FAI Final Project

Texas Hold'em Casino

FAI 2023 Spring Semester
Instructors: Shang-Tse Chen & Yun-Nung Chen
Due date: 2023/06/21 23:59

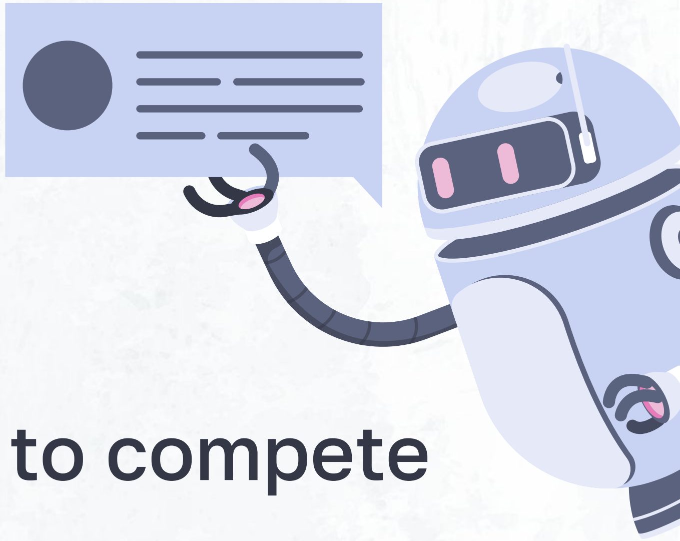
(AI)

Outline

01 →

Introduction

Implement Texas Hold’em AI to compete in the CSIE casino



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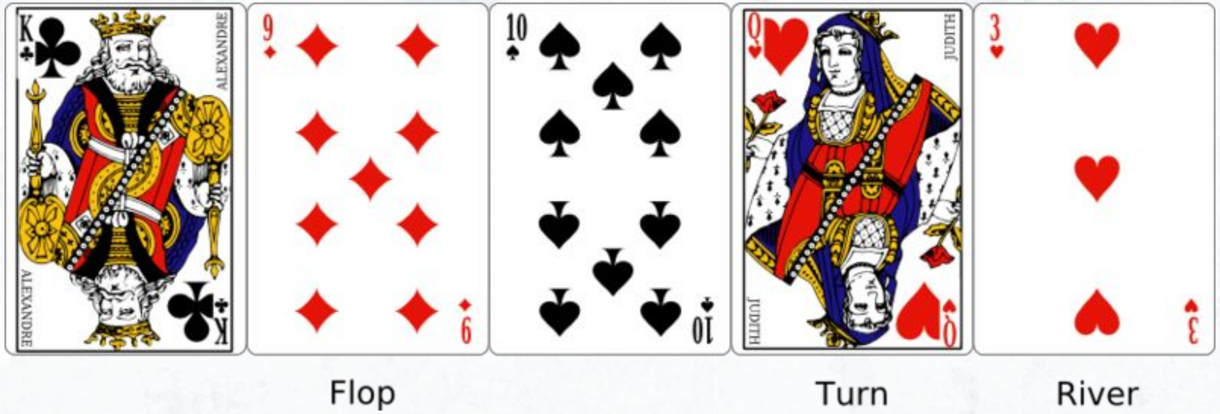
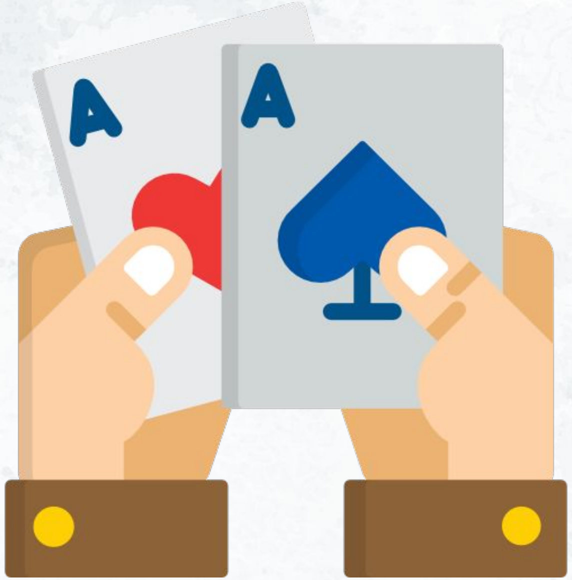
Texas Hold’em Rules –Heads Up

