AP® Computer Science A Elevens Lab Student Guide

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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

   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.

Glossary

assertion: Boolean expressions that should be true if the program is running correctly. The Java `assert` statement can be used to check assertions in a program.

class invariant: A logical statement relating to the values of the instance variables of a class that is always true between calls to the class's methods (also referred to as a "data invariant"). ("Invariant" means "not varying" or "not changing.")

client class: A class that uses another class (e.g., The `Deck` class is a client of the `Card` class.).

helper method: A method, usually `private`, that is called by another method. Helper methods are used to simplify the calling method. They also facilitate code reuse when they provide a function that can be used by more than one calling method.

loop invariant: A logical statement that is always true when execution reaches a loop's termination test.

model: A class with behaviors and state that represent key features of some "real-world" object or process. We say that a class models the "real-world" object. For example, the `Deck` class models a real deck of cards.

perfect shuffle: A card-shuffling method that starts with dividing the deck into two stacks, then interleaving the cards, first a card from stack 1, then a card from stack 2, then another card from stack 1, another from stack 2, and so on.

permutation: A rearrangement of a given sequence of values. There are six permutations of the sequence [1,2,3], namely [1,2,3] (the "identity" permutation), [1,3,2], [2,1,3], [2,3,1], [3,1,2], and [3,2,1]. If the given sequence contains duplicate values, so will its permutations. For example, the permutations of [1,1,2] are [1,1,2], [1,2,1], and [2,1,1].

polymorphism: A process that Java uses where the method to execute is based on the object executing the method. For example, if `board.anotherPlayIsPossible()` is executed, and `board` references an `ElevensBoard` object, then the `ElevensBoard` `anotherPlayIsPossible` method will be called.

probabilistic: Based on chance or involving the use of randomness.

pseudo-random number generator: A procedure that produces a sequence of values that passes various statistical tests for randomness (e.g., any value is just as likely to occur in a given position in the sequence as any other).

random number generator: See **pseudo-random number generator**.

refactor: Reorganizing code. One example of refactoring is creating helper methods to simplify code or eliminate duplicate code. Another is splitting a class into a superclass and a subclass, putting the code that would be common to other subclasses into the new superclass.

selection shuffle: A card-shuffling method that works similarly to the selection sort. It randomly selects a card for each position in the deck from the remaining unselected cards.

shuffle: A method of permuting (mixing up) the cards in a deck. See **perfect shuffle** and **selection shuffle**.

simulation: Imitation, using a computer program, of some real-world process. The "actors" in the process correspond to objects and variables in the simulation, while the interactions between the actors correspond to program methods.

systematic: Performed using a logical step-by-step process.

truncation: Removal of the fractional part of a real or double value, producing an integer.

References

The Complete Book of Solitaire and Patience Games, by Albert H. Morehead and Geoffrey Mott-Smith, Bantam Books (1977).