Lab Exercise 3: Inheritance and File

ALL

- This lab exercise is divided into four stages – Stage 1, Stage 2, and Stage 3.
- You need to complete Stage 1 without errors before you can proceed to Stage 2, and complete Stage 2 without errors before you can proceed to Stage 3.

Question:

Consider the following UML inheritance class diagram shown in Figure1 and the class interface tables:

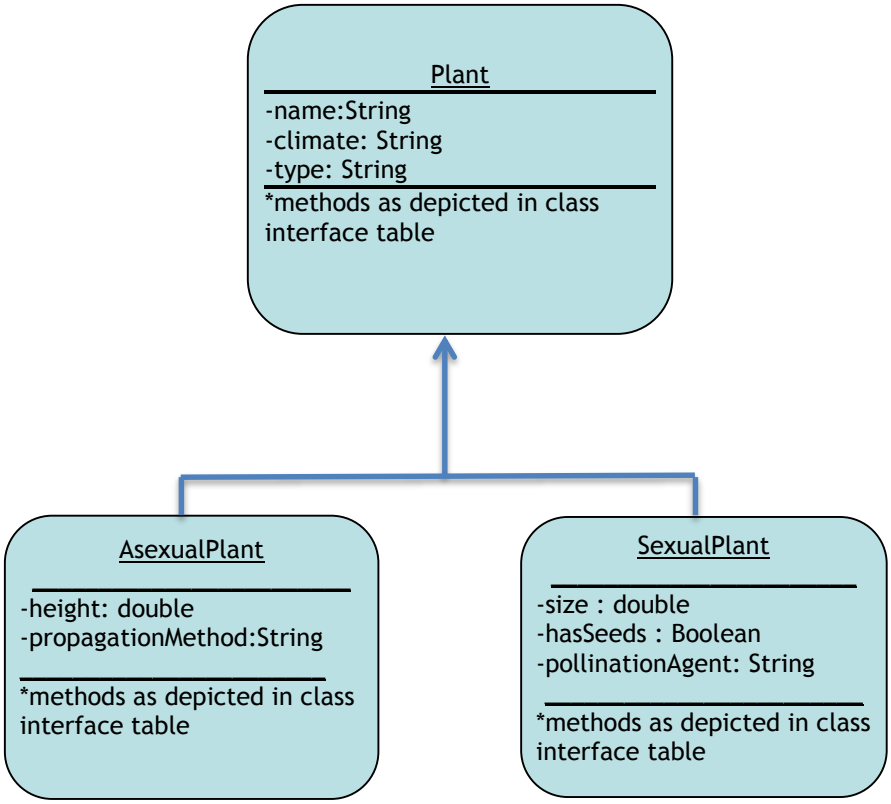

Figure 1

Task:

Plants can be categorized into two namely Asexual plants and Sexual plants. Asexual plants rarely have seeds and are usually propagated through methods such as stem cutting (example roses), dividing clump of plants into individual (example chrysanthemum), leaves (example setawar) and by spreading spores (example ferns). On the other hand, sexual plants usually have seeds and require pollination agent such as insects, birds and bats to propagate. In this exercise, tester app will read data from an input file named `plants.dat`.

Creative Landscape is a nursery which sells indoor and outdoor plants to its customers. The company suggests to its customer based on criteria requested namely indoor or outdoor, climate, how to propagate and the growth rate of the chosen plants. You need to develop programs to determine how many indoor and outdoor, asexual and sexual plants the nursery has and determine the growth of each plant. In general, Sexual plants grow slower than Asexual plants.

Asexual plants growth rates are as follows:

```
GROWTH_RATE_INDOOR = 0.5
GROWTH_RATE_OUTDOOR = 1.5
```

For indoor Asexual plant, you can calculate the height of an Asexual plant according to the following formula:

Propagation method	Formula
Stem or Dividing	`height += days * 2 * GROWTH_RATE_INDOOR`
Leaves or Spores	`height += days * GROWTH_RATE_INDOOR`

For outdoor Asexual plant, you can calculate the height of an Asexual plant according to the following formula:

Propagation method	Formula
Stem or Dividing	`height += days * 2 * GROWTH_RATE_OUTDOOR`
Leaves or Spores	`height += days * GROWTH_RATE_OUTDOOR`

Sexual plants growth rates are as follows:

```
GROWTH_RATE_INDOOR = 0.25
GROWTH_RATE_OUTDOOR = 1.25
```

For indoor sexual plant, size can be calculated as:

```
size += days * GROWTH_RATE_INDOOR
```

For outdoor sexual plant, you can calculate the size of a sexual plant according to whether it grown using seeds and which pollination agent:

Has seeds	Pollination agent	Formula
yes	birds	`size += days * GROWTH_RATE_OUTDOOR`
yes	bats	`size += days * 2 * GROWTH_RATE_OUTDOOR`
no	insect	`size += days * 2 * GROWTH_RATE_OUTDOOR`
no	birds	`size += days * GROWTH_RATE_OUTDOOR`

Stage 1:

1. Create a Java project named `Lab4-Stage1`.
2. Copy file `Tester1.java` into your project.
3. Create a text file named `plants` and copy the content from the file provided. (Right-click on project->new File) or copy the file provided into project directory.