- Each player has two face-down cards, called the **“hole cards”**
- The face-up cards are called the **“community cards”**
- Goal: use the community cards combined with their hole cards to build a five-card poker hand (Build best 5 combination out of 7 cards)



Small Blind & Big Blind

- A game features **several betting rounds**
- Players get two private and up to five community cards
- All blinds **must** bet
  - 1st player: “small blind”
  - 2nd player: “big blind”
  - Big blind is two times larger than small blind

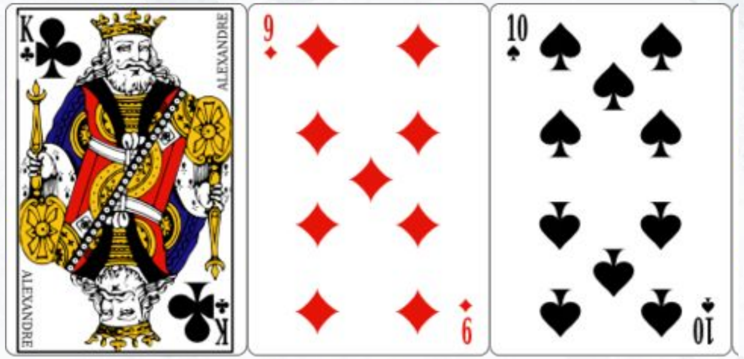


First Betting Round: Preflop

- The player has 3 options
  - **Call**: match the amount of the big blind
  - **Raise**: increase the bet within the limits of the game
  - **Fold**: throw the hand away. If the player chooses to fold, he or she is out of the game and no longer eligible to win the current hand.

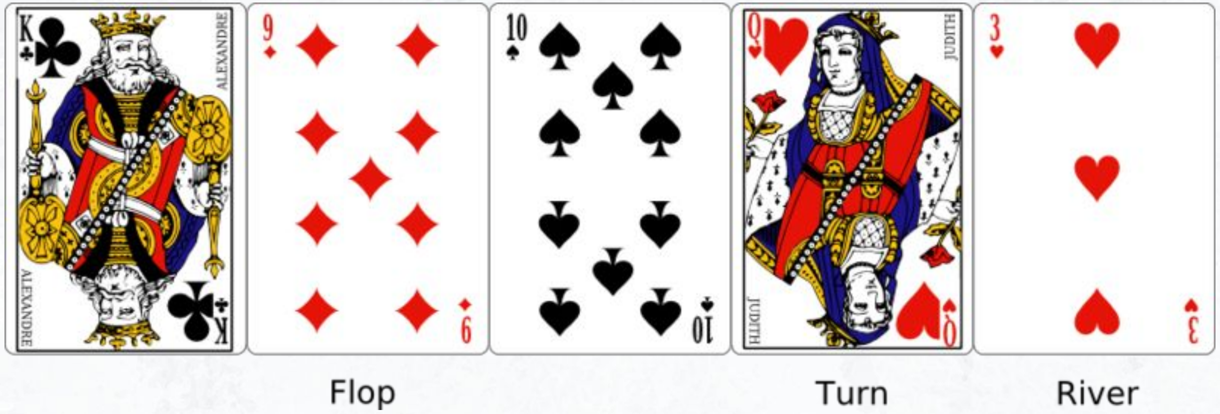
Second Betting Round: Flop

- The first three community cards are dealt
- Players can only choose action **“call”**, **“raise”** or **“fold”**


