COMP 302 Software Engineering
Game Project Requirements
KU Royale

Fall 2025 - Phase 1

October 26, 2025
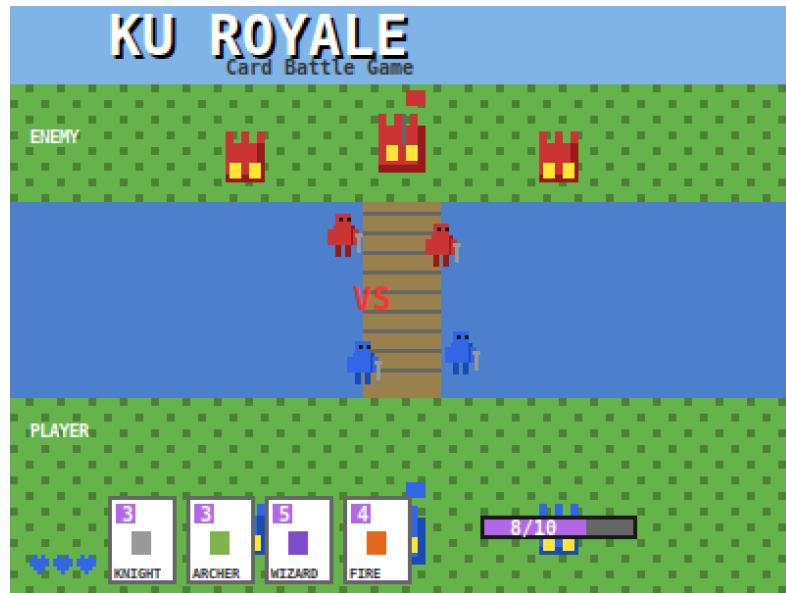
A Single-Player Strategy Battle Game

Contents

1. What is This Game?

1.1. The Big Picture

You have a deck of cards, and each card represents something you can place on your side of a playing field - like a soldier, a building, or a magical spell. Your opponent (controlled by the computer) is doing the same thing on their side.

Your goal: Destroy your opponent's main structure before they destroy yours.

The challenge: You can't just play all your cards at once. You need to have enough "energy points" (we'll call them **"Elixir"**) to play each card. These points refill slowly during the game, so you must make smart decisions about when and where to play your cards.

1.2. How Does a Match Work?

Think of it like this:

1. The game shows you a playing field split down the middle with a river - your side and the computer's side

2. You both start with three towers: 1 main tower (King Tower) and 2 side towers (Crown Tower)

3. You play cards from your hand to deploy units, build defenses or cast spells

4. The units move across the field trying to destroy the opponent's units

5. The first player whose main tower gets destroyed loses

6. If time runs out (3 minutes), whoever destroyed more enemy towers wins

1.3. A Typical Gameplay
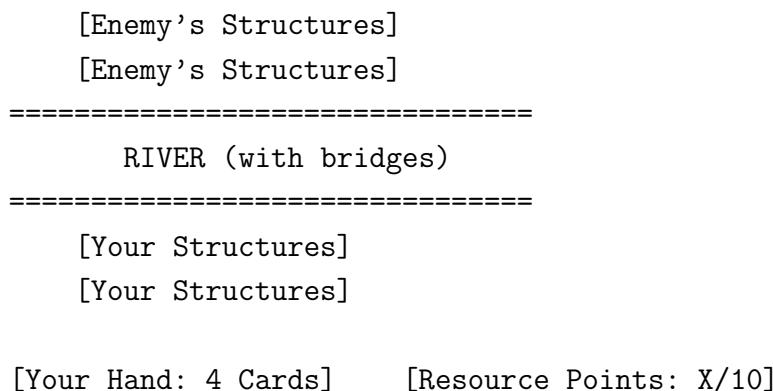
Here's what you do during the game:

1. Look at the 4 cards in your hand

2. Wait until you have enough Elixir to play a card

3. Click on a card, then click where you want to place it on YOUR side of the field (or you can implement it as drag&drop)

