Software Construction (L+E) HS 2022

Instructor: Prof. Dr. Alberto Bacchelli   Assignment 2

Tutors: Adam Bauer, Loris De Luca, David Moser, Jonas Zellweger   Week 08

To correctly complete this assignment you **must**:

- Carry out the assignment with <u>your team only</u> (unless otherwise stated). You are allowed to discuss solutions with other teams, but each team should come up its own personal solution. A strict plagiarism policy is going to be applied to all the artifacts submitted for evaluation.

- Prepare the solutions to the exercises by <u>strictly</u> following this structure:

    - A root folder named: `Group[id on OLAT]-a[AssignmentNumber]`[1]
    - One subfolder per each exercise named using the double digit number of the exercise.[2]
    - Inside each subfolder:
        * an `answer.pdf` file that answers the exercise's questions, directly and/or by explaining the decision taken in the source code, depending on the exercise's requirements;
        * only for questions requiring code: a `src` subfolder with the source code of your solution.

- Package your root folder into a single <u>ZIP file</u> named:
  `Group[id on OLAT]-a[AssignmentNumber].zip`[3]

- Upload the solution to the right OLAT task by the <u>deadline</u> (*i.e.*, **Dec 05, 2022 @ 18:00**)

Exercise 1 - A Terminal-based Tutto Game - Design

Referring to the game requirements in Appendix A and to the rules you find in Appendix B, use what you have learned in the lecture about Responsibility Driven Design to do the following tasks:

1. Following the Responsibility Driven Design, start from the game's requirements and rules and derive classes, responsibilities, and collaborations (use CRC cards). Describe each step you make and store the final cards in your answer.

2. Following the Responsibility Driven Design, describe the *main* classes you designed to be your project in terms of responsibilities and collaborations; also draw their class diagram.

Exercise 2 - A Terminal-based Tutto Game - Implementation

Implement in Java the game design that you designed in the previous exercise.[4] Make sure to put in practice what you have learned in the sessions until Nov 08, 2022 included and explain how you did so in the accompanying `answer.pdf` file.

Exercise 3 - A Terminal-based Tutto Game - Testing

Test your implementation of the game. Make sure to use JUnit version 5.9+ and to reach at least 70% branch coverage. If, for some reasons, it is not possible to reach this branch coverage, clearly explain the reasons in the accompanying `answer.pdf` file.

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[1] *e.g.*, a correct name would be: `Group1-a1`.
[2] *e.g.*, the subfolder `01` contains the answer to exercise *1*.
[3] *e.g.*, a correct name would be: `Group1-a2.zip`.
[4] For the assignment to be valid, it should also be possible to play the entire game on the terminal.

Appendix A: Requirements for a Terminal-based Tutto Game

In this implementation of the game, two up to four players can play the game. The computer takes care of the logistics of the game (turns, dice rolling, keeping the score, etc.), but the players have to take their strategic decision at each turn.

When the game starts, the program asks how many players want to play; afterwards it asks for their names. The computer also asks the points that are necessary to win the game (e.g., 6'000). The players then take turns following an alphabetical order based on their names.

At the start of each turn, the user can: Roll the dice or Display the current scores, by inputing either one of the underlined characters. Once the user selects R, a card is automatically drawn and its type shown on the terminal. Subsequently, the computer rolls the dice, shows the results to the user, and, based on the rules, either inform the user that their turn is finished or asks them whether they want to Roll the dice or End their turn. At the end of each turn, the current scores are updated.

At the end of every turn, the game checks whether a user reaches the points necessary to win the game. In this case, this user is declared as the winner and the scores of all the other players are also shown; the game ends. Otherwise, the turn passes to the next player in alphabetical order.

Appendix B: Rules of Tutto

Please refer to the official rules by ABACUSSPIELE, which are available here and are reported in the following page for your convenience. All the rights are with ABACUSSPIELE.

TUTTO

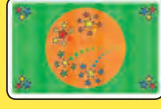## GAME MATERIALS

1 set of instructions, 6 dice and 56 game cards overall:
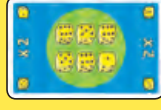
1 "Cloverleaf" card

5 "Fireworks" cards

5 "Straight" cards

5 "Plus/Minus" cards

25 "Bonus" cards (5 cards each, worth 200, 300, 400, 500, 600)

10 "Stop" cards

5 "x2" cards

In addition, you will need paper and pencil to write down the score.

GAME IDEA

With the luck of the dice and a bit of strategy, all players try to accumulate as many points as possible. But before you roll the dice, the cards come into play. They often promise a hefty bonus – but if you risk too much, you'll go away empty-handed.

SET-UP

🍀 The player who is considered the luckiest of the lot by the others takes paper and pencil. He'll note down the scores of all the players during the course of the game.

🍀 Then he shuffles the cards and puts them as a face-down pile on the table, easily accessible to everybody.

🍀 He is the starting player and begins the game!

THE CARDS

Bonus: If you accomplish a **"TUTTO"**, you get the bonus points indicated on the card in addition to the points you have rolled. If you stop and have not accomplished a **"TUTTO"**, you score only the points rolled without getting the bonus.

x2: If you accomplish a **"TUTTO"**, all points you have rolled so far on this turn are doubled. If you stop and have not accomplished a **"TUTTO"**, you score only the points rolled.

Stop: Tough luck! You have to end your turn, and your left neighbour has his turn.

