

Large Language Models Play StarCraft II: Benchmarks and A Chain of Summarization Approach

Weiyu Ma^{1,2}, Qirui Mi^{1,2}, Xue Yan^{1,2}, Yuqiao Wu^{1,2}, Runji Lin^{1,2},
 Haifeng Zhang^{*1,2,4}, Jun Wang^{*3}

¹ Institute of Automation, Chinese Academy of Sciences, China

² School of Artificial Intelligence, University of Chinese Academy of Sciences, China

³ Department of Computer Science, University College London, UK

⁴ Nanjing Artificial Intelligence Research of IA, China

Abstract

StarCraft II is a challenging benchmark for AI agents due to the necessity of both precise micro-level operations and strategic macro-awareness. Previous works, such as Alphastar and SCC, achieve impressive performance on tackling StarCraft II, however, still exhibit deficiencies in long-term strategic planning and strategy interpretability. Emerging large language model (LLM) agents, such as Voyage and MetaGPT, presents the immense potential in solving intricate tasks. Motivated by this, we aim to validate the capabilities of LLMs on StarCraft II, a highly complex RTS game. To conveniently take full advantage of LLMs' reasoning abilities, we first develop textual StratCraft II environment, called TextStarCraft II, which LLM agent can interact. Secondly, we propose a Chain of Summarization method, including single-frame summarization for processing raw observations and multi-frame summarization for analyzing game information, providing command recommendations, and generating strategic decisions. Our experiment consists of two parts: first, an evaluation by human experts, which includes assessing the LLMs' mastery of StarCraft II knowledge and the performance of LLM agents in the game; second, the in-game performance of LLM agents, encompassing aspects like win rate and the impact of Chain of Summarization. Experiment results demonstrate that: 1. LLMs possess the relevant knowledge and complex planning abilities needed to address StarCraft II scenarios; 2. Human experts consider the performance of LLM agents to be close to that of an average player who has played StarCraft II for eight years; 3. LLM agents are capable of defeating the built-in AI at the Harder(Lv5) difficulty level. We have open-sourced the code² and released demo videos³ of LLM agent playing StarCraft II.

1 Introduction

StarCraft II is one of the most popular and challenging esports games in the world today. With its high demands on players in strategic planning and real-time operations, StarCraft II has become an ideal testing platform for AI capabilities. DeepMind's achievement in defeating world Go champion Lee Sedol with AlphaGo[19][20][18]. The BiCNet[16] marks a significant advancement in multi-agent coordination within StarCraft I AI research. StarCraft II emerged as the next conquest for AI. In 2019, DeepMind introduced the groundbreaking AlphaStar[22], which defeated professional

^{*}Corresponding to Haifeng Zhang (haifeng.zhang@ia.ac.cn) and Jun Wang (jun.wang@cs.ucl.ac.uk).

²<https://github.com/histmeisah/Large-Language-Models-play-StarCraftII/tree/main>

³<https://www.youtube.com/playlist?list=PL2vvP3CXffZxrjxSjVAL7QXNFqNq96mcy>

players TLO and MANA in public matches⁴, sparking increased attention from AI researchers. Subsequent releases, such as Mini-AlphaStar[12], a simplified version with fewer network parameters and observation dimensions, and HierNet-SC2[11], capable of reinforcement learning without relying on supervised learning, further demonstrated the evolving landscape of AI in StarCraft II. Various AIs, such as SCC[26](a Terran AI), and DI-Star⁵ (which defeated Chinese professional player Rex in an exhibition match and is deployable for home use), have showcased the advancements in AI development for StarCraft II. The rise of offline reinforcement learning led to the introduction of AlphaStar Unplugged[13] by DeepMind, which surpassed behavior clone AI trained in the original AlphaStar. Despite AI's past successes against professional players, challenges emerged in traditional reinforcement learning for StarCraft II, including issues like lack of interpretability, short-sighted macro decisions, and slow unit transitions.

To address these challenges, we explore the potential of Chain of Thought (CoT)[28] in enhancing LLMs' reasoning abilities, potentially applying them to complex real-time strategic tasks. CoT has been extended to tree structures, resulting in CoT-SC[27] and Thought Trees (ToT)[30], and even to graph structures like Graph of Thought (GoT)[2]. Recent works such as Voyager[24], GITM[34] (Ghost in the Minecraft), and Spring[29] utilize language models as agents[25], learning skills in complex open-world scenarios like Minecraft. In multi-agent tasks, works like Camel[9] and MetaGPT[8] employ multiple language model agents with specific roles to complete complex tasks such as brainstorming and software development[4][17]. In the realm of social simulation, Generative Agents[15] innovatively use language model agents to create 25 different NPCs, simulating a human town to model human society. The introduction of CoT strengthens the reasoning and logical abilities of language models, enabling language model agents to demonstrate strategic interpretability and long-term planning advantages in natural language-described environments, potentially benefiting language model agents playing StarCraft II.

Therefore, this paper aims to leverage the strategic interpretability of language models and the logical reasoning capabilities of CoT to enable language model agents to engage in long-term strategic planning and real-time strategy adjustments in complex real-time strategy games like StarCraft II. To facilitate interaction between LLMs and the StarCraft II client, we propose TextStarCraft II, a text-based environment built on the python-sc2 framework. Using the python-sc2⁶ interface, we present raw game information in textual form, define language commands for common macro actions. For micro actions, we adopt a rule-based methodology akin to the one employed by OpenAI Five in Dota 2[1]. This enables language models to engage in battles against StarCraft II's built-in AI through TextStarCraft II.

Decision-making in StarCraft II involves handling complex information. It demands thorough, long-term planning and the ability to model opponents' strategies. All these tasks must be done while ensuring real-time responsiveness. However, the original Chain of Thought (CoT) method and its improvements encountered three main issues when applied to TextStarCraft II: 1. An inability to comprehend the complex and varied information of StarCraft II, 2. A failure to analyze the trends and game dynamics in StarCraft II situations, and 3. An inability to offer useful suggestions and decisions based on the current game state. To address these challenges, we introduce the Chain of Summarization(CoS) method, aimed at enhancing the LLM Agent's capability to extract and analyze information for making comprehensive decisions. Our CoS method consists of two core modules: single-frame summarization and multi-frame summarization. The first, single-frame summarization, distills key information from raw data to help the LLM agent quickly grasp the current status of the game. The second, multi-frame summarization, processes several steps of critical information. This enables the LLM agent to swiftly analyze the ongoing game situation, offer counter-strategies, and make informed decisions.

In our experiments, we assessed various LLMs' knowledge of StarCraft II by using five part of question-and-answer challenges. Additionally, we compare the performance of different language models with the CoS approach, including GPT3.5-Turbo, GPT3.5-Turbo-16k, GPT4, Finetune-ChatGPT 6b, and Finetune-Llama2 7b. Our findings show that under the CoS method, GPT3.5-Turbo-16k and GPT-4 demonstrate advanced reasoning. They successfully beat the StarCraft II Zerg AI at Harder (Level 5) difficulty playing as Protoss. This success showcases their ability to

⁴<https://www.youtube.com/watch?v=GKX6AcgFOZU>

⁵<https://github.com/opendilab/DI-star>

⁶<https://github.com/BurnySc2/python-sc2>

make complex strategic decisions, including scouting, expanding the economy, building defenses, upgrading research, and switching units. Finally, we conduct ablation experiments to validate the impact of the CoS method and different prompts on the performance of GPT3.5-Turbo-16k. Importantly, our experiments feature a robust evaluation system involving 30 grandmaster-level players and professional StarCraft II players who provide blind assessments of language models' knowledge mastery and strategic capabilities. The contributions of this paper can be summarized as follows:

1. We developed the TextStarCraft II environment, providing a platform for natural language interaction with StarCraft II.
2. We designed the Chain of Summarization (CoS) method, enhancing the language model's multi-layer reasoning capabilities and global decision-making speed, defeating the built-in AI with a harder difficulty level in the latest game versions and maps.
3. The emergence of advanced tactics, including reconnaissance (Fig 5.a and Fig 5.b), economic expansion, defensive building construction (Fig 5.c), research upgrades (Fig 5.d), and unit transitions (Fig 6.a, Fig 6.c, and Fig 6.d). Our experiments show that by utilizing LLMs without additional training, our AI achieves competitive performance in StarCraft II, effectively integrating human strategies. Moreover, our method adapts to the latest game versions and maps through adjustments in both prompts and scripts, showcasing its versatility and prompt-script based adaptability.
4. We invited 30 grandmaster-level StarCraft II players for blind assessments, comparing the knowledge mastery and strategy levels of various large models such as GPT3.5, GPT4, Claude2 and Bard.

2 Related work

StarCraft II Full Game AI: In the era of StarCraft I, a large number of researchers began to study StarCraft AI. BiCNet[16] approach significantly enhanced multi-agent coordination in StarCraft I, marking a key advancement in the field. With the introduction of the PySC2⁷[23] learning environment for StarCraft II by DeepMind and the provision of tens of thousands of replays by Blizzard Entertainment, research on StarCraft II AI began to thrive. By 2019, DeepMind introduced AlphaStar[22], which employed a federated learning approach. It first defeated European professional players TLO and MANA. Later, it was tested on the European ladder server, reaching the level of mid-tier Grandmaster among human players. Ultimately, at the 2019 BlizzCon, it defeated the world's top Zerg player, Serral⁸. This achievement demonstrated that reinforcement learning methods can reach human top-tier levels in such a complex and changeable POMDP environment. This sparked researchers' enthusiasm for StarCraft II, with subsequent works taking AlphaStar as a starting point. PySC2 has since become the only environment for StarCraft II Full Game research. After AlphaStar, research in StarCraft II global game AI can be categorized into two types based on whether it can achieve real-time human-computer gameplay.

Research Without Real-Time Human-AI Interaction Mini-AlphaStar[12] aims to reduce the number of input variables without significantly compromising learning effectiveness. TG[10] achieves efficient StarCraft reinforcement learning using abstract forward models and transfer learning. HierNet-SC2[11] employed data mining combined with hierarchical reinforcement learning, skipping the supervised learning pre-training step and starting training the agent from scratch. DeepMind launched their latest creation, AlphaStar Unplugged[13], which used a large number of human player replays for offline reinforcement learning, and ultimately succeeded in defeating the previous AlphaStar agent trained through behavior cloning.

Research Involving Real-Time Human-AI Interaction TStarBotsX[7] developed a new federated learning approach and utilized rule-guided policy search methods to aid in training the AI agent, successfully defeating master and grandmaster level players from China and the USA. SCC[26] almost perfectly replicates AlphaStar's results and defeated the Chinese champion "Time" in human-computer combat. However, some players and researchers believe that during training and combat,

⁷<https://github.com/google-deepmind/pysc2>

⁸https://www.youtube.com/watch?v=nbiVbd_CEIA

the AI was not limited by reaction speed, EPM, etc. "DI-star"⁹ In addition, DI-star also offers a version that can be locally deployed for home computers, allowing ordinary players to compete against it. In addition, DI-star also offers a version that can be locally deployed for home computers, allowing ordinary players to compete against it.

LLM Agent: Since the emergence of GPT3.5[14], research on LLM agents has begun to rise. Starting with the earliest works like React[31] and Autogpt¹⁰, numerous studies have been inspired by this approach. Research utilizing the innovative environment, MineDojo¹¹[6], has opened new avenues in AI research, focusing on extensive task diversity and open-ended world development, distinguishing it from previous reinforcement learning environments. GITM (Ghost in the Minecraft)[34] successfully decomposed tasks into subtasks and unlocked the entire Minecraft task tree by setting up a Decomposer, Planner, and Interface. Voyager[24] implemented the discovery of new items, unlocking skill trees, and exploring the unknown world through automatic curricula, skill libraries, and iterative prompting. In multi-agent scenarios, "Camel"[9] designed a role-playing framework, allowing language models to collaborate and align with human intent. "MetaGPT"[8] integrated SOPs (Standard Operating Procedures) into multiple agents, enabling LLM agents to collaborate in a pipeline of roles, accomplishing software development tasks. In social simulation, "Generative Agents"[15] innovatively built a virtual town using LLM agents, supporting 25 agents with distinct personalities to communicate and establish social relationships.

Although these studies about starcraft II achieved powerful agents, some could defeat StarCraft II's Level 10 built-in AI (e.g., TG), while others could beat human professional players (e.g., "SCC", "DI-star"). However, all have shortcomings such as a lack of long-term strategies, unexplainable tactics, and the inability to adapt troop compositions based on the opponent's status. From the current work on LLM agents, we see their potential in addressing issues like the lack of long-term strategies in StarCraft II Full Game. Through our research, we found that the mainstream LLM agent studies have chosen GPT3.5-turbo and GPT4 and achieved excellent results. Therefore, we chose the GPT3.5-turbo-16k model for our LLM. And the existing StarCraft II learning environment, PySC2, does not support natural language interaction. Hence, we proposed "TextStarCraft II", a StarCraft II environment that allows natural language interactions

3 TextStarCraft II

We introduce "TextStarCraft II", a novel text-based interface for the StarCraft II environment. This interface is specifically designed to enable LLM agents to interact in a way similar to that of Reinforcement Learning (RL) agents. Built upon the 'python-sc2' framework, known for its extensive API and thorough documentation, TextStarCraft II provides detailed textual game data, which enhances the decision-making capabilities of LLM agents in the context of StarCraft II."

The environment is consist of original StarCraft II game client and two adapters (We developed):

1. **Observation-to-Text Adapter:** Transforms game details into textual data, making the game's complex scenarios comprehensible to LLM agents.
2. **Text-to-Action Adapter:** Interprets textual commands from the agents, turning them into actual game moves.

POMDP Formulation for TextStarCraft II We formulate the TextStarCraft II as a multi-agent Partially Observable Markov Decision Process (POMDP). Denote the POMDP as a tuple $\langle \mathcal{S}, \mathcal{A}, \mathcal{R}, \Omega, \mathcal{T}, \mathcal{O} \rangle$. \mathcal{S} is the state space of the underlying StarCraft II game engine, which is not directly observable to the agents. Ω is the observation space, in which an observation $o \in \Omega$ consists of resources, buildings, enemy information, etc. The observation $o \in \mathcal{V}^K$ is represented by natural language sentences, where \mathcal{V} is the vocabulary with finite words in it. $\mathcal{A} = \{\mathcal{A}_P, \mathcal{A}_M\}$ is the action space, which combines the primitive action space \mathcal{A}_P of StarCraft II and the high-level action space \mathcal{A}_M of the macro actions. Each macro action is a sequence of primitive actions to complete a subgoal, such as producing units, building structures, and researching technologies. \mathcal{R} is the reward function, and the reward $\mathcal{R}(s, a)$ belongs to $\{-1, 0, 1\}$ representing lose, draw and win respectively.

⁹<https://github.com/opendilab/DI-star>

¹⁰<https://github.com/Significant-Gravitas/AutoGPT>

¹¹<https://github.com/MineDojo/MineDojo>

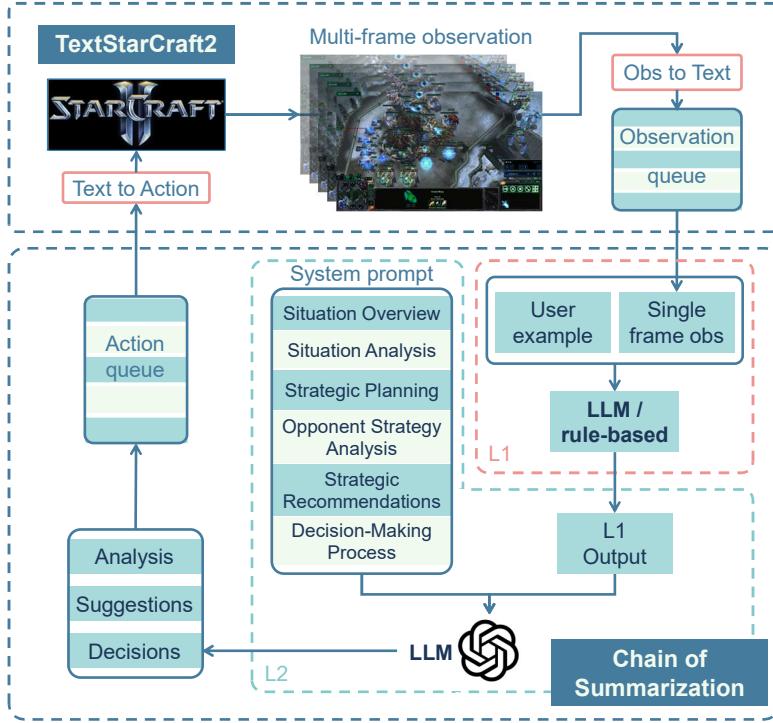


Figure 1: **Interacting with Large Language Models: The Enhanced Chain of Summarization Method in TextStarCraft II.** A streamlined approach to LLM-driven strategic gameplay, the method starts with *Initialization*, converting the game’s initial data to text then queuing it for processing. *Single-Frame and Multi-Frame Summarization* follows, refining observations and summarizing them into actionable insights through advanced LLM reasoning. The *Directive Formulation and Action Scheduling* phase segments the insights into specific actions, populating an action queue for subsequent execution. Finally, *Action Retrieval and Execution* implements these actions within the game, closing the loop by converting new data into text for continuous interaction. This cyclical process advances LLM performance in the complex, strategic environment of TextStarCraft II.

$\mathcal{T} : \mathcal{S} \times \mathcal{A} \rightarrow \mathcal{S}$ is the deterministic transition function, which is a mapping to the next state with the current state and action given. The function $\mathcal{O} : \mathcal{S} \rightarrow \Omega$ maps from the state space to the observation space.

4 Chain of Summarization

In the intensely competitive and highly complex game of StarCraft II, making efficient and professional decisions is crucial. Existing Chains of Thought (CoT) methods and their derivatives perform well in simple tasks but still face challenges in complex decision-making and comprehensive analysis required in StarCraft II. These include difficulties in understanding the game’s situation, slow interaction speed, and less professional decision-making. To address these challenges, inspired by the cache mechanism of computer hardware and frame skipping techniques in reinforcement learning, we propose the Chain of Summarization method. We optimize the decision-making process through the following key strategies:

Information Compression: We summarize and abstract game data, eliminating unnecessary informational noise to extract the most critical game information.

