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Abstract

Here goes the abstract

Dedication and acknowledgements

Here goes the dedication.

Author's declaration

I declare that the work in this dissertation was carried out in accordance with the requirements of the University's Regulations and Code of Practice for Research Degree Programmes and that it has not been submitted for any other academic award. Except where indicated by specific reference in the text, the work is the candidate's own work. Work done in collaboration with, or with the assistance of, others, is indicated as such. Any views expressed in the dissertation are those of the author.

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Chapter 1 Introduction

1 Overview

Magic: The Gathering (MTG) is a Trading Card Game (TCG) designed by Wizards of the Coast (WOTC). Players take the role of a wizard, whose deck is a library of spells with which they battle one or more similarly equipped opponents. Pursuit of the hobby thus involves mastery of both gameplay and deck construction. While tournament-level participation relies on "netdecking" - copying a decklist with a history of competitive success - the hobby is intended to have a significant creative component, with the unranked Commander format gaining popularity in recent years through its focus on unique and personal decks [**?**].

In addition to spell cards, decks also contain "land" cards, which generate "mana", a resource expended to cast spells. A deck's lands collectively form its "manabase". Mana comes in five colours: White, Blue, Black, Red and Green (abbreviated respectively to W, U, B, R and G, or WUBRG collectively). Spells require specific colours, and lands produce one or more colours. A deck including spells of many colours has access to more spells, but runs an increased risk of a "colour screw", in which the player does not draw lands of the colours they need. Whereas selecting a list of spells is a stimulating creative pursuit, choosing a deck's manabase is less so: within a set budget, and notwithstanding the minority of lands which come with effects outside mana provision, there are objectively lists of lands that will maximize a player's chances of being able to play their spells.

LandFill is a webapp that automates this aspect of deck building. Users input a list of spell cards, select some broad preferences for their manabase, and are provided with a manabase that has been optimized within those preferences to facilitate reliable casting of their spells. This optimization is necessarily approximate: Churchill *et al* have demonstrated that, as it is possible to construct within an MTG game a Turing Machine whose halting is the necessary condition for a player's victory, a deck's winning strategy is undecidable [**?**], meaning that it is beyond LandFill's capacity to determine what lands support the most decisive plays. Nevertheless, the heuristic that the winning MTG player is typically the one who spends the most mana over the course of the game [**?**] provides an opening for approximating the optimum via Monte Carlo methods. Using a stripped-down MTG simulator, in which the simulated player aims only to spend as much mana as possible each turn, LandFill estimates over iterated games how effective a given manabase is. It then produces successively optimized manabases via a Hill Climbing Algorithm. While LandFill may never rival the experienced eye of a seasoned competitive deckbuilder, it is nevertheless my contention that an app that provides a list of lands of demonstrated efficiency, via a click of a button, would pay dividends for casual players in ease of deckbuilding and satisfaction of games.

2 Thesis Layout

My writeup here documents the development and testing of LandFill. I will begin by outlining relevant MTG rules and design trends, and the difficulties these introduce for optimization, followed by an overview of how LandFill will approach these. I will then outline my initial consultations with MTG players, and the features they require from a manabase optimization app. Dividing LandFill into four components - a MTG card database, an MTG game simulator, an optimization algorithm implementer, and a user interface - I will then outline its structure, and justify the decisions made during development. I will then summarize a second round

of user-testing, and outline the value added by LandFill. I will conclude with an evaluation of the strengths and limitations of the app, and areas for future development.