4. Watch your units move toward the enemy's units

5. Your towers automatically shoot at enemy units that get in their range

6. Repeat until someone wins or time runs out!

2. Visual Overview of the Game

2.1. The Playing Field (Arena)

The game takes place on a rectangular field divided into two halves by a river:

```
    [Enemy's Structures]
    [Enemy's Structures]
  ===============================
        RIVER (with bridges)
  ===============================
    [Your Structures]
    [Your Structures]

 [Your Hand: 4 Cards]    [Resource Points: X/10]
```

Key Visual Elements:

- **Top half:** Computer opponent's territory

- **Bottom half:** Your territory (where you can place cards)

- **River in middle:** Units must cross via bridges

- **Bottom of screen:** Shows your cards and Elixir

2.2. What Do the Structures Look Like?

Towers: Imagine medieval castle towers. Each player has 3 towers:

- **1 King Tower** (the main one - if this falls, you lose immediately)

- **2 Crown Towers** on the left and right sides (destroy these to win if time runs out)

These towers automatically shoot at enemy units that comes in their range.

2.3. What Do Cards Represent?

When you play a card, it spawns something on the field:

- **Troop Cards:** Spawn units who move toward enemies and attack

  - Example: A knight, an archer, a wizard

- **Building Cards:** Place a stationary structure on your side

  - Example: A cannon that shoots enemies, a hut that spawns more soldiers

- **Spell Cards:** Create an instant effect (like an explosion)

  - Example: A fireball that damages multiple enemies in an area

3. Core Concepts Explained

Now that you understand the basic idea, let's explain the key concepts you'll see throughout this document.

3.1. Resources (Called "Elixir" in this game)

What is it? Think of Elixir as your "mana" or "energy points" - the resource you spend to play cards.

How does it work?

- You start each match with 5 Elixir points

- Maximum is 10 points

- It refills automatically: You gain 1 point every 2.8 seconds

- Each card costs a certain amount (shown on the card)

- If you don't have enough Elixir, you can't play that card yet

Example: If a Knight card costs 3 Elixir, you need to wait until your Elixir reaches at least 3 to play it. After playing it, your Elixir drops to (Current - 3), and then it starts refilling again.

3.2. The Two Types of Towers

Crown Towers (the side towers):

- Each player has 2 of these

- They defend your territory by shooting enemies

- Destroying enemy Crown Towers gives you points

- If all yours are destroyed but your King Tower survives, you can still win

King Tower (the main tower):

- Each player has 1 of these (in the center, behind the Crown Towers)

- This is your "life" - if it's destroyed, you lose immediately

- Also shoots at enemies

- Typically stronger than Crown Towers

3.3. Your Deck and Hand

Deck: Before a match starts, you choose 8 cards from all available cards (28 total). These 8 cards are your "deck."

Hand: During the match, you can see 4 cards from your deck at a time. When you play one, another card from your deck appears in your hand. The cards cycle through your deck repeatedly.

Analogy: Think of a deck of playing cards. You hold some cards in your hand, play one, and draw a new one from the deck.

3.4. How Units Move and Attack

Automatic Movement: When you place a troop card, the soldier spawns on your side and automatically starts moving toward the nearest enemy. You don't control it directly after placement.

Target Selection: Soldiers automatically attack the nearest enemy or tower.

Ground vs Air Units:

- **Ground units** must walk across bridges to reach the enemy side

- **Air units** (like flying creatures) can fly directly over the river

4. Before You Play: Setup Stages

4.1. Stage 1: Designing the Arena (One-Time Setup)

Before your first match, you design the layout of the playing field.
What you do:

1. Place your 3 towers (2 Crown Towers + 1 King Tower) on your side

2. Place 1 to 3 bridges across the river

3. Save this layout

The computer opponent gets a mirrored version of your layout automatically.
Why? This lets you customize the battlefield. More bridges = more paths for units to cross = more complex strategy.
Note: You only do this once (or whenever you want to change your arena design). It's saved for all future matches.