Flop

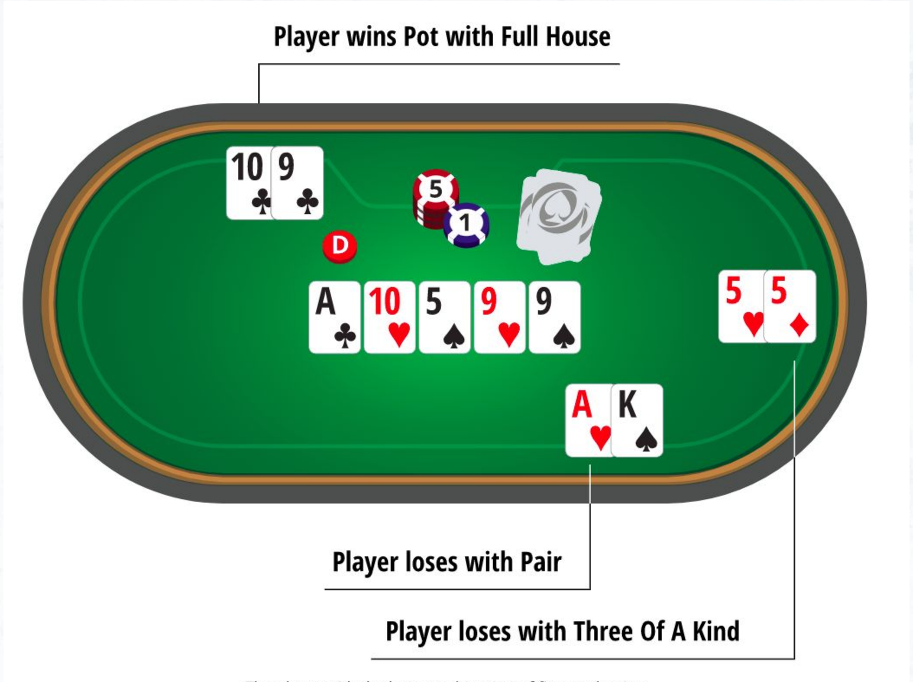
Third & Fourth Betting Round: Turn & River

- The fourth community card, called the **turn**, is dealt face-up
- Players can only choose action “call”, “raise” or “fold”
- The fifth community card, called the **river**, is dealt face-up
- Players can only choose action “call”, “raise” or “fold”



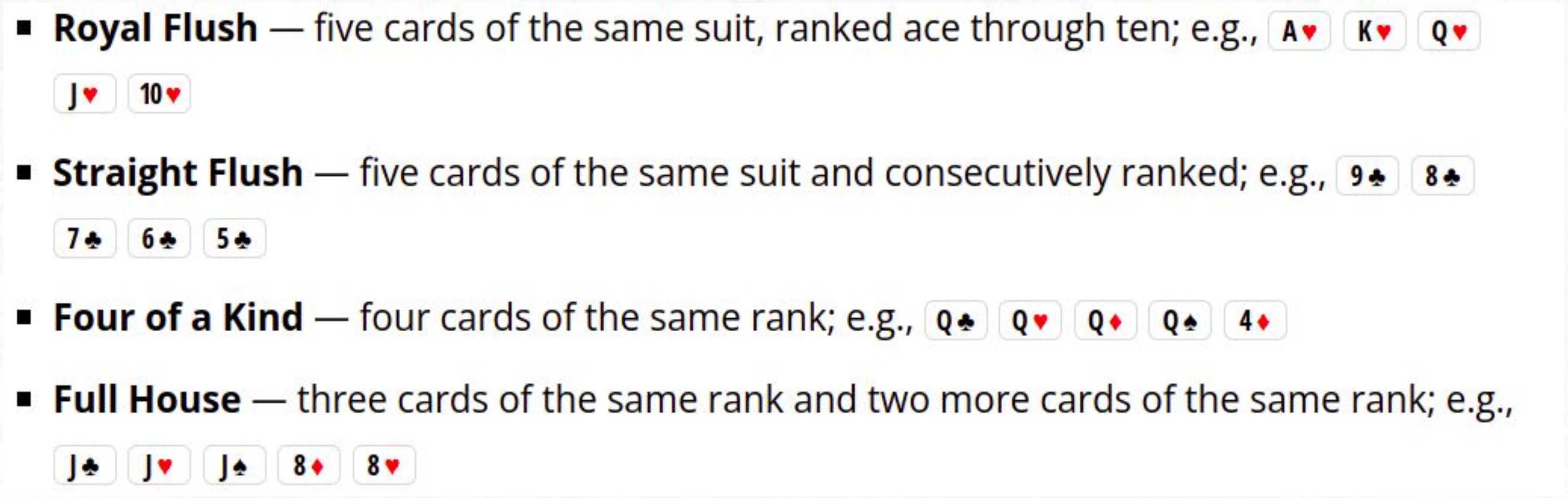
Showdown

- All players expose their holdings to determine a winner.



