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An Adversarial Approach for Automated *Pokém* Team Building and Metagame Balance

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***Abstract*—Metagame balance is a crucial task in game development, and automation of this process could assist game developers by vastly reducing time costs. We explore and evaluate a metagame balance model over the recently proposed VGC AI Competition Framework. We propose an adversarial model where team builder agents try to maximize their win rate by narrowing to the most optimal team configurations, resulting in a reduction of the diversity of *Pokémon* employed, while a balancing agent readapts the *Pokémon* inner attributes to incentivize the team builder agents to incorporate a greater variety of *Pokémon* into their teams increasing the metagame's overall diversity and balance. Furthermore, we develop multiple team builder agents divided into two groups: the first group assumes that individual *Pokémon* advantages are the primary factor to determine the outcome of game matches; the second group also exploits the implicit synergy between teammates. These agents make use of metagaming, linear optimization, and evolutionary search to find strong combinations against the current metagame. The strongest team builder is faced against the team metagame balance agent for its evaluation. Deep learning is also employed to predict the outcome of matches and recommend constructive elements of teams.**

***Index Terms*—Automatic game design, competitive games, deep reinforcement learning, evolutionary algorithms, game balance, game theory, optimization.**

I. Introduction

for diverse gameplay. The process to enforce such re
in a game is known as balance.

In reality, there is a lack of consensus on what a
game" really means. Becker and Görlich [1] exam
from 14 lead game designers and critics, trying to
conceptual basis for the term. The authors conclu
four elements more present in the reports are: 1) di
balancing (as a purposive act); 3) symmetry; and 4
characteristics of a well-balanced game. One of thos
characteristics is that multiple winning strategies
viable. The authors also report that balancing as a
not unique, with probable cause for the lack of conse
term. Most importantly, the balancing process is diffic
all the elements of a game work in a fragile equilibr
small changes may drastically change how the game
changing how the players see the game.

Carter et al. [2] discuss the definition of the term
The term is employed by players, game designers, and
as both activities performed outside the game, and as a
strategic analysis of the behavior of opponents and the
choices before a game starts. It is important to
between metagame balance and in-game balance:
balance is an inverse process where strategies are