Fireworks: You have to keep throwing the dice until you roll a null. After each roll, you need to keep all valid single dice and triplets. If you accomplish a **"TUTTO"**, you have to continue without revealing a new card. Your turn ends only when you roll a null. However, you score all points you have rolled on this turn.

Plus/Minus: You must try to accomplish a **"TUTTO"** and may not stop before you do. If you roll a null, you don't score any points. But if you succeed, you score exactly 1,000 points, irrespective of the number of points you have rolled. Besides this, the leading player has 1,000 points deducted.

If more than one player is leading with the same number of points, each of them has 1,000 points deducted. Nevertheless, you, as the player who is currently rolling the dice, score 1,000 points only once. If it is the leading player who reveals this card, naturally he doesn't have to deduct any points from his score when he accomplishes a **"TUTTO"**.

Cloverleaf: You have to try to accomplish a **"TUTTO"** twice in a row on this turn and may not stop before you do. If you roll a null, you don't score any points. But if you succeed, the game ends immediately, and you win – no matter what score you have!

Straight: Attention! This card changes the rules for valid dice. You have to try to accomplish a "Straight" and may not stop before you do. A "Straight" consists of all six numbers ⚀ ⚁ ⚂ ⚃ ⚄ ⚅ . As usual, you have to keep at least one valid die after each roll. In this case, a valid die is a die that shows a number that you have not yet put aside. If the roll doesn't contain any valid die, it counts as a null and you don't score any points. But if you accomplish a "Straight", you score 2,000 points for it. A "Straight" is considered a **"TUTTO"** – consequently, you may continue if you want.

COURSE OF THE GAME

On your turn, you first flip over the top card of the pile and lay it face up next to the pile. The revealed card indicates a special feature for your turn. Most cards give you bonus points, but there are also cards that force you to end your turn. The different cards and their meaning are explained in detail in the section **THE CARDS**.

Normally, after revealing the card, you roll all 6 dice and check your result for valid single dice or dice combinations of triplets that you can keep.

The following single dice and triplets are valid and might score you points:

Single die: each ⚄ = 50 points

each ⚀ = 100 points

Triplets: ⚁⚁⚁ = 200 points

⚂⚂⚂ = 300 points

⚃⚃⚃ = 400 points

⚄⚄⚄ = 500 points

⚅⚅⚅ = 600 points

⚀⚀⚀ = 1,000 points

Each die counts only once, that means that a ⚄ or a ⚀ counts either as a single die or as a part of a triplet. A triplet is valid only if it has been thrown in one roll – dice that you have put aside after other rolls may never be used for a triplet.

Note: If you keep a triplet of ⚀⚀⚀ or ⚄⚄⚄, you have to make sure that you keep these dice together and don't mix them with saved single dice.

The possibilities you have now depends on the result of the roll:

Null

If your roll doesn't contain any valid single die or triplet, you have rolled a null. Tough luck! Example: ⚁⚂⚃⚅⚅⚁. Your turn is over and you don't score any points. You pass all dice to your left neighbour who then has his turn.

Valid dice

If the roll contains at least one valid die and/or triplet, you may choose whether you want to stop or to continue:

🍀 **Stop:** You end your turn and score the total of all the points you have rolled on this turn. Add them to the points that you have scored on your past turns. Then it's your left neighbour's turn.

🍀 **Continue:** You have to keep at least one valid die or triplet. Then you continue your turn by rolling the remaining dice. If you throw a null, all points that you have scored on this turn are forfeited, and it becomes your left neighbour's turn. If this roll contains at least one valid single die or triplet, you can choose again to stop and write down the points you have scored or to continue and try to improve your score. However, dice that you had put aside may be used again only if you accomplish a **"TUTTO"**.

"TUTTO"

If you have put aside all dice after one or more rolls, this is called a **"TUTTO"**. Example: ⚀⚄⚀⚀⚄⚄. After a **"TUTTO"**, you can also choose whether to stop or to continue. If you decide to go on, you have to memorise the points you have scored so far and flip over the next card of the pile, which is valid for you from now on. After that, you reroll all six dice. But if you reveal a "Stop" card (see **THE CARDS**) or roll a null during your turn, you have bad luck! All points that you have accumulated on this turn go to waste.

END OF THE GAME

When one of the players reaches at least 6,000 points, the round is continued until each player has had the same number of turns; that means that the player to the right of the starting player is the last to have a turn. Then the game ends and the player with the most points wins.

A detailed example:

A player flips over the "600 Bonus" card and rolls ⚄⚀⚁⚄⚂⚅. He keeps the ⚀ and rerolls the remaining dice. He throws ⚄⚁⚁⚁⚄. If he stopped now and added up the points of what he has put aside, he would score 100+200+50 = 350 points. But since he wants to accumulate more points and relishes the idea of getting a bonus, he keeps only the ⚄ and continues. He rolls the four remaining dice and is lucky: The dice show ⚅⚅⚅⚄ (600+50). "TUTTO"! If he stops now, he'll score 100+50+600+50 = 800 + 600 (bonus for the card) = 1,400 points in total.

But this gambler still hasn't got enough. He decides to continue and reveals a new card – even though he knows that a "Stop" card would cost him the points he has accumulated so far. He draws a "Straight" card and now has to put aside the numbers "1" to "6". His first roll results in ⚀⚁⚂⚃⚄, and he keeps ⚀⚁⚃⚄. His second roll shows ⚀⚂, and all his efforts have been in vain. He doesn't score any points for this turn, and now his left neighbour has his turn.