VG101 — Intoduction to Computers & Programming

Lab 2

Instructor: Manuel Charlemagne

TA: Yihao Liu – UM-JI (Summer 2018)

Goals of the lab

- Advanced scripting in MATLAB
- Function
- Recursion
- File I/O

1 Introduction

Frank and Krystor are addicted to a traditional Chinese card game "Fight the Landlord" ("Dou dizhu" in Chinese) recently. On wechat, there is a mini program called "fight the landlord with fun", it provides many tasks (final phases of games) and ask the player to win the game with some specific cards. However, some of the tasks are very difficult and they may waste many hours and miss several dues before completing one task.

Frank knows some thoughts in programming. He thinks that they can use the Brute Force Attack to solve the tasks.

According to the rules, Frank applied his brute force attack to one of the tasks and successfully complete it. Before he is going to start another, Krystor stopped him. "Why don't we write a MATLAB script to list all of the possible hands exhaustively?", Krystor asked. However, they found themselves not able to figure out this simple script. Reminding your mastery in MATLAB in the last week, they turned to you for help again.

2 Working Flow

2.1 String and Cell Array

Run and understand the following MATLAB code.

```
1  a = {}
2  b = 'VG101'
3  c = '12'
4  a = [a [b ',' c]]
5  a = [a [c ',' b]]
```

2.2 Split a string

Write a function `cards=readcards(str)`, which takes an argument `str`, a string of cards owned by the player and return a vector `cards` of length 13, which represents the number of each type of card.

It is recommended to use the function `strsplit`.

For example, input: `'5,7,2,4,8,2,4,7,7,4,7,5,10,K'`; output: `[0 2 0 3 2 0 4 1 0 1 0 0 1]`.

2.3   Recursion of Single Cards

First, consider you can only deal single cards (which is called Solo, see the Appendix), write a function `hands=doudizhu(cards, ...)`, in which `cards` is the return value of `cards=readcards(str)`. You should return a permutation with all of these cards. `hands` is a cell array of strings containing the permutation. You can add any other parameters to this function.

For example, input: `[0 0 1 2 0 0 0 0 0 0 0 0 0]`;
output: `{{3,4,4},{4,3,4},{4,4,3}}`.

Note that there may occur some duplicates in this permutation, you should not generate them.

2.4   Recursion of more Categories (advanced)

Since the rules of "Dou Dizhu" are too complicated, Frank and Krystor only ask you to implement some simple categories and then they will modify your code based on that.

- Solo (3)

- Pair (3-3)

- Trio (3-3-3)

- Four (3-3-3-3)

With these more categories, here is an example for the cards '5,7,2,4,8,2,4,7,7,4,7,5,10,K',
input: `[0 0 2 3 0 0 0 0 0 0 0 0 0]`;
output:

```
1  {{3,3,4,4,4},{3,3,4,[4 4]},{3,3,[4 4],4},{3,3,[4 4 4]},{3,4,3,4,4},{3,4,3,[4
↪  4]},{3,4,4,3,4},{3,4,4,4,3},{3,4,[4 4],3},{3,[4 4],3,4},{3,[4 4],4,3},{3,[4 4
↪  4],3},{[3 3],4,4,4},{[3 3],4,[4 4]},{[3 3],[4 4],4},{[3 3],[4 4
↪  4]},{4,3,3,4,4},{4,3,3,[4 4]},{4,3,4,3,4},{4,3,4,4,3},{4,3,[4 4],3},{4,[3
↪  3],4,4},{4,[3 3],[4 4]},{4,4,3,3,4},{4,4,3,4,3},{4,4,[3
↪  3],4},{4,4,4,3,3},{4,4,4,[3 3]},{4,[4 4],3,3},{4,[4 4],[3 3]},{[4
↪  4],3,3,4},{[4 4],3,4,3},{[4 4],[3 3],4},{[4 4],4,3,3},{[4 4],4,[3 3]},{[4 4
↪  4],3,3},{[4 4 4],[3 3]}}
```

(Optional) Base on these simple categories, there are many more complicated categories. If you are interested in them, try them after the lab.

