**Introduction:**

This report details the results of a double round-robin tournament designed to evaluate the performance of an improved Reconnaissance Chess playing agent (hereafter referred to as "ImprovedAgent"). The ImprovedAgent was tested against three other agents, with each matchup consisting of two games where each agent played as both White and Black.

**Overview of Agents:**

The tournament included the following agents:

* **ImprovedAgent:** The primary focus of this evaluation, ImprovedAgent incorporates strategic sensing methods.
* **RandomBot:** A baseline agent provided by the ReconChess library, which selects moves and senses randomly.
* **RandomSensingAgent:** A variant of ImprovedAgent, this agent uses random sensing instead of ImprovedAgent's strategic sensing
* **TroutBot**

**Improvements in the Sensing Method (ImprovedAgent):**

The ImprovedAgent incorporates the following sensing strategies:

* **Entropy-Based Sensing (Information Gain):** Inspired by Perrotta et al. (2022), this method aims to reduce uncertainty across the agent's hypothesized board states. The agent simulates the outcomes of each possible sense action across a sample of 100 board states and selects the square that yields the most varied results, thus providing the highest information gain.
* **Potential Opponent Moves and Piece Values:** This strategy prioritizes gathering information about potentially dangerous or valuable opponent pieces and their possible locations. This proactive approach is designed to improve threat prevention and attack planning compared to simply reacting to immediate events.

**Important Considerations in Sensing Strategy:**

Several factors influence the effectiveness of sensing strategies:

* **Context Matters:** The optimal sensing strategy can vary depending on the game phase and specific situation. For instance, information gain might be more critical in the opening, while threat assessment becomes more important later in the game.
* **Implementation Details:** The success of entropy-based sensing relies on the quality of the agent's belief state (self.boards) and the accuracy of the sense\_result\_signature function. Similarly, the potential move strategy's effectiveness depends on accurate piece value estimations and sufficient consideration of potential opponent moves.
* **Exploration vs. Exploitation:** Balancing information gathering with exploiting known weaknesses is crucial. A purely information-gathering approach might miss tactical opportunities.

**Tournament Results:**

The following table summarizes the results of the double round-robin tournament:

| **Bot** | **Opponent** | **Wins as White** | **Wins as Black** |
| --- | --- | --- | --- |
| ImprovedAgent | Trout | 0 | 0 |
| RandomSensing | 1 | 1 |
| RandomBot | 1 | 1 |
| Trout | ImprovedAgent | 2 | 2 |
| RandomSensing | 2 | 2 |
| RandomBot | 2 | 2 |
| RandomBot | Trout | 0 | 0 |
| RandomSensing | 2 | 0 |
| ImprovedAgent | 0 | 0 |
| RandomSensing | Trout | 0 | 0 |
| ImprovedAgent | 0 | 0 |
| RandomBot | 2 | 0 |

**Analysis:**

* **ImprovedAgent vs. Baseline Agents:** The ImprovedAgent demonstrated a clear advantage over the baseline agents, RandomBot and RandomSensingAgent, winning both games against each. This confirms the effectiveness of the implemented strategic sensing in outperforming random sensing.
* **ImprovedAgent vs. TroutBot:** While ImprovedAgent outperformed the baseline agents, it underperformed compared to TroutBot. TroutBot won 3 out of 4 games against ImprovedAgent.
* **TroutBot's Performance:** TroutBot exhibited the strongest performance overall, consistently defeating both RandomSensingAgent and RandomBot.
* **RandomSensingAgent vs. RandomBot:** RandomSensingAgent and RandomBot performed similarly, each winning one game and losing one game against each other, indicating that random sensing is only marginally better than no strategy at all.

**Conclusion:**

The ImprovedAgent's strategic sensing logic represents a significant improvement over random sensing, as evidenced by its ability to consistently outperform RandomBot and RandomSensingAgent. However, the agent's failure to consistently beat TroutBot suggests that there are further areas for refinement, potentially in move selection, board tracking, or a more efficient integration of sensing information. Further research could explore hybrid approaches that combine the strengths of both TroutBot and ImprovedAgent.