers game and have a deep learning AI implemented in it so he started to code following a tutorial.

February 28, 2023 10:50 am - 11:31 am

Day #13

Nick and Josh

Nick continued his research on Deep Q-Learning today but now he knew that he would have to make an entirely new program. The focus of his research today was on the Bellman Equation which plays a major role in all of machine learning. Today Josh completed his constants file as well as started the main file. The main file was just a creation of where the game would run from.

March 2, 2023 10:50 am - 11:31 am

Day #14

Nick and Josh

Nick moved past the Bellman Equation today even though he did not fully understand it. Nick looked into Q-Tables, the aspect of Q-learning that gives it its name. A Q-Table is a table which contains the relative values of taking a certain action in a certain state. Josh finished his main file today. He then started to work on the actual board file which would initialize the board and allow you to move.

March 6, 2023 10:50 am - 11:31 am

Day #15

Nick and Josh

Nick continued his research on the Bellman Equation over the weekend but he didn't understand how the probability part of the equation worked since it was dependent on two different variables. To try and get a better understanding, he started reading a textbook on AI. Josh spent today working on his board and trying to fix errors with some

of his code in the board file. He was able to figure out where he mistyped some of his code and worked out the errors. He also was able to complete most of the board file.

March 7, 2023 10:50 am - 11:31 am

Day #16

Nick and Josh

Nick felt like he was lacking knowledge on machine learning as a whole so he started reading a textbook. He began reading a textbook about artificial intelligence. He started with the chapter about solving complex problems. Today Josh finished his board file. He then created the piece file and started to code that. The point of this file was to display the pieces of both colors on the board.

March 8, 2023 10:50 am - 11:31 am

Day #17

Nick and Josh

Nick continued reading his textbook today. The solving complex problems chapter focuses on markov decision processes which is how machines solve complex problems. Josh finished the piece file today and was coming to almost be done making his functional checkers board.

March 9, 2023 10:50 am - 11:31 am

Day #18

Nick and Josh

After reading about markov decision processes, Nick started to look at the utility function which is used to determine how valuable an action is in a given state. The utility function updates as the agent begins to explore more of the environment, eventually allowing the agent to find the most optimal policy, solving the environment. Josh today went onto the final video of the tutorial he was watching which incorporated jumping into the game. It also allowed for king pieces to move in certain directions differently from the rest of the pieces.

March 10, 2023 10:50 am - 11:31 am

Day #19

Nick and Josh

Nick began reading about reinforcement learning in his textbook today. He needed to have somewhat of an understanding of mdp's and utility functions before reading about reinforcement learning since it incorporates both concepts. Josh was able to complete this final code and had a working checkers game where two people would be able to play. Once Josh finished he got right to working on understanding tensorflow.

March 13, 2023 10:50 am - 11:31 am

Day #20

Nick and Josh

Nick continued reading about reinforcement learning today. He was able to finish the chapter but the pseudocode detailed in the textbook was difficult to understand so he felt like he still did not know how to fully implement reinforcement learning on his own. Josh continued to research tensorflow discovering how complicated it was. He was having a hard time figuring out how he would be able to create an AI that would be able to understand checkers.

March 14, 2023 10:50 am - 11:31 am

Day #21

Nick and Josh

To try to progress his project more, Nick started looking at the AlphaZero paper which details outlines how AlphaZero was made. It uses a Monte Carlo Tree Search (MCTS) as a Q-Network which estimates the value of potential moves in a given state. Josh discovered that the AI he would need to create would be considered a deep learning AI. This type of AI basically tries to think like a human in simple terms and play more like how a human would.

March 15, 2023 10:50 am - 11:31 am

Day #22

Nick and Josh

Nick started reading about somebody else's implementation of reinforcement learning into chess. The main part of the code Nick focused on was the creation of their Q-Network. Nick found it very difficult to understand. Josh realized that creating an AI would actually take a lot more time than anticipated. So he decided to watch the same person's tutorial who showed how you could create a checkers game to create a minimax algorithm to play.

March 16, 2023 10:50 am - 11:31 am

Day #23

Nick and Josh

Nick continued to look at the implementation of reinforcement learning for chess. He was starting to understand their Q-Network a bit more now so he looked into their MCTS. To make a MCTS, he found that you need to have a good understanding of tree data structures. Josh spent today implementing the algorithm and it seemed to be coming along pretty well. Josh was able to get most of the code done.

March 17, 2023 10:50 am - 11:31 am

Day #24

Nick and Josh

Nick's focus for today was on learning about MCT and tree data structures. Tree data structures were not that complicated but it seemed difficult to actually create one since

there are so many parts included. Using this knowledge about tree data structures, he started looking at MCTS again and was able to understand much more about it. Today Josh figured out how he could also display the moves of the algorithm with drawing circles and showing what the algorithm was doing while it was trying to decide its moves.

Work at Home

February 10, 2023 12:15 am - 1:40 am

Nick

Nick worked with his sister to set up a GitHub account so that he can transfer his project between his personal computer and the school laptop. He had to install git first and then he created a repo. In this repo, he created a text file for testing. Using powershell, he used pull to clone the repo to his computer. He then edited the text file and pushed and committed it to GitHub. This served as an example for how to use GitHub which he will apply to his project.

February 14, 2023 11:00 pm - 12:30 am, 3:00 am - 4:15 am

Nick

Nick finished creating most of his GUI for his game. To do this he created a function to draw the current board by iterating through the board object. Then, he called this function whenever a legal move was made. For a legal move to be made, Nick took the relative coordinates of the mouse when clicked and then mapped them to a certain square on the board. By doing this, he could get a from square and a to square to make a move.

