**Home exercise 1 (Programming)**

**Course name: Object oriented programming and design for engineering**

**Course number: 157109**

**Subject: Interfaces**

The goal of this exercise is to make sure you are on the same page for subjects like Java programming, inheritance, interfaces and polymorphism.

**Part 1 (Introduction): Interface definition**

Below is a code segment with no errors in it:

public static void main(String[] args)

{

int x = 5;

String y = “hello”;

C b1 = new B();

C[] arrC = new C[3];

arrC[0] = new B(99);

arrC[1] = new A();

arrC[2] = new B(5);

arrC[0].f1();

arrC[0].f2();

((A)arrC[1]).f3();

}

**Section A**

Write *C* fully, assuming that it is an interface.

**Section B**

Write classes *A* and *B*.

Do not implement the classes’ methods, only write their signatures (including constructors). If the classes have attributes, write them as well. Assume that the constructor parameters are used for initializing object properties of the same name.

**Section C**

Draw a UML diagram which displays the exact relations between *A*, *B* and *C*. You can choose using a drawing tool (Intellij, Rhapsody, drawio, whiteStarUML) or drawing on a page.

Explain the basis for deducing these relations.

**Section D**

Can *B* be an interface? If so, write it as an interface. If not, explain why.

**Part 2 (programming): Seasons simulation system**

Write a program that simulates an information system regarding the changing seasons and their influence on various trees/animals.

The system includes the following enum which denotes seasons:

public enum Season {  
 *WINTER*, *SPRING*, *SUMMER*, *FALL*}

In addition, the system includes the following enum which denotes Colors:

public enum Color {  
 *GRAY*, *BROWN*, *BLACK, WHITE, YELLOW, GREEN*}

**The Seasonable interface**

You are provided with the Seasonable interface, representing objects that are influence by the turning seasons.

public interface Seasonable {  
 Season getCurrentSeason();  
 void changeSeason();  
}

The function getCurrentSeason returns the Season the object is currently in.

The function changeSeason sets the object’s current season to the next season (The seasons order is: Winter, Spring, Summer, Fall and so on)

**The Animal abstract class**

This class defines an object of type “Animal” and implements the Seasonable and [Comparable](https://docs.oracle.com/javase/8/docs/api/java/lang/Comparable.html) interfaces.

The Animal attributes are:

1. weight: an integer. If the weight changes, it should be rounded to the closest integer.
2. color
3. season: The season where the animal lives

Each season affects specific animals differently (see infra).

The Animal operation, implementing the relevant interfaces are:

1. compareTo: compares the weight of the objects
2. changeSeasons: changes the animal’s season to the next season.
3. toString (overrides the function from Object): returns a string representing the animal’s current details.

**The Tree abstract class**

This class defines an object of type “Tree” and implements the Seasonable and [Comparable](https://docs.oracle.com/javase/8/docs/api/java/lang/Comparable.html) interfaces.

The Animal attributes are:

1. height: an integer. If the height changes, it should be rounded to the closest integer.
2. color. Some trees shed their leaves in specific seasons.
3. season: The season where the tree grows

Each season affects specific trees differently (see infra).

The Tree operation, implementing the relevant interfaces are:

1. compareTo: compares the height of the objects
2. changeSeasons: changes the animal’s season to the next season.
3. toString (overrides the function from Object): returns a string representing the tree’s current details.

**Two Classes extend Animal**

**The Bear class**

This class should override the following functions:

1. toString: returns a string that describes how the bear changes in the current season and in addition the object’s attributes
2. changeSeason: changes the season and then changes the relevant fields according to the current season.

In the winter: The bear loses 20% of its weight. The bear hibernates.

In the spring: The bear loses 25% of its weight.

In the summer: The bear gains one third of its weight.

In the fall: The bear gains 25% of its weight.

The bear is brown all year round.

**The Caribou class**

This class should override the following functions:

1. toString: returns a string that describes how the caribou changes in the current season and in addition the object’s attributes
2. changeSeason: changes the season and then changes the relevant fields according to the current season.

In the winter: The caribou’s fur becomes white. The caribou migrates south.

In the spring: The caribou’s fur becomes brown.

In the summer: The caribou migrates north.

In the fall: No change.

**Two Classes extend Tree**

**The FigTree class**

This class should override the following functions:

1. toString: returns a string that describes how the tree changes in the current season and in addition the object’s attributes
2. changeSeason: changes the season and then changes the relevant fields according to the current season.

In the winter: The tree grows by 20cm. The tree has no leaves.

In the spring: The tree grows by 30cm. The tree grows green leaves.

