

**Spike:** 10

**Title:** Tactical Analysis with Planets

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**Objectives and Deliverables:**

Tactical analysis techniques enable game agents to make intelligent decisions and plan strategically in challenging, dynamic game environments. The game environment must provide adequate and appropriate information for effective analysis.

The goal is to develop at least two different "bot" agents for the PlanetWars simulation:

- One bot can be a simple bot created earlier, as long as it makes valid moves.
- One bot must utilize tactical analysis to inform its decision-making process.

**Tools, Technologies, and Resources Utilized:**

Tools:

- Python 3.12.0
- ChatGPT: <https://chat.openai.com/>
- Claude: <https://claude.ai/chats>

Resources:

- Lab 09 -- PlanetWars

**Undertaken Tasks:**

For this task, I developed two additional bots for the PlanetWars Game:

1. The first bot, named "Simple," is based on the "BestWorth" bot from Lab 9. It sends ships from its own planet to an enemy or neutral planet:
  - a. The source planet has the maximum number of ships among the bot's planets. The fleet is sent only if both the source and destination are valid, and the source planet has more than 10 ships. The fleet size is 50% of the total ships in the source planet.
  - b. The destination planet is the wealthiest (highest growth rate) among the enemy or neutral planets.

c. Only one fleet is present in each frame.

2. The second bot is a tactical analysis version of the simple bot, with two modes: "attack" and "defend." The modes are determined by a "weak\_rate" method:

Weak:

- A planet is considered "weak" if it has less than 15 ships.
- The weak rate is the ratio of the bot's weak planets to its total planets.
- The game starts in "attack" mode. If the weak rate exceeds 0.3, it switches to "defend" mode; otherwise, it remains in "attack" mode.

Attack:

- If the weak rate is less than 0.3, the bot sends 50% of the ships from its strongest planet (source) to the wealthiest enemy or neutral planet that is near the source planet (destination).
- The "enemy\_wealthiest\_near\_planet" method calculates the average distance from the source planet to all enemy or neutral planets and selects the wealthiest planet among those with a distance shorter than the average.

Defend:

- If the weak rate is greater than 0.3, the bot sends ships between its own planets.
- The destination planet is the weakest planet (minimum number of ships).
- The source planet is the strongest planet that is different from the destination planet, ensuring support even if all planets have the same number of ships.
- If the bot has only one planet left, the "defend" mechanism is not applicable, and the bot switches to "attack" mode.

## Findings:

	<u>BestWorth</u> vs Simple	<u>BestWorth</u> vs <u>TacticalAnalysis</u>	Simple vs <u>TacticalAnalysis</u>
<u>map0.txt</u>	<u>BestWorth</u> wins in 111 steps	<u>BestWorth</u> wins in 81 steps	N/A (>1000 frames)
<u>map5.txt</u>	Simple wins in 457 steps	<u>TacticalAnalysis</u> wins in 288 steps	<u>TacticalAnalysis</u> wins in 86 steps
<u>map10.txt</u>	<u>BestWorth</u> wins in 358 steps	<u>BestWorth</u> wins in 413 steps	<u>TacticalAnalysis</u> wins in 148 steps
<u>map20.txt</u>	Simple wins in 304 steps	<u>TacticalAnalysis</u> wins in 222 steps	<u>TacticalAnalysis</u> wins in 233 steps
<u>map30.txt</u>	Simple wins in 631 steps	<u>TacticalAnalysis</u> wins in 346 steps	<u>TacticalAnalysis</u> wins in 23 steps
<u>map50.txt</u>	Simple wins in 242 steps	<u>BestWorth</u> wins in 151 steps	Simple wins in 41 steps
<u>map100.txt</u>	Simple wins in 566 steps	<u>TacticalAnalysis</u> wins in 414 steps	<u>TacticalAnalysis</u> wins in 191 steps

Since my bots do not utilize randomness, I conducted a single run for each test case.

[Include the table of results here]

1. "BestWorth" vs "Simple":

- The main difference between the two bots is the chosen destination: BestWorth selects the enemy or neutral planet with the minimum number of ships (strongest), while Simple chooses the one with the maximum growth rate (wealthiest).

- The Simple bot slightly outperforms the BestWorth bot, winning in most test maps with a few exceptions.

2. "BestWorth" vs "TacticalAnalysis":

- The TacticalAnalysis bot is designed as an advanced version of the BestWorth bot and generally performs better.

3. "Simple" vs "TacticalAnalysis":

- In very simple maps (e.g., map0.txt), both bots make similar decisions, resulting in an indefinite match.
- In more complex maps, the TacticalAnalysis bot generally performs better due to its additional functionalities, such as selecting nearby attacking targets and switching to "defend" mode when the weak rate exceeds 0.3.

### **Open Issues, Risks, and Recommendations:**

The TacticalAnalysis bot does not consistently outperform the Simple bot and is sometimes defeated by the BestWorth bot. This suggests that the analysis mechanism may not be fully optimized. Potential improvements include:

- Adjusting the mode-switching criteria based on the number of conquered planets remaining the same or decreasing after consecutive actions.
- Sending more ships per fleet or increasing the number of fleets.
- Further refining the decision-making process based on additional factors and game state analysis.