**Bulls and Cows - Game Design Document**

**1. Game Overview**

**Core Gameplay Mechanics**

* A number guessing game where players try to guess a 4-digit secret number
* Each digit must be unique (0-9)
* After each guess, players receive feedback in the form of:
  + Bulls: Digits in correct position
  + Cows: Correct digits in wrong position

**Target Audience**

* Primary: Casual gamers, puzzle enthusiasts
* Age Range: 8+
* Platform: Web browsers (desktop and mobile)

**Key Features**

* Single-player mode against computer
* Two-player mode (alternating turns)
* Customizable difficulty settings
* Real-time feedback system
* Game statistics tracking
* Responsive design for all devices

**2. Gameplay Specifications**

**Game Flow**

1. Player starts new game
2. System generates 4-digit number (unique digits)
3. Player inputs guess
4. System provides bulls/cows feedback
5. Steps 3-4 repeat until:
   * Correct guess (win)
   * Max attempts reached (lose)

**Rules**

* Secret number: 4 unique digits (0-9)
* No repeating digits allowed
* First digit cannot be zero
* Maximum 10 attempts per game
* Time limit: Optional, configurable (default: none)

**Scoring System**

* Bulls: Digit matches in correct position
* Cows: Digit exists but wrong position
* Example:
* Secret: 4271
* Guess: 4721
* Result: 2 bulls (4,1), 2 cows (2,7)

**3. User Interface Design**

**Screen Layout**

1. Main Menu Screen
   * New Game button
   * Game Mode selection
   * Settings button
   * Rules button
   * Statistics button
2. Gameplay Screen
   * Input field for guesses
   * History of previous guesses
   * Bulls/Cows indicators
   * Attempts remaining
   * Timer (if enabled)
   * Surrender button
3. Settings Screen
   * Difficulty selection
   * Time limit toggle
   * Sound toggle
   * Theme selection

**UI Elements**

* Input: Numeric keypad for mobile, text input for desktop
* Feedback: Visual indicators for bulls (🔴) and cows (⚪)
* History: Scrollable list of previous guesses
* Statistics: Win/loss ratio, average attempts, best time

**4. Visual Design**

**Color Palette**

Primary: #2196F3 (Blue)

Secondary: #FF4081 (Pink)

Background: #F5F5F5 (Light Gray)

Text: #212121 (Dark Gray)

Success: #4CAF50 (Green)

Error: #F44336 (Red)

**Typography**

* Headings: Roboto Bold
* Body: Roboto Regular
* Numbers: Roboto Mono

**Animations**

* Subtle feedback animations for correct/incorrect guesses
* Smooth transitions between screens
* Victory celebration animation
* Error shake animation for invalid inputs

**5. Technical Requirements**

**Development Stack**

* Framework: Angular 18+
* State Management: Angular Signals
* Styling: CSS Modules/SCSS
* Testing: Jasmine/Karma

**Browser Support**

* Chrome 90+
* Firefox 90+
* Safari 14+
* Edge 90+

**Performance Targets**

* Initial load: < 2s
* Input response: < 100ms
* Animation frame rate: 60fps

**6. Game Modes**

**Single Player**

* Computer generates number
* Player has 10 attempts
* Difficulty levels:
  + Easy: 3 digits, unlimited time
  + Normal: 4 digits, unlimited time
  + Hard: 4 digits, 5-minute limit

**Two Player**

* Player 1 sets number
* Player 2 guesses
* Switch roles after each game
* Scoring based on attempts used

**7. Future Enhancements**

**Planned Features**

1. Online multiplayer
2. Daily challenges
3. Achievement system
4. Global leaderboards
5. Custom themes
6. Social sharing

**Expansion Ideas**

* Variable digit length (3-6)
* Special game modes (time attack, survival)
* Tutorial system
* Profile customization
* Sound effects and music

This design document provides a solid foundation for implementing Bulls and Cows in Angular while maintaining flexibility for future enhancements. The modular approach allows for incremental development and easy feature additions.