In the summer: The tree grows by 30cm. The fig tree gives fruit.

In the fall: The tree grows by 20cm. The tree’s leaves become yellow.

**The OliveTree class**

This class should override the following functions:

1. toString: returns a string that describes how the tree changes in the current season and in addition the object’s attributes
2. changeSeason: changes the season and then changes the relevant fields according to the current season.

In the winter: The tree grows by 5cm.

In the spring: The tree grows by 10cm.

In the summer: The tree grows by 10cm.

In the fall: The tree grows by 5cm. The olive tree gives fruit.

**The SeasonUtil class**

This is a service class which includes static methods which allow the user to sort various seasonable objects and produces reports about their currentcondition. You should implement the following interface:

|  |  |
| --- | --- |
| **The method’s signature** | **The method’s description** |
| static void sort  (Comparable[] comparable) | Sorts an array of objects of type Comparable according to the “comparison key” defined for them |
| static String reportAll (Seasonable [] seasonable) | Returns a string for all objects of type Seasonable in the supplied array (see example below) |

In order to implement the *sort*() method, use the static method *sort*(Object[] a) of the *Arrays* class as described is in the [Java API](https://docs.oracle.com/javase/8/docs/api/java/util/Arrays.html).

1. Complete and test the Animal, Tree, Bear, Caribou, FigTree, and OliveTree classes
2. Complete and test the SeasonUtil class

After you have written the three classes, test them with the code appearing in the SeasonUtilTest.

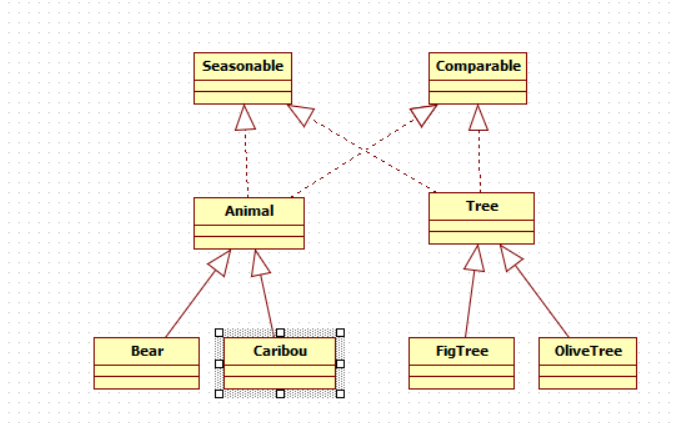
**Make sure you completed all the places marked with TODO! These indicate the required implementation. There may be other ways to solve the assignments, which do not follow these markings. The code will be checked according to the requirements described above.**

1. Theoretical question: What would happen if we initialized an array of Comparable with trees and animals and called *sort* on it? Explain! During the course we will learn how to handle this issue.

You are supplied with a skeleton for the project. You should complete the classes Tree, Animal, SeasonUtil, Caribou, Bear, FigTree, OliveTree and submit and verify them through the VPL component. You are also required to fill the file with the submitters' names and IDs. In addition, your submission should contain a pdf file which includes the students’ details and the answers for part 1 and section C of part 2. The pdf file will be named based on the submitter’s ID number (for example 12346\_1235.pdf). Make sure you have read the general instruction file for programming exercises and that your exercise meets the instructions.

Good luck!

Appendix 1: The types of relations used in the program are described in the following diagram:



Appendix 2: Below are segments from the expected output. Use this example and the automatic checker in order to have the full details on the requirements. Note, the following segments should appear in **exactly** the same way in your program (an exercise whose output will appear differently, even if only in things like spacing or punctuation marks, will be graded 0). We used a seed which fixes the randomly generated values. Grading will be done with a different seed.

Enter Seed:

