**Assignment 2**

1. In this assignment negmax variant of minmax algorithm has been used in both minmax and alpha beta search algorithm.
2. Function Prototypes are the one which has been used for various questions and Matrices are the output containing time and nodes expended.
3. Matrices for all the questions are as followed.

**Question 1:**

|  |  |
| --- | --- |
| **Function Prototype 1:** | **Matrics:** |
| run\_game(basic\_player, basic\_player) | Execution Time: 54.3500454486  Nodes Expanded: 28214 |

**Question 2:**

**Description of Heuristic Improvement:**

We have added changes to give the weight age for the cases where other player is going to win and our state is stopping that.

So on rank of Priority:

1. Our wining scenario: Topmost
2. Stopping the winning move of other player: Moderate
3. Giving weight age to move near the center: least

For finding the situation of winnings of other player and our states stopping those:

X000X--, 000X0--.

Similarly checking in columns and diagonals.

|  |  |
| --- | --- |
| **Function Prototype 1:** | **Matrics:** |
| run\_game(new\_player ,basic\_player) | Execution Time: 60.148703975  Nodes Expanded: 28214 |

|  |  |
| --- | --- |
| **Function Prototype 2:** | **Matrics:** |
| run\_game(new\_player, new\_player) | Execution Time: 63.101704486  Nodes Expanded: 28214 |

**Question 3:**

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| --- | --- |
| **Function Prototype 1:** | **Matrics:** |
| run\_game(alphabeta\_player, basic\_player) | Execution Time: 52.3867512474  Nodes Expanded: 28214 |

|  |  |
| --- | --- |
| **Function Prototype 2:** | **Matrics:** |
| run\_game(alphabeta\_player, alphabeta\_player)  *(significant improvement here)* | Execution Time: 43.821435944  Nodes Expanded: 28214 |

**Question 4:**

|  |  |  |
| --- | --- | --- |
| **Part** | **Function Prototype** | **Matrics:** |
| **A** | run\_game(alphabeta\_player, basic\_player, ConnectFourBoard(5)) | Execution Time: 47.3174230442  Nodes Expanded: 31285 |
| **B** | run\_game(alphabeta\_player, basic\_player, longest\_streak = True) | Execution Time: 30.3384573854  Nodes Expanded: 30518 |