Algorithm-Jitsu

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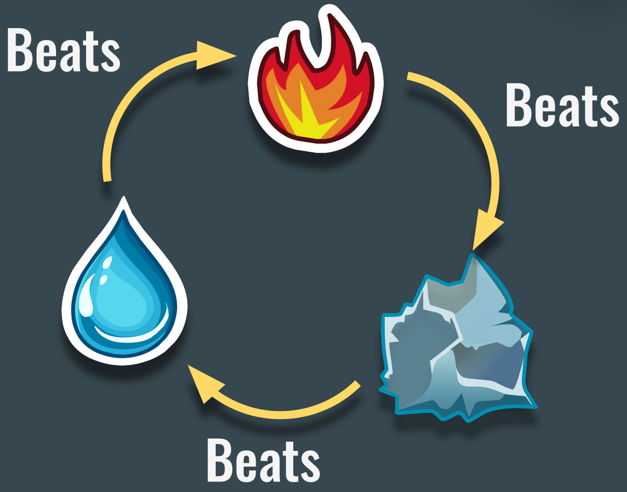
Card-Jitsu

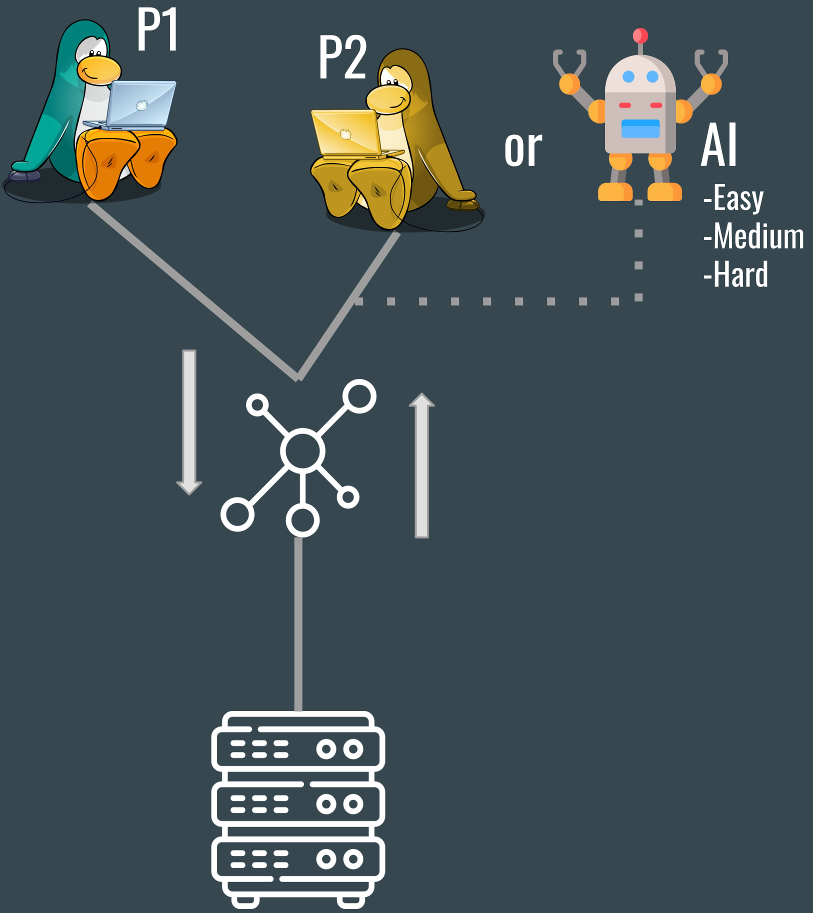
- Club Penguin was one of the first online games we played as kids, so there is some sentimental motivation behind this project.

- The Card-Jitsu game is complex enough to involve strategy but simple enough that we have time to develop our own version and still work on the card choice algorithms.