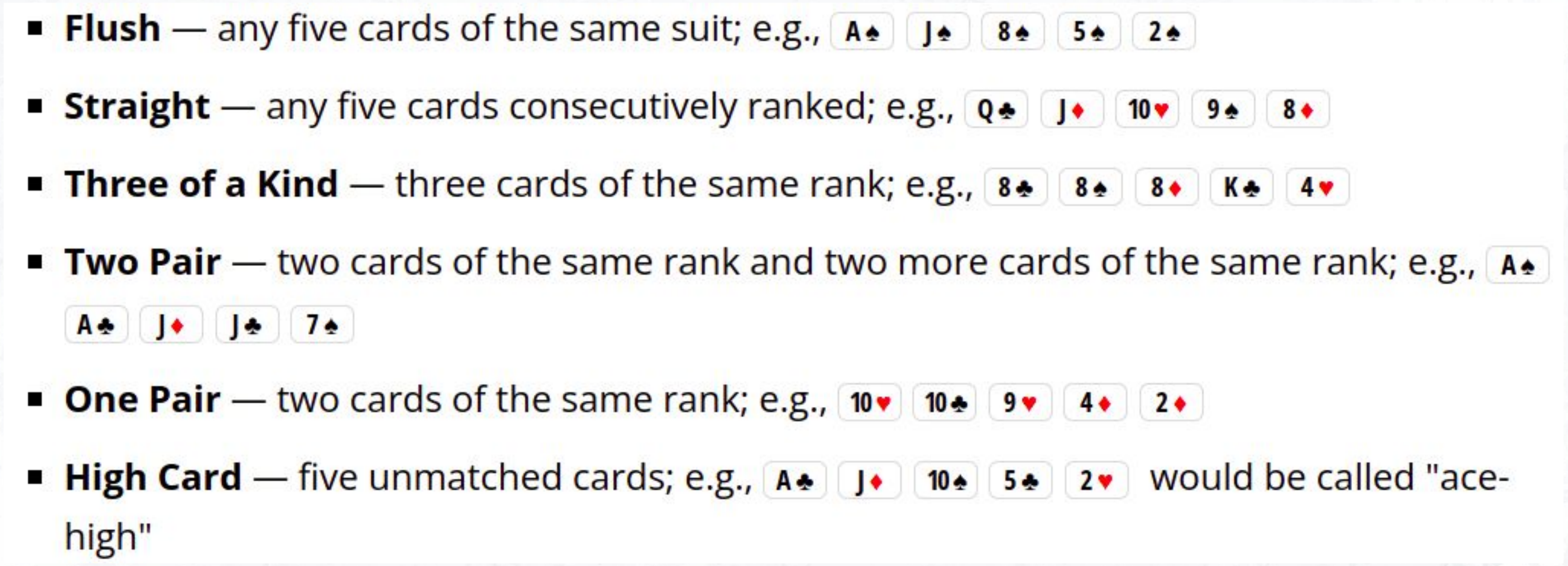
The player with the best combination of five cards wins

Hands Rank



- **Royal Flush** — five cards of the same suit, ranked ace through ten; e.g., A♥ K♥ Q♥ J♥ 10♥
- **Straight Flush** — five cards of the same suit and consecutively ranked; e.g., 9♣ 8♣ 7♣ 6♣ 5♣
- **Four of a Kind** — four cards of the same rank; e.g., Q♣ Q♥ Q♦ Q♠ 4♦
- **Full House** — three cards of the same rank and two more cards of the same rank; e.g., J♣ J♥ J♠ 8♦ 8♥

Hands Rank



- **Flush** — any five cards of the same suit; e.g., A♠ J♠ 8♠ 5♠ 2♠
- **Straight** — any five cards consecutively ranked; e.g., Q♣ J♦ 10♥ 9♠ 8♦
- **Three of a Kind** — three cards of the same rank; e.g., 8♣ 8♠ 8♦ K♣ 4♥
- **Two Pair** — two cards of the same rank and two more cards of the same rank; e.g., A♠ A♣ J♦ J♣ 7♠
- **One Pair** — two cards of the same rank; e.g., 10♥ 10♣ 9♥ 4♦ 2♦
- **High Card** — five unmatched cards; e.g., A♣ J♦ 10♠ 5♣ 2♥ would be called "ace-high"

02 →

Game Parameters & Environment

(AI)

