

CS524 Project Proposal: StarCraft Mixed Integer Program

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Background

StarCraft is a real-time strategy PC game released by Blizzard Entertainment in 1998. It is widely regarded as the defining game of the genre, receiving broad critical acclaim and many years of commercial success. The game retains a large and loyal fanbase and is a popular e-sport, especially in Korea. StarCraft also contributes to artificial intelligence research, serving as a testbed for agent design competitions.

Problem Statement

The first minutes of a StarCraft match frequently decide its outcome. During this time, players make crucial decisions about resource management and production in order to build their bases and militaries as quickly as possible. Players who grow the fastest are at an advantage; in some cases they are able to overwhelm their opponents within four minutes of the game's start. This is a strategy known as "rushing".

I propose to build an optimization model, answering the following question: *What choices maximize military strength at the four-minute mark in a StarCraft match?* Written mathematically, solve

$$\operatorname{argmax}_{\delta_{t,e}} \sum_{t \in T} \sum_{e \in E} \delta_{t,e} \cdot \text{strength}_e \quad \text{s.t.} \quad \delta_{t,e} \in \{0, 1\} \quad (1)$$

where T is the set of timesteps; E is the set of entities; $\delta_{t,e}$ represents the decision to build entity of type e on timestep t ; and strength_e is a measure of an entity's strength, based on its attack strength, range, firing rate, and hit points. Additional constraints would encode build dependencies and resource availability. I estimate 120 timesteps and 10 entity types, resulting in approximately 1200 binary decision variables. Constraint count would be linear with timesteps.

The results of this research would inform the strategies of amateur and professional players; it could also serve as a performance benchmark for those who use StarCraft in their AI research.

Requisite Data

A wealth of data for StarCraft game mechanics is available at such fan websites as Liquipedia. This includes entity strength data, resource costs, build times, and resource gathering rates.



(L) Resource-gathering and base-building; (R) Defending base from an early attack