

Magic the Gathering Lite Project

(DEADLINE: 5th of June 23:59)

“Duels of the Planeswalkers ...”

Outline: In this project, you are expected to write a program that simulates a simplified version of the Magic the Gathering (MtG) card game by Wizards of the Coast.



MtG is a collectable card game where you fight with an opponent where both you and your opponent use a deck of cards each. The deck of each player consists of creature cards, land cards, sorcery cards, and enchantment cards. Each turn, you play some of the cards that you have and let your creatures attack your opponent. **Each player has a starting hit point (HP) of 15 and whoever is reduced to 0 HP (or lower) first loses the game.** The game is played over turns and at the end of a turn, the game passes to the other player. This cycle continues until one of the players die.



Cards:

In MtG there are a lot of different cards. Each card has certain properties: its name, its type, its mana cost (if not a land card), its color (if not a land card), its attack power and HP (if a creature card), and abilities/effects. The type of a card can either be “land”, “creature”, “enchantment,” or “sorcery”. The mana cost represents the cost of playing the card from your hand. There are basically five types of currency in the game:

- Black mana
- White mana
- Red mana
- Green mana
- Blue mana

In order to play a card, you have to pay this amount of mana from your available mana. Some cards can also have colorless mana cost. This colorless cost can be paid from any one of the colors.



Example: The Armored Pegasus card on the left costs 1 colorless mana and 1 white mana to play. Since all five colors can be used to pay the colorless part of the cost of this card, you can pay either

- 2 white mana
- 1 white mana + 1 black mana
- 1 white mana + 1 red mana
- 1 white mana + 1 green mana
- 1 white mana + 1 blue mana

to play this card from your hand into the play area.

NOTE: Land cards do NOT have any mana costs.

NOTE: Color icons are not important for the project.

Each card also has a color which can be either one of the five colors. There is no such thing as a colorless card.

A creature card will have an attack power and a HP. The attack power represents how much this card will hit its target in a combat. The HP represents after how much damage this card will be destroyed.

NOTE: After each phase, the HP of a creature card goes back to its baseHP.

Finally, a creature card can have one or more abilities; an enchantment or sorcery card can have effects which can vary a lot and will be explained in the card list below.

Four Card Piles:

Each player has four card piles as library, hand, in play, and discard pile.

- **Library:** Cards in library represents cards that can be used in the future. All the cards start at the library. When a player draws a card, the top card of the library is moved to the player's hand.
At the start of the game each player immediately draws 5 cards from the library.
- **Hand:** Cards in hand are the only cards that can be played. When a player "plays" a card, if it is a land, creature, or enchantment card it goes to in play pile. Sorcery cards though do something based on their effects and are placed into the discards pile.
The hand pile has a limit of 7 cards. As long as a player has 7 cards in hand, s/he cannot draw more cards.
- **In play:** Cards in play stay in play as long as they are not destroyed and generally do something beneficial to the player. A creature or land card in the in play pile always have a "untapped" and "tapped" state. "untapped" state means the card can be used to do something (e.g., untapped creature cards can attack; untapped land cards can be tapped to gain mana). When an "untapped" card is used, it becomes "tapped". When a land, creature, or enchantment card in play is destroyed it moves to the discard pile.
At the start of the game, the in play pile starts empty.
- **Discards:** Cards in discard are generally used up cards that have no effect over the game. Though, some effects allow a card to be moved from the discard pile back to the hand.
At the start of the game, the discard pile starts empty.

Turn order:

In MtG, a player's turn consists of the following phases in this order: Draw, Untap, Play, Combat, Play, and End.

1. **Draw:** In this phase, the player draws 1 card from the library if the player has less than 7 cards in his/her hand.
If there are no cards in the library and the player tries to draw a card, the player loses the game.
2. **Untap:** In this phase, all "tapped" cards in play become once again "untapped".
3. **Play:** In this phase, the player can play a maximum of **ONE** land card from his hand. Then, can play as many non-land cards as possible according to the mana cost rules explained above. The player can also "tap" land cards in-play to gain mana.