Inference Acceleration: Abandoning traditional single-frame reasoning, we employ multi-frame information for a comprehensive analysis of the game situation and strategy formulation. This approach significantly reduces the time from analysis to action implementation.

Algorithm 1 Chain of Summarization (CoS)

Input: The game round is current at the i -th period. Frame number K per period. The observations of the $i - 1$ period: $\{o_{(i-1)*K+1}, \dots, o_{i*K}\}$.

Output: $\{a_{i*K} + 1, \dots, a_{(i+1)*K}\}$: predicted action sequence for the i -th round

- 1: Initialize observation summary list $\hat{O} = \{\}$
- 2: **for** $j = (i - 1) * K + 1$ to $i * K$ **do**
- 3: Perform single-frame summarization as Eq. (1): $\hat{o}_j \leftarrow \mathcal{F}(o_j)$
- 4: Add \hat{o}_j to summary list: $\hat{O} = \hat{O} \cup \{\hat{o}_j\}$
- 5: **end for**
- 6: Perform multi-frame summarization as Eq. (2): $\mathcal{S}_i = \mathcal{A}(\hat{o}_{(i-1)*K+1} \dots \hat{o}_{i*K}, \text{prompts})$
- 7: Apply Chain of Thought reasoning as Eq. (3): $v_i = \text{CoT}(\mathcal{S}_i, \text{prompts})$
- 8: Extract the predicted K step actions Eq. (4): $\{a_{i*K+1}, \dots, a_{(i+1)*K}\} \leftarrow \mathcal{E}(v_i)$
- 9: **return** $\{a_{i*K+1}, \dots, a_{(i+1)*K}\}$

Global Understanding: By compressing key information and using multi-frame analysis to discern game trends, language models can understand complex game strategies and dynamics, enabling professional decision-making and promoting higher-level strategic planning.

The **Chain of Summarization** method is capable of handling the intricacies and fast-paced strategies of StarCraft II, facilitating efficient and strategically significant decision-making.

4.1 Components of Chain of Summarization

The **Chain of Summarization** comprises: Single Frame Summarization, Multi-Frame Summarization, and Action Extraction for Action Queue.

Single-frame Summarization (Level-1 Summarization): Because it is redundant and difficult for LLMs to understand the raw observation representation from TextStarCraft. This method compresses and extracts essential information from the TextStarCraft’s raw observation. During this phase, dense and intricate text-based observational data from TextStarCraft II is condensed, preparing it for more efficient subsequent processing. Denote the Single-frame Summarization module as $\mathcal{F}(\cdot)$, the processed observation as \hat{o} , and the whole process is formally written as:

$$\hat{o} = \mathcal{F}(o). \quad (1)$$

The compression can be implemented in two different ways: a language model-based approach and a rule-based approach. The language model-based approach employs few-shot learning, which, although time-consuming, allows for an analysis more in line with game rules using Large Language Models (LLMs), resulting in better compression outcomes. To reduce processing time, we improved upon previous methods and developed a rule-based approach. This method employs rules for extraction and filtering to ultimately distill key information, providing a faster but less precise alternative. For the sake of accelerating interactions, our experiments primarily utilize the rule-based approach.

Multi-frame Summarization(Level-2 Summarization): Existing works [32; 3] adapt the paradigm of querying LLMs at each time step for actions to solve decision-making tasks. However, due to the high computation cost for LLM inference and the long time duration of StarCraft game, the per-time query paradigm is not suitable. Additionally, LLMs need to understand game’s situation and evolving dynamics by analyzing multiple game frames simultaneously, facilitating complex reasoning. To address this, we introduce the Multi-frame summarization method, inspired by the caching mechanisms of computer hardware and the frame skipping techniques in reinforcement learning. This method aims to bridge the speed disparity between the fast-paced game environment and the slower LLM inference while ensuring real-time decision efficiency and enhance the LLMs understand ability in complex environment. Instead of querying LLMs at each time step, our method uses LLMs to aggregate the observations for K steps and generate K actions next corresponding to each time step by querying LLMs one time. Every K frames (time steps), the level-1 summarized observations $\{\hat{o}_{(i-1)*K+1}, \dots, \hat{o}_{i*K}\}$ are aggregated into a period summarization, we call that situation overview,

Algorithm 2 Chain of Summarization Interaction in TextStarCraft II

Input: Environment: env (TextStarCraft II); Chain length: K; Frame Queue: FQ; Action Queue: AQ; Chain of Summarization: CoS

- 1: Initialize the TextStarCraft II environment
- 2: $o_0 \leftarrow \text{env.reset}()$ ▷ Initial observation
- 3: $a_0, \dots, a_k \leftarrow \text{CoS}(o_0)$ ▷ Generate initial actions
- 4: AQ.enqueue(a_0, \dots, a_k)
- 5: **while** not env.is_terminated() **do**
- 6: $\text{action} \leftarrow \text{AQ.dequeue}()$
- 7: $reward, obs \leftarrow \text{env.step}(\text{action})$
- 8: FQ.enqueue(obs)
- 9: **if** len(FQ) $\geq K$ **then**
- 10: $o_{(i-1)*K}, \dots, o_{i*K} \leftarrow \text{FQ.dequeue}()$
- 11: $a_{i*K}, \dots, a_{(i+1)*K} \leftarrow \text{CoS}(o_{(i-1)*K}, \dots, o_{i*K})$
- 12: AQ.enqueue($a_{i*K}, \dots, a_{(i+1)*K}$)
- 13: **end if**
- 14: **end while**
- 15: **return** total_reward

S_i for the period i . Formally, the aggregation process is written by:

$$S_i = \mathcal{A}(\hat{o}_{(i-1)*K+1} \dots \hat{o}_{i*K}, \text{prompts}) \quad (2)$$

With period summarization, the CoT reasoning is then performed to process the complex reasoning for decision-making. In the TextStarCraft II game, the CoT process performs below reasoning steps by step with deliberately designed prompts:

1. **Situation Overview:** Review the current batch of L1 observations and summarize the prevailing state.
2. **Situation Analysis:** Evaluate the current state, gauge the strengths and weaknesses of both sides, and discern the strategies being deployed by each.
3. **Strategic Planning:** Based on the current situation, propose tactics that our side should adopt.
4. **Opponent Strategy Analysis:** Based on the current situation, we analyze the enemy's strategy and intentions.
5. **Suggestion Formulation:** Given our strategic position and tactics, offer logical recommendations.
6. **Decision-Making Phase:** Formulate decisions based on insights and recommendations from the preceding five stages.

Assume v_i as the thoughts for observation summarization S_i generated by the CoT process, written as:

$$v_i = \text{CoT}(S_i, \text{prompts}) \quad (3)$$

Action Extraction for Action Queue The action queue is a bridge connecting the multi-frame summarization results, denoted as v_i , with the TextStarCraft II environment, ensuring seamless communication between the LLM and TextStarCraft II. Within v_i , three components exist: analysis, suggestions, and decisions. To extract actionable items from the decisions, we utilize regular expression matching and similarity searching techniques through the action extractor \mathcal{E} . Extracted actions are then stored in the action queue, primed for execution within TextStarCraft II. Specifically, actions designated for the time steps between $i * K + 1$ and $(i + 1) * K$ are derived from thoughts in v_i . The extraction can be represented as:

$$a_{i*K+1} \dots a_{(i+1)*K} = \mathcal{E}(v_i). \quad (4)$$

4.2 Interacting with the Environment Using Chain of Summarization

Figure 1 illustrates the interaction process within the TextStarCraft II environment using the Chain of Summarization method. Implementing the **Chain of Summarization** within game interactions

involves four stages: initialization, single-frame and multi-frame summarization, directive formulation and action scheduling, and action retrieval and execution. The Chain of Summarization method excels in eliciting the macro-decision capabilities of the Large Language Model (LLM), enabling the generation of high-level, quality decisions from a plethora of game observations. Additionally, to further enhance interaction speed, we have set the environment’s interaction frequency to a 2:1 ratio, utilizing one frame of information in TextStarCraft II to represent two actual frames in the StarCraft II game, thereby interacting every two frames.

Stage 1: Initialization Central to our method is the parameter \mathbf{k} , which sets the number of text-based observations to be synthesized. TextStarCraft II converts the initial first-frame information into textual observations through an observation-to-text adapter, storing it in the frame queue, FQ. The Chain of Summarization then processes only one frame observation, and generates an action sequence of length \mathbf{k} , ensuring the smooth progression of subsequent processes.

Stage 2: Single-Frame and Multi-Frame Summarization During the core interaction stage, the system extracts \mathbf{K} observations from the frame queue, FQ, specifically $o_{(i-1)*K} \cdots o_{i*K}$. These observations undergo an initial refinement through the Single-frame Summarization function $\mathcal{F}(.)$, resulting in a set of processed observations: $\hat{o}_{(i-1)} * K \cdots \hat{o}_i * K$. Following this, the Multi-frame Summarization phase commences, consisting of two key procedures. First, the aggregation function \mathcal{A} consolidates the processed observations $\hat{o}_{(i-1)*K} \cdots \hat{o}_{i*K}$ into an integrated situation overview, designated as \mathcal{S}_i . Next, the system applies the Chain of Thought (CoT) reasoning method, CoT, directly to \mathcal{S}_i . This application synthesizes the data into a final, actionable output, represented as v_i , ready for execution. This streamlined process ensures efficient decision-making, drawing from comprehensive data analysis and strategic reasoning.

Stage 3: Directive Formulation and Action Scheduling This stage refines the outputs from the Multi-frame Summarization v_i , segmenting them into distinct categories: analysis, suggestions, and decisions. Utilizing an action extractor \mathcal{E} , the system translates these comprehensive thought processes v_i into a series of specific actions, denoted as $a_{i*K} \cdots a_{(i+1)*K}$. These formulated actions are then systematically stored in the action queue, referred to as AQ, awaiting deployment.

Stage 4: Action Retrieval and Execution During each engagement cycle with TextStarCraft II, the system retrieves the next sequence of actions from the Action Queue AQ, translating them into executable game commands through a text-to-action adapter. After these commands are executed within the game environment, TextStarCraft II reciprocates by converting the new game data into textual format via an observation-to-text adapter, subsequently enqueueing it. Beyond the initial setup, every operational cycle of the Chain of Summarization method enriches the frame queue with an additional \mathbf{k} frames of observational data o , perpetuating the data processing and decision-making continuum.

Our Chain of Summarization method, invoked once every \mathbf{k} frames, demonstrates its efficiency in handling and responding to high-risk, multifaceted information in fast-paced, strategy-intensive environments. It underscores the effectiveness of the Chain of Summarization method in fostering rapid and prudent decisions in complex tasks, especially where traditional modes of thinking fall short. Through this innovative approach, we have significantly enhanced the language model’s performance in intricate environments like StarCraft II, setting the stage for potential future applications.

5 Experiment

5.1 Evaluation of the Chain of Summarization Method

We chose GPT3.5-turbo-16k as our Large Language Model (LLM) and conducted tests in scenarios both with and without the Chain of Summarization (CoS) method. Notably, the python-sc2 package facilitates an interaction frequency of around 55 times every 10 seconds. Table 1 presents the comparative results of using CoS and not using it.

Without Multi-level Summarization: From an analysis of the number of API calls, playing a game of StarCraft II with game time 21 minutes, required approximately 7,000 API calls, leading to high costs and a total duration of roughly 70 hours (assuming that each API call requires approximately

Table 1: Performance Comparison Between Methods With and Without Chain of Summarization: Interaction frequency is approximately 55 times in 10 seconds, assuming each API call takes about 1.66 seconds and game . Using the Chain of Summarization significantly accelerates decision-making speed and reduces the number of API calls.

Method	Number of API Calls	Time Cost (hours)
With Chain of Summarization	700	7
Without Chain of Summarization	7,000	70

1.66 seconds). In terms of decision-making, without the use of the chain of summarization method, the LLM lacked the capability for strategic planning and decision-making.

With Chain of Summarization: Analyzing the number of API calls, playing a game of StarCraft II necessitated around 700 API calls, resulting in relatively lower costs and an average game duration of about 7 hours. In terms of decision-making capabilities, the use of the chain of summarization allowed the LLM to comprehend complex information in StarCraft II, distill critical game data, formulate strategic overviews, and make effective decisions.

The Chain of Summarization not only significantly reduced the need for excessive API calls, saving time, but also notably enhanced the LLM’s game comprehension and strategic abilities. This enabled the LLM to analyze, judge, and strategize at a strategic level for complex scenarios like StarCraft II.

5.2 Impact of Different Prompts on Strategy Formulation

Table 2: Comparison of LLM Agents’ Win Rates Against Various Difficulty Levels of Built-in AI in TextStarCraft II with Chain of Summarization Using Different Prompts. Notably, Prompt2 significantly enhances LLM agent performance, enabling victories against the Harder difficulty level of built-in AI.

LLMs	Difficulty Level					
	VeryEasy	Easy	Medium	Hard	Harder	Very Hard
GPT3.5-turbo-16k with prompt1	2/2	TBD	TBD	0/2	TBD	TBD
GPT3.5-turbo-16k with prompt2	8/8	9/9	8/8	21/25	7/14	0/12

We used the GPT3.5-turbo-16k model as our LLM, applying the Chain of Summarization method with two different types of prompts. In this context, ‘prompt’ specifically refers to the prompts used in the multi-frame summarization method. We evaluated the effectiveness of these prompts in the TextStarCraft II environment, where the LLMs, playing as Protoss, faced off against Zerg opponents of varying difficulties. The results, displayed in Table 2, demonstrate that Prompt2 significantly enhances the performance of the LLM agents.

Simple Thought Chain : In this context, we employ prompt1(In appendix Prompt1) to initiate a fundamental reasoning sequence, enabling the LLM agent to perform an elementary understanding and analysis of StarCraft II dynamics. This approach facilitates basic operations like generating workers, establishing new bases, producing combat units (e.g., Protoss Zealots or Zerg Roaches), and conducting reconnaissance. Nevertheless, it falls short of undertaking research upgrades or accessing advanced technologies, signifying that prompt1 limits the LLM’s capacity for in-depth strategy formulation or comprehensive awareness of the ongoing game scenario.

Complex Thought Chain : Prompt2 (In appendix Prompt2) assimilates insights regarding StarCraft II’s intricate mechanics, necessitating that the LLM navigates six critical phases: Situation Overview, Situation Analysis, Strategic Planning, Opponent Strategy Analysis, Strategic Recommendations, and the Decision-Making Process(In appendix Prompt2). This holistic cognitive pathway empowers the LLM agent to engage in nuanced game aspects, such as initiating research upgrades, exploring the tech tree, erecting defensive infrastructures, transitioning military compositions, and orchestrating diversified forces. Demonstrably, it exhibits proficiency in clinching victories over the “buil-in”



(a) Amidst rising tensions, the Zerg initiates an assault on the Protoss base.



(b) The Zerg's roach and hydra assault gains momentum against the Protoss.



(c) The Zerg's onslaught continues, pressuring the Protoss's second base.



(d) The Zerg are attacking the Protoss main base, and the Protoss are defending with shield batteries and voidrads.



(e) Protoss defended with voidrads and phoenixes, leaving one roach damaging their weakened base.



(f) Protoss prioritizes economy and voidray production, alongside researching phoenix range upgrade.



(g) Protoss defends Zerg's roach and hydra attacks with voidrads and phoenixes.



(h) Protoss protected their third base from Zerg roach and hydra assault with voidrads and phoenixes.

Figure 2: Protoss Strategic Defense Against Zerg Assaults: In the depicted scenes from StarCraft II, the LLM agent, controlling the Protoss, initially faces losses including the destruction of the second base during a Zerg Roach-Hydra assault. Despite this, the Protoss strategically expand their economy and transition to an air force with Void Rays and Phoenixes, successfully repelling a subsequent Zerg attack.

AI, "Harder" (level 5) difficulty level opponents, underlining its strategic acumen in complex gaming scenarios.

We discovered that it's necessary to teach LLMs how to analyze the StarCraft II game. Formerly simple analytical prompts do not suffice for the LLM to understand the specialized information within StarCraft II. We need to design prompts reflecting the intricate thought processes of StarCraft II players, based on the game's characteristics, to enhance LLMs' comprehension abilities regarding StarCraft II itself.

5.3 Performance Evaluation of Various Large Language Models

Here, we evaluated only GPT3.5-Turbo, GPT3.5-Turbo-16k, GPT4, and models finetuned with data collected via GPT, namely Finetune-ChatGlm2 6b and Finetune-Llama2 7b. When testing the capabilities of different Large Language Models (LLMs), we uniformly applied the chain of summarization method and consistent prompts to assess their performance in the TextStarCraft II environment (Figure 1). In this context, we set LLMs to function as Protoss players, contending against built-in Zerg opponents of Harder.

GPT3.5: We observed performance differences between GPT3.5-Turbo and GPT3.5-Turbo-16k within the TextStarCraft II scenarios. Our TextStarCraft II setting is highly complex, and under the chain of summarization approach, it requires the LLM to undertake intricate analysis and understanding of multi-frame information. The GPT3.5-Turbo model, with its 4k window, could generate only the analysis segment due to window size constraints, failing to produce the final suggestion and decision sections, resulting in an inability to play TextStarCraft II effectively. In contrast, the 16k version, with its extended processing window, does not truncate prematurely and can provide complete outputs. In extensive testing under these conditions, we found that the LLM agent could defeat AI opponents up to the "Harder" difficulty.

GPT4: We also conducted limited testing with GPT4. We utilized GPT4 for tests against the built-in "Harder" difficulty within TextStarCraft II. Our tests revealed that GPT4 is incapable of overcoming the built-in AI at the "Very Hard" level. Observations from replaying the matches indicated that GPT4's performance did not significantly surpass that of GPT3.5 16k.

