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AP® Computer Science A Elevens Lab Student Guide

The AP Program wishes to acknowledge and thank the following individuals for their contributions in developing this lab and the accompanying documentation.

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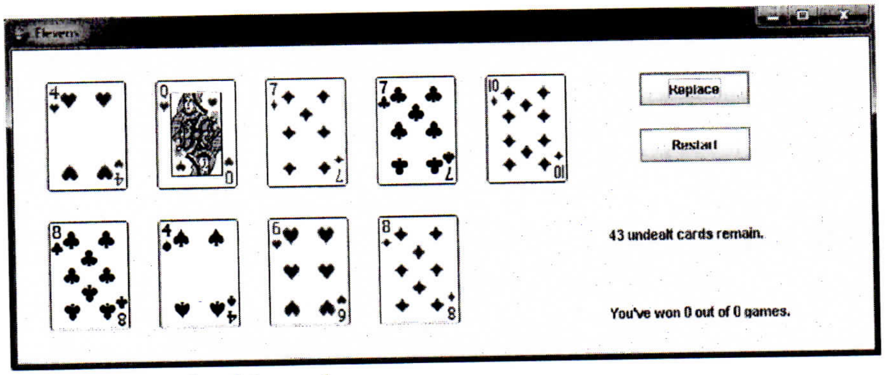
Elevens Lab Student Guide

Introduction

The following activities are related to a simple solitaire game called Elevens. You will learn the rules of Elevens, and will be able to play it by using the supplied Graphical User Interface (GUI) shown at the right. You will learn about the design and the Object Oriented Principles that suggested that design. You will also implement much of the code.



43 undealt cards remain.

You've won 0 out of 0 games.

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Activity 1: Design and Create a `Card` Class

Introduction:

In this activity, you will complete a `Card` class that will be used to create card objects.

Think about card games you've played. What kinds of information do these games require a card object to "know"? What kinds of operations do these games require a card object to provide?

Exploration:

Now think about implementing a class to represent a playing card. What instance variables should it have? What methods should it provide? Discuss your ideas for this `Card` class with classmates.

Read the partial implementation of the `Card` class available in the **Activity1 Starter Code** folder. As you read through this class, you will notice the use of the `@Override` annotation before the `toString` method. The Java `@Override` annotation can be used to indicate that a method is intended to override a method in a superclass. In this example, the `Object` class's `toString` method is being overridden in the `Card` class. If the indicated method doesn't override a method, then the Java compiler will give an error message.

Here's a situation where this facility comes in handy. Programmers new to Java often encounter problems matching headings of overridden methods to the superclass's original method heading. For example, in the `Weight` class below, the `tostring` method is intended to be invoked when `toString` is called for a `Weight` object.

```
public class Weight {
   private int pounds;
   private int ounces;
       . . .
   public String tostring(String str) {
      return this.pounds + " lb.  " + this.ounces + " oz.";
   }
       . . .
}
```

Unfortunately, this doesn't work; the `tostring` method given above has a different name and a different signature from the `Object` class's `toString` method. The correct version below has the correct name `toString` and no parameter:

```
public String toString() {
   return this.pounds + " lb.  " + this.ounces + " oz.";
}
```

The `@Override` annotation would cause an error message for the first `tostring` version to alert the programmer of the errors.

Exercises:

1. Complete the implementation of the provided `Card` class. You will be required to complete:

   a. a constructor that takes two `String` parameters that represent the card's rank and suit, and an `int` parameter that represents the point value of the card;

   b. accessor methods for the card's rank, suit, and point value;

   c. a method to test equality between two card objects; and (note that they name this 'matches' and their comments state what it means)

   d. the `toString` method to create a `String` that contains the rank, suit, and point value of the card object. The string should be in the following format:

      rank of *suit* (point value = *pointValue*)

2. Once you have completed the `Card` class, find the `CardTester.java` file in the **Activity1 Starter Code** folder. Create three `Card` objects and test each method for each `Card` object.

