CS 101 - Algorithms & Programming I

Fall 2024 - Lab 5

Due: Week of November 4, 2024

The objective of this lab is to learn how to use **for** and **do-while loop** to implement automated repetition. Remember that analyzing your problems and designing them on a piece of paper *before* starting implementation/coding is always a best practice.

0. Setup Workspace

Start VSC and open the previously created workspace named `labs_ws`. Now, under the `labs` folder, create a new folder named `lab5`.

In this lab, you are to have two Java classes/files (under `labs/lab5` folder) as described below. A third Java file containing the revision should go under this folder as well. We expect you to submit a total of 3 files, including the revision, **without compressing** them. Do *not* upload other/previous lab solutions in your submission. The user inputs in the sample runs are shown in blue color.

1. CS Shape

Create a new/empty file of your own under the `lab5` folder named `Lab05_Q1.java` with a class with the same name. In this program, you are expected to print "CS" with stars. To decide the height of the CS letters, you will get an input **integer** from the user. You are supposed to check the input and proceed if it is a positive number and less than 30. <u>You should ask for input until a valid number is given.</u> Your task is to print CS letters using stars at a height provided by the user (see sample runs below).

Sample run 1:

```
Please input the height: 8

  * * * * *     * * * * *
 *            *
 *            *
 *            *
 *              * * * * *
 *                      *
 *                      *
  * * * * *     * * * * *

```

```
Please input the height: 30

   * * * * *     * * * * *
  *              *
  *              *
  *              *
  *              *
  *              *
  *              *
  *              *
  *              *
  *              *
  *              *
  *              *
  *              *
  *              *
  *              *
  *                 * * * * *
  *                          *
  *                          *
  *                          *
  *                          *
  *                          *
  *                          *
  *                          *
  *                          *
  *                          *
  *                          *
  *                          *
  *                          *
  *                          *
   * * * * *     * * * * *
```

2. Ticket to Ride[1] (Board Game)

Create a new file under the `lab5` folder named `Lab05_Q2.java`, containing a class with the same name. Your task is to implement a simplified version of the popular board game "Ticket to Ride." Even if you are familiar with the original game, please carefully read the instructions, as there are several simplifications and modifications. A sample game run is provided at the end of the explanation—*make sure your output aligns exactly with the given examples.*

Remark: You are **not** allowed to use any data types or classes that we have not yet covered (e.g., classes from the Collection framework such as `List`, `Array`, and `ArrayList`).

Game Overview:
Our version of "Ticket to Ride" is a 3-player card game involving Player-1, Player-2, and Player-3. All players' hands will be visible. This game is played with "railway car cards" of various colors (Red, Green, Blue, Magenta, and Yellow) drawn from a deck. Details of the railway car cards are provided below. The computer will act as the dealer and also play the game. Therefore, you will not provide any input to select a move— the computer will automatically decide the move based on the cards in each player's hand.

Objective:
The objective of the game is to complete the "Ticket" card, which consists of different "Routes" between various cities. To achieve this, players must collect railway car cards of specific colors and play them to complete a route. The routes vary in length. The game ends when one player completes all the routes on their Ticket, meaning that all routes are filled with railway car cards.

Gameplay:
Each player starts with 5 railway car cards in hand. In each round, players have two options: they can either "draw 3 random cards from the deck" or "complete a route." There are 5 different routes: Route#2, Route#3, Route#4, Route#5, Route#6. The number in the route name represents the number of railway car cards, all of the **same** color, that need to be spent to complete that route. For instance, if a player wants to complete Route#3, they must use 3 railway car cards of the **same** color from their hand.

As mentioned, players have two options for each round, but they cannot perform both actions in one turn. The priority between these two options is "completing a route." Therefore, if a player has enough cards to complete a route, they must do so. If not, the player should draw 3 random cards from the deck. Each game round is complete when all three players have made their moves. The game continues until one player completes all the routes.

The game can be summarized by the following steps, which are detailed in the subsequent sections:
a. Deck creation & initial card drawing
   ● Create the railway car deck using five different colors: Red, Green, Blue, Magenta, and Yellow.
   ● There should be 25 cards of each color, for a total of 125 cards in the deck.
   ● Deal 5 cards to each player at the start of the game.
b. Game Rounds
   ● Check if a player can complete a route. If yes, complete that route and remove the corresponding cards from the player's hand.
   ● If there are not enough cards in hand to complete a route, draw 3 cards from the deck.