4.2. Stage 2: Building Your Deck (Before Each Match)

Before each match begins, you choose which 8 cards (out of 28 available) you want in your deck.
Available Cards:

- 15 different troop cards (soldiers with different abilities)

- 9 different building cards (defensive or support structures)

- 4 different spell cards (instant effects)

Deck Rules:

- Must choose exactly 8 cards

- No duplicates (each card can appear only once)

- Can mix troops, buildings, and spells freely

The computer opponent also gets 8 random cards for its deck.

4.3. Stage 3: The Battle (3 Minutes)

Once both decks are ready, the match begins! See Section 1 for how a match plays out.

5. Detailed Game Mechanics

5.1. Win Conditions (How to Win)

There are 3 ways to win:

1. **Instant Victory:** Destroy the opponent's King Tower

   - The match ends immediately
   - You win regardless of anything else

2. **Victory by Points (if 3 minutes expire):**

   - Count how many Crown Towers each player destroyed
   - Whoever destroyed more Crown Towers wins
   - Example: You destroyed 2, opponent destroyed $1 \rightarrow$ You win

3. **Tiebreaker (if Crown Tower count is equal):**

   - All remaining towers start losing health rapidly at the same rate
   - The first tower to reach 0 health loses
   - This ensures there's always a winner (very rare to tie)

5.2. The Double Elixir Phase

To make the game more exciting toward the end:

- **Minutes 0-2:** Elixir refills at normal speed (1 point every 2.8 seconds)
- **Minutes 2-3:** Elixir refills TWICE as fast (1 point every 1.4 seconds)

This means in the final minute, you can play cards much more frequently, leading to intense action!

5.3. How Damage Works

When a soldier attacks:

1. The soldier identifies its target (nearest enemy within range)

2. It attacks at its specified speed (e.g., once per second)

3. Each attack reduces the target's health by the soldier's damage amount

4. When health reaches 0, the target is destroyed and disappears

Health Bars: All units, buildings, and towers display a health bar so you can see how much damage they've taken.

Ranged vs Melee Attacks:

- **Melee:** Soldier must be right next to the target (like a knight with a sword)

- **Ranged:** Soldier can attack from a distance (like an archer with arrows)

5.4. Area of Effect (AoE) Attacks

Some attacks damage multiple targets at once:

Example: A wizard's fireball explodes on impact, damaging all enemies within a small radius around the explosion point (ranged AoE). A Valkyrie spins and damages all nearby enemies (melee AoE).

Why it matters: Good for dealing with groups of weak enemies (swarms).

6. The 28 Available Cards

This section lists all cards you can choose when building your deck. Each card shows:

- **Name**

- **Elixir Cost** (how much it costs to play)

- **What it does**

- **Key stats** (health, damage, speed, etc.)

6.1. Understanding Card Stats

Before we list the cards, here's what the stats mean:

- **HP (Hitpoints):** How much damage the unit can take before dying

- **DMG (Damage):** How much damage each attack deals

- **Hit Speed:** Time between attacks (in seconds). Lower = attacks faster

- **DPS (Damage Per Second):** DMG divided by Hit Speed = total damage per second

- **Range:** How far the unit can attack (melee = must be adjacent)

- **Speed:** How fast the unit moves across the arena

- **Target:** What the unit can attack (Ground only, Air only, or Both)

6.2. Troop Cards (15 cards)

Troops are soldiers that move and attack. When you play a troop card, the soldier spawns on your side and walks toward the enemy.

Notes:

- Each troop has a type (Ground or Air) and target (types it can attack). A troop cannot attack an enemy outside its target type.

- Ground types must use bridges to cross the river. Air types can just cross it. Buildings are stationary.

- Spells can be cast anywhere on the map

- Every troop can attack buildings and towers.

- Hog Rider and Giant only attacks buildings and towers.

