Artificial Intelligence Nanodegree Programm

Project 4: Build a Game-playing Agent

To get started I implemented alpha-beta pruning and iterative deepening from the lectures.

This gave me a very good baseline of 76% wins at 200 games.

I then decided for option 2 and created an opening book. Again I followed the sample from the lectures and also tried to adopt the recommendations:

- Player 1 always choses center position first
- Player 2 always choses center position first if possible, otherwise a non-mirror able position. I decided for the position left to the center.

The other player can chose any position from the field. I made these assumptions to reduce the size of the tree and still cover every option that can occur. For depth 3 and 4 I created games with random moves.

The games are randomly played to the end and evaluated according to win and loss as shown in the lectures. But this approach did not give me any benefit at all. It's obvious that I made a mistake when adopting the recommendations from the lecture.

So in a second try I decided to go for a more generic approach. I decided to play 100 random games from all possible start positions, for a total of 970200 (?99*98*100) random games

This new opening book gives me 82.5% wins. 6% points improvement over the baseline.

Experiment	**Matches Won in % (200 games played)**
Baseline	76%
Opening Book 1 (Center Pos + 1 off)	75%
Opening Book 2 (All Positions)	82.5%

But why is the new book better? The best 4 move combination directly out of the book are:

0 : 41
1 : 78
2 : Action.ESE
3 : Action.SSW
The board the looks like this:

```
+ - + - + - + - + - + - + - + - + - + - + - + - + - +
|   |   |   |   |   |   |   |   |   |   |   |   |
+ - + - + - + - + - + - + - + - + - + - + - + - + - +
|   |   |   |   |   |   |   |   |   |   |   |   |
+ - + - + - + - + - + - + - + - + - + - + - + - + - +
|   |   |   |   |   |   |   |   |   |   |   | X |
+ - + - + - + - + - + - + - + - + - + - + - + - + - +
|   |   |   |   |   |   |   |   |   |   |   |   |
+ - + - + - + - + - + - + - + - + - + - + - + - + - +
|   |   |   |   |   |   |   |   |   |   | 2 |   |
+ - + - + - + - + - + - + - + - + - + - + - + - + - +
|   |   |   |   |   |   |   |   | X |   |   |   |
+ - + - + - + - + - + - + - + - + - + - + - + - + - +
|   |   |   |   |   |   |   |   |   |   |   | 1 |
+ - + - + - + - + - + - + - + - + - + - + - + - + - +
|   |   |   |   |   |   |   |   |   |   |   |   |
+ - + - + - + - + - + - + - + - + - + - + - + - + - +
|   |   |   |   |   |   |   |   |   |   |   |   |
+ - + - + - + - + - + - + - + - + - + - + - + - + - +
```

This book looks quite different from my initial approach. Position 1 starts clearly off center. Also player 2 does not take the center in his first move but goes for the boarder.

A 100 games played randomly might not be enough data to generate a perfect book. But from this two experiments it seems fair to say an off center approach is the way to go.