Game Parameters in Final Project

- The winner is the one has more money after all games
    - Max round of game: 20
    - Initial stack for each player: 1000
    - Small blind: 5
- No upper bound for “raise”, you can **all in** at once.
- You must take action within **5** seconds in every turn, or treated as **“fold”**
- You must take a valid action in every turn, or treated as **“fold”**

Environment

- Setup python version, on *linux{1~15}.csie.org* workstation

```
pyenv install -v  3.8.13
```

- Switch to the installed python 3.8.13

```
pyenv global 3.8.13
```

- Install the packages

```
pyenv exec pip install -r requirement.txt
```

- Run the ***start_game.py*** to see how the game works

```
pyenv exec python start_game.py
```

Environment

- python 3.8.13
- numpy==1.22.3
- torch==1.11.0
- scikit-learn==1.0.2
- tensorflow==2.8.0
- keras==2.8.0
- pytorch_lightning==1.6.1
- tqdm==4.64.0
- If you want to use other packages, please email the TA first.

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Sample Code Explanation

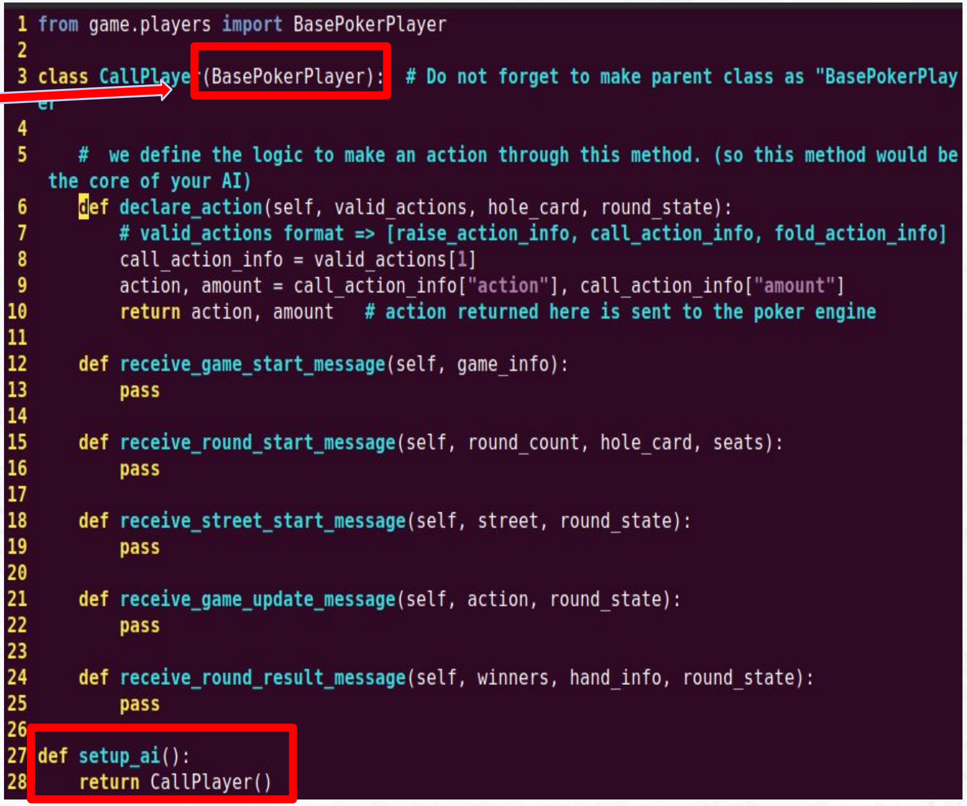
(AI)

Sample Code Explanation

- final_project/
  - |--- start_game.py *<the code to help you test locally>*
  - |--- requirement.txt *<python package needed in this project>*
  - |--- baseline0.cpython-38-x86_64-linux-gnu.so
    <the binary file that can be import in csie workstation>
  - |--- game/
    <it contains all needed game objects, you should not modify any file in this directory>
  - |--- agents/ *<it contains sample agents for you to play with>*
    - |--- call_player.py *<the agent always to “call” action>*
    - |--- random_player.py *<the agent choose action randomly>*
    - |--- console_player.py *<you can play the game in interaction mode with this player>*

