# Exercises: Abstract Classes and Interfaces

You can check your solutions in **Judge system**: <https://judge.softuni.bg/Contests/3165/Abstract-Classes-and-Interfaces>

## Shapes

**NOTE**: You need a public StartUp class with the namespace Shapes.

Build **hierarchy** of **interfaces** and **classes**:



You should be able to use the class like this:

Graphical user interface, text, application

Description automatically generated

### Examples

|  |  |
| --- | --- |
| **Input** | **Output** |
| 3  4  5 | \*\*\*\*\*\*\*  \*\* \*\*  \*\* \*\*  \* \*  \*\* \*\*  \*\* \*\*  \*\*\*\*\*\*\*  \*\*\*\*  \* \*  \* \*  \* \*  \*\*\*\* |

### Solution

The algorithm for drawing a circle is:

Graphical user interface, text

Description automatically generated

The algorithm for drawing a rectangle is:

Graphical user interface, text, application

Description automatically generated

## Cars

**NOTE**: You need a public StartUp class with the namespace Cars.

Build a **hierarchy** of **interfaces** and **classes**:

Diagram

Description automatically generated

Your hierarchy must be used with this code:

Graphical user interface, text

Description automatically generated

### Examples

|  |
| --- |
| **Output** |
| Grey Renault Duster  Engine start  Breaaak!  Red Tesla Model 3 with 2 Batteries Engine start  Breaaak! |

## Define an Interface IPerson

**NOTE**: You need a public StartUp class with the namespace PersonInfo.

Define an **interface IPerson** with properties for **Name** and **Age**. Define a class **Citizen** that implements **IPerson** and has a constructor which takes a **string** **name** and an **int** **age**.

Try to create a new **Person** like this:

Text

Description automatically generated

### Examples

|  |  |
| --- | --- |
| **Input** | **Output** |
| Pesho  25 | Pesho  25 |

## Multiple Implementations

**NOTE**: You need a public StartUp class with the namespace PersonInfo.

Using the code from the previous task, define an **interface** **IIdentifiable** with a **string** property **Id** and an **interface** **IBirthable** with a **string** property **Birthdate** and implement them in the **Citizen** class. Rewrite the **Citizen** constructor to accept the new parameters.

Test your class like this:

Graphical user interface, text, application

Description automatically generated

### Examples

|  |  |
| --- | --- |
| **Input** | **Output** |
| Pesho  25  9105152287  15/05/1991 | 9105152287  15/05/1991 |

## Telephony

You have a business - **manufacturing phones**. However, you have no software developers, so you call some friends of yours and ask them to help you create a phone software. They have already agreed and you started working on the project. The project consists of two main **models – Smartphone** and **StationaryPhone**. Each of your smartphones should have functionalities of **calling other phones** and **browsing in the world wide web. The StationaryPhone can only call other phones.**

These friends of yours though are very busy, so you decide to write the code on your own. Here is the mandatory assignment:

You should have a **model** - **Smartphone** and two separate functionalities, which your **Smartphone** has - to **call other phones** and to **browse in the world wide web**. You should also have a **model** – **StationaryPhone** and one fuctionality which your **StationaryPhone** has – **to call other phones**. You should end up with **two classes** and **two interfaces**.

### Input

The input comes from the console. It will hold two lines:

* **First line**: **phone numbers** to call (**string**), separated by spaces.
* **Second line: sites** to visit (**string**), separated by spaces.

### Output

* First **call all numbers** in the order of input then **browse all sites** in order of input
* The functionality of calling phones is printing on the console the number which is being called
* If the number is 10 digits long, you are making a call from your smartphone and you print:

**Calling... {number}**

* If the number is 7 digits long, you are making a call from your stationary phone and you print:

**Dialing... {number}**

* The functionality of the browser should print on the console the site in format:

**Browsing:** **{site}!**

* If there is a number in the input of the URLs, print: **"****Invalid URL!"** and continue printing the rest of the URLs.
* If there is a character different from a digit in a number, print: **"****Invalid number!"** and continue to the next number.

### Constraints

* Each site's URL should consist only of letters and symbols (**No digits are allowed** in the URL address)
* The phone numbers will always be 7 or 10 digits long

### Examples

|  |  |
| --- | --- |
| **Input** | **Output** |
| 0882134215 0882134333 0899213421 0558123 3333123  http://softuni.bg http://youtube.com http://www.g00gle.com | Calling... 0882134215  Calling... 0882134333  Calling... 0899213421  Dialing... 0558123  Dialing... 3333123  Browsing: http://softuni.bg!  Browsing: http://youtube.com!  Invalid URL! |

## Border Control

It’s the future, you’re the ruler of a totalitarian dystopian society inhabited by **citizens** and **robots**, since you’re afraid of rebellions you decide to implement strict control of who enters your city. Your soldiers check the **Id**s of everyone who enters and leaves.