Define a class named `Plant` (in file Plant.java) according to the following class interface:

Plant	Description
-name:String	- variable to store the plant name
-climate: String	- variable to store suitable climate for the plant
-type: String	- variable to store the plant type indoor or outdoor
+ Plant(n:String, cl:String, t: String)	- Constructor to set the name, climate and type to the values specified by the user (Postcondition: name = n, climate = cl, type = t)
+ setName (n : String) : void	- Method to set the name to the value specified by the user (Postcondition : name = n)
+ setClimate(cl :String) : void	- Method to set the climate the value specified by the user (Postcondition: climate = cl)
+ setType(t:String): void	Method to set the type to the value specified by the user (Postcondition: type = t)
+ getName(): String	- Method to get the name of the plant
+ getClimate() : String	- Method to get the climate suitable for the plant
+ getType() : String	- Method to get the type of the plant
+printDetails(): void	- Method to print the values of Plant class attributes

Define a class named `AsexualPlant` (in file AsexualPlant.java) according to the following class interface. For stage 1 write method definition until method `printDetails()`:

AsexualPlant	Description
- height:double	- variable to store the height of the asexual plant
- propagationMethod:String	- variable to store the propagation method of the plant
+ AsexualPlant(n:String, cl:String, t: String, initHeight:double, pm:String)	Constructor to set the attributes' values specified by the user by calling constructor of its super class. (Postcondition: name = n, climate = cl, type = t, height = initHeight, propagationMethod = pm)
+ setHeight(h: double) : void	- Method to set the height of an asexual plant (Postcondition : height = h)
+ setPropagationMethod (pm:String) : void	- Method to set the propagation method of an asexual plant (Postcondition :propagationMethod = pm)
+ getHeight(): double	- Method to get the height of an asexual plant
+ getPropagationMethod():String	- Method to get the propagation method of an asexual plant
+printDetails(): void	- Override method to print all attributes' values by calling its superclass's printDetails() method

+determineGrowth(days:int): void	- A method to determine the growth (height) of an asexual plant after a certain number of days
+countIndoorPlant(ArrayList<Plant> plantList):int	- A method to count how many indoor asexual plants in the plantList
+ countOutdoorPlant(ArrayList<Plant> plantList)	- A method to count how many outdoor asexual plants in the plantList

Define a class named `SexualPlant` (in file SexualPlant.java) according to the following class interface. For stage 1 write method definition until method `printDetails()`:

SexualPlant	Description
-size: double	- variable to store the size of a sexual plant
-hasSeeds: Boolean	- variable to store the status if a sexual plant has seeds
-pollinationAgent: String	- variable to store the pollination agent of a sexual plant
+ SexualPlant(n:String, cl:String, t:String, hs: Boolean, pa:String)	Constructor to set the attributes' values specified by the user by calling the constructor of its super class. Also set the initial size = 1. (Postcondition: name = n, climate = cl, type = t, size = 1, hasSeeds = hs, pollinationAgent = pa)
+ setSize(s: double): void	- Method to set the size of sexual plant to value specified by the user (Postcondition size = s)
+ setHasSeeds(hs: Boolean): void	- Method to set the status hasSeeds to true or false as specified by the user (Postcondition hasSeeds = hs)
+setPollinationAgent(pa: String) void	- Method to set the pollination agent of a sexual plant as specified by the user (Postcondition pollinationAgent = pa)
+getSize(): double	-Method to get the size of a sexual plant
+getHasSeeds(): Boolean	-Method to get the status has seeds of a sexual plant
+getPollinationAgent(): String	-Method to get the pollination agent of a sexual plant
+printDetails(): void	- Override method to print all attributes' values by calling its superclass's printDetails() method
+determineGrowth(days:int): void	-A method to determine the growth (height) of an sexual plant after a certain number of days
+countIndoorPlant(ArrayList<Plant> plantList):int	- A method to count how many indoor sexual plants in the plantList
+ countOutdoorPlant(ArrayList<Plant> plantList)	A method to count how many outdoor sexual plants in the plantList