Finetune-ChatGlm2 6b [5] and **Finetune-Llama2 7b** [21]: We employed the GPT3.5-Turbo-16k model as the LLM agent, using data from interactions under TextStarCraft II to finetune these two models. We discovered that, within the complex TextStarCraft II environment, even with game-specific data finetuning, these models could not comprehend the intricacies of StarCraft II gameplay, producing disorganized responses. They remained incapable of effectively playing TextStarCraft II.

5.4 Assessing LLMs' Mastery of StarCraft II Concepts

Preliminary Evaluation: After the release of GPT-4, we utilized **build order** data from renowned StarCraft II forums such as Team Liquid¹² and Spawning Tool¹³ to assess the understanding of StarCraft II by GPT-3.5 and GPT-4. We observed that these models demonstrated a decent level of understanding and analytical ability regarding game situations. However, they often overlooked aspects like the tech tree and supply constraints, leading to shortcomings in accuracy.

In-depth Evaluation: To explain why LLM agents can play StarCraft II using the CoS method in the TextStarCraft II environment, we propose that these LLMs have acquired extensive knowledge about StarCraft II during their pre-training. This encompasses extensive textual knowledge about StarCraft II, covering aspects like build orders, game details, the history of the game's development, and esports information. To validate our hypothesis that LLM agents have acquired a wealth of StarCraft II knowledge during their pre-training, we adopted a unique approach. We posed questions to the language models and had human experts and GPT4 models blindly rate the responses. This method assessed the LLMs' understanding of StarCraft II knowledge. The models evaluated were GPT-3.5, GPT-4, Claude2, and Bard. Our questions covered five key areas:

¹²https://liquipedia.net/starcraft2/Main_Page

¹³<https://lotv.spawningtool.com/>

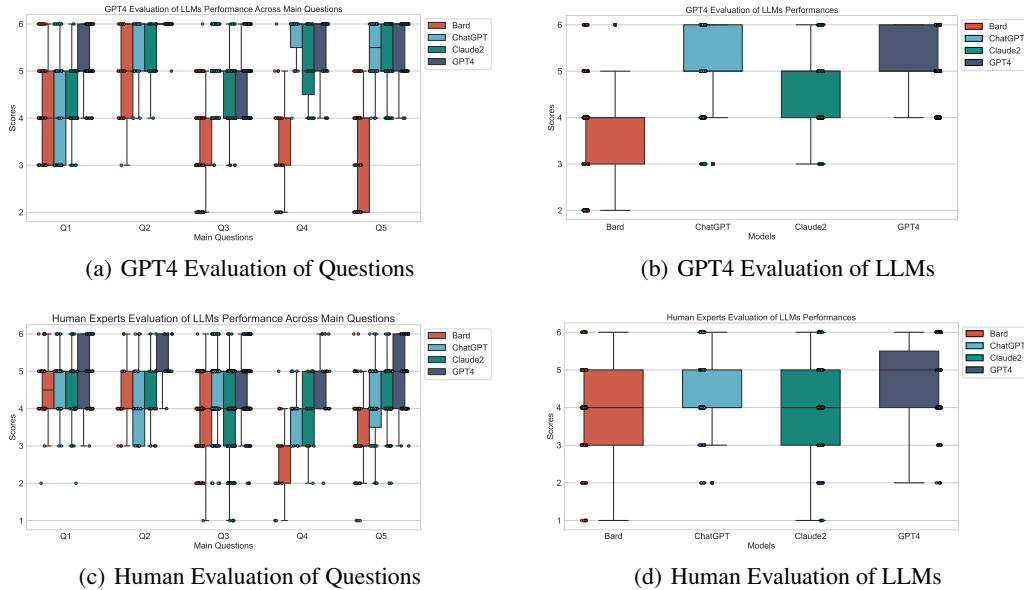


Figure 3: The result of Double-Blind Assessment. In our double-blind assessment, 30 human experts were invited to conduct evaluations, and separately, GPT-4 was used to perform 30 evaluations. The results revealed that Bard’s responses were the least effective among the LLMs, particularly in questions 3, 4, and 5. It was observed that GPT-4 tended to give higher scores to GPT-3.5 and itself, indicating a significant variance in ratings across different LLMs. In contrast, human experts, while rating GPT-4 highly, generally scored the other models more evenly, demonstrating less disparity in their evaluations.

1. Basic Knowledge of StarCraft II.
2. Racial Mechanics in StarCraft II.
3. Typical Strategies in StarCraft II for Different matchups.
4. Standard build orders for each race.
5. Classic Strategies and Counterplays in StarCraft II.

For detailed questions and LLM responses, please refer to the appendixB.

Evaluation Methodology: We employed a double-blind evaluation method, hiding and randomizing the order of responses during the review and scoring by human experts and GPT-4. This approach mitigates biases to a certain extent, focusing solely on the content and comprehension of the responses themselves.

Evaluation Results: Our evaluations by 30 human experts and GPT-4 (see Figures 3) reveal that:

- **ChatGPT and GPT4:** Both human experts and GPT-4 evaluations indicate that GPT-4 and ChatGPT perform significantly better than other models in addressing StarCraft II questions, with GPT-4 outperforming ChatGPT. Their responses align more closely with the game dynamics of StarCraft II and match players’ common understanding. Notably, GPT-4 can generate professional build ordersB.4 that take into account the game’s mechanics and unique racial features, rivaling the expertise found on professional gaming websites.
- **Bard:** Bard’s responses in the StarCraft II QA were not as effective as those of other LLMs, especially in areas covered by questions 3, 4, and 5. Both human experts and GPT-4 evaluations highlighted significant errors in Bard’s answers, expressing dissatisfaction. Notably, Bard’s build orders did not align with the game’s dynamics and logic. This misalignment is a critical flaw for decision-making in StarCraft II, significantly impacting the effectiveness of gameplay strategies.

- **Claude2:** Although Claude2’s performance is not as strong as GPT-4 and it shows considerable variability in answer quality, it generally satisfies human experts in most questions, achieving results comparable to ChatGPT.

Based on the combined ratings from human experts and GPT-4, the models’ proficiency in StarCraft II knowledge is ranked as follows: GPT-4 > GPT-3.5 > Claude2 > Bard. Despite varying levels of ability, all these models have acquired a substantial amount of StarCraft II-related knowledge through pre-training. Interestingly, when GPT-4 was involved in the evaluation, it tended to give higher scores to GPT-3.5 and itself, but lower scores to Bard. GPT-4’s ratings showed significant variances across different LLMs. In contrast, human experts, while also rating GPT-4 highly, tended to score the other LLMs more evenly, without such large disparities.

5.5 Strategic Patterns and Behavior Analysis of ChatGPT in StarCraft II

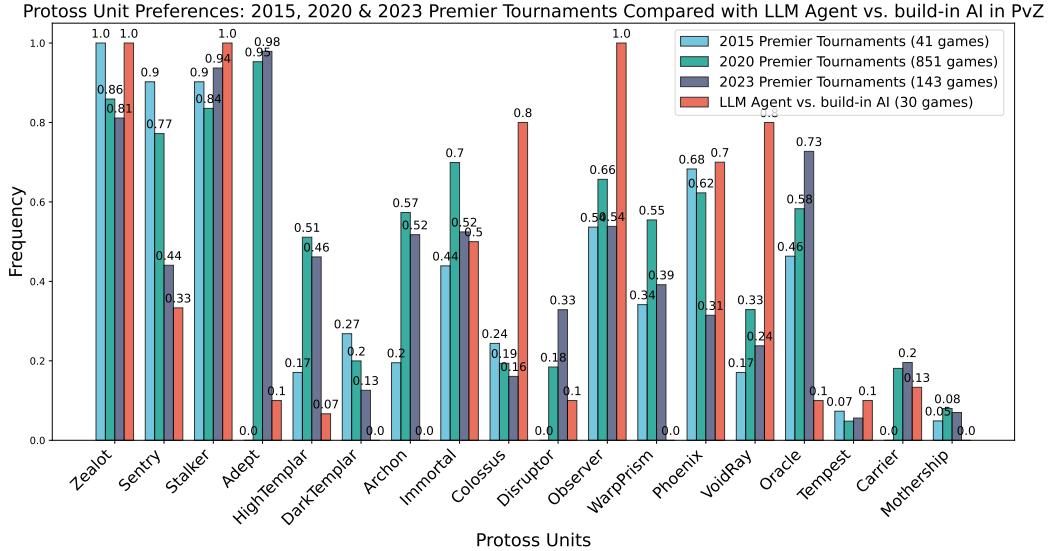


Figure 4: Unit preferences of starcraft II players

We conducted a further analysis of ChatGPT’s performance and strategic choices in StarCraft II, as illustrated in Figure 4. This analysis draws on data from 30 replays involving the GPT3.5 16K model, which employed the chain of summarization method and played as Protoss against the built-in Zerg AI on "Harder(1v5)" difficulty. Our study chiefly investigates ChatGPT’s army composition and unit preferences, uncovering pronounced patterns and specific strategic tendencies in its decision-making process.

Untapped Units: Despite having access to the necessary tech tree, LLM agents consistently avoid using several units, including the Mother ship, dark templar, archon, and warp prism. This suggests a significant divergence in strategy from top human players, possibly underestimating or overlooking the strategic importance of these units.

Infrequently Used Units: LLM agents show a cautious tendency in training combat units, rarely using oracle, adepts, carriers, tempests, disruptors, sentries, and high templars. This reflects some deficiencies in strategic diversity and adaptability compared to top human players, as these units usually require more intricate micromanagement, which may not be LLM Agents’ forte.

Commonly Used Units: LLM agents prefer using units such as observers, phoenixes, zealots, stalkers, colossi, void rays, and immortals. This indicates a more defense-oriented gameplay style compared to professional human players, favoring units that require less micromanagement in combat.

The strategy of LLM agents resembles that of Protoss players during the 'Heart of the Swarm' era of StarCraft II (Figure 2). It focuses on economic development, building defenses, and upgrading technology, showcasing robust tactics commonly employed by skilled players. However, there is a



(a) In the early game stage, scouting is crucial. The Protoss have decided to dispatch a Probe to scout the enemy’s main base.

(b) The LLM agent values enemy scouting. The Protoss Observer spotted Brood Lords and advanced tech in the Zerg’s third base.



(c) The Protoss employs Shield Batteries as a pivotal defensive strategy against Zerg aggression.



(d) The Protoss are utilizing the Chronoblast ability to accelerate the “Protoss Air Weapon Level 1” upgrade in the Cybernetics Core.

Figure 5: Early and mid-game snapshots of the Protoss (LLM agent), emphasizing defense and scouting.

significant gap between its strategy and that of professional human players, lacking creativity and exhibiting a more monotonous gameplay style.”

5.6 Policy interpretability

Even the AI like AlphaStar, capable of defeating human professional players in StarCraft II, often makes irrational or inexplicable decisions and actions. In contrast, while the LLM agent may not excel at micromanagement like AlphaStar, its capacity for thinking and reasoning enables it to analyze and predict, thereby making more rational decisions. We summarize our findings as follows.

Foreseeing Danger and Constructing Defensive Structures: As shown in Figure 7.a, AlphaStar (blue Zerg) had previously observed the Master Player’s (red Protoss) harassing air unit, Oracle, but failed to construct the anti-air Spore Crawler in advance for defense. This resulted in significant damage when the Master Player used Oracle for harassment, as AlphaStar had insufficient anti-air firepower and could only construct Spore Crawlers reactively. Conversely, the LLM agent, utilizing the Chain of Summarization method, can anticipate potential crises. As depicted, the LLM agent (green Protoss, Figure 7.b) constructed the defensive structure Shield Battery before the attack of the built-in AI (red Zerg), completing it just in time to assist the defense forces in successfully repelling the assault.

Adapting Unit Composition Based on Battlefield Situations: AlphaStar fails to adjust its unit composition in response to the enemy’s forces, not utilizing the most effective troop configurations to defeat the opponent. Specifically, in Figure 13.a, AlphaStar (blue Zerg) uses numerous Queens to counter Terran’s Liberators, whereas it should have transitioned to producing Corruptors against Liberators. In Figure 13.b, AlphaStar (red Zerg) builds three Spore Crawlers to defend against the Master Player’s (blue Protoss) Shield Battery and Immortal rush. However, Spore Crawlers, being anti-air structures, offer minimal defense against Immortal attacks. In Figure 13.c, the Master Player’s



(a) The Protoss strategically transitions to a Void Ray-centric composition, adept at countering the might of Zerg’s Ultralisks.

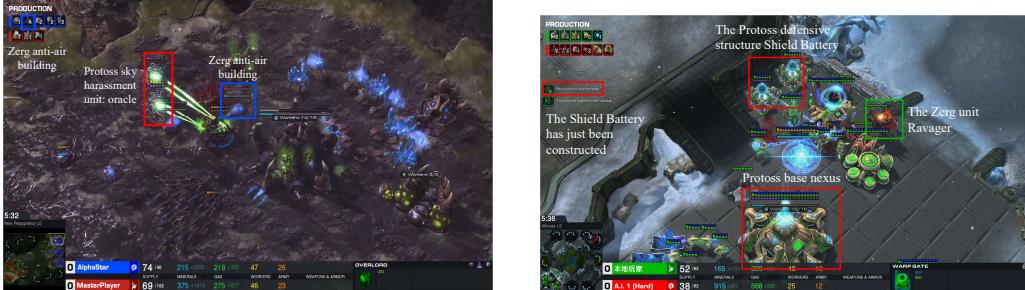
(b) Protoss defended against Zerg’s third wave with phoenixes, tempests, and voidrays.



(c) The Protoss, employing the classic combination of Colossus and Voidray units, successfully decimated the Zerg’s expansion base.

(d) The LLM agent uses stalkers, zealots and observers to counter the Harder AI’s attacks, gradually shifting towards a powerful air unit and Psionic Storm strategy.

Figure 6: Mid to late-game visuals of the Protoss (LLM agent), showcasing mixed-unit assembly and troop transitioning.



(a) Alphastar failed to construct preemptive defensive structures such as Spore Crawlers to prevent Oracle incursions by the MasterPlayer, resulting in inadequate defensive capabilities against the Oracle harassment.

(b) The LLM agent demonstrated proactive defense measures by constructing Shield Batteries ahead of time, indicating its proactive awareness and preparedness for defensive strategies.

Figure 7: The ability to construct defensive structures and anticipate dangers in advance: Alphastar (left) vs. LLM agent (right).

(blue Protoss) army, composed of Immortals and Disruptors, perfectly counters the Zerg’s Roach forces. Yet, AlphaStar (red Zerg), despite being in a strong economic and technological position, continues to produce Roach units without transitioning. In Figure 13.d, the Master Player’s (red Terran) army employs a Bio-Tank (Marine, Medivacs, Marauders, Tanks) composition with almost no air units. AlphaStar (blue Zerg) opts for Corruptors, Ravagers, and Brood Lords, where the abundance of Corruptors is largely ineffective against the Master Player’s ground forces, also compromising mobility.

LLM agent adapts its unit composition based on the enemy’s forces, employing efficient troop configurations to defeat the opponent. In Figure 13.e, the LLM agent (green Protoss) uses Voidrays to counter the built-in AI’s (red Zerg) Roach and Hydra forces, continually producing Voidrays. Since the Roach and Hydra lack anti-air capabilities, Voidrays effectively handle them. In Figure 13.f, the LLM agent (red Protoss) chooses a Stalker and Immortal troop composition against the built-in AI’s (blue Zerg) Roach and Hydra forces. It also upgrades Psionic Storm technology, providing AoE damage effective against Roach and Hydra forces. In Figure 13.g, the built-in AI’s (blue Zerg) forces primarily consist of Ultralisks, while the LLM agent (red Protoss) is producing Immortals, countering Ultralisks through troop transition. In Figure 13.h, the built-in AI’s forces are composed of Banelings and Ultralisks. The LLM agent’s (red Protoss) troops are already capable of handling the opponent’s forces and are transitioning to air units, ensuring subsequent troop transitions and more diverse strategies.

LLM agent utilizes multi-frame summarization to analyze L1 results(Figure 14,16,18,20), achieving outputs(C,C,C,C) that are both interpretable and rational. Compared to AlphaStar, the decision-making(Figure 15,17,19,21) of the LLM agent is aided by human historical experience and logical reasoning. Consequently, in terms of interpretability and rationality, it surpasses AlphaStar.

6 Discussion

In this study, we successfully introduced TextStarCraft II, a textual representation of the starcraft II environment. This representation enables the LLM agent to interact with the starcraft II game solely through natural language. Our novel multi-level summarization approach allows the language model to understand the game’s progression and discern strategies employed by both allies and adversaries. Coupled with our tailored prompt design, the language model can leverage historical human gameplay experience and recognize in-game scenarios in starcraft II, subsequently deciding upon the most suitable strategies to adopt.

Compared to previous works on the starcraft II full game, our methodology stands out by achieving competitive results without the necessity for additional data and training. Specifically, by solely utilizing the gpt3.5 API, our prompt design, and the multi-level summarization technique, we demonstrated zero-shot capability in defeating the medium-hard built-in AI. Furthermore, our LLM agent exemplifies higher-order decision-making capabilities absent in prior works. It excels in Adaptive Strategic Adjustment(Fig6.a), aligning its strategies in real-time with the opponents’ troop transitions. The agent also demonstrates prowess in Technological Evolution and Innovation(Fig5.c), advancing in various tech domains proactively. It embodies Crisis Prevention and Management(Fig5.d) by constructing defensive structures preemptively, showcasing acute awareness of potential threats. Moreover, the agent’s Macro-economic and Defensive Strategizing(Fig5.c), coupled with its acumen in Intelligence Gathering and Analysis(Fig5.a and Fig5.b) illustrate its comprehensive strategic insight and versatile adaptability in StarCraftII’s intricate environments.