- Movement speed of troops may change based on how the arena and movement mechanism is implemented, so we only provide 5 classes of speed and not exact numbers: Very Slow, Slow, Medium, Fast, Very Fast.

6.2.1. Single-Target Troops

Card Name	Cost	Type	Target	Description & Stats
Knight	3	Ground	Ground	A tough soldier with a sword. Good for soaking up damage. HP: 600, DMG: 75, Hit Speed: 1.1s, Speed: Medium
Musketeer	4	Ground	Air & Ground	A ranged shooter. Can hit ground and air targets. HP: 340, DMG: 100, Hit Speed: 1.1s, Range: 6.5 tiles, Speed: Medium
Mini P.E.K.K.A	4	Ground	Ground	A powerful armored warrior. Slow but deals massive damage. HP: 600, DMG: 325, Hit Speed: 1.8s, Speed: Slow
Giant	5	Ground	Buildings	A huge tank unit. Ignores soldiers and attacks buildings/towers only. HP: 2000, DMG: 126, Hit Speed: 1.5s, Speed: Very Slow
Hog Rider	4	Ground	Buildings	Fast unit that rushes toward buildings. Ignores soldiers. HP: 800, DMG: 160, Hit Speed: 1.5s, Speed: Fast

6.2.2. Area-of-Effect (AoE) Troops

Card Name	Cost	Type	Target	Description & Stats
Bomber	3	Ground	Ground (AoE)	Throws bombs that explode on impact. HP: 150, Area DMG: 100, Hit Speed: 1.9s, Range: 5 tiles
Valkyrie	4	Ground	Ground (Melee AoE)	Spins and damages all nearby enemies. HP: 880, Area DMG: 120, Hit Speed: 1.5s, Speed: Medium
Wizard	5	Ground	Air & Ground (AoE)	Shoots fireballs that explode. HP: 340, Area DMG: 130, Hit Speed: 1.7s, Range: 5 tiles

6.2.3. Swarm Troops (Multiple Units Per Card)

Card Name	Cost	Type	Target	Description & Stats
Skeletons	1	Ground	Ground	Spawns 4 very weak but very fast soldiers. Each: HP: 30, DMG: 30, Speed: Very Fast
Goblins	2	Ground	Ground	Spawns 3 fast, weak melee fighters. Each: HP: 80, DMG: 50, Speed: Fast
Spear Goblins	2	Ground	Air & Ground	Spawns 3 ranged goblins (can hit air). Each: HP: 52, DMG: 24, Range: 5.5 tiles, Speed: Fast
Archers	3	Ground	Air & Ground	Spawns 2 ranged soldiers (can hit air). Each: HP: 125, DMG: 40, Range: 5.5 tiles, Speed: Medium
Minions	3	Air	Air & Ground	Spawns 3 flying units that attack from the air. Each: HP: 90, DMG: 40, Range: 2.5 tiles, Speed: Very Fast
Minion Horde	5	Air	Air & Ground	Spawns 6 flying units (double the Minions). Each: HP: 90, DMG: 40, Speed: Very Fast
Barbarians	5	Ground	Ground	Spawns 4 tough melee fighters. Each: HP: 300, DMG: 75, Speed: Fast

6.3. Building Cards (9 cards)

Buildings are stationary structures you place on your side. They don't move but provide defense or other benefits.

6.3.1. Defensive Buildings

Card Name	Cost	Type	Target	Description & Stats
Cannon	3	Building	Ground	Basic defensive tower. HP: 400, DMG: 60, Range: 5.5 tiles, Lifetime: 30s
Tesla	4	Building	Air & Ground	Defensive tower that can hit both air and ground. HP: 400, DMG: 64, Range: 5.5 tiles, Lifetime: 40s
Mortar	4	Building	Ground	Long-range artillery. HP: 600, Area DMG: 108, Range: 4.5–11 tiles, Lifetime: 30s
Bomb Tower	5	Building	Ground (AoE)	Defensive tower with explosive shells. HP: 900, Area DMG: 100, Range: 6 tiles, Lifetime: 40s
Inferno Tower	5	Building	Air & Ground (Beam)	Shoots a laser that grows stronger over time. HP: 800, DMG: 20–400 (ramps up), Range: 6 tiles, Lifetime: 40s

Note on Lifetime: Defensive buildings automatically self-destruct after their lifetime expires (even if not destroyed by enemies).