Make sure to test the matches method and to String().
No need to test the accessors.

show one that matches ~~works~~; show one that does not match

Activity 2: Initial Design of a Deck Class

Introduction:

Think about a deck of cards. How would you describe a deck of cards? When you play card games, what kinds of operations do these games require a deck to provide?

Exploration:

Now consider implementing a class to represent a deck of cards. Describe its instance variables and methods, and discuss your design with a classmate.

Read the partial implementation of the `Deck` class available in the **Activity2 Starter Code** folder. This file contains the instance variables, constructor header, and method headers for a `Deck` class general enough to be useful for a variety of card games. Discuss the `Deck` class with your classmates; in particular, make sure you understand the role of each of the parameters to the `Deck` constructor, and of each of the private instance variables in the `Deck` class.

Exercises:

1. Complete the implementation of the `Deck` class by coding each of the following:

- `Deck` constructor — This constructor receives three arrays as parameters. The arrays contain the ranks, suits, and point values for each card in the deck. The constructor creates an `ArrayList`, and then creates the specified cards and adds them to the list. For example, if `ranks = {"A", "B", "C"}`, `suits = {"Giraffes", "Lions"}`, and `values = {2,1,6}`, the constructor would create the following cards:

  ```
  ["A", "Giraffes", 2], ["B", "Giraffes", 1], ["C", "Giraffes", 6],
  ["A", "Lions", 2], ["B", "Lions", 1], ["C", "Lions", 6]
  ```

  and would add each of them to `cards`. The parameter `size` would then be set to the size of `cards`, which in this example is 6.

  Finally, the constructor should shuffle the deck by calling the `shuffle` method. Note that you will not be implementing the `shuffle` method until Activity 4.

notice, this creates 6 cards. The value of each rank is constant in a Deck

make sure you get exactly this result prior to showing me

- `isEmpty` — This method should return `true` when the size of the deck is 0; `false` otherwise.

- `size` — This method returns the number of cards in the deck that are left to be dealt.

- deal — This method "deals" a card by removing a card from the deck and returning it, if there are any cards in the deck left to be dealt. It returns null if the deck is empty. There are several ways of accomplishing this task. Here are two possible algorithms:

  Algorithm 1: Because the cards are being held in an ArrayList, it would be easy to simply call the List method that removes an object at a specified index, and return that object. Removing the object from the end of the list would be more efficient than removing it from the beginning of the list. Note that the use of this algorithm also requires a separate "discard" list to keep track of the dealt cards. This is necessary so that the dealt cards can be reshuffled and dealt again.

  Algorithm 2: It would be more efficient to leave the cards in the list. Instead of removing the card, simply decrement the size instance variable and then return the card at size. In this algorithm, the size instance variable does double duty; it determines which card to "deal" and it also represents how many cards in the deck are left to be dealt. **This is the algorithm that you should implement.**

2. Once you have completed the Deck class, find DeckTester.java file in the **Activity2 Starter Code** folder. Add code in the main method to create three Deck objects and test each method for each Deck object.

(This includes the Deck toString(). Also, show that your code can handle dealing from an empty deck. without giving an Exception

Questions:

1. Explain in your own words the relationship between a deck and a card.

2. Consider the deck initialized with the statements below. How many cards does the deck contain?

```
String[] ranks = {"jack", "queen", "king"};
String[] suits = {"blue", "red"};
int[] pointValues = {11, 12, 13};
Deck d = new Deck(ranks, suits, pointValues);
```

3. The game of Twenty-One is played with a deck of 52 cards. Ranks run from ace (highest) down to 2 (lowest). Suits are spades, hearts, diamonds, and clubs as in many other games. A face card has point value 10; an ace has point value 11; point values for 2, …, 10 are 2, …, 10, respectively. Specify the contents of the ranks, suits, and pointValues arrays so that the statement

```
Deck d = new Deck(ranks, suits, pointValues);
```

   initializes a deck for a Twenty-One game.

4. Does the order of elements of the ranks, suits, and pointValues arrays matter?