Sample Code Explanation

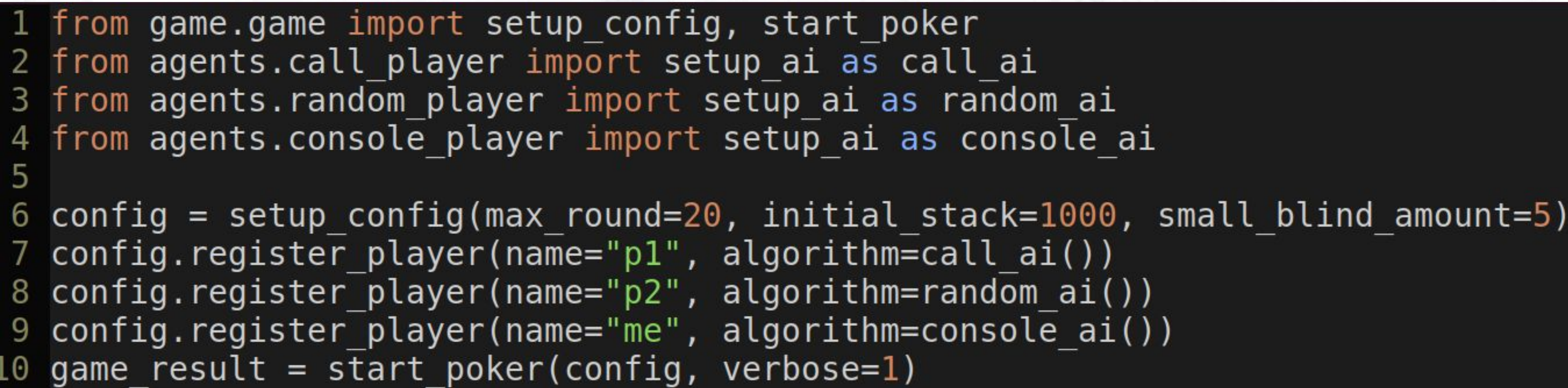
- Your agent should make parent class as **“BasePokerPlayer”**
- You should override 7 functions
  - declare_action
  - receive_game_start_message
  - receive_round_start_message
  - receive_street_start_message
  - receive_game_update_message
  - Receive_round_result_message
- You should include a function named “setup_ai” that return your agent class



```
from game.players import BasePokerPlayer

class CallPlayer(BasePokerPlayer):  # Do not forget to make parent class as "BasePokerPlayer"

    #  we define the logic to make an action through this method. (so this method would be the core of your AI)
    def declare_action(self, valid_actions, hole_card, round_state):
        # valid_actions format => [raise_action_info, call_action_info, fold_action_info]
        call_action_info = valid_actions[1]
        action, amount = call_action_info["action"], call_action_info["amount"]
        return action, amount   # action returned here is sent to the poker engine

    def receive_game_start_message(self, game_info):
        pass

    def receive_round_start_message(self, round_count, hole_card, seats):
        pass

    def receive_street_start_message(self, street, round_state):
        pass

    def receive_game_update_message(self, action, round_state):
        pass

    def receive_round_result_message(self, winners, hand_info, round_state):
        pass

def setup_ai():
    return CallPlayer()
```