- Solo Chain (3-4-5-6-7)

- Trio + Solo (3-3-3+4)

- Trio + Pair (3-3-3+4+4)

- Trio Airplane (3-3-3-4-4-4)

- Trio Airplane + Solo (3-3-3-4-4-4+5+6)

- Trio Airplane + Pair (3-3-3-4-4-4+5-5+6-6)

- Pair Sisters (3-3-4-4-5-5)

- Four + Dual solo (3-3-3-3+4+5)

- Four + Dual pair (3-3-3-3+4-4+5-5)

2.5 File Input and Output

Write a script to open an input file, call the function `doudizhu(cards)` and write the results to an output file.

The input is given by a file "input.txt"", which contains only one line of cards owned by the player, same as the format of the argument `str` of function `readcards(str)`.

The output file should be named "output.txt", with each element in `hands` printed on one line.

3 Ending

You completed Frank and Krystor's request successfully again. They completed all the tasks in "fight the landlord with fun" and became a master in that area. You really do a good job!

4 Appendix

Simon will explain some rules of Dou Dizhu for you:

Rules of Fight the Landlord (Dou dizhu)

The rules are not complicated; basic knowledge of poker hand rankings helps players get started. However, many of Dou Dizhu's rules are different from Poker and Big Two.

The Rocket and the Bomb
The Rocket and the Bomb are groups of cards that work differently in terms of game play.

Rocket Colored Joker and black-and-white Joker. It can beat everything in the game.

Bomb 4 cards of the same rank. It can beat any other category and individual card except Rocket or another Bomb with a higher or equal rank.

Category of hands
The game uses the concept of hands, similar to the hands in poker, except there are more variations and not necessarily consisted of only five cards. There are some rules for comparisons:

- Compare only the same Category. A player can only beat the prior hand using of the same Category but not the others.

- Compare only the Chains with the same length. Beat the prior hand using the same number of cards is a basic doctrine which only the Rocket and the Bomb may violate. For example, although both 9-10-J-Q-K and 3-4-5-6-7-8-9 are Single Chains, 9-10-J-Q-K cannot beat 3-4-5-6-7-8-9, nor vice versa.

- Compare the rank in the Primal cards only. The Kicker's rank is irrelevant to the comparison unless a variation with 2+ decks is being played.

- Jokers and 2 are non-consecutive cards. Colored Joker, black-and-white Joker, and 2 cannot be used in any of the Primal cards of the Chains since they are not traditionally considered as the consecutive cards sequentially next to the Ace. Examples of illegal Chain: 2-3-4-5-6, 2-2-2-3-3-3 w/ A-A-7-7, K-A-2 + B&W Joker + Colored Joker

Primal	Category with (+) kicker	Chain	Description and Example
Solo	X	—	Any single card (3)
Solo	X	Chain	⩾ Five consecutive individual cards (3-4-5-6-7)
Pair	X	—	Two matching cards of equal rank (3-3)
Pair	X	Sisters	⩾ Three consecutive pairs (3-3-4-4-5-5)
Trio	—	—	Three-of-a-kind: Three individual cards of the same rank (3-3-3)
Trio	—	Airplane	⩾ Two consecutive trios (3-3-3-4-4-4)
Trio	Solo	—	Three cards of the same rank with a solo as the kicker (3-3-3+4)
Trio	Solo	Airplane	⩾ Two consecutive trios with each carries a distinct individual card as the kicker (3-3-3-4-4-4+5-6)
Trio	Pair	—	Full house: Three cards of the same rank with a pair as the kicker. (3-3-3+4-4)
Trio	Pair	Airplane	⩾ Two consecutive trios with each carrying a pair as the kicker (3-3-3-4-4-4+5-5-6-6)
Four	—	X	Four cards of the same rank without the kicker is called a bomb, which defies category rules, even beats four with a kicker. (3-3-3-3)
Four	Dual Solo	X	Four-of-a-kind with two distinct individual cards as the kicker (3-3-3-3+4+5)
Four	Dual Pair	X	Four-of-a-kind with two sets of pair as the kicker (3-3-3-3+4-4+5-5)
Rocket	X	X	Colored Joker and black-and-white Joker. It can beat everything in the game.