4. **Combat:** In this phase, the player can attack with any creature(s) he has in play and all attacking creatures become “tapped”. For each attacking creature, the opponent can dedicate one defending creature which is “untapped” or no creature to defend. Defending creatures do **NOT** become “tapped”. Then, the combat is resolved as explained below.
5. **Play:** This is the same as the previous play phase with one exception. If the player had played **ONE** land card in **phase 3**, s/he **CANNOT** play a land card in this phase.
6. **End phase:** A simple cleanup phase. All unused mana of the player is depleted. The turn is given to the opponent player.

Playing a Card:

Playing each type of card follows different rules as explained below:

1. **Land Cards:** When a player plays a land card, s/he simply moves the card from his/her hand to the in play pile. Newly played land cards enter the game as “untapped”. A player can play only ONE land card each turn, either in **phase 3 or phase 5**.
2. **Creature Cards:** When a player plays a creature card, s/he moves the card from his/her hand to the in play pile by paying its mana cost. Newly played creature cards enter the game as “untapped”. Then the effect of enchantment cards already in play are applied to this creature card.

Example: The Armored Pegasus card is played. There is already an enchantment card that gives +1 attack power and +1 HP to all white creatures the player has. Then, after entering into play both the attack power and the HP of the Armored Pegasus is increased by “+1”.

3. **Enchantment Cards:** When a player plays an enchantment card, s/he moves the card from his/her hand to the in play pile by paying its mana cost. Enchantment cards do NOT have “untapped”/ “tapped” status. Then, the effect of this enchantment card is immediately applied to ALL applicable creature cards in play. If an enchantment card is destroyed, its effect is reversely applied to ALL applicable creature cards in play.

Example: After the Armored Pegasus card entered into play, a Sorcery card destroyed the enchantment card that is giving +1 attack power and +1 HP to all white creatures the player has. Therefore, the Armored Pegasus loses its “+1” increase to its attack power and its HP.

4. **Sorcery Cards:** When a player plays a sorcery card, s/he moves the card from his/her hand to the **discard** pile by paying its mana cost. Then, the effect of this sorcery card is immediately applied to ALL applicable creature(s) cards in play and player(s).

Combat:

In MtG combat is conducted between either two creature cards (i.e., attacker and defender) or one creature card and the opposing player.

1. **Combat between two creature cards:** Reduce the defending creature’s HP by the attack power of the attacking creature card AND reduce the attacking creature’s HP by the attack power of the defending creature card. If either the attacker or the defender or both of them is/are reduced to 0 HP or lower these creatures are destroyed.

Special abilities:

- a. If the attacking creature has “Trample” ability, the excess amount of attack power is dealt to the opposing player (which can cause the opposing player dying). Here the excess amount of attack power is calculated as:

$$\text{Excess attack power} = \text{Attacker's attack power} - \text{defender's HP}$$

- b. If the attacking creature has “First Strike” ability,
 - i. If the defending creature also has “First Strike” ability, normal attack procedure.
 - ii. If the defending creature does **NOT** have “First Strike” ability; then first the Attacker’s attack power is applied to the defender’s HP. If the defender is destroyed then the combat stops here (i.e., the defender CANNOT deal its damage to the attacker)

- c. If the attacking creature does **NOT** have “*First Strike*” ability,
 - i. If the defending creature has “*First Strike*” ability, then first the Defender’s attack power is applied to the attacker’s HP. If the attacker is destroyed then the combat stops here (i.e., the attacker **CANNOT** deal its damage to the defender)
 - ii. If the defending creature also does **NOT** have “*First Strike*” ability; normal attack procedure.
2. **Combat between one creature card and the opposing player:** Reduce the HP of the opposing player by the attack power of the attacking creature card. If the opposing player’s HP is reduced to 0 or lower, that player loses the game.



Example: The Air Elemental is attacking, and the Armored Pegasus is selected as the defender. Since none of them has first strike ability, the Air Elemental deals 4 damage (its attack power) to the Armored Pegasus. At the same time the Armored Pegasus deals 1 damage (its attack power) to the Air Elemental. The Air Elemental has 4 HP, more than the 1 damage so it lives. The Armored Pegasus has 2 HP, less than the 4 damage so it dies.