However, despite our achievements against several built-in AIs, we have identified several areas for improvement. **Rule-Based Macro Actions:** The current actions are heavily reliant on human prior knowledge as they are rule-based macro actions. We aim to mitigate this by incorporating hierarchical reinforcement learning in future implementations. **Lack of Visual Information:** The absence of visual input means the LLM agent lacks comprehensive battlefield awareness. Advancements in Visual Language Models (VLMs), such as miniGPT [33], are believed to have the potential to address this limitation. **No Feedback Loop:** The existing environment does not provide a feedback loop, rendering the multi-level LLM agent incapable of learning. The incorporation of a feedback mechanism is in our plans for future research. **Memory Limitations:** Due to API call speed constraints, our model only achieves two-tiered summarization, leading to a lack of both short-term and long-term memory in our LLM agent. This is another area we intend to explore in our subsequent work.

We posit that, moving forward, TextStarCraft II will serve as an excellent benchmark for assessing the capabilities of both LLMs and LLM agents. Pitting LLM agents against each other on TextStarCraft II offers a more intuitive and intricate evaluation approach than traditional dataset assessments. Moreover, we envision a fusion of LLM and reinforcement learning in future starcraft II full game AIs. Such a combination can potentially lead to enhanced strategic gameplay and a heightened degree of interpretability, setting a new standard beyond what has been achieved with AlphaStar.

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Appendix

A Prompt and data Example

Figure 8, 9, 10, 11, and 12 depict sample data from the interaction process between the Chain of Summarization method and the TextStarCraft II environment.

Raw text observation	
1. Game time	game_time: 15:27
2. Resource information	enemy_UnitTypeId.OVERSEER: 2 enemy_UnitTypeId.OVERLORDTRANSPORT: 3 enemy_UnitTypeId.ZERGLING: 3 enemy_UnitTypeId.QUEEN: 1 enemy_UnitTypeId.HYDRALISKBURROWED: 1
3. Military information	worker_supply: 47 mineral: 3005 gas: 4872 supply_left: 29 supply_cap: 131 supply_used: 102 base_count: 6 planning_base_count: 1
4. Building information	dark_shrine_count: 0 robotics_bay_count: 0 fleet_beacon_count: 0 planning_pylon_count: 0 planning_gas_buildings_count: 0 planning_gateway_count: 0 planning_forge_count: 0 planning_photon_cannon_count: 0 planning_shield_battery_count: 0 planning_warp_gate_count: 0 planning_cybernetics_core_count: 0 planning_twilight_council_count: 0 planning_robots_facility_count: 0 planning_statgate_count: 1 planning_templar_archives_count: 0 planning_dark_shrine_count: 0 planning_robots_bay_count: 0 planning_fleet_beacon_count: 0
5. Unit information	enemy_UnitTypeId.INFESTOR: 2 enemy_UnitTypeId.ROACH: 16 enemy_UnitTypeId.HYDRALISK: 5
6. Research information	Zealot_count: 0 stalker_count: 0 sentry_count: 0 adept_count: 0 high_templar_count: 0 dark_templar_count: 0 immortal_count: 0 colossus_count: 0 disruptor_count: 0 archon_count: 0 observer_count: 1 warp_prism_count: 0 phoenix_count: 0 voidray_count: 8 Oracle_count: 0 Carrier_count: 0 tempest_count: 0 mothership_count: 0
7. Enemy Building information	planning_worker_count: 0 planning_Zealot_count: 0 planning_stalker_count: 0 planning_sentry_count: 0 planning_adept_count: 0 planning_high_templar_count: 0 planning_dark_templar_count: 0 planning_immortal_count: 0 planning_colossus_count: 0 planning_disruptor_count: 0 planning_archon_count: 0.0 planning_observer_count: 0 planning_warp_prism_count: 0 planning_phoenix_count: 0 planning_voidray_count: 3 planning_Oracle_count: 0 planning_Carrier_count: 0 planning_tempest_count: 0 planning_mothership_count: 0
8. Enemy Unit information	protoss_air_armor_level_1_research_status: 1 protoss_air_armor_level_2_research_status: 0 protoss_air_armor_level_3_research_status: 0 protoss_ground_armor_level_1_research_status: 0 protoss_ground_armor_level_2_research_status: 0 protoss_ground_armor_level_3_research_status: 0 protoss_ground_weapon_level_1_research_status: 0 protoss_ground_weapon_level_2_research_status: 0 protoss_ground_weapon_level_3_research_status: 0 protoss_shield_level_1_research_status: 0 protoss_shield_level_2_research_status: 0 protoss_shield_level_3_research_status: 0
	enemy_UnitTypeId.HATCHERY: 2 enemy_UnitTypeId.EXTRACTOR: 1 enemy_UnitTypeId.SPAWNINGPOOL: 1

Figure 8: An example of the TextStarCraft II's Raw text observation.

There are two types of system prompts in the 5.2 section.

1. **Prompt1:** You are an AI trained in analyzing and summarizing StarCraft II games. You understand the nuances and strategies of the race race. Based on the summaries of multiple rounds in a game, we want you to analyze the game progression in a structured way. Your analysis should include the following aspects:
 - (a) **Information Overview:** Provide a brief overview of the current situation based on all the rounds.
 - (b) **Current Game Stage:** Determine the stage of the game based on the information of all rounds. Is it the early game, mid-game, or late game?

L1 results	
At 15:27 game time, our current StarCraft II situation is as follows:	cybernetics_core_count: 1 twilight_council_count: 1 robotics_facility_count: 1 statgate_count: 4 planning_base_count: 1 planning_statgate_count: 1
Resources:	
game_time: 15:27 worker_supply: 48 mineral: 3005 gas: 4872 supply_left: 33 supply_cap: 131 supply_used: 98 army_supply: 41 enemy_units_count: 32 base_count: 6	enemy_units_count: 32 base_count: 6 pylon_count: 7 gas_buildings_count: 10 shield_battery_count: 4 warp_gate_count: 5 cybernetics_core_count: 1 twilight_council_count: 1 robotics_facility_count: 1 statgate_count: 4 observer_count: 1 voidray_count: 7 planning_voidray_count: 3
Buildings:	
enemy_units_count: 32 base_count: 6 pylon_count: 7 gas_buildings_count: 10 shield_battery_count: 4 warp_gate_count: 5	in-process: planning_base_count: 1 planning_statgate_count: 1 planning_voidray_count: 3
Units:	
	research: warpgate_research_status: 1 protoss_air_armor_level_1_research_status: 1
	Enemy Information: enemy_units_count: 32 enemy_UnitTypeId.ROACH: 15 enemy_UnitTypeId.OVERLORDTRANSPORT: 3 enemy_UnitTypeId.HYDRALISKBURROWED: 1 enemy_UnitTypeId.ZERGLING: 3 enemy_UnitTypeId.OVERSEER: 2 enemy_UnitTypeId.HYDRALISK: 5 enemy_UnitTypeId.INFESTOR: 2 enemy_UnitTypeId.QUEEN: 1 enemy_UnitTypeId.HATCHERY: 2 enemy_UnitTypeId.EXTRACTOR: 1 enemy_UnitTypeId.SPAWNINGPOOL: 1

Figure 9: L1 summarization

System prompt	
You are an AI trained in analyzing and summarizing StarCraft II games. You understand the nuances and strategies of the protoss (or zerg) race.	
Based on the summaries of multiple rounds in a game, we want you to analyze the game progression in a structured way. Your analysis should include the following aspects:	
1. Game Overview: Provide a brief overview of the current situation based on all the rounds.	
2. Current Game Stage: Determine the stage of the game based on the information of all rounds. Is it the early game, mid-game, or late game?	
3. Our Situation: Describe our current status in terms of:	
3.1 Units and Buildings: Analyze the state of our units and buildings.	
3.2 Economy: Evaluate our economic condition, including resource collection and usage.	
3.3 Technology: Describe the status of our technological research and what technologies we have unlocked so far. Analyze our technology tree, indicating the available and potential upgrades or units.	
4. Our Strategy: Infer our potential strategy based on our current situation and the information of all rounds.	
5. Enemy's Strategy: Infer the enemy's potential strategy, based on the available information.	
6. Key Information: Highlight the most important aspects from all rounds that have significantly influenced the game.	
For Protoss, keep an eye on Nexus's energy to Chrono Boost important structures.	
Based on the game situation and strategies used by both sides, provide specific suggestions for the following areas:	
1. Our Strategy: Propose adjustments to our current strategy to counter the enemy's moves and capitalize on our strengths.	
2. Units and Buildings: Offer ways to enhance our unit composition and improve our building layout, suited to the current stage of the game.	
3. Economy: Recommend better practices for resource gathering and usage, in line with our strategic needs.	
4. Technology: Suggest focused research paths to gain technological advantages, considering our current research status and technology tree.	
Lastly, consider the current situation and the suggestions provided, make {K} actionable and specific decisions from the action dictionary protoss_action_dict . This dictionary comprises four categories of actions: unit production, building construction, technology research, and other actions. Remember to align these decisions with the current stage of the game, and avoid proposing actions that are not currently feasible.	

Figure 10: System prompt from L2 summarization. This prompt enables the Large Language Model to engage in playing StarCraft 2. The process includes several key steps: Situation Overview, Situation Analysis, Strategic Planning, Opponent Strategy Analysis, and Strategic Recommendations, concluding with the Decision-Making Process.

- (c) **Our Current Strategy:** From the information of all rounds, infer what our strategy might be.
 - (d) **Enemy's Strategy:** Infer what the enemy's strategy might be, based on the information available.
 - (e) **Key Information:** Highlight the most important aspects from all rounds that have significantly influenced the game.
2. **Prompt2:** You are an AI trained in analyzing and summarizing StarCraft II games. You understand the nuances and strategies of the self.race race. Based on the summaries of multiple rounds in a game, we want you to analyze the game progression in a structured way. Your analysis should include the following aspects:

LLM Analysis

1. Game Overview:

At 15:28 game time, our situation is as follows: We have 49 workers, 2970 minerals, and 4884 gas. Our supply cap is at 131 with 33 supply left, and our army supply is 41. We have six bases and a decent number of buildings and units.

2. Current Game Stage:

Based on the game time and resource availability, we are still in the mid-game stage.

3. Our Situation:

3.1 Units and Buildings: We have a diverse unit composition, including Voidrads, and a decent number of buildings, including a Cybernetics Core, Twilight Council, and Robotics Facility. We also have a good number of Pylons and gas buildings.

3.2 Economy: Our economy is stable, with a sufficient number of workers and a good balance of minerals and gas.

3.3 Technology: We have started researching Warpgate and Protoss Air Armor Level 1. However, there is room for further technological development and research.

4. Our Strategy:

Our strategy seems to be focused on air dominance with Voidrads. We should continue to leverage our air superiority while expanding our technological capabilities.

5. Enemy's Strategy:

The enemy seems to be focused on a ground-based army composition, with Roaches, Zerglings, and Hydralisks. They also have some support units like Overseers and Infestors. We should be cautious of potential ground attacks and plan our defenses accordingly.

6. Key Information:

The most important aspect at this moment is our air superiority with Voidrads. However, we need to be prepared for potential ground-based attacks from the enemy's Roaches and Hydralisks. Our future success will depend on how we can maintain our air dominance while countering the enemy's ground forces.

Figure 11: LLM analysis: LLM take Situation Overview, Situation Analysis, Strategic Planning, Opponent Strategy Analysis these four stages.

- (a) **Game Overview:**Provide a brief overview of the current situation based on all the rounds.
- (b) **Current Game:**Determine the stage of the game based on the information of all rounds.
Is it the early game, mid-game, or late game?
- (c) **Our Situation:** Describe our current status in terms of:
 - i. **Units and Buildings:**Analyze the state of our units and buildings.
 - ii. **Economy:**Evaluate our economic condition, including resource collection and usage.
 - iii. **Technology:**Describe the status of our technological research and what technologies we have unlocked so far. Analyze our technology tree, indicating the available and potential upgrades or units.
- (d) **Our Strategy:**Infer our potential strategy based on our current situation and the information of all rounds.
- (e) **Enemy's Strategy:**Infer the enemy's potential strategy, based on the available information.
- (f) **Key Information:**Highlight the most important aspects from all rounds that have significantly influenced the game.
- (g) **race specific prompt**
 - i. Zerg :For Zerg, pay attention to whether there are enough larvae. If not, we should consider adding the INJECTLARVA command to the queue.
 - ii. Protoss:For Protoss, keep an eye on Nexus's energy to Chrono Boost important structures.
- (h) Based on the game situation and strategies used by both sides, provide specific suggestions for the following areas:
 - i. **Our Strategy:**Propose adjustments to our current strategy to counter the enemy's moves and capitalize on our strengths.
 - ii. **Units and Buildings:**Offer ways to enhance our unit composition and improve our building layout, suited to the current stage of the game.
 - iii. **Economy:**Recommend better practices for resource gathering and usage, in line with our strategic needs.

LLM Suggestions & Decisions

Suggestions:

1. Our Strategy:

We should continue to produce Voidrays and maintain air superiority. However, we should also focus on developing a strong ground army to counter the enemy's Roaches and Hydralisks.

2. Units and Buildings:

Consider building more Gateways and producing units like Stalkers and Immortals to strengthen our ground army. Additionally, expanding our shield battery count can provide better defense against ground attacks.

3. Economy:

Ensure that our workers are efficiently gathering resources. Consider expanding to new bases to further boost our economy and support our unit production.

4. Technology:

Continue researching upgrades for our air units, such as Protoss Air Armor Level 2 and Level 3. Additionally, consider researching upgrades for our ground units, such as Protoss Ground Weapons and Armor.

Decisions:

- 0: <TRAIN STALKER>
- 1: <TRAIN IMMORTAL>
- 2: <BUILD GATEWAY>
- 3: <BUILD SHIELDBATTERY>
- 4: <EXPAND BASE>

Figure 12: LLM suggestions and decision: LLM give useful Strategic Recommendations and finally take the Decision-Making Process. Our Action-Extractor can extract the actions from Decisions. The actions of this infer are train stalker, train immortal, build gateway, build shield battery and expand base.

iv. **Technology:** Suggest focused research paths to gain technological advantages, considering our current research status and technology tree.

- (i) Lastly, consider the current situation and the suggestions provided, make K actionable and specific decisions from the action dictionary. This dictionary comprises four categories of actions: unit production, building construction, technology research, and other actions. Remember to align these decisions with the current stage of the game, and avoid proposing actions that are not currently feasible.

B Appendix: Questions and LLM Responses

In subsection 5.4, we documented the responses from various LLMs, encompassing GPT3.5, GPT4, Claude2, and Bard, spanning five distinct question categories.

1. Q1:Basic Knowledge of StarCraft2
 - (a) Are you familiar with StarCraft2?
 - (b) Could you provide an overview of StarCraft2,including its races, esports scene, and other pertinent details?
2. Q2:Racial Mechanics in StarCraft2 Discuss the unique mechanisms of the following races:Zerg,Protoss and Terran.
3. Q3:Typical Strategies in StarCraft2 for Different matchups?
 - (a) TVZ:What's a common strategy for Teeran vs Zerg?
 - (b) TTVT:What's a typical stragy in Terran vs Terran matchups?
 - (c) TVP:How do Terran players generally approach a Protoss opponent?
 - (d) ZVZ:What's standard strategy in Zerg vs Zerg battles?
 - (e) ZVP:What are Zerg strategies when facing Protoss?
 - (f) ZVT:How do Zerg Players counter Terran tactis?
 - (g) PVZ:How should Protoss approach a Zerg opponent?
 - (h) PVP:What's the strategy for Protoss vs Protoss gams?
 - (i) PVT:How do Protoss players generally strategize against Terran?

4. Q4: Ability to Outline Build Orders for Different Races. Can you provide a standard build order for each race?
5. Q5: Classic Strategies and Counterplays in StarCraft2
 - (a) PVZ: What are effective strategies and counterplays against a roach-hydra attack?
 - (b) TVZ: How should Terran approach a mutalisk-zergling-baneling composition? Are there gambits or counter-strategies to consider?
 - (c) TVP: When faced with an archon-zealot push, what are the best strategies and counters for Terran?

B.1 Basic Knowledge of StarCraft II

Q1: Are you familiar with StarCraft II?

GPT3.5: Yes, I'm familiar with StarCraft II. StarCraft II is a popular real-time strategy (RTS) video game developed and published by Blizzard Entertainment. It is the sequel to the original StarCraft and was released in three separate episodes: Wings of Liberty, Heart of the Swarm, and Legacy of the Void. The game is set in a science fiction universe and features three distinct factions: the Terrans, the Zerg, and the Protoss, each with its own unique units and abilities. Players in StarCraft II engage in strategic and tactical battles, gathering resources, building armies, and competing against other players or AI opponents. The game has a strong competitive scene, with professional players and tournaments, and it has a dedicated fanbase worldwide. If you have any specific questions about StarCraft II or need information on a particular aspect of the game, feel free to ask!

GPT4: Yes, I'm familiar with "StarCraft II," the popular real-time strategy (RTS) game developed and published by Blizzard Entertainment. The game is a sequel to the original "StarCraft" from 1998 and is set in a distant part of the Milky Way galaxy in the 26th century. It maintains the classic RTS elements of gathering resources, building bases, and commanding armies to defeat opponents. "StarCraft II" consists of three main installments representing each of the game's species: (1) "Wings of Liberty" (released in 2010) - This is the base game where the primary campaign focuses on the Terrans, specifically on the character Jim Raynor, who is leading a rebellion against the autocratic Terran Dominion. (2) "Heart of the Swarm" (released in 2013) - This expansion focuses on the Zerg race and follows the story of Sarah Kerrigan (formerly a Terran who was transformed into the Queen of Blades, the leader of the Zerg) in her quest to reunite the Zerg Swarm and exact revenge on the Terran Dominion's emperor, Arcturus Mengsk. (3) "Legacy of the Void" (released in 2015) - The final installment concentrates on the Protoss and features the character Artanis as he works to unite the Protoss and confront a cosmic threat known as the "Dark Voice" or "Amon."

The game is recognized for its competitive multiplayer mode, where players from around the world compete in leagues. Each of the three races in the game (Terrans, Zerg, and Protoss) has its unique set of units and structures, which results in very different strategies and requires a deep understanding of the game to master. "StarCraft II" has also been a significant part of the professional e-sports scene, with numerous tournaments worldwide, including the prestigious StarCraft II World Championship Series (WCS). The game's emphasis on quick decision-making, strategic diversity, and real-time tactical execution contribute to its standing as a respected e-sport.