Check your answer by invoking the `main` method in class `Tester1` (just run project as Java Application) and your output should be as follows:

```
Plant Name: Hibisbus
Suitable Climate: Hot
Plant Type: Outdoor
Height: 20.0 cm
Propagation Method: Stem

Plant Name: Setawar
Suitable Climate: Hot
Plant Type: Outdoor
Height: 0.5 cm
Propagation Method: Leaves

Plant Name: Fern
Suitable Climate: Tropical
Plant Type: Indoor
Height: 10.0 cm
Propagation Method: Spores

Plant Name: Crysanthemum
Suitable Climate: tropical
Plant Type: Outdoor
Height: 10.0 cm
Propagation Method: Dividing

Plant Name: Rose
Suitable Climate: Mediterranean/tropical
Plant Type: Outdoor
Height: 20.0 cm
Propagation Method: Stem

Plant Name: Broccoli
Suitable Climate: Mediterranean/tropical
Plant Type: Outdoor
Size: 1.0 cm
Has seeds: false
Pollination agent: Insects

Plant Name: Guava
Suitable Climate: Tropical
Plant Type: Outdoor
Size: 1.0 cm
Has seeds: true
Pollination agent: Bats

Plant Name: Cardamon
Suitable Climate: Tropical
Plant Type: Outdoor
Size: 1.0 cm
Has seeds: true
Pollination agent: Insects

Plant Name: Orchids
Suitable Climate: Tropical
Plant Type: Indoor
Size: 1.0 cm
Has seeds: false
Pollination agent: Birds
```

*Proceed to Stage 2 only after you have completed Stage 1 without errors.

Stage 2:

1. Create a Java project named `Lab4-Stage2`.
2. Copy file `Tester2.java` into your project.
3. Copy files `Plant.java`, `AsexualPlant.java`, `SexualPlant.java`, in Stage 1 into your Stage 2 Java project.
4. Copy input file `plants.dat` provided into current project workspace. Or right-click on project->new File and copy the content.

Add into the `AsexualPlant` and `SexualPlant`class:

   i. A method named `determineGrowth(days)` as explained in the respective class interface tables. Use the formula provided for each case.

5. Check your answer by running `Tester2` which will should show plants' growth after 10 days. Your output should be as follows:

```
Plant Name: Hibisbus
Suitable Climate: Hot
Plant Type: Outdoor
Height: 50.0 cm
Propagation Method: Stem

Plant Name: Setawar
Suitable Climate: Hot
Plant Type: Outdoor
Height: 15.5 cm
Propagation Method: Leaves

Plant Name: Fern
Suitable Climate: Tropical
Plant Type: Indoor
Height: 15.0 cm
Propagation Method: Spores

Plant Name: Crysanthemum
Suitable Climate: tropical
Plant Type: Outdoor
Height: 40.0 cm
Propagation Method: Dividing

Plant Name: Rose
Suitable Climate: Mediterranean/tropical
Plant Type: Outdoor
Height: 50.0 cm
Propagation Method: Stem

Plant Name: Broccoli
Suitable Climate: Mediterranean/tropical
Plant Type: Outdoor
Size: 1.0 cm
Has seeds: false
```

```
Pollination agent: Insects

Plant Name: Guava
Suitable Climate: Tropical
Plant Type: Outdoor
Size: 1.0 cm
Has seeds: true
Pollination agent: Bats

Plant Name: Cardamon
Suitable Climate: Tropical
Plant Type: Outdoor
Size: 1.0 cm
Has seeds: true
Pollination agent: Insects

Plant Name: Orchids
Suitable Climate: Tropical
Plant Type: Indoor
Size: 3.5 cm
Has seeds: false
Pollination agent: Birds
```

*Proceed to Stage 3 only after you have completed Stage 2 without errors.

Stage 3:

1. Create a Java project named `Lab4-Stage3`.
2. Copy file `Tester3.java` into your project.
3. Copy files `Plant.java`, `AsexualPlant.java`, `SexualPlant.java`, in Stage 2 into your Stage 3 Java project.
4. Copy input file `plants.dat` provided into current project workspace. Or right-click on project->new File and copy the content.

Add into the `AsexualPlant` and `SexualPlant`class:

i. A method named `countIndoorPlant` which receives an `ArrayList<Plant> plantList` to calculate how many indoor AsexualPlant and SexualPlant in the plant list and prints the values.

ii. A method named `countOutdoorPlant` which receives an `ArrayList<Plant> plantList` to calculate how many outdoor AsexualPlant and SexualPlant in the plant list and prints the values.

Check your answer by running `Tester3` and your output should be as follows:

```
Number of indoor AsexualPlant: 1
Number of outdoor AsexualPlant: 4
Number of indoor SexualPlant: 1
Number of outdoor SexualPlant: 3
```