If the Air Elemental had “Trample” ability, the excess attack power (i.e., $4 - 2 = 2$) would have been dealt to the player of the Armored Pegasus.

Abilities:

In normal MtG game there are a lot of abilities. For this project we will consider only two abilities:

- Trample (as explained above)
- First Strike (as explained above)

Effects:

In normal MtG game there are a lot of effects. For this project we will consider only the following effects:

- Target creature card in play is destroyed
- Target land card in play is destroyed
- Target enchantment card in play is destroyed
- All of [COLOR] creatures cards get +1 attack power, +1 HP
- All of [COLOR] creatures cards get -1 attack power, -1 HP
- Deal [X] damage to target creature card OR player
- Move one creature card from your discard pile back to your hand pile
- Target creature gets/loses “First Strike”
- Target creature gets/loses “Trample”

Objective of the Project:

In the project, you are expected to simulate a combat according to the rules explained above between two opponents. Player#1 and Player#2 will have the decks composed of the cards given below. Game will start by Player#1. The game will continue until one of the players die. Check the Appendix A below for the meaning of the cards.

Player #1 Deck:

- 5x Plains
- 3x Forest
- 1x Island
- 10x creature (3x Soldier, 2x Armored Pegasus, 2x White Knight, 1x Angry Bear, 1x Guard, 1x Werewolf)
- 4x Sorcery (1x Disenchant, 1x Lightning Bolt, 2x Flood)
- 3x Enchantment (1x Rage, 1x Holy War, 1x Holy Light)

Player #2 Deck:

- 5x Swamp
- 3x Mountain
- 1x Island
- 10x creature (3x Skeleton, 2x Ghost, 2x Black Knight, 1x Orc Maniac, 1x Hobgoblin, 1x Vampire)
- 4x Sorcery (1x Reanimate, 1x Plague, 2x Terror)
- 3x Enchantment (1x Unholy War, 1x Restrain, 1x Slow)

Each turn, game will automatically apply the draw and untap phases of the player. Then, the game will write down all the cards in the player's hand and list all the cards in play for both players. Then, the player will have the option to conduct the actions explained in **phase 3, phase 4, and phase 5** by getting input from the user.

NOTE: Do NOT try to add AI to the game, it is very, very complex! Both players will be managed by the user inputs.

Input:

- In the play phases, a selection for choosing card(s) from hand to play (if any), land cards to “tap”, in attack phases which creature(s) to attack, which card(s) or player to affect with the effects
- In case your opponent is attacking, and you have at least one “untapped” defender, choose if any of your creatures will defend and if so which one will defend.

Output:

- At the start of each turn, the current state of the game
 - o Which cards are in play
 - o What are the cards in the hand of the active player
 - o HP of each player
- At the end of each card play, what has happened.
- At the end of each combat, what has happened.
- At the end of each round, print out “End of Round 1, 2, ...”
- At the end of the game, which player has won, with how many HPs left.

Object Oriented Programming Requirements & Hints

1. You are expected to have the following classes based on the mechanics of the game:
 - **class Card**
 - o **class landCard: public Card**
 - o **class creatureCard: public Card**
 - o **class enchantmentCard: public Card**
 - o **class sorceryCard: public Card**
 - **(OPTIONAL) class colorCost**
 - **class Effect**
 - o **class DestroyCreatureEffect: public Effect**
 - o **etc...**
 - **class Player**
2. **You are expected to write appropriate fields and functions to each of the classes above**
Example: class creatureCard has int attackPower, maxHP, bool hasFirstStrike, ...
3. Local fields of **ALL** classes **MUST BE PROTECTED**.
4. **DO NOT USE POINTERS, INSTEAD USE SMART POINTERS.**
5. While designing the classes, if two classes having the same parent class having a similar functionality, try to write it as a virtual function
Example: You play land, creature, sorcery, and enchantment cards. However, their “play” mean different things. Therefore Card class should have a virtual play() function
6. Each enchantmentCard and sorceryCard object should have a field to keep its Effect using an Effect object (or its sub-classes).
7. In the player class there should be four vectors (or smart point to vectors) representing the four decks of the player
Example: std::vector<Card> hand; std::vector<Card> deck;
8. You **SHOULD** use randomization to randomize the deck **AT THE BEGINNING OF THE GAME**.
9. You **MAY** use operator overloading for colorCost class to check if a card is playable given the current mana amount.