February 14, 2023 7pm-9:30pm

Josh

Josh worked on trying to understand how he would be using the chess library to implement it into pygame. He discovered that the chess library has all of the legal moves and requirements for a chess game built in. This would make implementing it with pygame easier as I wouldn't have to code the game from scratch. He was also looking for tutorials on how he could start coding this chess game that he would want to implement a deep learning AI into.

February 22, 2023, 1:00 am - 3:30 am

Nick

Nick started researching bitboards today since they are a useful way to help determine mobility in chess engines. Bitboards are essentially a matrix of bits that use very little memory to read and manipulate which allows for quicker operations and searching which helps with lowering evaluation time as the depth of your engine increases. The chess library has bitboard implementation and functions which are helpful to use once you figure them out.

February 25, 2023 3:15 pm - 5:15 pm

Josh

Josh worked on trying to understand checkers and how he would be able to code it in python. He found some tutorials on it and he discovered that he would be able to use pygame to create this checkers board. He also discovered he could use a minimax algorithm to have a basic algorithm that you would be able to play against.

February 28, 2023 7-8:30 pm

Josh

Josh did some research for the computer in Mr. Detrick's room. He discovered how he would be able to get the product key off of the old hard drive so he would be able to have the paid for windows version on the computer. While he was at home he also spent some time installing windows onto a hard drive. He then came in in the morning to try and install it on the hard drive.

Makeup Time

March 11, 2023 6:30-8:45 pm

Josh

Josh started to research how he could incorporate tensorflow into his code. He discovered that tensorflow is a library that you would import. He also discovered that the simplest way to incorporate machine learning would be through using the checkers game as a list filled with items that differentiate between pieces and blank spaces. This was the very simplistic way of looking at machine learning that Josh started to look at.

March 16, 2023 8pm-9pm

Josh

Josh decided he wanted to make his game in fullscreen so he did some research. He discovered that you could either make the game full screen or use another method where you could make the display fit the screen. Josh eventually decided to go with the fullscreen option because it would most likely look better.

Write Up

Goals: Their initial goals were to create fully functional AIs that would be able to play checkers and chess. They planned to use TensorFlow and Keras in order to make their programs. The goal was to create a GUI for each of the games and then explore how an AI would be implemented into these games. Josh and Nick wanted their programs to be intelligent to the point where they would be equivalent to an average player or possibly better.

Accomplishments: Josh accomplished creating a checkers game. He attempted to create an AI using tensorflow but was unsuccessful. It was just too complex to understand for the amount of time and with Josh's little experience with python. Josh was able to create a minimax algorithm for his checkers game which was able to play like an AI. The only difference was there was no machine learning involved in the algorithm and just code running through a few moves ahead using an algorithm to tell it which the best scoring move was. Nick created his chess GUI and was able to develop a decent understanding of reinforcement learning and many other elements of machine learning as a whole.

Learned: Josh learned some basics of python coding and how he could use libraries to create games using other things than just the console. This was valuable because python was a little confusing for Josh but it helped him get a little better understanding of the code and how he might be able to change or add more to the game. He even learned some very basic ways tensorflow works to determine things and how it learns from what information it is given. Nick learned about implementing machine learning in stochastic environments, which means that the outcome of any state has some random element to it. Nick's main focus was on reinforcement learning which is just one solution to stochastic environments, however this will prove to be extremely useful in the future if he decides to create another machine learning program.

Problems: Josh came across a few problems. Some of the problems were with errors just importing his libraries. For some reason visual studio code wouldn't recognize that the libraries were installed. He did end up restarting the computer and for some reason the library actually imported them. Josh also ran into an issue while Mr. Detrick had faced the AI. The issue was when you were going to double jump with a king you weren't able to go forwards and then change direction to go backwards. So if you weren't jumping two pieces with a king forwards or backwards you wouldn't be able to. Nick's main issue was spending a significant amount of time trying to understand every little aspect of reinforcement learning which may have ended up leading to a lack of physical achievement because he felt like the learning module would not have been valuable if he had just copied another person's program, but he was able to learn a lot in the process. His time may have been better spent if he started reading the textbook he found earlier which would have given him a more solid foundation.

Suggestions: A suggestion Josh would make is make sure your game allows you to double jump backwards and forwards in one move or Mr. Detrick will think you did it on purpose. Also another suggestion is if you are going to try and create a tensorflow AI of some sort you will need to spend a lot of time at home understanding python or whatever language you would be

using to code the AI. Additionally, you should try to have some background in the math required for machine learning since many of the equations and functions used can be math intensive.

Resources

Libraries:

[pygame](#)

[pygame_gui](#)

[TensorFlow](#)

[chess](#)

[Numpy](#)

Chess Engine Resources:

[Chess Programming Wiki](#)

[Bitboards](#)

Machine Learning Resources:

[Artificial Intelligence: A Modern Approach](#)

[Guide to Reinforcement Learning with Python and TensorFlow](#)

[Deep Q-Learning Tutorial: minDQN](#)

[Can Deep Reinforcement Learning Solve Chess?](#)

[AlphaZero Paper](#)

Videos:

[Part one of designing a checkers board](#)

[Part two of creating a checkers board](#)

[Part three of creating a checkers board](#)

[Learning the basics to creating an algorithm](#)

[Creating a minimax algorithm](#)