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[1] "Ticket to Ride", Wikipedia. Available at: https://en.wikipedia.org/wiki/Ticket_to_Ride_(board_game)

a. Deck creation & initial card drawn

- First, construct a **string** that will represent the card deck. The deck comprises five colors, represented as follows: "R" for Red, "G" for Green, "B" for Blue, "M" for Magenta, and "Y" for Yellow. In total, there are 125 cards, with each color appearing 25 times. Use a **for** loop to create a string that represents the entire deck. Then, shuffle the deck randomly and print it.

```
Welcome!
Lets shuffle the deck:
BYGYGRYRRYRGRYRYMGRRGMRRMBBMRMYMMMGGBBGBBGGMYMGGMYMYGRGGGMMBRBBBRGBBRMYY
YRBYGYMYMMYMYRGRGGBRGYYYMBBRBMRRGYMGYBBGYBBBBYMRMBRRM
```

Tip: To randomize, you can use methods from the Java <u>Random</u> class.

- Before the game rounds begin, deal five cards to each of the three players in turn. Player 1 will be the first to play.

```
Game begins!
    Player1: BYGYG
    Player2: RYRRY
    Player3: RGRYR
```

- Start the game rounds and decide each player's move based on their hand and the available routes. The hands of all players should be visible. Note that the cards are dealt from the shuffled deck in order.
- <u>Sample runs are provided below, with important scenarios in the gameplay highlighted in</u> <mark>yellow</mark>. <u>Make sure to carefully consider and address these cases in your algorithm!</u>

b. Game Round

- The game always starts with Player 1. Print Player 1's previous hand, the action taken, and the current hand after the move (whether completing a route or drawing cards from the deck). Also, print all of Player 1's routes. In the example below, Player 1 has two Yellow (Y) and two Green (G) railway car cards in their hand. Therefore, Route#2 can be completed using either one of these colors, and the action should be "complete the route."

```
###### Game round #1
  ## Player1 ##
      Previous Hand: BYGYG
      Route Completed!
      Current Hand: BYY
      Route#2: GG
      Route#3:
      Route#4:
      Route#5:
      Route#6:
```

- Now it's Player 2's turn. Note that in this scenario, Player 2 has three Red (R) cards and two Yellow (Y) cards. The player (i.e., the program on behalf of the player) should **tactically choose to complete the longer route first**, as it is more challenging to complete.

```
## Player2 ##
   Previous Hand: RYRRY
   Route Completed!
   Current Hand: YY
   Route#2:
   Route#3: RRR
   Route#4:
   Route#5:
   Route#6:
```

- The game then continues with Player 3. Player 3 also has three Red (R) cards in hand. When a player has three cards of the same color, it does not make sense to use only two cards to complete Route#2 before completing Route#3—unless Route#3 has already been completed. If Route#3 is already completed and the player has three cards along with an empty Route#2, then the player can choose to complete Route#2.

```
## Player3 ##
   Previous Hand: RGRYR
   Route Completed!
   Current Hand: GY
   Route#2:
   Route#3: RRR
   Route#4:
   Route#5:
   Route#6:
```

- The game then continues with the next round. In this round, Players 1 and 3 end up drawing cards as there is no incomplete route that can be completed with their current hands. Player 2, on the other hand, completes Route#2 by using all their cards.

```
###### Game round #2
  ## Player1 ##
     Previous Hand: BYY
     Card Drawn: YMG
     Current Hand: BYYYMG
     Route#2: GG
     Route#3:
     Route#4:
     Route#5:
     Route#6:

  ## Player2 ##
     Previous Hand: YY
     Route Completed!
     Current Hand:
     Route#2: YY
     Route#3: RRR
     Route#4:
     Route#5:
     Route#6:

  ## Player3 ##
     Previous Hand: GY
     Card Drawn: RRG
     Current Hand: GYRRG
     Route#2:
     Route#3: RRR
     Route#4:
     Route#5:
     Route#6:
```