Sample Code Explanation

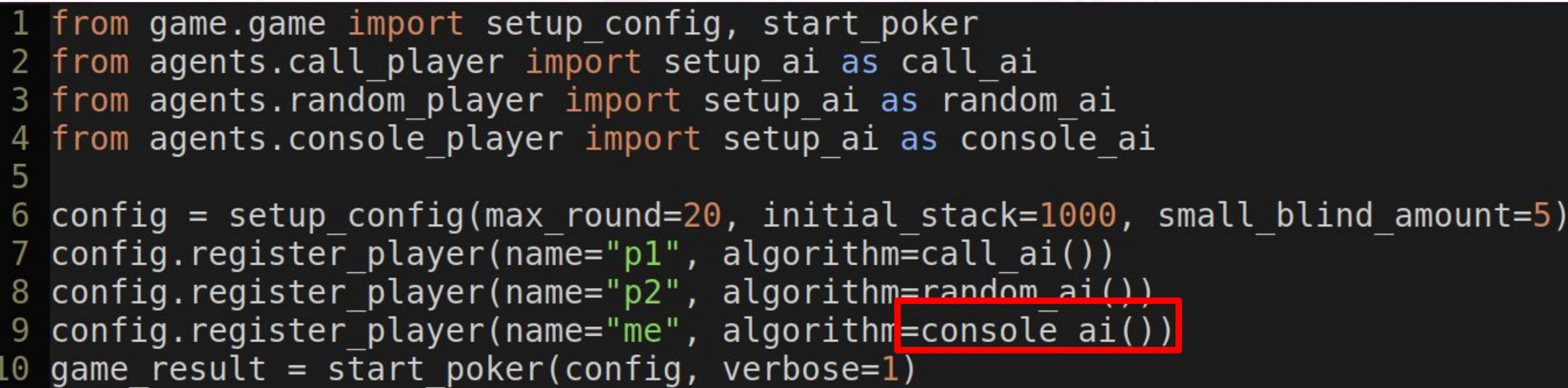
- To test your agent locally, you can use “*python3 start_game.py*”
  1. Import setup_ai function for every agent
  2. Setup game configuration with predefined rules
  3. Register users with the agent
  4. Play the game and get the result



```python
from game.game import setup_config, start_poker
from agents.call_player import setup_ai as call_ai
from agents.random_player import setup_ai as random_ai
from agents.console_player import setup_ai as console_ai

config = setup_config(max_round=20, initial_stack=1000, small_blind_amount=5)
config.register_player(name="p1", algorithm=call_ai())
config.register_player(name="p2", algorithm=random_ai())
config.register_player(name="me", algorithm=console_ai())
game_result = start_poker(config, verbose=1)
```

Sample Code Explanation

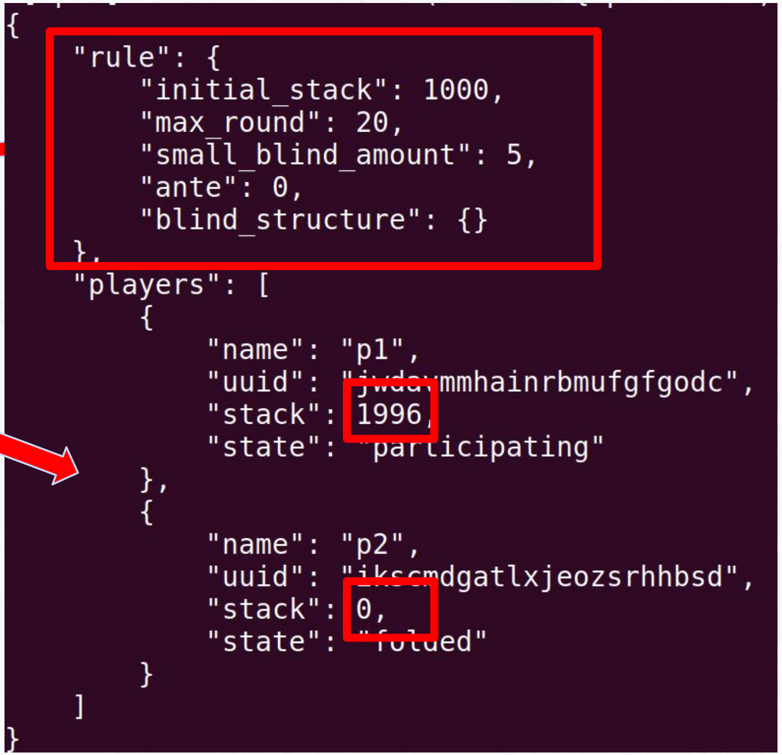
- To play the game interactively, you can use ”console_player.py”.
    - It allows you to play the game step by step.
    - Baselines cannot be played in an interactive mode; you can only test it locally.



```python
from game.game import setup_config, start_poker
from agents.call_player import setup_ai as call_ai
from agents.random_player import setup_ai as random_ai
from agents.console_player import setup_ai as console_ai

config = setup_config(max_round=20, initial_stack=1000, small_blind_amount=5)
config.register_player(name="p1", algorithm=call_ai())
config.register_player(name="p2", algorithm=random_ai())
config.register_player(name="me", algorithm=console_ai())
game_result = start_poker(config, verbose=1)
```