6.3.2. Spawner Buildings

Card Name	Cost	Type	Target	Description & Stats
Tombstone	3	Building	Ground	Spawns 1 Skeleton every 2.9s. When destroyed, spawns 4 more. HP: 200, Lifetime: 40s
Goblin Hut	5	Building	Ground	Spawns Spear Goblins periodically. HP: 700, Spawns 1 every 4.9s, Lifetime: 60s
Barbarian Hut	7	Building	Ground	Spawns 2 Barbarians periodically. HP: 1100, Spawns 2 every 14s, Lifetime: 60s

6.3.3. Special Building

Card Name	Cost	Type	Target	Description & Stats
Elixir Collector	5	Building	None	Generates Elixir over time. HP: 640, Lifetime: 70s, Produces 1 Elixir every 10s, Total: 7 Elixir

Strategy Tip: The Elixir Collector is an investment—costs 5 Elixir but generates 7 over time, netting +2 if it survives.

6.4. Spell Cards (4 cards)

Spells are instant effects. When you play a spell, it activates immediately (no delay).

Card Name	Cost	Description & Stats
Zap	2	Small area damage + stuns enemies for 0.5 seconds. Area DMG: 80, Radius: 2.5 tiles, Stuns for 0.5s
Arrows	3	Medium area damage. Good for killing swarms. Area DMG: 115, Radius: 4 tiles
Fireball	4	Large area damage. Good for clusters of enemies. Area DMG: 325, Radius: 2.5 tiles
Rocket	6	Massive damage in a small area. Expensive but powerful. Area DMG: 700, Radius: 2 tiles

Note: Spells deal reduced damage to towers (about 40% of their unit damage).

7. Technical Requirements

7.1. Programming Language and Tools

You must use:

- **Java** (JDK 8 or higher)

- **Swing or JavaFX** for the graphical interface (choose one)

    - Swing: Older, simpler, more tutorials available
    - JavaFX: Newer, more modern, better graphics

You may NOT use:

- Game engines (Unity, Unreal, etc.)

- Game libraries (libGDX, LWJGL, etc.)

- Any library that handles game loops, physics, or rendering for you

Why? This is a software engineering course. We want you to learn how to design and structure code, not how to use a specific game engine.

7.2. Save/Load Functionality

Your game must be able to save and load:

1. Arena layouts (tower and bridge positions)

2. Deck configurations (which 8 cards the player chose)

How to implement:

- **Option A:** Use Java's Serialization (Serializable interface)

- **Option B:** Write your own file format (JSON, XML, plain text, etc.)

The data should persist even after closing the game application.

7.3. User Interface Requirements

Main Menu: Must have buttons for:

- New Game

- Map Editor (arena designer)

- Quit

Battle Screen: Must display:

- The arena (both sides, river, bridges, towers)

- Your 4 cards in hand (bottom of screen)

- Current Elixir amount (e.g., "7/10")

- Timer (MM:SS format)

- Crown Tower count for both players

- Pause button

- Speed control (1x / 2x speed)

Health Bars: All units, buildings, and towers must show health bars that update in real-time.

7.4. Computer Opponent

You need to implement a computer opponent that plays against the human player.
Minimum Requirements:

- The computer opponent must follow the same rules as the player

- It must spend Elixir to play cards

- It must place cards only on its own side

Computer Opponent Difficulty (Your Choice):
You can implement the computer opponent as simple or complex as you want:

- **Simple:** Randomly plays cards when it has enough Elixir

- **Medium:** Plays defensive cards when the player attacks, offensive cards when Elixir is high

- **Advanced:** Tries to counter the player's strategy (e.g., uses AoE spells vs swarms)

A simple computer opponent is perfectly acceptable for this phase.