You will receive an unknown amount of lines from the console until the command "**End**" is received, on each line there will be a piece of information for either a citizen or a robot who tries to enter your city in the format: "**{name} {age} {id}**" for **citizens** and "**{model} {id}"** for **robots**. After the end command on the next line you will receive a single number representing **the last digits of fake ids**, all citizens or robots whose **Id** ends with the specified digits must be detained.

The output of your program should consist of all detained **Id**s each on a separate line in the **order** of **input**.

### Input

The input comes from the console. Every commands’ parameters before the command "**End**" will be separated by a **single space**.

### Examples

|  |  |
| --- | --- |
| **Input** | **Output** |
| Pesho 22 9010101122  MK-13 558833251  MK-12 33283122  End  122 | 9010101122  33283122 |
| Toncho 31 7801211340  Penka 29 8007181534  IV-228 999999  Stamat 54 3401018380  KKK-666 80808080  End  340 | 7801211340 |

## Birthday Celebrations

It is a well known fact that people celebrate birthdays, it is also known that some people also celebrate their pets’ birthdays. Extend the program from your last task to add **birthdates** to citizens and include a class **Pet**, pets have a **name** and a **birthdate**. Encompass repeated functionality into interfaces and implement them in your classes.

You will receive from the console an unknown amount of lines. Until the command "**End**" is received, each line will contain information in one of the following formats "**Citizen <name> <age> <id> <birthdate>**" for **Citizen**, "**Robot** **<model> <id>**" for **Robot** or "**Pet <name> <birthdate**" for **Pet**. After the "**End**" command on the next line you will receive a single number representing **a specific year**, your task is to print all birthdates (of both **Citizen** and **Pet**) in that yearin the format **day/month/year** in the **order** of **input**.

### Examples

|  |  |
| --- | --- |
| **Input** | **Output** |
| Citizen Pesho 22 9010101122 10/10/1990  Pet Sharo 13/11/2005  Robot MK-13 558833251  End  1990 | 10/10/1990 |
| Citizen Stamat 16 0041018380 01/01/2000  Robot MK-10 12345678  Robot PP-09 00000001  Pet Topcho 24/12/2000  Pet Kosmat 12/06/2002  End  2000 | 01/01/2000  24/12/2000 |
| Robot VV-XYZ 11213141  Citizen Penka 35 7903210713 21/03/1979  Citizen Kane 40 7409073566 07/09/1974  End  1975 | <empty output> |

## Food Shortage

Your totalitarian dystopian society suffers a shortage of food, so many rebels appear. Extend the code from your previous task with new functionality to solve this task.

Define a class **Rebel** which has a **name**, **age** and **group** (**string**)**,** names are **unique -** there will never be 2 **Rebel**s/**Citizen**s or a **Rebel** and **Citizen** with the same name**.** Define an interface **IBuyer** which defines a method **BuyFood()** and an integer property **Food**. Implement the **IBuyer** interface in the **Citizen** and **Rebel** class, both **Rebel**s and **Citizen**s **start with 0 food**, when a **Rebel** buys food his **Food** increases by **5**, when a **Citizen** buys food his **Food** increases by **10**.

On the first line of the input you will receive an integer **N** - the number of people, on each of the next **N** lines you will receive information in one of the following formats "**<name> <age> <id> <birthdate>**" for a **Citizen** or "**<name> <age><group>**" for a **Rebel**. After the **N** lines until the command "**End**" is received, you will receive names of people who bought food, each on a new line. Note that not all names may be valid, in case of an incorrect name - nothing should happen.

### Output

The **output** consists of only **one line** on which you should print the **total** amount of food purchased.