- The game continues in the same manner. The number of game rounds may vary with each execution. The game ends when one player completes all their routes. **Hint**: The sum of the total points for the completed routes, the remaining cards in each player's hand, and the cards left in the deck should always equal 125.

```
###### Game round #3
   ## Player1 ##
      Previous Hand: BYYYMG
      Route Completed!
      Current Hand: BMG
      Route#2: GG
      Route#3: YYY
      Route#4:
      Route#5:
      Route#6:

   ## Player2 ##
      Previous Hand:
      Card Drawn: MRR
      Current Hand: MRR
      Route#2: YY
      Route#3: RRR
      Route#4:
      Route#5:
      Route#6:

   ## Player3 ##
      Previous Hand: GYRRG
      Route Completed!
      Current Hand: GYG
      Route#2: RR
      Route#3: RRR
      Route#4:
      Route#5:
      Route#6:

 ###### Game round #4
   ## Player1 ##
      Previous Hand: BMG
      Card Drawn: MBB
      Current Hand: BMGMBB
      Route#2: GG
      Route#3: YYY
      Route#4:
      Route#5:
      Route#6:

   ## Player2 ##
      Previous Hand: MRR
      Card Drawn: MRM
      Current Hand: MRRMRM
      Route#2: YY
      Route#3: RRR
      Route#4:
      Route#5:
      Route#6:

   ## Player3 ##
      Previous Hand: GYG
      Card Drawn: YMM
      Current Hand: GYGYMM
      Route#2: RR
      Route#3: RRR
      Route#4:
      Route#5:
      Route#6:

  ###### Game round #5
```

```
###### Game round #9
  ## Player1 ##
     Previous Hand: BMMBBMMYYGR
     Card Drawn: RBB
     Current Hand: BMMBBMMYYGRRBB
     Route#2: GG
     Route#3: YYY
     Route#4: GGGG
     Route#5:
     Route#6:

  ## Player2 ##
     Previous Hand: RRRBBGGGGGG
     Route Completed!
     Current Hand: RRRBB
     Route#2: YY
     Route#3: RRR
     Route#4: MMMM
     Route#5:
     Route#6: GGGGGG

  ## Player3 ##
     Previous Hand: GYGYBBGYMMB
     Card Drawn: BRG
     Current Hand: GYGYBBGYMMBBRG
     Route#2: RR
     Route#3: RRR
     Route#4: MMMM
     Route#5:
     Route#6:

###### Game round #10
  ## Player1 ##
     Previous Hand: BMMBBMMYYGRRBB
     Route Completed!
     Current Hand: MMMMYYGRR
     Route#2: GG
     Route#3: YYY
     Route#4: GGGG
     Route#5: BBBBB
     Route#6:

  ## Player2 ##
     Previous Hand: RRRBB
     Card Drawn: BBR
     Current Hand: RRRBBBBR
     Route#2: YY
     Route#3: RRR
     Route#4: MMMM
     Route#5:
     Route#6: GGGGGG

  ## Player3 ##
     Previous Hand: GYGYBBGYMMBBRG
     Card Drawn: MYY
     Current Hand: GYGYBBGYMMBBRGMYY
     Route#2: RR
     Route#3: RRR
     Route#4: MMMM
     Route#5:
     Route#6:
```

```
   ## Player1 ##                              ###### Game round #11
      Previous Hand: BMGMBB                       ## Player1 ##
      Card Drawn: MGG                                Previous Hand: MMMMYYGRR
      Current Hand: BMGMBBMGG                        Card Drawn: YRB
      Route#2: GG                                    Current Hand: MMMMYYGRRYRB
      Route#3: YYY                                   Route#2: GG
      Route#4:                                       Route#3: YYY
      Route#5:                                       Route#4: GGGG
      Route#6:                                       Route#5: BBBBB
                                                     Route#6:
   ## Player2 ##
      Previous Hand: MRRMRM                        ## Player2 ##
      Card Drawn: BBG                                 Previous Hand: RRRBBBBR
      Current Hand: MRRMRMBBG                         Card Drawn: YGY
      Route#2: YY                                     Current Hand: RRRBBBBRYGY
      Route#3: RRR                                    Route#2: YY
      Route#4:                                        Route#3: RRR
      Route#5:                                        Route#4: MMMM
      Route#6:                                        Route#5:
                                                      Route#6: GGGGGG
   ## Player3 ##
      Previous Hand: GYGYMM                        ## Player3 ##
      Card Drawn: BBG                                 Previous Hand: GYGYBBGYMMBBRGMYY
      Current Hand: GYGYMMBBG                         Route Completed!
      Route#2: RR                                     Current Hand: GGBBGMMBBRGM
      Route#3: RRR                                    Route#2: RR
      Route#4:                                        Route#3: RRR
      Route#5:                                        Route#4: MMMM
      Route#6:                                        Route#5: YYYYY
                                                      Route#6:
###### Game round #6
   ## Player1 ##                              ###### Game round #12
      Previous Hand: BMGMBBMGG                     ## Player1 ##
      Card Drawn: GMY                                 Previous Hand: MMMMYYGRRYRB
      Current Hand: BMGMBBMGGGMY                      Card Drawn: MYM