7.5. Performance Requirements

- The game should run smoothly (minimum 30 frames per second)

- Card placement should feel responsive (no noticeable delay)

- Should handle at least 20 units on screen at once

8. What You Need to Submit

8.1. Code and Repository

- All Java source code (.java files)

- A runnable JAR file

- A Git repository with clear commit history

- A README.md file with:

  - How to build the project

  - How to run the game

  - Team member names and contributions

  - Known bugs or limitations

- A credits.txt file listing any assets you used and their sources

9. Frequently Asked Questions

Q: I've never played a card game before. Will I be able to do this project?

A: Yes! This document explains everything you need to know. You don't need gaming experience - you need programming skills and the ability to follow specifications.

Q: Do I need to make the graphics myself?

A: No. You can use the provided asset packs (see Section 10.1) or find free assets online. Just give proper credit.

Q: How do I make units move smoothly?

A: Use a game loop that updates positions every frame (e.g., 30-60 times per second). Each update, move the unit a small distance toward its target.

Q: What if I can't figure out pathfinding?

A: Start simple - make ground units walk in a straight line to the nearest bridge (if there is no nearby enemy before the bridge), cross it, then walk to their target. You can improve this later with A* algorithm.

Q: Do cards need animations?

A: Not required, but recommended. Even simple animations (like a projectile moving) make the game much clearer.

Q: What if the player places a building on a bridge?

A: Don't allow it. Show a red overlay or error message.

Q: Can I change the card stats if the game feels unbalanced?

A: Yes! The stats provided are guidelines. Balance the game through playtesting.

Q: What happens if two King Towers are destroyed at the exact same time?

A: Declare it a draw (tie).

10. Graphical Asset Resources

You must use graphics for the game. Here are recommended free asset packs:

- **Soldiers and Units:**
  `https://zerie.itch.io/tiny-rpg-character-asset-pack`

- **Bridges:**
  `https://free-game-assets.itch.io/free-bridges-top-down-pixel-art-asset-pack`

  Alternative Sources:

- `https://opengameart.org/` - Large collection of free game assets

- `https://itch.io/game-assets/free` - Free game assets marketplace

- Create your own using simple graphics software (MS Paint, GIMP, etc.)

  Important: Always credit the asset creators in your credits.txt file!

11. Getting Help and Resources

11.1. Java and GUI Programming

- **JavaFX:** `https://openjfx.io/`

- **JavaFX Tutorial:** `https://docs.oracle.com/javase/8/javafx/get-started-tutorial/`

- **Swing Tutorial:** `https://docs.oracle.com/javase/tutorial/uiswing/`

11.2. Game Programming Concepts

- **Game Loop:** `https://gameprogrammingpatterns.com/game-loop.html`

- **Pathfinding:** `https://www.redblobgames.com/pathfinding/a-star/introduction.html`

11.3. Getting Unstuck

- Read the FAQ section (Section 9)

- Search for similar problems online (Stack Overflow)

- Ask your teammates

- Post on the course forum

12. Summary: What You're Building

Let's recap the entire project in simple terms:

1. A single-player card game where you battle a computer opponent

2. You place soldiers and buildings by spending Elixir (resource points)

3. Goal: Destroy the enemy's main tower before they destroy yours

4. Before each match:
    - Design your arena layout (one-time setup)
    - Choose 8 cards for your deck

5. During the match:
    - Play cards from your 4-card hand
    - Watch units move and attack automatically
    - Manage Elixir (refills slowly)
    - 3-minute time limit

6. Technical requirements:
    - Java with Swing or JavaFX
    - Save/load functionality
    - Simple computer opponent
    - 28 cards total (15 troops, 9 buildings, 4 spells)

Remember: Start with the basics (arena, card placement, movement) and add complexity gradually. Test frequently. Have fun!