2

---All animals---

Caribou: My weight is: 208 and my color is: BROWN

Caribou: My weight is: 222 and my color is: BROWN

Caribou: My weight is: 240 and my color is: BROWN

Caribou: My weight is: 217 and my color is: BROWN

Bear. My weight is: 239 and my color is: BROWN

Bear. My weight is: 200 and my color is: BROWN

Bear. My weight is: 206 and my color is: BROWN

Bear. My weight is: 219 and my color is: BROWN

---All trees---

Olive tree. I give fruit. My height is: 197 and my color is: GREEN

Olive tree. I give fruit. My height is: 168 and my color is: GREEN

Olive tree. I give fruit. My height is: 194 and my color is: GREEN

Olive tree. I give fruit. My height is: 186 and my color is: GREEN

Fig tree. My height is: 184 and my color is: YELLOW

Fig tree. My height is: 164 and my color is: YELLOW

Fig tree. My height is: 164 and my color is: YELLOW

Fig tree. My height is: 166 and my color is: YELLOW

---Sorting animals---

Bear. My weight is: 200 and my color is: BROWN

Bear. My weight is: 206 and my color is: BROWN

Caribou: My weight is: 208 and my color is: BROWN

Caribou: My weight is: 217 and my color is: BROWN

Bear. My weight is: 219 and my color is: BROWN

Caribou: My weight is: 222 and my color is: BROWN

Bear. My weight is: 239 and my color is: BROWN

Caribou: My weight is: 240 and my color is: BROWN

---Sorting trees---

Fig tree. My height is: 164 and my color is: YELLOW

Fig tree. My height is: 164 and my color is: YELLOW

Fig tree. My height is: 166 and my color is: YELLOW

Olive tree. I give fruit. My height is: 168 and my color is: GREEN

Fig tree. My height is: 184 and my color is: YELLOW

Olive tree. I give fruit. My height is: 186 and my color is: GREEN

Olive tree. I give fruit. My height is: 194 and my color is: GREEN

Olive tree. I give fruit. My height is: 197 and my color is: GREEN

---All together---

Bear. My weight is: 200 and my color is: BROWN

Fig tree. My height is: 164 and my color is: YELLOW

Bear. My weight is: 206 and my color is: BROWN

Fig tree. My height is: 164 and my color is: YELLOW

Caribou: My weight is: 208 and my color is: BROWN

Fig tree. My height is: 166 and my color is: YELLOW

Caribou: My weight is: 217 and my color is: BROWN

Olive tree. I give fruit. My height is: 168 and my color is: GREEN

Bear. My weight is: 219 and my color is: BROWN

Fig tree. My height is: 184 and my color is: YELLOW

Caribou: My weight is: 222 and my color is: BROWN

Olive tree. I give fruit. My height is: 186 and my color is: GREEN

Bear. My weight is: 239 and my color is: BROWN

Olive tree. I give fruit. My height is: 194 and my color is: GREEN

Caribou: My weight is: 240 and my color is: BROWN

Olive tree. I give fruit. My height is: 197 and my color is: GREEN

---change six seasons for animals and trees---

---All together after changing season---

Bear. I am sleeping. My weight is: 160 and my color is: BROWN

Fig tree. My height is: 184 and I have no leaves

Bear. I am sleeping. My weight is: 165 and my color is: BROWN

Fig tree. My height is: 184 and I have no leaves

Caribou: I am migrating south. My weight is: 208 and my color is: WHITE

Fig tree. My height is: 186 and I have no leaves

Caribou: I am migrating south. My weight is: 217 and my color is: WHITE

Olive tree. My height is: 173 and my color is: GREEN

Bear. I am sleeping. My weight is: 175 and my color is: BROWN

Fig tree. My height is: 204 and I have no leaves

Caribou: I am migrating south. My weight is: 222 and my color is: WHITE

Olive tree. My height is: 191 and my color is: GREEN

Bear. I am sleeping. My weight is: 191 and my color is: BROWN

Olive tree. My height is: 199 and my color is: GREEN

Caribou: I am migrating south. My weight is: 240 and my color is: WHITE

Olive tree. My height is: 202 and my color is: GREEN

---All together after changing season---

Bear. My weight is: 120 and my color is: BROWN

Fig tree. My height is: 214 and my color is: GREEN

Bear. My weight is: 124 and my color is: BROWN

Fig tree. My height is: 214 and my color is: GREEN

Caribou: My weight is: 208 and my color is: BROWN

Fig tree. My height is: 216 and my color is: GREEN

Caribou: My weight is: 217 and my color is: BROWN

Olive tree. My height is: 183 and my color is: GREEN

Bear. My weight is: 131 and my color is: BROWN

Fig tree. My height is: 234 and my color is: GREEN

Caribou: My weight is: 222 and my color is: BROWN

Olive tree. My height is: 201 and my color is: GREEN

Bear. My weight is: 143 and my color is: BROWN

Olive tree. My height is: 209 and my color is: GREEN

Caribou: My weight is: 240 and my color is: BROWN

Olive tree. My height is: 212 and my color is: GREEN