      Route#2: GG                                     Current Hand: MMMMYYGRRYRBMYM
      Route#3: YYY                                    Route#2: GG
      Route#4:                                        Route#3: YYY
      Route#5:                                        Route#4: GGGG
      Route#6:                                        Route#5: BBBBB
                                                      Route#6:
   ## Player2 ##
      Previous Hand: MRRMRMBBG                      ## Player2 ##
      Card Drawn: MGG                                 Previous Hand: RRRBBBBRYGY
      Current Hand: MRRMRMBBGMGG                      Card Drawn: MYM
      Route#2: YY                                     Current Hand: RRRBBBBRYGYMYM
      Route#3: RRR                                    Route#2: YY
      Route#4:                                        Route#3: RRR
      Route#5:                                        Route#4: MMMM
      Route#6:                                        Route#5:
                                                      Route#6: GGGGGG
   ## Player3 ##
      Previous Hand: GYGYMMBBG                      ## Player3 ##
      Card Drawn: MYM                                 Previous Hand: GGBBGMMBBRGM
      Current Hand: GYGYMMBBGMYM                      Card Drawn: YRG
      Route#2: RR                                     Current Hand: GGBBGMMBBRGMYRG
      Route#3: RRR                                    Route#2: RR
      Route#4:                                        Route#3: RRR
      Route#5:                                        Route#4: MMMM
      Route#6:                                        Route#5: YYYYY
                                                      Route#6:
   ###### Game round #7
   ## Player1 ##                              ###### Game round #13
      Previous Hand: BMGMBBMGGGMY                  ## Player1 ##
      Route Completed!                               Previous Hand: MMMMYYGRRYRBMYM
      Current Hand: BMMBBMMY                         Route Completed!
      Route#2: GG                                    Current Hand: YYGRRYRBY
      Route#3: YYY                                   Route#2: GG
      Route#4: GGGG                                  Route#3: YYY
      Route#5:                                       Route#4: GGGG
      Route#6:                                       Route#5: BBBBB
                                                     Route#6: MMMMM
```

```
   ## Player2 ##                              ## Player2 ##
      Previous Hand: MRRMRMBBGMGG                Previous Hand: RRRBBBBRYGYMYM
      Route Completed!                           Card Drawn: RGG
      Current Hand: RRRBBGGG                      Current Hand: RRRBBBBRYGYMYMRGG
      Route#2: YY                                Route#2: YY
      Route#3: RRR                               Route#3: RRR
      Route#4: MMMM                              Route#4: MMMM
      Route#5:                                   Route#5:
      Route#6:                                   Route#6: GGGGGG

   ## Player3 ##                              ## Player3 ##
      Previous Hand: GYGYMMBBGMYM                Previous Hand: GGBBGMMBBRGMYRG
      Route Completed!                           Card Drawn: BRG
      Current Hand: GYGYBBGY                      Current Hand: GGBBGMMBBRGMYRGBRG
      Route#2: RR                                Route#2: RR
      Route#3: RRR                               Route#3: RRR
      Route#4: MMMM                              Route#4: MMMM
      Route#5:                                   Route#5: YYYYY
      Route#6:                                   Route#6:
###### Game round #8                       ********************
   ## Player1 ##                           Game finished!
      Previous Hand: BMMBBMMY
      Card Drawn: YGR                       Player1 total route points: 20,
      Current Hand: BMMBBMMYYGR              Player1's remaining card count in the hand:
      Route#2: GG                           9
      Route#3: YYY                          Player2 total route points: 15,
      Route#4: GGGG                         Player2's remaining card count in the hand:
      Route#5:                              17
      Route#6:                              Player3 total route points: 14,
                                            Player3's remaining card count in the hand:
   ## Player2 ##                           18
      Previous Hand: RRRBBGGG               Number of remaining cards on deck 32
      Card Drawn: GGG                       TOTAL = 125
      Current Hand: RRRBBGGGGGG
      Route#2: YY
      Route#3: RRR
      Route#4: MMMM
      Route#5:
      Route#6:

   ## Player3 ##
      Previous Hand: GYGYBBGY
      Card Drawn: MMB
      Current Hand: GYGYBBGYMMB
      Route#2: RR
      Route#3: RRR
      Route#4: MMMM
      Route#5:
      Route#6:
```