Claude2: Yes, I'm familiar with StarCraft 2! It's a popular real-time strategy video game developed by Blizzard Entertainment. Here are some key facts about StarCraft 2:

- It's the sequel to the original StarCraft game that came out in 1998. StarCraft 2 was released in 2010.
- There are three installments or chapters in StarCraft 2 - Wings of Liberty, Heart of the Swarm, and Legacy of the Void.
- Players can play as three factions or races - the Terrans (humans), the insect-like Zerg, and the technologically advanced Protoss.
- The gameplay involves gathering resources, building bases and armies, and battling opponents in real-time. The goal is to destroy the enemy base.

- StarCraft 2 has a thriving eSports scene with many professional tournaments and leagues. Top players can earn significant prize money.
- It's considered one of the greatest and most influential real-time strategy franchises to date, known for its balanced asynchronous gameplay, strategic depth, and cinematic storytelling.
- Blizzard continues to support StarCraft 2 with updates, new co-op commanders, and balance changes to keep the multiplayer aspect fresh.

Let me know if you have any other specific questions about StarCraft 2! I'm happy to discuss strategies, lore, competitive play, or anything else related to this classic RTS game.

Bard: Yes, I am familiar with StarCraft II. It is a science fiction real-time strategy video game developed and published by Blizzard Entertainment. It was released worldwide in July 2010 for Microsoft Windows and Mac OS X. StarCraft II is the sequel to the 1998 game StarCraft, and it is set four years after the events of the original game. StarCraft II features three playable races: the Terrans, the Zerg, and the Protoss. Each race has its own unique units and abilities, and the player must use their strengths to defeat their opponents. StarCraft II can be played in single-player mode, cooperative mode, or multiplayer mode. The single-player campaign in StarCraft II is divided into three parts: Wings of Liberty, Heart of the Swarm, and Legacy of the Void. Each campaign follows the story of a different character from one of the three races. The cooperative mode in StarCraft II allows players to team up with other players to complete missions against computer-controlled enemies. The multiplayer mode in StarCraft II allows players to compete against each other in ranked or unranked matches. StarCraft II is a very popular game, and it has a large and dedicated esports scene. StarCraft II tournaments are held all over the world, and some of the best players in the world can earn millions of dollars in prize money.

Is there anything else you would like to know about StarCraft II?

Q2: Could you provide an overview of StarCraft II, including its races, esports scene, and other pertinent details?

GPT3.5: Certainly! Here's an overview of StarCraft II, including its races, esports scene, and other important details:

Game Overview:

- Release: StarCraft II was released in three separate episodes. The first episode, "Wings of Liberty," was released in July 2010. The second episode, "Heart of the Swarm," followed in March 2013, and the final episode, "Legacy of the Void," was released in November 2015.
- Genre: StarCraft II is a real-time strategy (RTS) game that focuses on resource management, base building, and strategic combat.
- Developer and Publisher: Developed and published by Blizzard Entertainment.
- Setting: The game is set in a futuristic science fiction universe and features three distinct races: Terrans, Zerg, and Protoss. Each race has its own unique units, buildings, and gameplay mechanics.

Single Player: Each episode of StarCraft II has a single-player campaign that follows the story of one of the three races. The campaigns offer engaging storytelling and missions with varying objectives.

Races:

- Terrans: Terrans are humans who have been exiled from Earth and are known for their adaptability and use of advanced technology. They have a wide range of mechanical units and structures.
- Zerg: Zerg are a highly adaptable and insectoid alien race that can rapidly grow and overwhelm their opponents with numbers. They are known for their biological units and ability to spread creep.
- Protoss: Protoss are a technologically advanced alien race with powerful psionic abilities. They have advanced units and structures, and their gameplay is focused on precision and strategy.

Esports Scene:

StarCraft II has a thriving esports scene, with numerous tournaments and professional players from around the world. Major tournaments include the World Championship Series (WCS), Intel Extreme Masters (IEM), GSL (Global StarCraft II League), and BlizzCon. Professional players and teams compete for significant prize money and recognition in these tournaments. The game's competitive nature and high skill ceiling make it a popular choice for both casual and professional players.

Legacy and Impact:

StarCraft II is the successor to the original StarCraft, which is considered one of the most influential and iconic real-time strategy games of all time. StarCraft II continued the legacy of its predecessor and expanded the game's lore and gameplay mechanics. The game has a dedicated fanbase and has had a significant impact on the esports industry.

Community and Custom Content:

StarCraft II has a vibrant modding and custom content community. Players can create and share custom maps, game modes, and mods through the StarCraft II Arcade. This community-driven aspect adds to the game's longevity and diversity of gameplay experiences. While my knowledge is based on information available up until September 2021, StarCraft II has likely continued to evolve and develop in the years since. If you have specific questions or need more recent information about the game or its esports scene, I recommend checking official sources and community forums for the latest updates.

GPT4: "StarCraft II" is a monumental figure in the world of real-time strategy (RTS) games and e-sports. Developed by Blizzard Entertainment, it's known for its demanding skill level, strategic diversity, and an active professional scene. Here's a comprehensive overview:

1. Overview:

Released in 2010, "StarCraft II" is set in a science fiction universe in the 26th century and focuses on the interstellar struggles between three species: the Terrans (humans exiled from Earth), the Zerg (a super-species of assimilated life forms), and the Protoss (a technologically advanced species with psionic abilities).

2. Gameplay:

Players choose one of three races to control, each offering a unique array of units and technologies. Games typically involve gathering resources, expanding bases, and commanding armies to defeat enemies. The game's asymmetrical balance is a defining characteristic, with each race having different units, strengths, and weaknesses, requiring distinct strategies.

3. Races:

Terrans: Known for their adaptability and defensive capabilities, Terrans have versatile units and a unique building mechanic (buildings can lift off and move). They are human exiles from Earth. Zerg: The Zerg are all about rapid proliferation and adaptation. They produce large numbers of units quickly and can evolve them into more advanced forms. They rely on overwhelming their opponents with sheer numbers and have the ability to rapidly spread across the map. Protoss: Protoss units and buildings are generally more expensive (in terms of in-game resources) but highly powerful and efficient. They have strong shields, advanced technology, and can warp units directly onto the battlefield.

4. Campaigns:

"StarCraft II" was released as a trilogy, with each installment focusing on a different race's perspective in the ongoing interstellar war. "Wings of Liberty": Focuses on the Terran campaign. "Heart of the Swarm": Revolves around the Zerg campaign. "Legacy of the Void": Concludes with the Protoss campaign.

5. E-Sports:

Shortly after its release, "StarCraft II" exploded into the e-sports scene. It built on the legacy of the original "StarCraft" game, which was one of the first globally recognized e-sports. The game is celebrated for its incredibly high skill ceiling and strategic depth, making professional matches

fascinating for spectators. The "StarCraft II World Championship Series (WCS)" was the premier competitive circuit for professional "StarCraft II" players, featuring several regional events leading up to a global year-end championship. South Korea, known for pioneering e-sports, has been particularly prominent in the "StarCraft II" scene, producing numerous professional players who dominate in international competitions.

6. Community and Legacy:

"StarCraft II" has a strong community of players, fans, and dedicated content creators. The game's custom map editor has led to a variety of player-created content, adding to the game's longevity. In October 2020, Blizzard announced the end of active development of new content for "StarCraft II," shifting to a maintenance mode for the game with a focus on balance and ecosystem health. Despite the reduction in developer-driven content, the community and e-sports scene remain active, with third-party organizers continuing to hold tournaments.

7. Free-to-Play Transition:

In 2017, "StarCraft II" became free-to-play, allowing players to access the original "Wings of Liberty" campaign and the multiplayer modes for free, which helped maintain the game's player base. The legacy of "StarCraft II" in the gaming community is marked by its technical and strategic depth, the skill it demands from its players, and its significant impact on the broader e-sports industry.

Claude2: Absolutely, here's an overview of StarCraft II:

- Races: There are three playable races in StarCraft II - the Terrans (humans), the insectoid Zerg, and the technologically advanced Protoss. Each race has distinct units, structures, abilities, and playstyles.
- Terrans are versatile and mobile, with units like Marines, Tanks, and Battlecruisers. They can adapt quickly and have a lot of defensive and zone control options.
- Zerg are focused on overwhelm and expansion, capable of producing large armies rapidly. Key units are Zerglings, Roaches, Hydralisks and Mutalisks. They can overrun opponents through sheer numbers.
- Protoss have advanced technology and psionic abilities. Their units like Stalkers, Immortals and Carriers are slower but more powerful. They rely on coordination and positioning in engagements.
- eSports Scene: StarCraft II has a longstanding professional esports scene in Korea especially. Top players compete in premier tournaments like GSL and Proleague for prize money and glory.
- Popular pro players include Serral, Maru, Rogue, Dark and soO. Blizzard directly supports the scene through the ESL Pro Tour and other circuits.
- Game Modes: The main competitive mode is 1v1, but 2v2, 3v3 and 4v4 team games are also popular. There is also a Co-op PVE mode where players team up against AI enemies. Custom games allow for all kinds of player-created variants.
- Expansions: Wings of Liberty, Heart of the Swarm and Legacy of the Void are the three installments that comprise StarCraft II. Each focuses on one race's campaign story while expanding multiplayer.

Let me know if you need any clarification or have additional questions!

Bard: Sure. Here is an overview of StarCraft II, including its races, esports scene, and other pertinent details:

Races: StarCraft II features three playable races: the Terrans, the Zerg, and the Protoss. Each race has its own unique units and abilities, and the player must use their strengths to defeat their opponents.

- Terrans: The Terrans are a versatile race that combines human ingenuity with advanced technology. They have a wide variety of units to choose from, including Marines, Siege Tanks, and Battlecruisers. Terrans are also known for their powerful mobile structures, such as Command Centers and Factories.
- Zerg: The Zerg are a swarm-based race that overwhelms their enemies with sheer numbers. They have a variety of cheap and expendable units, such as Zerglings and Roaches, as well as more powerful units such as Hydralisks and Ultralisks. Zerg players are also known for their ability to quickly expand their bases and produce units.

- Protoss: The Protoss are a highly advanced race that relies on powerful technology and psionic abilities. They have a limited number of units to choose from, but each unit is very powerful. Protoss players are known for their strong economies and their ability to build powerful armies.

Esports scene

StarCraft II has a large and dedicated esports scene. StarCraft II tournaments are held all over the world, and some of the best players in the world can earn millions of dollars in prize money. The biggest StarCraft II tournament of the year is the Global StarCraft II League (GSL). The GSL is a premier tournament series that features the best players from all over the world. Other major StarCraft II tournaments include the Intel Extreme Masters (IEM) and the World Championship Series (WCS).

Other pertinent details

- StarCraft II is a very challenging game, and it takes a lot of practice to master. The game is also very popular among competitive gamers, and it has a very active esports scene. Here are some other pertinent details about StarCraft II:
- StarCraft II is a free-to-play game. The base game includes the single-player campaign for Wings of Liberty, as well as the multiplayer mode. The other two campaigns, Heart of the Swarm and Legacy of the Void, can be purchased separately.
- StarCraft II has a very active modding community. There are thousands of mods available for StarCraft II, which can add new units, maps, and gameplay mechanics to the game.
- StarCraft II is a very popular game among streamers. There are many professional StarCraft II streamers who broadcast their gameplay to viewers on Twitch and YouTube.

If you are interested in learning more about StarCraft II, I recommend visiting the official Blizzard website or watching some StarCraft II streams on Twitch or YouTube.

B.2 Racial Mechanics in StarCraft II

Q: Discuss the unique mechanisms of the following races: Zerg, protoss and Terran

GPT3.5: Certainly! Each of the three races in StarCraft II has its own unique mechanics and gameplay style. Here's an overview of the racial mechanics for the Zerg, Protoss, and Terran factions:

Zerg:

- Creep Spread: Zerg players can spread "creep" across the map. Creep is a slimy substance that not only provides vision but also enhances the movement speed of Zerg units when they are on it. Creep is generated by buildings called "Creep Tumors" and the primary Zerg building, the Hatchery or Lair.
- Larva Mechanic: Zerg units are produced from Larvae, which are spawned by Hatcheries and Lairs. The number of Larvae determines how quickly a Zerg player can build units. Managing Larvae effectively is crucial to Zerg gameplay.
- Biological Units: The Zerg rely heavily on biological units and are known for their ability to quickly swarm opponents with large numbers of units. Their units often have regenerative abilities and can be upgraded to various forms. Evolution Chambers: Zerg units can be upgraded at Evolution Chambers, allowing players to adapt their units to counter their opponent's strategies.

Protoss:

- Warp-In Mechanic: Protoss units can warp in directly onto the battlefield from Pylons or Warp Gates, providing a unique mobility advantage. However, this requires strategic placement of Pylons and Warp Gates.
- Shields: Many Protoss units have energy-based shields in addition to their regular health. Shields regenerate over time, making hit-and-run tactics effective when used wisely.

- Psionic Abilities: Protoss units often have psionic abilities that can be used for offense or defense. Examples include Force Fields, which can block enemy units, and Psionic Storm, which deals area damage.
- Warpgate Research: Protoss players can research the "Warpgate" technology, allowing them to transform their Gateways into Warp Gates, significantly increasing their flexibility in producing units.

Terran:

- MULEs and SCVs: Terran players can call down MULEs (Mechanized Utility Drones) to quickly gather resources. SCVs (Space Construction Vehicles) can also repair buildings and mechanical units.
- Building Mobility: Terran buildings are often mobile, with the ability to lift off and land in new locations. This flexibility allows for repositioning and strategic play.
- Supply Depots and Wall-offs: Terran players use Supply Depots to provide supply and can use them to create wall-offs to block enemy movement.
- Terran Infantry: Terran infantry units can be upgraded with a variety of weapons and equipment, making them versatile and adaptable to different situations.
- Siege Tanks: Terran players often employ Siege Tanks, which can transform into siege mode to deal massive area damage. This unit is a cornerstone of Terran defensive strategies.

Each race in StarCraft II offers a distinct and challenging gameplay experience, and mastering their unique mechanics is essential for success in the game. Players often choose a race that suits their preferred playstyle, whether it's the swarm tactics of the Zerg, the advanced technology of the Protoss, or the adaptability of the Terran.

GPT4: "StarCraft II" stands out in the RTS genre due to its distinct, asymmetric gameplay, meaning each race has unique mechanisms, units, and strategies that create a deep, strategic environment. Here's a detailed look at the specific racial mechanics for the Zerg, Protoss, and Terran factions:

1. Zerg:

- Creep: One of the most distinctive aspects of the Zerg is their reliance on Creep, a living mat of bio-organic substance that spreads from their main structures. Zerg buildings, except for the Hatchery, must be built on Creep. It also allows Zerg units to move faster when they are on it, providing both strategic and defensive advantages.
- Larvae and Macro Mechanics: Zergs uniquely produce units through Larvae generated by their primary structure, the Hatchery (which can be upgraded to a Lair and then a Hive for more advanced units). These Larvae morph into different units, meaning the Zerg can adapt their production in real-time as they see fit. The Queen unit can also spawn additional Larvae to speed up production, emphasizing the Zerg's swarm-oriented strategy.
- Rapid Expansion: Zerg players often rapidly colonize areas of the map to gain more resources, using inexpensive units to overwhelm opponents. Their ability to quickly spread Creep helps in establishing new bases and fortifying territories.

2. Protoss:

- Warp Gate Technology: A definitive feature for the Protoss is their advanced technology, represented through the transformation of their Gateway buildings into Warp Gates. This allows the production and immediate deployment of units across the battlefield, provided there is a power field (generated by structures like the Pylon). This ability is crucial for both reinforcing units during a battle and executing surprise attacks.
- Shields and Health: Protoss units and buildings have two layers of health: a regenerative shield and their actual health. This characteristic allows Protoss armies to be very resilient, as shield points regenerate over time when not under attack.
- Chrono Boost: The Protoss Nexus, the main base structure, has an ability called Chrono Boost that can be used to speed up the production of units, research, and buildings. This feature is integral to the race's adaptability, allowing them to respond quickly to threats.

3. Terran:

- Building Mobility: Terran structures, unique amongst the races, have the ability to lift off and relocate, allowing for strategic repositioning, surprise tactics, and base migration. This feature is particularly useful for avoiding threats, scouting, and creating forward unit production points.
- MULEs and Macro Mechanics: Terran Command Centers can call down MULEs (Mining Unit, Lifting Equipment), temporary units that gather resources at a much higher rate than SCVs, the standard worker unit. This ability provides a significant boost to the Terran economy over short periods, allowing for bursts of increased production.
- Bunkers and Siege Warfare: The Terrans have a defensive style of play, with structures like Bunkers and units like the Siege Tank. Bunkers can be garrisoned with infantry units to improve their survivability and increase the Bunker's firepower. Siege Tanks have a transformation ability, allowing them to switch to a stationary siege mode with increased range and damage, ideal for both defense and area control.

Each race's unique mechanics require players to adopt very different strategies for each, contributing to the game's dynamic competitive environment. Mastering the utilization of these racial features—along with understanding those of potential opponents—is crucial for success in "StarCraft II."

Claude2: Here's an overview of the unique racial mechanics for each of the three StarCraft II races:

Zerg

- - Larva - Zerg units are produced from larva generated by Hatcheries. This allows the Zerg player to quickly amass large armies.
- - Creep - Zerg buildings must be built on creep, the purple biological carpet produced by Hatcheries and Creep Tumors. Units move faster on creep.
- - Inject Larva - Queens can inject larva into Hatcheries to boost unit production. Proper injecting is essential for Zerg macro.
- - Morphing - Many Zerg units can morph or evolve into more powerful variants. Examples: Banelings, Lurkers, Brood Lords.

Protoss

- - Warp-in - Protoss can warp-in units directly onto the battlefield provided they have a Pylon power source and Gateway/Warp Gate ready. Critical for reinforcements.
- - Chrono Boost - The Nexus's Chrono Boost ability accelerates building and research times. Important for protoss economy and tech.
- - Psionics - Many protoss units have psionic abilities like force fields, hallucination and psi storms that provide battlefield control.
- - Power Fields - Pylons power protoss buildings and enable warp-in. Destroying Pylons cuts power and supply for an area.