Architecture

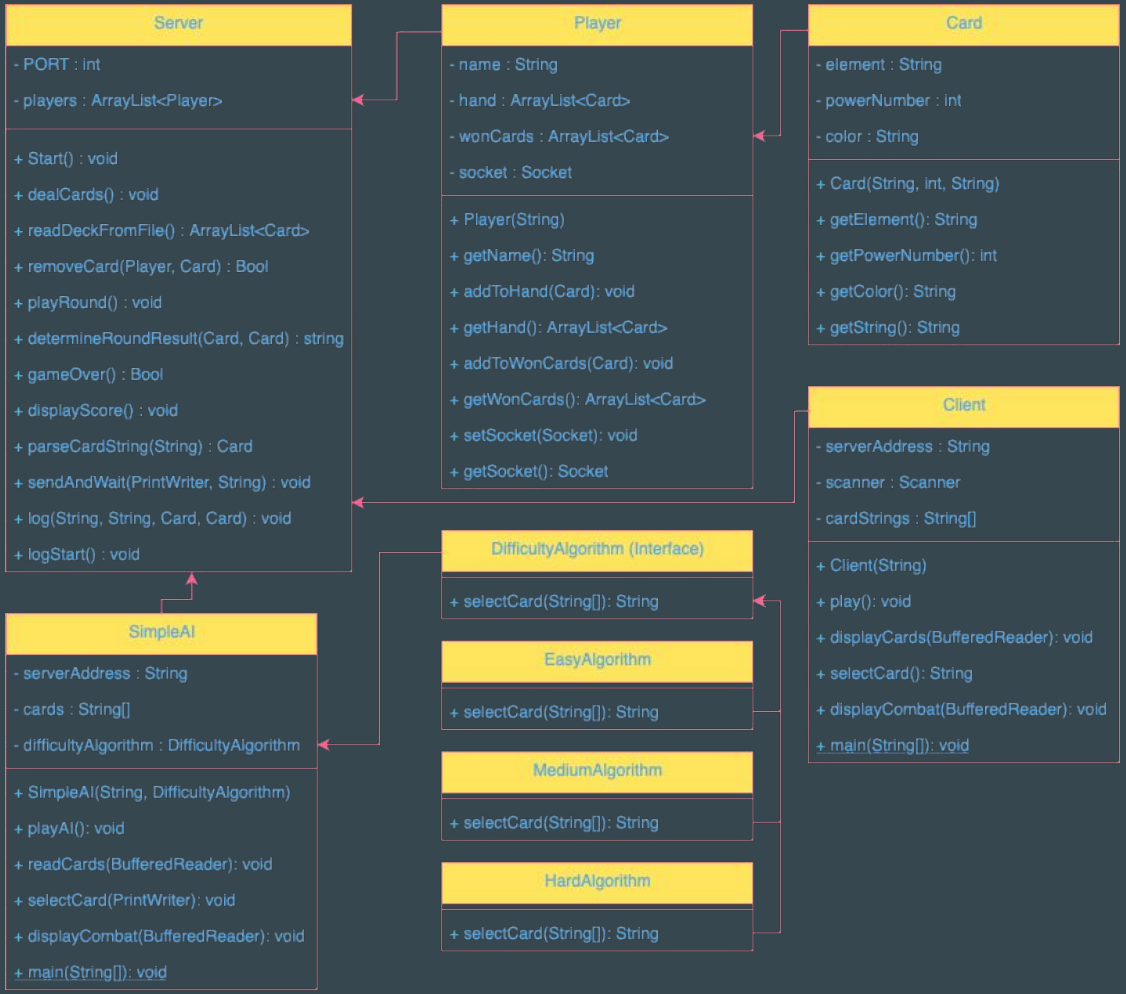
- We utilized a Client - Server architecture for its modularity and simplicity.
    - The Client chooses between playing as a person or an easy, medium, or hard AI.
    - The Server waits for two clients to connect, deals cards, and facilitates communication between the two clients as well as the relevant game logic that must be handled.
- The Server is also responsible for logging the games and storing the information in a text file, which we use to develop and test our AI.
- The Client is only responsible for determining which card is picked via user interface or the selected opponent algorithm.



Implementation

- Java was our programming language of choice because of its portability and straightforward socket support.
- The Server opens a socket on a specific port for the clients to connect to, creating each player object and their cards as well as dealing them.
- Each round the server checks for win conditions, sends card information to players, and receives card choices via messages sent over sockets.
  - The first word of the message indicates how it is to be interpreted by the client.
  - The rest of the message is the data that comes along with the message.
- Each Client works similarly, but leaves card choice up to the given algorithm or human opponent.