Sample Code Explanation

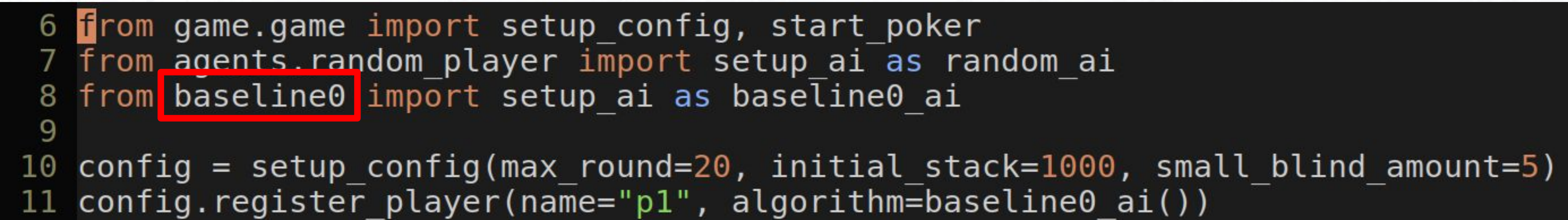
- Example result after submit to baseline server.
- Game Rules
- Game result after playing 20 runs
- p1 won in this example



```
{
    "rule": {
        "initial_stack": 1000,
        "max_round": 20,
        "small_blind_amount": 5,
        "ante": 0,
        "blind_structure": {}
    },
    "players": [
        {
            "name": "p1",
            "uuid": "jwdaymmhainrbmufgfgodc",
            "stack": 1996,
            "state": "participating"
        },
        {
            "name": "p2",
            "uuid": "ikscmdgatlxjeozsrhhbsd",
            "stack": 0,
            "state": "folded"
        }
    ]
}
```

Sample Code Explanation

- We will be given **5 black-box baselines** (different levels of difficulty)
- Baselines are in **binary executable format** compatible in csie workstation
    - <your student id>@linux{1~15}.csie.org
    - If you don't have a csie workstation account, please refer to the link
- We will release baseline agents in the following dates.
    - baseline0 (test only;no credit): 5/21
    - baseline1 & baseline2: 5/24
    - baseline3 & baseline4: 5/31
    - baseline5: 6/07



```python
from game.game import setup_config, start_poker
from agents.random_player import setup_ai as random_ai
from baseline0 import setup_ai as baseline0_ai

config = setup_config(max_round=20, initial_stack=1000, small_blind_amount=5)
config.register_player(name="p1", algorithm=baseline0_ai())
```

04 →

Competition Rules

(AI)

Competition Rules

- Each match (two players compete with each other) consists of 5 games
- Each game consists of 20 rounds starting from 1,000 stacks for both
- The player **“wins”** the game if they have **more money left** after 20 rounds

Competition Rules

- **Round-Robin Tournament**
  - Each player is randomly assigned into **a group of 6 people**
    - 5 opponents in total
    - Winners for the matches will get 2 points
    - You can get maximum 10 points if you win all matches
- **Single Elimination**
  - Top 32 players with highest scores (left money summed over 5 matches) are selected to participate in the single elimination tournament
  - Top 4 can get bonus for the final grades (4pt~1pt)

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Submission

(AI)

Submission

- Due date: 2023/06/21 23:59
- Upload to NTU COOL
- No late submission is allowed

Submission

- TAs will evaluate both **code functionality** and the **report quality**
- Please compress your agent and the related files in a single .zip named with your student id in lowercase.
- The size of the submitted .zip file should be less than 500MB.
- Example:
    - b0x902xxx.zip
    - b0x902xxx/
        - |-- report.pdf
        - |-- src/
            - |-- agent.py
            - |-- other related file needed

Report

- Your report should include but not limited to
    - The methods you have tried
    - Your configurations (e.g. hyperparameters)
    - Comparison of your methods
    - Discussion and conclusion
    - What method you choose to submit finally.
- You should write your report in maximum **4 A4 pages in pdf format**
- The grading of the report will base on the **number of methods you tried**, **completeness**, **novelty**, and **clarity of writing**

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Grading Policy

(AI)

Grading (105 pts in total)

- Report (55 pts)
- Baseline Competition (30 pts)
  - baseline1~baseline5 (6 pts for each)
- **Unseen** Strong Agent Competition (10 pts)
  - strong1~strong5 (2 pts for each)
- Round-Robin Tournament (10 pts)
  - Total 5 matches (2 pts for each)
- Single Elimination Tournament (bonus 4 pts)

fai23@csie.ntu.edu.tw

Q & A