Terran

- - MULEs - SCVs can build MULEs at Orbital Commands that harvest resources at a faster rate than SCVs. Boosts income.
- - Salvage - Most Terran structures can be salvaged to recoup some of the resources invested into them. Provides economic flexibility.
- - Add-ons - Buildings like Barracks and Factories can have Reactor or Tech Lab add-ons to enhance unit production capabilities.
- - Transforming Units - Many Terran units like Hellions and Vikings can transform between modes to adapt as needed during battle.

Let me know if you need any clarification or have additional questions!

Bard: Zerg

The Zerg are a swarm-based race that overwhelms their enemies with sheer numbers. They have a variety of cheap and expendable units, such as Zerglings and Roaches, as well as more powerful units such as Hydralisks and Ultralisks. Zerg players are also known for their ability to quickly expand their bases and produce units.

Here are some of the unique racial mechanics of the Zerg:

- Inject Larva: Zerg Hatcheries produce Larva, which can then be morphed into different types of units. The Inject Larva ability allows Zerg players to increase the production rate of their Hatcheries.
- Creep Spread: Zerg Creep is a substance that spreads from Zerg structures and units. Zerg units gain movement speed and attack speed on Creep. Zerg players can use Creep to quickly move their armies around the map and to gain an advantage in battles.
- Overlord Speed: Overlords are Zerg flying units that provide vision and can transport units. Zerg players can upgrade the speed of their Overlords, which allows them to quickly scout the map and to transport their armies to different locations.
- Zerg Rush: A Zerg Rush is a strategy where Zerg players produce a large number of cheap and expendable units early in the game and attack their opponent. Zerg Rushes can be very effective, but they can also be countered by players who are prepared for them.

Protoss

The Protoss are a highly advanced race that relies on powerful technology and psionic abilities. They have a limited number of units to choose from, but each unit is very powerful. Protoss players are known for their strong economies and their ability to build powerful armies.

Here are some of the unique racial mechanics of the Protoss:

- Warp Gate: Warp Gates are Protoss structures that allow Protoss players to warp in units directly from their Nexus. This allows Protoss players to quickly produce units at any location on the map.
- Chrono Boost: Chrono Boost is a Protoss ability that can be used to speed up the production of units or the research of technologies. Protoss players can use Chrono Boost to gain an advantage in the early game or to quickly produce a powerful army.
- Shields: Protoss units have shields, which are a layer of energy that protects them from damage. Shields regenerate over time, but they can be depleted by enemy attacks. Protoss players can use their shields to their advantage by engaging in hit-and-run tactics or by using their shields to absorb damage while their units attack.
- Psionic Storm: Psionic Storm is a Protoss spell that creates a storm of psionic energy that damages enemy units in a large area. Protoss players can use Psionic Storm to clear out enemy armies or to damage enemy structures.

Terran

The Terrans are a versatile race that combines human ingenuity with advanced technology. They have a wide variety of units to choose from, including Marines, Siege Tanks, and Battlecruisers. Terrans are also known for their powerful mobile structures, such as Command Centers and Factories.

Here are some of the unique racial mechanics of the Terrans:

- MULE: MULEs are Terran worker units that can be called down from Orbital Command Centers. M.U.L.E.s mine minerals at a faster rate than SCVs, which can help Terran players to quickly build up their economies.
- Supply Drops: Terran Supply Depots provide supply, which is needed to produce units. Terran players can also call down Supply Drops from their Command Centers, which provides additional supply. This allows Terran players to quickly build up their armies.
- Siege Tanks: Siege Tanks are Terran tank units that can transform into a siege mode. In siege mode, Siege Tanks have a longer range and deal more damage. Terran players can use Siege Tanks to defend their bases or to attack enemy bases from a distance.

- Medivacs: Medivacs are Terran flying units that can transport units and heal them. Terran players can use Medivacs to quickly move their armies around the map and to keep their units alive in battle.

Each race in StarCraft II has its own unique strengths and weaknesses. Zerg players are known for their ability to quickly produce large armies, Protoss players are known for their strong economies and powerful units, and Terran players are known for their versatility and mobile structures. The best way to learn about the unique racial mechanics of each race is to experiment with them and to play against other players.

B.3 Typical Strategies in StarCraft II for Different Matchups

Q1: TvZ: What's a common strategy for Terran vs. Zerg?

GPT3.5: Terran vs. Zerg (TvZ):

- Bio-Mech Composition: Terran often uses a combination of infantry (Marines, Marauders) and mechanical units (Siege Tanks, Hellbats) against Zerg. This composition allows for mobility and firepower.
- Harassment: Terran players often employ drop tactics, using Medivacs to drop units into Zerg bases to disrupt their economy and force them to split their forces.
- Widow Mines: Widow Mines can be used to deter Zergling and Baneling attacks, and they can also be dropped into Zerg mineral lines to deal economic damage.

GPT4: A common strategy involves harassment to prevent the Zerg from comfortably expanding and massing their forces. Terrans might use Hellions to attack Zerg's worker units or dropships to move units behind enemy lines. The overall aim is to control the pace, forcing Zerg to react to Terran threats while building a strong economy and army for a decisive push.

Claude2: Terran often opens with a Reaper expand into Hellions for map control and harassment. This transitions to Marine/Medivac for mobility and bio strength. Tanks added for splash against Zerglings.

Bard: A common strategy for Terran vs. Zerg is to go for a macro build, such as Bio (Marines, Medivacs, and other support units) or Mech (Siege Tanks, Hellions, and other mechanical units). Terran players can also try to rush their Zerg opponent with early aggression, such as a Reaper Rush or a Marine/Marauder Rush.

Q2: TvT: What's a typical strategy in Terran vs. Terran matchups?

GPT3.5:

- Tank Warfare: TvT often involves tank battles. Players set up Siege Tanks defensively and try to gain positional advantages while avoiding being caught unsieged.
- Viking Control: Air control is crucial in TvT. Vikings are used to gain air superiority and vision for Siege Tanks. Raven usage for interference matrix can also be a key factor.
- Bio vs. Mech: Terran players can choose between a bio-heavy composition (Marines, Marauders) and a mech-heavy composition (Siege Tanks, Hellions). The choice can depend on personal preference and map.

GPT4: TvT often revolves around positioning and tank warfare. Siege Tanks are critical for area control, and players jockey for position and map control. Air superiority via Vikings is also crucial to provide vision and control. Since all units are available to both sides, scouting, deception, and adaptability are key.

Claude2: Both players open Reaper expand for scouting information. Focus is on securing additional bases for economy. Tanks, Vikings and air control are critical for positioning and engagements.

Bard: A typical strategy in Terran vs. Terran matchups is to go for a macro build, such as Bio or Mech. Terran players can also try to scout their opponent's build early and counter it with a specific composition. For example, if a Terran player sees that their opponent is going for Bio, they can counter with Siege Tanks and Hellions.

Q3: TvP: How do Terran players generally approach a Protoss opponent?

GPT3.5:

- Bio Play: Terran often employs bio compositions (Marines, Marauders, Medivacs) against Protoss. Micro-intensive battles and mobility are key.
- Ghost Usage: Ghosts can snipe high-value Protoss units like Templars and Observers. They also have EMP to drain Protoss shields and energy.
- Liberator Zones: Liberators can establish zones of control and disrupt Protoss positioning with their anti-ground mode.

GPT4: Terrans often use a mixture of bio units (Marines and Marauders) supplemented with Medivacs for healing and mobility against Protoss. Harassment with drops to disrupt the Protoss economy and tech is common. Terrans need to be aggressive, as a fully tech'd and maxed Protoss army can be difficult to defeat head-on.

Claude2: Terran applies early pressure with units like Reapers, Hellions and Widow Mines. Goal is to slow Protoss economy and tech while expanding themselves. Marines and Ghosts counter late-game Protoss power units.

Bard: Terran players generally approach a Protoss opponent by trying to expand their economy and build up a strong army. Terran players can also try to rush their Protoss opponent with early aggression, such as a Reaper Rush or a Hellion Rush.

Q4: ZvZ: What's a standard strategy in Zerg vs. Zerg battles?

GPT3.5:

- Zergling-Baneling Wars: ZvZ is known for Zerglings and Banelings clashing. Players aim to control these units efficiently and gain map control.
- Roach Timing Attacks: Roach-based strategies can be effective for pushing across the map and pressuring the opponent.
- Mutalisk Play: Mutalisks are used for harassment and map control in the mid-to-late game.

GPT4: ZvZ can be very volatile and is often characterized by early aggressive plays, like Zergling and Baneling skirmishes. Map control via scouting with Overlords is crucial to see incoming threats. Due to the mirror nature, small advantages can escalate quickly, and tech switches to counter the opponent's unit composition are common.

Claude2: Quickly droning up to 3 bases while producing defensive units like Queens. Tech to either Roaches for safety or Mutalisks for harassment. Late-game transition to Brood Lords.

Bard: A standard strategy in Zerg vs. Zerg battles is to go for a macro build, such as Mutalisk/Zergling or Roach/Hydra. Zerg players can also try to rush their opponent with early aggression, such as a Zergling Rush or a Baneling Rush.

Q5: ZvP: What are Zerg strategies when facing Protoss?

GPT3.5:

- Hydralisk and Lurker Play: Hydralisks and Lurkers are often used against Protoss, as they can deal with Gateway units effectively.

- Creep Spread: Zerg players work to spread creep to control the map and gain vision, which is crucial in ZvP.
- Tech Switches: Zerg may transition between unit compositions, such as Roach-Ravager into Brood Lords or Ultralisks, to keep Protoss players guessing.

GPT4: Zerg players aim to out-expand their Protoss rivals early on, using units like Zerglings and Roaches to defend against early aggression. They must be wary of Protoss area-of-effect (AoE) damage from units like High Templars and Colossi, often opting for tech like Corruptors or Vipers to neutralize key threats, and tech switches to keep Protoss guessing.

Claude2: Defend early Protoss pressures like Adepts while droning up. Roach/Ravager with Infestors to counter Immortals, or Hydra/Lurker for anti-air. Vipers critical for late-game.

Bard: Zerg strategies when facing Protoss typically involve trying to overwhelm their opponent with a large army of cheap and expendable units, such as Zerglings and Banelings. Zerg players can also try to flank their Protoss opponent with Mutalisks or to use their Hydralisks to pick off Protoss units from a distance.

Q6: ZvT: How do Zerg players counter Terran tactics?

GPT3.5:

- Baneling-Mutalisk: Zerg players often use Banelings and Mutalisks for harassment and map control. Banelings can be used to deal with Terran infantry.
- Infestors: Infestors can be used to fungal growth Terran bio units and neural parasite powerful Terran units like Siege Tanks or Thors.
- Brood Lords and Ultralisks: Late-game ZvT often involves transitioning into Brood Lords and Ultralisks for power and durability.

GPT4: Zerg often faces bio-ball compositions (Marines, Marauders, Medivacs) or mechanical units (like Tanks and Thors). Zerg needs to expand quickly, defend against harassment, and may use Banelings, Zerglings, and Hydralisks for defense transitioning to more robust units like Ultralisks or Brood Lords depending on Terran composition.

Claude2: Ling/Bane for Bio defense. Fast spire into Mutalisk harass. Transition to Ultralisks supported by Queens and Infestors for the often mech-heavy Terran end-game.

Bard: Zerg players counter Terran tactics by using their superior mobility and economy to their advantage. Zerg players can also use their powerful units, such as Ultralisks and Brood Lords, to defeat Terran armies

Q7: PvZ: How should Protoss approach a Zerg opponent?

GPT3.5:

- Gateway Expand: Protoss players often open with a Gateway expansion, using units like Adepts and Stalkers to control the early game.
- Tech Choices: Protoss can opt for Stargate play (Phoenixes or Oracles) for harassment, or they may go for a Robo facility for Immortals or Disruptors.
- High Templars: Templars are used for their Psionic Storm ability to deal with large Zerg armies.

GPT4: Protoss players must secure a solid economic base while defending against Zerg's potential for rushes and harassment. Walling off chokepoints with buildings and using units like Zealots and Sentries to defend is common early game. They rely on powerful AoE units (like Colossi and High Templars) later in the game, often leveraging tech advantages for strong pushes.

Claude2: Fast expand into Immortal/Archon/Chargelot to defend Zerg attacks. High Templar for storms against Hydras. Skytoss deathball critical for late game.

Bard: Protoss players approach a Zerg opponent by trying to expand their economy and build up a strong army of powerful units, such as Zealots, Stalkers, and Immortals. Protoss players can also use their Colossi to deal damage to Zerg units from a distance.

Q8: PvP: What's the strategy for Protoss vs. Protoss games?

GPT3.5:

- Stalker-Sentry: Early PvP often features Stalkers and Sentries for map control and defense.
- Disruptor Play: Disruptors are a key unit in PvP, used for their ability to deal massive area damage to enemy units.
- Blink Stalker Micro: Micro-management of Blink Stalkers can be a deciding factor in PvP engagements.

GPT4: Early game revolves around preventing enemy harassment and scouting to anticipate tech choices. The mid-game often sees a lot of positioning battles and potential for blink Stalker harassment. Since Protoss units are powerful but costly, efficient trades and protecting key units are paramount, with late-game often seeing advanced units like Carriers or Tempests.

Claude2: Robo for Immortals or fast expand with Blink Stalkers. Disruptors and High Templar for splash against massed Gateway units. Whoever gets Tempests wins the late game.

Bard: The strategy for Protoss vs. Protoss games typically involves trying to scout their opponent's build early and counter it with a specific composition. For example, if a Protoss player sees that their opponent is going for a Colossi build, they can counter with Immortals and Void Rays.

Q9: PvT: How do Protoss players generally strategize against Terran?

GPT3.5:

- Adept Openings: Protoss may open with Adepts for early map control and harassment.
- Colossi and/or Storm: Colossi are strong against Terran bio, while High Templars with Storm can deal with clumped bio forces.
- Disruptors: Disruptors can be used to disrupt Terran positioning and force engagements.

GPT4: Protoss strategies often involve careful defense against early Terran aggression, using units like Stalkers and Sentries, while advancing tech. Harassment with units like Oracles or Phoenixes can keep Terran unbalanced. In the later game, Protoss looks to leverage high-tech units (like Colossi, High Templars, or Carriers) to break through Terran's defenses.

Claude2: openings to secure expand. Robo for Observer scouting and Immortals against Terran vehicles. Storms and Archons counter Marine/Marauder bio play.

Bard: Protoss players generally strategize against Terran by trying to expand their economy and build up a strong army of powerful units, such as Zealots, Stalkers, and Immortals. Protoss players can also use their Colossi to deal damage to Terran units from a distance.

B.4 Ability to Outline Build Orders for Different Races

Q:Can you provide a standard build order for each race?

GPT3.5: Terran Standard Build Order:

- Opening: Start with an SCV and send it to gather minerals.
- Supply Depot: Build a Supply Depot at 14 supply to ensure you don't get supply blocked.
- Barracks: Build a Barracks at 16 supply.
- Refinery: Take a Refinery at 17 supply for gas income.
- Orbital Command: When the Barracks is complete, upgrade your Command Center to an Orbital Command.
- Reaper: Train a Reaper from the Barracks for scouting and early map control.
- Factory: At 100 gas, build a Factory.
- Second Refinery: Take a second Refinery after the Factory.
- Starport: Build a Starport when the Factory is complete.
- Tech Lab: Attach a Tech Lab to the Barracks.
- Marine Production: Start producing Marines from the Barracks.
- Reactor: Attach a Reactor to the Factory.
- Medivac: Build a Medivac from the Starport.
- Tech Choices: Depending on your strategy, you can go for upgrades, more production facilities, or expand.

Protoss Standard Build Order:

- Opening: Start with a Probe and send it to gather minerals.
- Pylon: Build a Pylon at 14 supply to avoid getting supply blocked.
- Gateway: Create a Gateway at 16 supply.
- Assimilator: Take an Assimilator at 16 supply for gas income.
- Cybernetics Core: Build a Cybernetics Core when the Gateway is complete.
- Pylon: Construct another Pylon at around 20 supply.
- Adept or Stalker: Train an Adept or Stalker from the Gateway for early defense or map control.
- Nexus: Expand to a natural expansion at around 21 supply.
- Warp Gate Research: Research Warp Gate technology at the Cybernetics Core.
- Additional Gateways: Add more Gateways and a Robotics Facility or Stargate based on your strategy.
- Tech Choices: Depending on your strategy, go for units like Stalkers, Adepts, or Oracles, and consider building more production structures.
- Upgrades: Start researching upgrades at the Forge.
- Expand: Consider taking a third base.

Zerg Standard Build Order:

- Opening: Start with a Drone and send it to gather minerals.
- Overlord: Build an Overlord at 13 supply.
- Drones: Continue to produce Drones.
- Hatchery: At 16 supply, send a Drone to build a Hatchery at your natural expansion.
- Extractor: Take an Extractor at 17 supply.
- Spawning Pool: Build a Spawning Pool at 17 supply.
- Overlord: Create another Overlord at around 19 supply.
- Queen: When the Spawning Pool is complete, produce a Queen from your main Hatchery.

- Zerglings: Train a set of Zerglings for scouting and defense.
- Extractor: Take a second Extractor at your natural.
- Evolution Chamber: Build an Evolution Chamber to start upgrades.
- Additional Queens: Create more Queens for larva injects and creep spread.
- Tech Choices: Depending on your strategy and opponent, go for Roaches, Banelings, or additional bases.
- Lair: Start a Lair tech structure when you have the resources.
- Further Expansion: Consider expanding to a third base.

These build orders provide a foundation for each race, but remember that flexibility and adaptation are key in StarCraft II. Adjust your build order based on scouting information and your opponent's actions to maximize your chances of success.