Class Diagram



Server
- - PORT : int
- - players : ArrayList<Player>
- + Start() : void
- + dealCards() : void
- + readDeckFromFile() : ArrayList<Card>
- + removeCard(Player, Card) : Bool
- + playRound() : void
- + determineRoundResult(Card, Card) : string
- + gameOver() : Bool
- + displayScore() : void
- + parseCardString(String) : Card
- + sendAndWait(PrintWriter, String) : void
- + log(String, String, Card, Card) : void
- + logStart() : void

Player
- - name : String
- - hand : ArrayList<Card>
- - wonCards : ArrayList<Card>
- - socket : Socket
- + Player(String)
- + getName(): String
- + addToHand(Card): void
- + getHand(): ArrayList<Card>
- + addToWonCards(Card): void
- + getWonCards(): ArrayList<Card>
- + setSocket(Socket): void
- + getSocket(): Socket

Card
- - element : String
- - powerNumber : int
- - color : String
- + Card(String, int, String)
- + getElement(): String
- + getPowerNumber(): int
- + getColor(): String
- + getString(): String

Client
- - serverAddress : String
- - scanner : Scanner
- - cardStrings : String[]
- + Client(String)
- + play(): void
- + displayCards(BufferedReader): void
- + selectCard(): String
- + displayCombat(BufferedReader): void
- + main(String[]): void

SimpleAI
- - serverAddress : String
- - cards : String[]
- - difficultyAlgorithm : DifficultyAlgorithm
- + SimpleAI(String, DifficultyAlgorithm)
- + playAI(): void
- + readCards(BufferedReader): void
- + selectCard(PrintWriter): void
- + displayCombat(BufferedReader): void
- + main(String[]): void

DifficultyAlgorithm (Interface)
- + selectCard(String[]): String

EasyAlgorithm
- + selectCard(String[]): String

MediumAlgorithm
- + selectCard(String[]): String

HardAlgorithm
- + selectCard(String[]): String

Data Structures/Algorithms

- Most of the game objects are stored in Java ArrayLists, but we utilize Java HashSets to check win conditions without counting duplicate cards.
- Algorithms play a card for the AI Client which is built very close to human client.
  - EMH: Identifying a card worth playing
  - MH: Considering goals of overarching game
  - H: Identifying losing streaks and playing preventative measures

Easy Algorithm

Random Card Selection

- A random card is selected from SimpleAI's hand
- No special justification nor judgement

Human vs SimpleAI Best of 3

- Game 1: Player 2 won with a score of 3-0.
- Game 2: Player 1 won with a score of 2-1.
- Game 3: Player 2 won with a score of 2-1.
- Human won 2-1 total

Medium Algorithm

Offensive Strategy

- Checks the amount of each element it has in hand
- Identifies the element with most quantity
- Play that card type until common element is not in hand
- Rerun Medium Algorithm for new element numbers (repeat)

Human vs Medium

- Game 4: The game ended in a draw with a score of 2-2.
- Game 5: Player 2 won with a score of 2-1.
- Game 6: Player 2 won with a score of 3-1.
- Human lost to Medium Algorithm 0-3 (0-2 + tie)

Hard Algorithm

- Improvement to ‘Lack of Variety’ in Medium Algorithm
- New Additions
  - Loss Count (understanding if the AI is losing to opponent)
  - selectedCard: scoring of value of cards to help pick the best option for winning
  - useAlternateStrategy: Swap between two strategies focused on game winning
    - Strategy 1: Focuses on getting 3 unique elements + colors
    - Strategy 2: Focuses on getting 3 matching elements w/ unique color
- Compares scores of cards to find best score
- If loss count reaches 2 in a row, swap strategy.

Work Division

Michael

- Core game and server implementation
  - Server, Client, Player classes
- DifficultyAlgorithm.java Interface
- HardAlgorithm.java and MediumAlgorithm.java
- Debugging

Jack

- AI interface implementation
  - SimpleAI.java
  - EasyAlgorithm.java
- Polishing Mechanics
  - Index based card selection
  - Difficulty selection
  - Game logic bug fixes
- Debugging

Max

- Log System implementation
- Polishing Mechanics
  - Cards pulled from deck after playing
  - Update deck state.
- MediumAlgorithm.java, HardAlgorithm.java
- Shell Scripts
- Debugging

Results/Future Direction

- Changing the game to be multiplayer over the internet would be an interesting way to expand this project.
  - Finding a way to connect players peer to peer would also be a very interesting path to go down.
  - (write an algorithm for matchmaking, and menu for offline mode)
- Another way to make the game more appealing would be to implement a graphical user interface.
  - Consider porting the game to javascript and implement HTML5 + CSS for graphics + lightweight
- Servers should be deployed from a main server, with a configuring client deployment automatically
  - In tandem with GUI recommendations, make a website for the game to be freely played on.

Literature Review

references to related work and theoretical background.

Rules: https://clubpenguin.fandom.com/wiki/Card-Jitsu

Original Game: https://en.wikipedia.org/wiki/Club_Penguin

Presentation Images: https://www.clipartmax.com/