

## Discussion chapter 7

### Magic the Gathering, DAF

The rules are as follows. (Please see page 208.)

- The game is played with a deck of 60 cards.
- Cards can be in one of 4 places.
  - The library
  - The hand
  - The table
  - The graveyard (only used spell cards are placed here. See 3d.)
- There are two kinds of cards: Spells and Lands.
  - Lands have cost 0. At every turn, you could place *at most* one land on the table. (See 3b.) When they're placed on the table, they will remain there for the rest of the game.
  - Spells have cost  $k$  (from 1 to 6). In order for you to use a spell of cost  $k$ , you must have at least  $k$  "untapped" lands on the table. Using a spell card "taps"  $k$  lands on the table. They remain tapped for the rest of the turn. If you have enough untapped lands, you could play more spell cards. (See step 3c.) At the end of the turn, the spell card is placed in the graveyard, and the "tapped" cards are "untapped".<sup>1</sup> (See step 3d.)

Here are the step-by-steps of how this game is played. Assume we play this game for  $T$  turns.

1. Initialize the game with a hand of 7 cards, and 53 cards in the library. The number of each spell card and land card may vary. (See the practice problems.)
2.  $\text{LANDSONTABLE} = 0$
3. For  $T$  turns:

- (a) **Draw.** Draw a card from your library, and put it into your hand.
- (b) **Put.** If you have a land in your hand, you may put it on the table.  $\text{LANDSONTABLE} += 1$ .
- (c) **Play.** You can now play your spell cards. You can play as many spells  $s_1, s_2, \dots, s_k$  as you want, provided that

$$\text{cost}(s_1) + \text{cost}(s_2) + \dots + \text{cost}(s_k) \leq \text{LANDSONTABLE}.$$

Using spell  $s_i$  taps  $\text{cost}(s_i)$  lands on the table.

*Note that in problem 7.5 and 7.6, we use **at most** one spell per turn. Problem 7.5 and 7.6 vary between picking the cheapest spell card, and picking the most expensive spell card.*

- (d) **Clean up.** Put each spell card played in the graveyard. Untap all of the lands played.

Note that we're **never removing** lands from the table. Therefore, the number of lands on the table only increases as the game goes on. Furthermore, there is no advantage of having lands in your hand; it's only natural that we want to place a land on the table when we have the opportunity. (See step 3b.)

<sup>1</sup>In his book, David untaps the cards at the beginning of the turn.