GPT4: Certainly, "StarCraft II" revolves heavily around build orders, which are pre-determined sets of actions aimed at maximizing efficiency, economy, and production. These build orders set the stage for your mid-game and late-game strategies. Below are standard build orders for each race, which are foundational and can be adapted based on opponents' actions. Remember, the numbers represent the total worker count you should have when you begin each step. Terran (Standard Opening):

- 14/15: Supply Depot
- 16/23: Barracks
- 16/23: Refinery
- 19/23: Orbital Command (immediately after Barracks completion)
- 20/23: Reaper (for scouting and slight harassment)
- 21/23: Command Center (on the low ground if you're feeling safe)
- 21/23: Factory (after Reaper starts)
- 23/31: Supply Depot
- Follow-up: Depends on scouting information (could include more Barracks, a Starport, or additional expansions and tech buildings).

Zerg (Hatch First Opening):

- 13/14: Overlord
- 17/22: Hatchery (expand)
- 18/22: Extractor (gas)
- 17/22: Spawning Pool
- 19/22: Overlord
- 20/22: Metabolic Boost (Zergling speed, once you have 100 gas)
- 21/30: Queen x2 (once Spawning Pool is done)
- 30/36: Zerglings or other defensive units depending on what you scout
- Follow-up: Based on the opponent's build, you might add additional bases, tech up (e.g., Roach Warren, Lair), or build more combat units.

Protoss (Standard Gateway Expand):

- 14/15: Pylon
- 16/23: Gateway
- 17/23: Assimilator
- 20/23: Nexus (expand)
- 20/23: Cybernetics Core

- 21/31: Assimilator
- 22/31: Pylon
- 23/31: Adept or Stalker (after Cybernetics Core finishes for defense/scouting)
- Follow-up: Varied based on scouting but might include additional Gateways, a Robotics Facility, or a Stargate, and tech advancements like Warp Gate research.

These build orders are basic openings designed for beginners to intermediates and are meant to establish your economy while keeping you safe in the early game. They are not rigid play patterns. "StarCraft II" is a dynamic game, and all strategies need to adapt to opponent actions. Effective scouting and understanding of your opponent's strategy are crucial, and as you gain more experience, you'll begin to learn how to alter your build order in response to what you're seeing on the battlefield.

Claude2: Here are some standard opening build orders for each race in StarCraft II:

Terran Build Order:

- 14 Supply Depot
- 16 Barracks
- 16 Refinery
- @100% Barracks - Reaper and Orbital Command
- 22 2nd Command Center
- @400 minerals - 2nd Barracks

This gets an early Reaper for scouting and harassment, while using the Orbital Command for extra economy and flexibility. The 2nd CC and Barracks enable a solid 2-base infrastructure.

Zerg Build Order:

- 17 Spawning Pool
- 17 Extractor
- 17 Hatchery
- @100% Spawning Pool - 2 Queens
- 21 3rd Hatchery
- @100 gas - Metabolic Boost (Zergling speed)
- @100% 3rd Hatch - 2 more Queens

This provides a quick Queen defense, fast Zergling speed, and lots of Larva for droning with the fast 3 Hatcheries.

Protoss Build Order:

- 14 Pylon
- 16 Gateway
- 17 Assimilator
- 20 Nexus
- 20 Cybernetics Core
- 22 Pylon
- @100% Cybernetics Core - Adept (or Stalker)

This gets an expand into early tech for defense and scouting. The Adept provides psionic pressure and intel gathering. The build has potential to transition into several tech paths.

Let me know if you need any clarification or have additional questions! Providing build orders is a great way to demonstrate StarCraft knowledge.

Bard: Sure, here is a standard build order for each race in StarCraft II: Terran Bio Build Order:

- 17 Supply Depot
- 18 Barracks
- 19 Refinery
- 20 Supply Depot
- 21 Barracks
- 22 Refinery
- 23 Factory
- 24 Supply Depot
- 25 Command Center (Second base)
- 26 Refinery
- 27 Engineering Bay
- 28 Supply Depot
- 29 Refinery
- 30 Supply Depot
- 31 Starport
- 32 Supply Depot

Mech Build Order:

- 17 Supply Depot
- 18 Refinery
- 19 Supply Depot
- 20 Factory
- 21 Supply Depot
- 22 Refinery
- 23 Barracks
- 24 Refinery
- 25 Command Center (Second base)
- 26 Refinery
- 27 Supply Depot
- 28 Engineering Bay
- 29 Supply Depot
- 30 Refinery
- 31 Supply Depot
- 32 Starport

Zerg

Mutalisk/Zergling Build Order:

- 17 Hatchery
- 18 Gas
- 19 Spawning Pool
- 20 Extractor
- 21 Overlord
- 22 Extractor

- 23 Overlord
- 24 Lair
- 25 Overlord
- 26 Overlord
- 27 Hydralisk Den
- 28 Overlord
- 29 Overlord
- 30 Overlord
- 31 Spire

Roach/Hydra Build Order:

- 17 Hatchery
- 18 Gas
- 19 Spawning Pool
- 20 Extractor
- 21 Overlord
- 22 Extractor
- 23 Overlord
- 24 Lair
- 25 Overlord
- 26 Overlord
- 27 Hydralisk Den
- 28 Overlord
- 29 Evolution Chamber
- 30 Overlord
- 31 Overlord

Protoss

Zealot/Stalker Build Order:

- 17 Gateway
- 18 Probe
- 19 Pylon
- 20 Forge
- 21 Gateway
- 22 Cybernetics Core
- 23 Pylon
- 24 Gateway
- 25 Gateway
- 26 Gateway
- 27 Stargate
- 28 Pylon
- 29 Pylon

Colossus Build Order:

- 17 Gateway

- 18 Probe
- 19 Pylon
- 20 Forge
- 21 Gateway
- 22 Cybernetics Core
- 23 Pylon
- 24 Gateway
- 25 Gateway
- 26 Gateway
- 27 Robotics Bay
- 28 Pylon
- 29 Pylon

These are just standard build orders, and you can adjust them to fit your own playstyle. It is also important to scout your opponent's build early and to counter it with a specific composition.

B.5 Classic Strategies and Counterplays in StarCraft II

Q1: PvZ: What are effective strategies and counterplays against a roach-hydra attack?

GPT3.5: PvZ: Against Roach-Hydra Attack:

Strategy for Protoss:

- Force Fields: Use Sentries to create Force Fields to segment the Roach-Hydra army, preventing it from engaging as a whole.
- Colossi: Colossus units deal area damage and are effective against clumps of Roaches and Hydralisks.
- Immortals: Immortals are strong against Roaches due to their bonus damage against armored units.
- Archons: Archons have splash damage and can help clear out Hydralisks.

Counterplay for Zerg:

- Tech to Hive: Transition to Hive tech for units like Vipers, which can abduct key enemy units or use Blinding Cloud to reduce the effectiveness of enemy ranged units.
- Hydra Speed Upgrade: Research Muscular Augments for Hydralisks to improve their mobility.
- Burrow: Use Burrow for Roaches to save them from being picked off and to regain health.
- Drop Play: Drop Roaches or Hydralisks into the Protoss main base for harassment to divert their attention. Creep Spread: Maintain good Creep spread to ensure mobility and vision.

GPT4: When Protoss players face a Zerg opponent focusing on Roach-Hydra, they're dealing with a versatile force that can be potent in a head-on fight due to its range, damage, and health, particularly in the mid-game.

- Strategic Positioning: Force engagements in narrow passages where the Zerg cannot leverage their numbers. Simultaneously, avoid open areas where the Zerg army can fully surround your forces.
- High Templars: These units are crucial. Their Psionic Storm ability deals massive damage to biological units, which makes them particularly effective against Hydralisks and clumped-up Roaches.
- Colossi: With their extended thermal lance upgrade, they can exploit their superior range and area-of-effect damage to decimate tightly packed Roach-Hydra armies.

- Sentries: Force Fields can cut off portions of the Zerg army, preventing them from engaging all at once, or Guardian Shield can reduce incoming ranged damage.
- Harassment: Divide the Zerg's attention. Warp Prisms, Zealot run-bys, and Dark Templars can force the Zerg player to split their army, making it less effective in a direct engagement.

Claude2: Against Roach-Hydra, go Immortal/Archon with chargelots. Immortals counter Roaches, Archons counter Hydras. Focus fire with Immortals.alternatively, fast tech to Colossus. Use Sentries for forcefields to split Zerg army. Expand behind and get High Templar for storms.

Bard: Effective Strategies:

- Go for a Colossus build. Colossi are very effective against Roaches and Hydras, and they can also deal damage to Zerg structures.
- Use Void Rays to pick off Roaches and Hydras from a distance. Void Rays are also very effective against Zerg Overlords, which can help you to deny your opponent vision and to make it more difficult for them to attack you.
- Use Warp Gates to quickly produce units and to respond to Zerg attacks. Warp Gates allow you to warp in units directly from your Nexus, which can help you to quickly build up your army and to defend your base. Effective Counterplays:
 - Use Observers to scout your opponent's base and to see what kind of army they are building. This will give you time to prepare for their attack and to build the appropriate counter-units.
 - Use Pylons to power your units and to build Shielding Batteries. This will help to protect your units from Zerg attacks.
 - Use Force Fields to block off Zerg units and to create chokepoints. This will make it more difficult for your opponent to attack your base.

Q2: TvZ: How should Terran approach a mutualisk-zergling-baneling composition? Are there gambits or counter-strategies to consider?

GPT3.5: TvZ: Against Mutualisk-Zergling-Baneling Composition:

Strategy for Terran:

- Thors: Thors are strong anti-air units that can target Mutualisks effectively.
- Widow Mines: Widow Mines can deal significant damage to clumps of Mutualisks if properly positioned.
- Marine Splitting: Split your Marines to minimize the impact of Baneling detonations.
- Missile Turrets: Build Missile Turrets in key locations to protect against Mutualisk harassment.
- Vikings and Liberators: Vikings can help control the air, and Liberators can provide anti-ground support.

Counterplay for Zerg:

- Baneling Drops: Use Overlords to drop Banelings onto clumps of Marines.
- Transition to Ultralisks: Ultralisks are powerful melee units that can be effective against Terran infantry.
- Corruptors: Corruptors can be used to target Thors and Vikings and reduce the anti-air capabilities of the Terran.
- Infestors: Fungal Growth can be used to lock down Marines and other units.
- Creep Spread: Maintain Creep spread to gain map control and mobility.

GPT4: The Muta-Ling-Bane composition is a highly mobile harassment force that seeks to control the map, prevent expansions, and pick off stray units. Dealing with it requires a mix of solid defense and map awareness.

- Marine-Medivac-Widow Mine: Marines, with their high DPS, are effective against Zerglings and Mutalisks, especially when combined with Medivacs for healing. Widow Mines add a layer of defense against Banelings and can devastate clumped Mutalisks.
- Thors and Liberators: Thors can help deter Mutalisks with their strong anti-air attack, especially in High Impact Payload mode. Liberators can zone out Mutalisks and provide support against ground units.
- Base Defense: Well-placed Missile Turrets and Bunkers can help defend against harassment. Building walls at choke points prevent Zergling run-bys.
- Map Control: Establish map control with Marine or Hellion squads and maintain good vision to see enemy movements. This approach helps in preparing for incoming attacks and catching the Zerg army out of position.

Claude2: Marines, Thors and Widow Mines counter Mutalisks. Thors splash damage and Widow Mine hits punish clumped Mutalisks. Turrets at mineral lines prevent economic harassment. Bio-mine with Medivacs can pick apart Zerglings. Siege Tanks zone out Banelings.

Bard: Effective Strategies:

- Go for a Bio build. Bio units are very effective against Mutalisks and Zerglings, and they can also deal damage to Zerg structures.
- Use Siege Tanks to deal damage to Mutalisks and Zerglings from a distance. Siege Tanks are also very effective against Zerg Overlords, which can help you to deny your opponent vision and to make it more difficult for them to attack you.
- Use Medivacs to heal your units and to transport them around the map. Medivacs can also be used to drop your units into the middle of a Zerg army, which can be a very effective way to engage your opponent. Effective Counterplays:
- Use Missile Turrets and Bunkers to defend your base from Mutalisk attacks. Missile Turrets and Bunkers are both very effective against Mutalisks, and they can also be used to defend your workers and your structures.
- Use Ravens to detect Mutalisks and to cast Interference Matrix on them. This will make it more difficult for your opponent to control their Mutalisks and to attack you.
- Use Vikings to shoot down Mutalisks. Vikings are the only Terran unit that can attack air units without moving, which makes them very effective against Mutalisks.

Q3: TvP: When faced with an archon-zealot push, what are the best strategies and counters for Terran?

GPT3.5: TvP: Against Archon-Zealot Push:

Strategy for Terran:

- Kite and Focus Fire: Kite the Zealots with your ranged units (e.g., Marines and Marauders) and focus fire on Archons.
- Medivac Micro: Use Medivacs to pick up and reposition units to avoid the melee engagements.
- Widow Mines: Position Widow Mines to hit the Zealots and soften the Archons.
- Ghosts: EMP from Ghosts can drain the shields of Protoss units, including Archons.

Counterplay for Protoss:

- Force Fields: Create Force Fields to segment the Terran army and prevent kiting.

- Immortals: Immortals are strong against Archons due to their bonus damage against armored units.
- High Templars: Use Psi Storm to deal AoE damage to the Terran infantry.
- Air Units: Consider incorporating air units like Void Rays or Phoenixes for added versatility.
- Guardian Shield: Use the Guardian Shield ability from Sentries to reduce incoming ranged damage.

Remember that these strategies and counterplays are not exhaustive, and adaptability is key in StarCraft II. The specific outcome of battles can depend on micro-management, unit composition, upgrades, and positioning, so always be prepared to adjust your tactics based on the evolving situation in the game.

GPT4: Archon-Zealot (often with some Immortals) is a powerful, close-quarters Protoss army composition that relies on brute force and strong front-line units.

- Ghost Usage: Ghosts' EMP Round is highly effective in draining the shields of Archons, Zealots, and Immortals, significantly weakening their upfront staying power in battles.
- Liberators and Siege Tanks: The use of Liberators with Defender Mode and Siege Tanks can create a zone of control that Zealots and Archons cannot approach easily. Kiting into these zones can decimate a Protoss army that's chasing.
- Micro-intensive Kiting: Using bio forces (Marines and Marauders) supplemented with Medivacs for healing, a player can continuously kite against Zealots and Archons, which lack ranged attacks.
- Sim City: Terrans can build in a way that chokes off paths (using Supply Depots, Bunkers, etc.), restricting the mobility and attack angles of melee units like Zealots and forcing Archons to funnel through tight spaces where they can't leverage their splash damage.

Each of these scenarios emphasizes not just the composition of your forces but also the importance of control, positioning, adaptability, and game sense. "StarCraft II" is a game of constant decision-making, and successful players must be able to read their opponents and adjust their strategies on the fly.

Claude2: Marines and Marauders counter Zealots, while Ghosts and Liberators counter Archons. Kite with bio and emp Archons. Siege Tanks in tank mode punish Zealot chargelots. Well-spread mines damage clumped Zealots. Scan aggressively to preemptively snipe Observers and enable Widow Mines.

Bard: Effective Strategies:

- Go for a Bio build. Bio units are very effective against Zealots and Archons, and they can also deal damage to Protoss structures.
- Use Siege Tanks to deal damage to Zealots and Archons from a distance. Siege Tanks are also very effective against Protoss Colossus, which can help you to defend your base and to make it more difficult for your opponent to attack you.
- Use Medivacs to heal your units and to transport them around the map. Medivacs can also be used to drop your units into the middle of a Protoss army, which can be a very effective way to engage your opponent.

Effective Counterplays:

- Use Missile Turrets and Bunkers to defend your base from Archon and Zealot attacks. Missile Turrets and Bunkers are both very effective against Zealots and Archons, and they can also be used to defend your workers and your structures.
- Use Scans to detect Protoss units and to see what kind of army they are building. This will give you time to prepare for their attack and to build the appropriate counter-units.
- Use Snipers to pick off Protoss units from a distance. Snipers are very effective against Zealots and Archons, and they can also be used to deal damage to Protoss Colossus.

C Alphastar vs LLM Agent in interpretability



(a) Game time 24:52: Terran's Liberator-heavy army establishes control zones, while Zerg (AlphaStar) persists with Queens for defense, which is ineffective against the Liberators.



(b) Protoss (Master player) employs a Cannon, Shield Battery, and Immortal rush strategy. In response, Zerg (AlphaStar) builds Spore Crawlers for defense, which is ineffective against the current Protoss strategy.



(c) Protoss (Master player) fields a heavy Immortal and Disruptor army. Despite a strong economy, Zerg (AlphaStar) continues producing Roaches, a unit countered by the Protoss forces, without opting for a transition.



(d) Terran (Master player) employs a bio-tank composition (Marines, Medivacs, Marauders, Tanks) with minimal air units. Zerg (AlphaStar) counters with a large number of Corruptors, which are ineffective against Terran's ground-focused army.



(e) Zerg (Built-in AI) utilizes a Hydra-Roach army composition, countered effectively by Protoss (LLM Agent) who defends with Voidrads and continues to produce more, capitalizing on their effectiveness against the Hydra-Roach combination.



(f) Zerg (Built-in AI) employs a Hydra-Roach composition, countered by Protoss (LLM Agent) using Stalkers and Immortals for defense, while also researching Psionic Storm technology to effectively manage the Zerg forces.



(g) Zerg (Built-in AI) fields an Ultralisk-heavy army, while Protoss (LLM Agent) responds with a composition of Stalkers and Immortals, actively producing more Immortals, highly effective against Ultralisks.



(h) Protoss (LLM agent) not only possesses units that counter the opponent's but also can expand its diverse array of strategies and army compositions, such as an air army.

Figure 13: The ability to adapt strategies based on the composition of enemy forces: AlphaStar (a, b, c, d) vs. LLM Agent (e, f, g, h).

