Project -- Short Essay 4

Graded

Group

AARTI MODI
SHUBH KATHURIA
AMBER LIM
...and 1 more
View or edit group

Total Points

3 / 3 pts

Question 1

Essay **3** / 3 pts

✔ **+ 3 pts** Complete, thought through, includes all aspects

Question assigned to the following page: 1

Short Essay 4

Group 2 - Shubh, Aarti, Amber, Kelly

February 2025

1 Project Plan - Chess Network

Chess is a game of structured decision-making, where each move influences the overall strategy and outcome. This project applies network analysis to chess by constructing a move transition network. In this network, nodes represent unique chess positions, edges represent legal move transitions between positions based on real game sequences, and edge weights represent the frequency of these move transitions. By analyzing this network, we aim to identify the most important moves and strategies that shape a game's trajectory.

In other words, our research question is **"How can network analysis help identify the most important moves and strategies in chess games?"**

We will use a dataset of professional chess games to extract opening sequences, midgame structures, and game outcomes, converting these into a graph-based model. We will apply various network metrics to understand which moves have the most influence:

- Degree Centrality: Identifies the most frequently occurring positions.
- Betweenness Centrality: Highlights pivotal moves that connect different game phases.
- Clustering Coefficient: Reveals how interconnected different move sequences are.
- Shortest Path Analysis: Determines the most efficient move sequences leading to victory.
- Community Detection: Clusters openings and strategies based on similarity.

By applying these techniques, we will be able to quantify which moves serve as strategic turning points, how different opening strategies shape the midgame, and whether certain positions consistently lead to victory or loss. This project will provide data-driven insights into chess strategy, helping players understand which moves and openings are most structurally significant in shaping a game's outcome.

Question assigned to the following page: 1

2 Member Role

- Introduction and Literature Search
  - Aarti will conduct background research and write the introduction.
- Data Cleaning and Preprocessing
  - Aarti and Amber will clean and structure the Lichess dataset, ensuring relevant game selection.
- Coding and Simulations
  - Shubh will handle most of the coding, including network modelling and algorithm implementation.
  - Kelly will assist with coding, particularly in visualization.
- Analysis and Interpretation
  - Aarti and Amber will analyze trends, identify key moves, and interpret results.
- Writing and Presentation
  - Shubh will draft the abstract.
  - Kelly and Amber will lead the discussion and conclusion writing.
  - Aarti will make presentation slides

3 Project Purpose

- Aarti - through this project I Hope to gain practical experience in network science and apply graph-based methods to a real-world strategic problem. I also aim to improve my ability to research, do data preprocessing, and literature review.
- Shubh - I've played about 10 games of chess daily for the last 5 months and this class is the perfect opportunity to further my interest in it. I hope to improve my knowledge of the game, learn implementation of network analysis algorithms, and scientific writing in general.
- Kelly - I hope to learn more about how to code networks and apply it towards a topic that I enjoy. I think this project would really benefit me in terms of thinking about how networks are in our everyday life and how we can apply this knowledge towards further research and scientific writing.
- Amber - I hope to learn more about applying math to real life. I think this project is a good opportunity to learn more about networks through real datasets and apply the skills I have learned in class. I hope to improve my research and data processing skills while learning more about chess.

Question assigned to the following page: 1

4 Data Set

- Dataset: We plan to use the Lichess open database of chess games. It is provided in PGN (Portable Game Notation) format, and contains metadata such as:
  - Player Information (Usernames, Ratings)
  - Game Result (1-0, 0-1, $\frac{1}{2}$-$\frac{1}{2}$)
  - Time Control (Bullet, Blitz, Rapid, Classical)
  - ECO Code Opening Name (Standard chess opening classification)
  - Move Sequences (Full game moves in PGN notation)
  - Timestamps (UTC time of when the game was played)
- Data Selection Criteria:
  - Using games from top-rated players (ELO ¿ 2500) to focus on strategic depth.
  - Extracting move sequences to construct a directed network of board positions.
- Data Processing Steps:
  - Cleaning and transforming raw data to extract move-by-move transitions.
  - Constructing a graph representation where nodes are board positions and edges are transitions.
  - Applying centrality measures and clustering techniques to identify crucial moves and common strategic patterns.

By leveraging network analysis, we aim to uncover key strategies and moves that influence game outcomes, providing a novel approach to understanding chess decision-making.