---All together after changing season---

Bear. My weight is: 160 and my color is: BROWN

Fig tree. I give fruit. My height is: 244 and my color is: GREEN

Bear. My weight is: 165 and my color is: BROWN

Fig tree. I give fruit. My height is: 244 and my color is: GREEN

Caribou: I am migrating north. My weight is: 208 and my color is: BROWN

Fig tree. I give fruit. My height is: 246 and my color is: GREEN

Caribou: I am migrating north. My weight is: 217 and my color is: BROWN

Olive tree. My height is: 193 and my color is: GREEN

Bear. My weight is: 175 and my color is: BROWN

Fig tree. I give fruit. My height is: 264 and my color is: GREEN

Caribou: I am migrating north. My weight is: 222 and my color is: BROWN

Olive tree. My height is: 211 and my color is: GREEN

Bear. My weight is: 191 and my color is: BROWN

Olive tree. My height is: 219 and my color is: GREEN

Caribou: I am migrating north. My weight is: 240 and my color is: BROWN

Olive tree. My height is: 222 and my color is: GREEN

---All together after changing season---

Bear. My weight is: 200 and my color is: BROWN

Fig tree. My height is: 264 and my color is: YELLOW

Bear. My weight is: 206 and my color is: BROWN

Fig tree. My height is: 264 and my color is: YELLOW

Caribou: My weight is: 208 and my color is: BROWN

Fig tree. My height is: 266 and my color is: YELLOW

Caribou: My weight is: 217 and my color is: BROWN

Olive tree. I give fruit. My height is: 198 and my color is: GREEN

Bear. My weight is: 219 and my color is: BROWN

Fig tree. My height is: 284 and my color is: YELLOW

Caribou: My weight is: 222 and my color is: BROWN

Olive tree. I give fruit. My height is: 216 and my color is: GREEN

Bear. My weight is: 239 and my color is: BROWN

Olive tree. I give fruit. My height is: 224 and my color is: GREEN

Caribou: My weight is: 240 and my color is: BROWN

Olive tree. I give fruit. My height is: 227 and my color is: GREEN

---All together after changing season---

Bear. I am sleeping. My weight is: 160 and my color is: BROWN

Fig tree. My height is: 284 and I have no leaves

Bear. I am sleeping. My weight is: 165 and my color is: BROWN

Fig tree. My height is: 284 and I have no leaves

Caribou: I am migrating south. My weight is: 208 and my color is: WHITE

Fig tree. My height is: 286 and I have no leaves

Caribou: I am migrating south. My weight is: 217 and my color is: WHITE

Olive tree. My height is: 203 and my color is: GREEN

Bear. I am sleeping. My weight is: 175 and my color is: BROWN

Fig tree. My height is: 304 and I have no leaves

Caribou: I am migrating south. My weight is: 222 and my color is: WHITE

Olive tree. My height is: 221 and my color is: GREEN

Bear. I am sleeping. My weight is: 191 and my color is: BROWN

Olive tree. My height is: 229 and my color is: GREEN

Caribou: I am migrating south. My weight is: 240 and my color is: WHITE

Olive tree. My height is: 232 and my color is: GREEN

---All together after changing season---

Bear. My weight is: 120 and my color is: BROWN

Fig tree. My height is: 314 and my color is: GREEN

Bear. My weight is: 124 and my color is: BROWN

Fig tree. My height is: 314 and my color is: GREEN

Caribou: My weight is: 208 and my color is: BROWN

Fig tree. My height is: 316 and my color is: GREEN

Caribou: My weight is: 217 and my color is: BROWN

Olive tree. My height is: 213 and my color is: GREEN

Bear. My weight is: 131 and my color is: BROWN

Fig tree. My height is: 334 and my color is: GREEN

Caribou: My weight is: 222 and my color is: BROWN

Olive tree. My height is: 231 and my color is: GREEN

Bear. My weight is: 143 and my color is: BROWN

Olive tree. My height is: 239 and my color is: GREEN

Caribou: My weight is: 240 and my color is: BROWN

Olive tree. My height is: 242 and my color is: GREEN

---Sorting animals after season change---

Bear. My weight is: 120 and my color is: BROWN

Bear. My weight is: 124 and my color is: BROWN

Bear. My weight is: 131 and my color is: BROWN

Bear. My weight is: 143 and my color is: BROWN

Caribou: My weight is: 208 and my color is: BROWN

Caribou: My weight is: 217 and my color is: BROWN

Caribou: My weight is: 222 and my color is: BROWN

Caribou: My weight is: 240 and my color is: BROWN

---Sorting trees after season change---

Olive tree. My height is: 213 and my color is: GREEN

Olive tree. My height is: 231 and my color is: GREEN

Olive tree. My height is: 239 and my color is: GREEN

Olive tree. My height is: 242 and my color is: GREEN

Fig tree. My height is: 314 and my color is: GREEN

Fig tree. My height is: 314 and my color is: GREEN

Fig tree. My height is: 316 and my color is: GREEN

Fig tree. My height is: 334 and my color is: GREEN