NOTE: Official Magic the Gathering game is more complicated as described in this document. You are required to implement what is written in the document, **NOT** what is in the game. However, if you want to experiment you can add additional components of the game (e.g., flying, protection from [COLOR], instant cards, etc...)

NOTE: In random number calculations, you can use the rand() function as well as the srand() function to set up the randomization seed value. If you wish, you can use more complicated randomization tools.

NOTE: As for more reference you can check numerous Magic the Gathering YouTube series as well as play the **free** Magic the Gathering Arena game: <https://magic.wizards.com/en/mtgarena> The tutorials will be enough for the core gameplay.

HINT: Writing the combat part could be tricky, since one creatureCard object is affecting potentially another creatureCard object and/or a player object. You can use a “isDestroyed” field within the creatureCard class. So, at the end of the combat, if this field has a true value than it means the creature is destroyed and should be moved to the discard pile.

HINT: Also, you consider two parameters to this attack function, a smart pointer to a creatureCard object and a smart pointer to a player object. If there is no defender creature, then the smart pointer will be a null pointer. You can check if a smart pointer pointing towards “null” by checking if the value of the smart pointer is 0 or not.

APPENDIX A – CARD LIST

Casting costs and mana gains are written with the following notation: G means 1 green mana, B means 1 black mana, W means 1 white mana, **R means 1 red mana**, L means 1 blue mana, Numbers mean that many colorless mana.

Land Cards:

| Card Name | Mana |
|-----------|-----------------------|
| Forest | Gives G when “tapped” |
| Island | Gives L when “tapped” |
| Mountain | Gives R when “tapped” |
| Plains | Gives W when “tapped” |
| Swamp | Gives B when “tapped” |

Creature Cards:

| Card Name | Mana Cost | Card Color | Attack Power | HP | Ability |
|-----------------|-----------|------------|--------------|----|--------------|
| Soldier | W | White | 1 | 1 | |
| Armored Pegasus | 1W | White | 1 | 2 | |
| White Knight | WW | White | 2 | 2 | First Strike |
| Angry Bear | 2G | Green | 3 | 2 | Trample |
| Guard | 2WW | White | 2 | 5 | |
| Werewolf | 2GW | Green | 4 | 6 | Trample |
| Skeleton | B | Black | 1 | 1 | |
| Ghost | 1B | Black | 2 | 1 | |
| Black Knight | BB | Black | 2 | 2 | First Strike |
| Orc Maniac | 2R | Red | 4 | 1 | |
| Hobgoblin | 1RB | Red | 3 | 3 | |
| Vampire | 3B | Black | 6 | 3 | |

Sorcery Cards:

| Card Name | Mana Cost | Card Color | Effect |
|------------------------|-----------|------------|--|
| Disenchant | 1W | White | Destroy 1 Target Enchantment |
| Lightning Bolt | 1G | Green | Deal 2 dmg to target creature or player |
| Flood | 1GW | Green | Destroy 1 Target Land |
| Reanimate ¹ | B | Black | Return 1 character card from discard to hand |
| Plague | 2B | Black | Deal 1 dmg to all creatures |
| Terror | 1B | Black | Destroy 1 Target Creature |

Enchantment Cards:

| Card Name | Mana Cost | Card Color | Effect |
|------------|-----------|------------|--------------------------------------|
| Rage | G | Green | 1 Target creature gains Trample |
| Holy War | 1W | White | All white creatures gain +1/+1 |
| Holy Light | 1W | White | All black creatures gain -1/-1 |
| Unholy War | 1B | Black | All black creatures gain +2/+0 |
| Restrain | 2R | Red | All green creatures lose Trample |
| Slow | B | Black | 1 Target creature loses First Strike |

¹ Reanimate is most likely a very different card. You simply select one character from your discard pile and move it to your hand. Here, you have also check that the hand limit is reached or not.