L1 results
At 00:46 game time, our current StarCraft II situation is as follows:
Resources: - game_time: 00:46 - worker_supply: 15 - mineral: 105 - supply_left: 7 - supply_cap: 23 - supply_used: 16 - base_count: 1
Buildings: - base_count: 1 - pylon_count: 1 - gas_buildings_count: 2 - planning_gas_buildings_count: 2 - planning_worker_count: 1
Units: - base_count: 1 - pylon_count: 1 - gas_buildings_count: 2 - planning_gas_buildings_count: 2 - planning_worker_count: 1
In-process: - planning_gas_buildings_count: 2 - planning_worker_count: 1
Enemy Information: - No known enemy units
At 00:46 game time, our current StarCraft II situation is as follows:
Resources: - game_time: 00:46 - worker_supply: 15 - mineral: 105 - supply_left: 7 - supply_cap: 23 - supply_used: 16 - base_count: 1
Buildings: - base_count: 1 - pylon_count: 1 - gas_buildings_count: 2 - planning_gas_buildings_count: 2 - planning_worker_count: 1
.....
Units: - base_count: 1 - pylon_count: 1 - gas_buildings_count: 2 - planning_gas_buildings_count: 2 - planning_worker_count: 1
In-process: - planning_gas_buildings_count: 2 - planning_worker_count: 1
Enemy Information: - No known enemy units
At 00:47 game time, our current StarCraft II situation is as follows:
Resources: - game_time: 00:47 - worker_supply: 15 - mineral: 105 - supply_left: 7 - supply_cap: 23 - supply_used: 16 - base_count: 1
Buildings: - base_count: 1 - pylon_count: 1 - gas_buildings_count: 2 - planning_gas_buildings_count: 2 - planning_worker_count: 1
Units: - base_count: 1 - pylon_count: 1 - gas_buildings_count: 2 - planning_gas_buildings_count: 2 - planning_worker_count: 1
In-process: - planning_gas_buildings_count: 2 - planning_worker_count: 1
Enemy Information: - No known enemy units

Figure 14: L1 results of 00:46 period

Example1: scouting probe

LLM output:

- 1. Game Overview: At 00:46 game time, our current situation is as follows. We have 15 workers and 105 minerals. Our supply cap is at 23 with 7 supply left, and our army supply is 16. We have one base, one pylon, and two gas buildings. There are no known enemy units.
- 2. Current Game Stage: Based on the limited resources and small army size, we are still in the early game stage.
- 3. Our Situation:
 - 3.1 Units and Buildings: We have a small worker force and limited infrastructure. We have one base, one pylon, and two gas buildings. There are no units present except for the workers.
 - 3.2 Economy: Our economy is just starting, with a small number of workers and limited resources.
 - 3.3 Technology: There is no evidence of any technological development or research at this stage.
- 4. Our Strategy: At this early stage, our strategy should focus on expanding our economy, establishing more bases, and increasing our worker count. **We should also consider scouting to gather information about the enemy's strategy.**
- 5. Enemy's Strategy: Since there is no information about enemy units, it is difficult to determine their strategy. However, it is important to remain vigilant and be prepared for any potential attacks.
- 6. Key Information: The most important aspect at this moment is to quickly expand our economy and increase our worker count. This will provide us with a stronger economic foundation and allow us to produce more units and buildings.

Suggestions:

- 1. Our Strategy: Prioritize expanding our economy by building additional bases and increasing our worker count. **Consider scouting to gather information about the enemy's strategy.**

- 2. Units and Buildings: Focus on building additional pylons to increase our supply cap and support future unit production. Consider constructing additional structures such as gateways or a robotics facility to start producing units.
- 3. Economy: Allocate workers to gather minerals and gas efficiently. Aim to saturate our current base and expand to new resource locations as soon as possible.
- 4. Technology: At this early stage, it is not necessary to focus on technology research. However, consider building a cybernetics core to unlock more advanced units and upgrades in the future.
- Decisions:
 - 0: <BUILD NEXUS>
 - 1: <BUILD PYLON>
 - 2: <BUILD GATEWAY>
 - 3: <TRAIN PROBE>
 - **4: <SCOUTING PROBE>**



Figure 15: Decision of LLM Agent: Scouting probe

L1 results
At 03:43 game time, our current StarCraft II situation is as follows:
Resources: - game_time: 03:43 - worker_supply: 24 - mineral: 390 - gas: 302 - supply_left: 25 - supply_cap: 54 - supply_used: 29 - army_supply: 4 - base_count: 2
Buildings: - base_count: 2 - pylon_count: 3 - gas_buildings_count: 4 - gateway_count: 2 - cybernetics_core_count: 1 - Zealot_count: 1 - planning_gateway_count: 1 - planning_Zealot_count: 1
Research: - warpgate_research_status: 0.829464316368103
Enemy Information: - enemy_UnitTypeId.HATCHERY: 1 - enemy_UnitTypeId.EXTRACTOR: 1 - enemy_UnitTypeId.SPAWNINGPOOL: 1
At 03:44 game time, our current StarCraft II situation is as follows:
Resources: - gas: 302 - supply_left: 23 - supply_cap: 54 - supply_used: 31
Buildings: - base_count: 2 - pylon_count: 3
Units: - base_count: 2 - pylon_count: 3
In-process: - planning_gateway_count: 1 - planning_Zealot_count: 2
Research: - warpgate_research_status: 0.8348214626312256
Enemy Information: - enemy_UnitTypeId.HATCHERY: 1 - enemy_UnitTypeId.EXTRACTOR: 1 - enemy_UnitTypeId.SPAWNINGPOOL: 1
At 03:44 game time, our current StarCraft II situation is as follows:
Resources: - game_time: 03:44 - worker_supply: 24 - mineral: 305 - gas: 306
Buildings: - base_count: 2 - pylon_count: 3
Units: - base_count: 2 - pylon_count: 3 - gas_buildings_count: 4 - gateway_count: 2 - cybernetics_core_count: 1 - Zealot_count: 1 - planning_gateway_count: 1 - planning_Zealot_count: 2
In-process: - planning_gateway_count: 1 - planning_Zealot_count: 2
Research:
Enemy Information: - enemy_UnitTypeId.HATCHERY: 1

Figure 16: L1 results of 03:43 period

Example2: chronoboost cyberneticscore

LLM output:

- 1. Game Overview: At 03:44 game time, our situation is relatively early in the game. We have 24 workers, 305 minerals, and 310 gas. Our supply cap is 54 with 23 supply left, and our army supply is 6. We currently have two bases.
- 2. Current Game Stage: Based on the resource levels and army size, we are still in the early game.
- 3. Our Situation:
 - 3.1 Units and Buildings: We have a limited number of units, with only 1 Zealot in our army. Our building count includes 3 pylons, 4 gas buildings, 2 gateways, and 1 Cybernetics Core. Additionally, we are planning to build 1 gateway and 2 Zealots.
 - 3.2 Economy: Our economy is modest, with a small worker supply and resource pool. It's crucial to boost our worker count and resource collection rate.
 - 3.3 Technology: **We have started researching Warpgate technology, which is a positive step.** However, our lack of advanced units indicates that our tech tree has not progressed significantly.
- 4. Our Strategy: Our current strategy appears to be a cautious early-game approach, focusing on tech development through Warpgate research.
- 5. Enemy's Strategy: The enemy seems to be expanding their Zerg infrastructure with a Hatchery, Extractor, and Spawning Pool. They might be preparing for Zergling production.
- 6. Key Information: The early game is a critical phase, and our limited unit count and resources indicate that we should prioritize both economy and army development. The ongoing Warpgate research suggests a transition to more advanced unit production.

Suggestions:

- 1. Our Strategy: **Continue with the Warpgate research as it will significantly improve our unit production capabilities.** Consider Chrono Boosting the Cybernetics Core to expedite this research.
- 2. Units and Buildings: Prioritize building more Zealots to bolster your army. Also, expand your Pylon network to increase your supply cap and ensure you don't get supply blocked.

- 3. Economy: Focus on worker production. Consider building more probes to saturate your mineral and gas collection, which will support both army and tech development.
- 4. Technology: After completing Warpgate research, evaluate your unit composition and decide which tech path to pursue based on the enemy's strategy. Consider building additional tech structures like a Twilight Council or a Robotics Facility.
- 5. Keep an eye on the enemy's expansion and unit production. Prepare for potential Zergling attacks by having Zealots ready for defense.
- Decisions:
 - 0: <RESEARCH WARP GATE RESEARCH>
 - 1: <BUILD ZEALOT>
 - 2: <BUILD PROBE>
 - 3: <BUILD PYLON>
 - 4: <CHRONOBOOST CYBERNETICS CORE>



Figure 17: Decision of LLM Agent: Chronoboost Cybernetics Core

L1 results
At 04:25 game time, our current StarCraft II situation is as follows:
Resources: - worker_supply: 26 - mineral: 215 - gas: 128 - supply_used: 38 - army_supply: 8
Buildings: - base_count: 2 - pylon_count: 3 - gas_buildings_count: 4 - gateway_count: 1 Units: - base_count: 2 - pylon_count: 3 - gas_buildings_count: 4 - gateway_count: 1 In-process: - planning_gateway_count: 1 - planning_twilight_council_count: 1 Research: - warpgate_research_status: 1
Enemy Information: - enemy_UnitTypeid:HATCHERY: 1 - enemy_UnitTypeid:EXTRACTOR: 1 - enemy_UnitTypeid:SPAWNINGPOOL: 1
At 04:25 game time, our current StarCraft II situation is as follows:
Resources: - supply_left: 16 - supply_cap: 54 - supply_used: 38 - army_supply: 8 - base_count: 2
Buildings: - base_count: 2 - pylon_count: 3 Units: - gateway_count: 1 - warp_gate_count: 2 In-process: - planning_robots_facility_count: 1 - planning_stargate_count: 1 - planning_worker_count: 2 Research: - warpgate_research_status: 1
Enemy Information: - enemy_UnitTypeid:HATCHERY: 1 - enemy_UnitTypeid:EXTRACTOR: 1 - enemy_UnitTypeid:SPAWNINGPOOL: 1
At 04:26 game time, our current StarCraft II situation is as follows:
Resources: - game_time: 04:26 - worker_supply: 27 - mineral: 235 Buildings: - cybernetics_core_count: 1 - twilight_council_count: 1 - robotics_facility_count: 1 - stargate_count: 1 - planning_gateway_count: 1 Units: - Zealot_count: 4 - planning_worker_count: 2 In-process: - planning_gateway_count: 1 - planning_twilight_council_count: 1 - planning_robots_facility_count: 2 - planning_stargate_count: 2 - planning_worker_count: 2 Research: - warpgate_research_status: 1
Enemy Information: - enemy_UnitTypeid:HATCHERY: 1 - enemy_UnitTypeid:EXTRACTOR: 1 - enemy_UnitTypeid:SPAWNINGPOOL: 1

Figure 18: L1 results of 04:25 period

Example3: chronoboost nexus

LLM output:

- 1. Game Overview: At 04:25 game time, our situation is quite challenging. We have limited resources with 215 minerals and 128 gas. Our supply cap is at 54 with 16 supply left, and our army supply is just 8. We currently have two bases.
- 2. Current Game Stage: Based on the limited resources and small army size, we are in the early game stage.
- 3. Our Situation:
 - 3.1 Units and Buildings: We have a modest army consisting of 4 Zealots. We are in the process of constructing additional Gateways, a Robotics Facility, and a Stargate.
 - 3.2 Economy: Our economy is struggling with minimal resources. We need to expand our resource collection urgently.
 - 3.3 Technology: We have already researched Warp Gate technology, which is a positive development. However, we lack diversity in our units and are still in the process of building advanced tech structures.
- 4. Our Strategy: It appears we are gearing up for a tech-heavy approach with the construction of advanced tech structures. However, our current economic state is not supporting this strategy well.
- 5. Enemy's Strategy: The enemy seems to be focusing on expanding with Hatchery and Extractor but has also started building a Spawning Pool, indicating the potential for Zerg unit production.
- 6. Key Information: The most crucial aspect at this moment is our resource scarcity. We need to address this issue immediately to support our tech-heavy strategy and build a more substantial army to defend against potential enemy threats.

Suggestions:

- 1. Our Strategy: Given our low resources, it's crucial to prioritize resource expansion in the short term. **Build additional Probes to maximize mineral and gas collection.** Consider a defensive strategy while we bolster our economy.

- 2. Units and Buildings: Continue constructing the planned tech structures, but also prioritize the construction of additional Gateways for faster unit production. Warp-in Zealots as a cost-effective defensive measure.
- 3. Economy: Expand to new resource locations to increase income. **Keep worker production consistent and utilize Chrono Boost on Nexus to accelerate Probe production.**
- 4. Technology: Complete the construction of the Robotics Facility and Stargate to unlock advanced unit options. Consider researching unit upgrades once these structures are operational. Given the early game situation, these adjustments will help us stabilize our economy and prepare for potential enemy threats.
- Decisions:
 - 0: <TRAIN PROBE>
 - 1: <BUILD GATEWAY>
 - 2: <EXPAND TO NEW RESOURCE LOCATION>
 - 3: <BUILD ROBOTICSFACILITY>
 - 4: <**CHRONOBOOST NEXUS**>



Figure 19: Decision of LLM Agent: Chronoboost Nexus

L1 results
At 13:26 game time, our current StarCraft II situation is as follows:
Resources: - game_time: 13:26 - worker_supply: 54 - mineral: 1065
Buildings: - enemy_units_count: 10 - base_count: 6 - pylon_count: 10 - gas_buildings_count: 10 - gateway_count: 1 - shield_battery_count: 4 - warp_gate_count: 7 - cybernetics_core_count: 1 - twilight_council_count: 1 - robotics_facility_count: 14
Units: - enemy_units_count: 10 - stalker_count: 5 - robotics_bay_count: 1 - stalker_count: 1 - colossus_count: 4 - disruptor_count: 1 - observer_count: 2 - phoenix_count: 2 - voidray_count: 13
At 13:27 game time, our current StarCraft II situation is as follows:
Resources: - game_time: 13:27 Buildings: - enemy_units_count: 12 - base_count: 6 - pylon_count: 10 - gas_buildings_count: 10 - gateway_count: 1 - shield_battery_count: 4 - warp_gate_count: 7 - cybernetics_core_count: 1
Units: - enemy_units_count: 12
Enemy Information: - enemy_UnitTypeid:BROODLING: 2 - enemy_UnitTypeid:OVERSEER: 2 - enemy_UnitTypeid:CORRUPTOR: 1 - enemy_UnitTypeid:OVERLORDTRANSPORT: 3 - enemy_UnitTypeid:BROOLDORLD: 4 - enemy_UnitTypeid:HATCHERY: 2 - enemy_UnitTypeid:SPORECRAWLER: 2 - enemy_UnitTypeid:EXTRACTOR: 3 - enemy_UnitTypeid:SPAWNINGPOOL: 1 - enemy_UnitTypeid:SPINECRAWLER: 1
At 13:28 game time, our current StarCraft II situation is as follows:
Resources: - game_time: 13:28 - worker_supply: 53 - mineral: 1105 - gas: 959 - supply_left: 7 - supply_cap: 155 - supply_used: 148 - army_supply: 87 - enemy_units_count: 10 - base_count: 6
Buildings: - enemy_units_count: 10 - base_count: 6 - pylon_count: 10 - gas_buildings_count: 10 - gateway_count: 1
Units: - enemy_units_count: 10 - stalker_count: 1 - colossus_count: 3 - disruptor_count: 1 - observer_count: 2 - phoenix_count: 2 - voidray_count: 13

Figure 20: L1 results of 13:28 period

Example4: Adapt strategy in response to opponent's tactics

LLM output:

- 1. Game Overview: At 13:28 game time, our situation is as follows: We have 54 workers, 1135 minerals, and 975 gas. Our supply cap is at 155 with 7 supply left, and our army supply is 87. We have six bases.
- 2. Current Game Stage: Based on the game time and resource availability, we are in the mid to late-game stage.
- 3. Our Situation:
 - 3.1 Units and Buildings: We have a decent worker count and a strong army composition with Stalkers, Colossi, Disruptors, Observers, Phoenixes, and Void Rays. Our building count is also significant, with multiple pylons, gateways, robotics facilities, and a robotics bay.
 - 3.2 Economy: Our economy is stable, with a good balance of minerals and gas. We have enough workers to maintain our resource collection efficiently.
 - 3.3 Technology: We have already researched Warpgate technology, which is essential for unit production. However, there is no information about further technological advancements or upgrades.
- 4. Our Strategy: Our strategy seems to be focused on a strong ground and air army composition, utilizing Stalkers, Colossi, Disruptors, Phoenixes, and Void Rays. We should continue to leverage our army strength and maintain a strong economy.
- 5. Enemy's Strategy: The enemy has a diverse unit composition, including Broodlords, Overlord Transports, Corruptors, Overseers, and ground units. They seem to be focusing on air superiority and potentially using Broodlords for high ground control.
- 6. Key Information: The most crucial aspect at this moment is our strong army composition, which includes anti-air units like Phoenixes and Void Rays. However, we should be cautious of the enemy's Broodlords, which can pose a significant threat to our ground forces. Additionally, we need to focus on further technological advancements and upgrades to stay ahead in the game.

Suggestions:

- **1. Our Strategy:** We should continue to strengthen our army composition by adding more anti-air units like Phoenixes and Void Rays. Additionally, we should consider countering the enemy's Broodlords with appropriate units or tactics.
- **2. Units and Buildings:** Given the enemy's air dominance, it would be beneficial to increase the production of Phoenixes and Void Rays. Additionally, consider building more Stargates to support the production of these units. It may also be necessary to reinforce our ground forces with additional Stalkers and Colossi.
- **3. Economy:** Maintain a steady worker production and ensure efficient resource gathering. Consider expanding to new resource locations to support the production of a larger army.
- **4. Technology:** Research upgrades that enhance the effectiveness of our units, such as air weapon and armor upgrades for Phoenixes and Void Rays. Additionally, consider researching extended thermal lance for increased Colossus range.

Decisions:

- **0: <TRAIN PHOENIX>**
- **1: <TRAIN VOIDRAY>**
- **2: <BUILD STARGATE>**
- **3: <TRAIN STALKER>**
- **4: <TRAIN COLOSSUS>**



Figure 21: Decision of LLM Agent: Adapt strategy in response to opponent's tactics.