### Examples

|  |  |
| --- | --- |
| **Input** | **Output** |
| 2  Pesho 25 8904041303 04/04/1989  Stancho 27 WildMonkeys  Pesho  Gosho  Pesho  End | 20 |
| 4  Stamat 23 TheSwarm  Toncho 44 7308185527 18/08/1973  Joro 31 Terrorists  Penka 27 881222212 22/12/1988  Jiraf  Jo ro  Jiraf  Joro  Stamat  Penka  End | 20 |

## Military Elite

Create the following class hierarchy:

* **Soldier** - general class for **Soldiers**, holding **id**, **first name** and **last name.**
  + **Private** - lowest base **Soldier** type, holding the **salary**(**decimal**).
    - **LieutenantGeneral** - holds a set of **Privates** under his command.
    - **SpecialisedSoldier -** general class for all specialised **Soldiers** - holds the **corps** of the **Soldier**. The corps can only be one of the following: **Airforces** or **Marines**.
      * **Engineer** - holds a set of **Repairs**. A **Repair** holds a **part name** and **hours worked**(**int**).
      * **Commando** - holds a set of **Missions**. A mission holds **code name** and a **state** (**inProgress** or **Finished**). A **Mission** can be finished through the method **CompleteMission()**.
  + **Spy** - holds the **code number** of the **Spy** (**int**).

Extract **interfaces** for each class. (e.g. **ISoldier**, **IPrivate**, **ILieutenantGeneral**, etc.) The interfaces should hold their **public** properties and methods (e.g. **ISoldier** should hold **id**, **first name** and **last name**). Each class should implement its respective interface. **Validate** the **input** where necessary (corps, mission state) - input should match **exactly** one of the **required values**, otherwise it should be treated as **invalid**. In case of **invalid** **corps** the entire line should be skipped, in case of an **invalid** **mission** **state** only the mission should be **skipped**.

You will receive from the console an unknown amount of lines containing information about soldiers until the command "**End**" is received. The information will be in one of the following formats:

* **Private**: "**Private <id> <firstName> <lastName> <salary>**"
* **LeutenantGeneral**: "**LieutenantGeneral <id> <firstName> <lastName> <salary> <private1Id> <private2Id> … <privateNId>**" where **privateXId** will **always** be an **Id** of a **Private** already received through the input.
* **Engineer**: "**Engineer <id> <firstName> <lastName> <salary> <corps> <repair1Part> <repair1Hours> … <repairNPart> <repairNHours>**" where **repairXPart** is the name of a repaired part and **repairXHours** the hours it took to repair it (the two parameters will always come paired).
* **Commando**: "**Commando <id> <firstName> <lastName> <salary> <corps> <mission1CodeName> <mission1state> … <missionNCodeName> <missionNstate>**" a missions code name, description and state will always come together.
* **Spy**: "**Spy <id> <firstName> <lastName> <codeNumber>**"

Define proper constructors. Avoid code duplication through abstraction. Override **ToString()** in all classes to print detailed information about the object.

* **Privates:**  
  Name: <firstName> <lastName> Id: <id> Salary: <salary>
* **Spy:**  
  Name: <firstName> <lastName> Id: <id>  
  Code Number: <codeNumber>
* **LieutenantGeneral:**  
  Name: <firstName> <lastName> Id: <id> Salary: <salary>  
  Privates:  
   <private1 ToString()>  
   <private2 ToString()>  
   …  
   <privateN ToString()>
* **Engineer:**  
  Name: <firstName> <lastName> Id: <id> Salary: <salary>  
  Corps: <corps>  
  Repairs:  
   <repair1 ToString()>  
   <repair2 ToString()>  
   …  
   <repairN ToString()>
* **Commando:**  
  Name: <firstName> <lastName> Id: <id> Salary: <salary>  
  Corps: <corps>  
  Missions:  
   <mission1 ToString()>  
   <mission2 ToString()>  
   …  
   <missionN ToString()>
* **Repair:**Part Name: <partName> Hours Worked: <hoursWorked>
* **Mission:**  
  Code Name: <codeName> State: <state>

**NOTE: Salary** should be printed rounded to **two decimal places** after the separator.

### Examples

|  |  |
| --- | --- |
| **Input** | **Output** |
| Private 1 Pesho Peshev 22.22 Commando 13 Stamat Stamov 13.1 Airforces  Private 222 Toncho Tonchev 80.08  LieutenantGeneral 3 Joro Jorev 100 222 1  End | Name: Pesho Peshev Id: 1 Salary: 22.22  Name: Stamat Stamov Id: 13 Salary: 13.10  Corps: Airforces  Missions:  Name: Toncho Tonchev Id: 222 Salary: 80.08  Name: Joro Jorev Id: 3 Salary: 100.00  Privates:  Name: Toncho Tonchev Id: 222 Salary: 80.08  Name: Pesho Peshev Id: 1 Salary: 22.22 |
| Engineer 7 Pencho Penchev 12.23 Marines Boat 2 Crane 17  Commando 19 Penka Ivanova 150.15 Airforces HairyFoot finished Freedom inProgress  End | Name: Pencho Penchev Id: 7 Salary: 12.23  Corps: Marines  Repairs:  Part Name: Boat Hours Worked: 2  Part Name: Crane Hours Worked: 17  Name: Penka Ivanova Id: 19 Salary: 150.15  Corps: Airforces Missions:  Code Name: Freedom State: inProgress |

## Collection Hierarchy

Create 3 different string collections - **AddCollection**, **AddRemoveCollection** and **MyList**.

The **AddCollection** should have:

* Only a single method **Add** which adds an item to the **end** of the collection.

The **AddRemoveCollection** should have:

* An **Add** method- which adds an item to the **start** of the collection.
* A **Remove** method, which removes the **last** item in the collection.

The **MyList** collection should have:

* An **Add** method, which adds an item to the **start** of the collection.
* A **Remove** method, which removes the **first** element in the collection.
* A **Used** property, which displays the number of elements currently in the collection.

Create **interfaces**, which define the **collections functionality**, think how to **model the relations** between interfaces to **reuse code**. Add an extra bit of functionality to the methods in the custom collections, **Add** methods should return the index in which the item was added, **Remove** methods should **return the item** that was **removed**.

Your task is to **create** a **single copy of your collections**, after which on the **first input line** you will **receive** a **random** **amount of strings** in a single line **separated by spaces** - the **elements** you must **add to each of your collections**. For each of your collections **write a single line** in the output that holds the results of all **Add operations** separated by spaces (check the examples to better understand the format). On the **second input line**, you will receive a **single** **number** - the **amount** of **Remove operations** you have to call on each collection. In the same manner, as with the **Add** operations for each collection (except the **AddCollection**), print a line with the results of each **Remove** operation separated by spaces.

### Input

The input comes from the console. It will hold two lines:

* The first line will contain a random amount of strings separated by spaces - the elements you have to **Add** to each of your collections.
* The second line will contain a single number - the amount of **Remove** operations.

### Output

The output will consist of 5 lines:

* The first line contains the results of all **Add** operations on the **AddCollection** separated by spaces.
* The second line contains the results of all **Add** operations on the **AddRemoveCollection** separated by spaces.
* The third line contains the result of all **Add** operations on the **MyList** collection separated by spaces.
* The fourth line contains the result of all **Remove** operations on the **AddRemoveCollection** separated by spaces.
* The fifth line contains the result of all **Remove** operations on the **MyList** collection separated by spaces.

### Constraints

* All collections should have a **length of 100.**
* There will never be **more than 100** add operations.
* The number of remove operations will never be more than the amount of add operations.

### Examples

|  |  |
| --- | --- |
| **Input** | **Output** |
| banichka boza tutmanik  3 | 0 1 2  0 0 0  0 0 0  banichka boza tutmanik  tutmanik boza banichka |
| one two three four five six seven  4 | 0 1 2 3 4 5 6  0 0 0 0 0 0 0  0 0 0 0 0 0 0  one two three four  seven six five four |

### Hint

Create an interface hierarchy representing the collections. You can use a List as the underlying collection and implement the methods using the List’s Add, Remove and Insert methods.

## Explicit Interfaces

Create 2 interfaces **IResident** and **IPerson**. **IResident** should have a **name**, **country** and a method **GetName()**. **IPerson** should have a **name**, an **age** and a method **GetName()**. Create a class **Citizen** which implements both **IResident** and **IPerson**, explicitly declare that **IResident**’s **GetName()** method should **return** "**Mr/Ms/Mrs** " before the name while **IPerson**’s **GetName()** method should **return just the name**. You will receive lines of **Citizen** information from the console until the command "**End**" is received. Each will be in the format "**<name> <country> <age>**" for each line create the corresponding **Citizen** and print his **IPerson’s GetName()** and his **IResitent’s GetName()**.

### Examples

|  |  |
| --- | --- |
| **Input** | **Output** |
| PeshoPeshev Bulgaria 20  End | PeshoPeshev  Mr/Ms/Mrs PeshoPeshev |
| JoroJorev Bulgaria 33  EricAnderson GreatBritain 28  PeterArmstrong USA 19  End | JoroJorev  Mr/Ms/Mrs JoroJorev  EricAnderson  Mr/Ms/Mrs EricAnderson  PeterArmstrong  Mr/Ms/Mrs PeterArmstrong |

### Hint

Check online about Explicit Interface Implementation.