SCIT

School of Computing and Information Technology
Faculty of Engineering & Information Sciences

CSIT121
Object Oriented Design and Programming
Assignment 1

INSTRUCTIONS TO CANDIDATES

1. The assignment consists of two parts. This is the part 1 of the assignment.
2. Part 2 is Moodle quiz. Should be done in class.
3. The name of the program must be **YourName_A1.**java (Only one Java file); remember to replace **YourName** by your actual "shorter" name.
4. Total mark of Assignment 1 is 10 marks; 4 marks for Part II.

Your program, should begin with

```
// Full Name:
// Part time or Full Time
// Tutorial Group
// Declaration: ...... tell me if it is your own work .... and whether you have
// passed your program to your friends.
```

Objectives:

Practice java programming with classes and objects, constructors, copy constructors, enum type, array, `ArrayList` (generic version), overloaded methods, passing by reference etc.

Task (6 marks)

In mathematics, a set is a collection of *distinct* elements and elements in a set are not in order. Here are some examples of sets:

(a) A set of integers, e.g. integerSet = {3, 1, 4, 2}
(b) A set of fruits, e.g. fruitSet = {apple, orange, papaya}
(c) A set of characters, e.g. charSet = {‘A’, ‘m’, ‘&’}

We always enclose elements of sets inside a pair of { }.

Here are some other properties on sets:

(1) A set can be empty, i.e. no element. We call it empty set. In mathematics, we have a special symbol to denote empty set. Convenient to our design later, we will use { } to denote an empty set.

(2) When checking an element is inside a set. We call it “belong to”.

(3) If a set contains in another set, we call it subset. For example, {1, 2, 3} is a subset of {2, 3, 4, 6, 1}. Therefore, empty set is a subset of every set.

(4) The *cardinal number* of a set is the number of elements in a set.

(5) The union of two sets A and B are all the elements belong to A and B, minus the duplications. For example, if A = {1, 2, 3} and B = {2, 3, 4, 5}, the union is {1, 2, 3, 4, 5}.

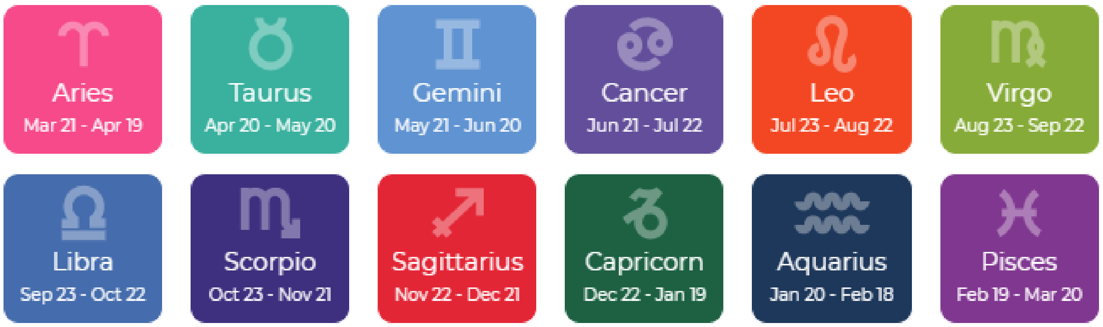
(6) The intersection of two sets A and B are the common elements of A and B. Using the example quoted in (5), the intersection is {2, 3}.

(7) The equality of two sets A and B are all the elements of A are in B and all the elements of B are in A. Or alternatively, A is the subset of B and vice versa.

(8) The difference of two sets A and B, for example A – B, is those elements in B should not be in A. For example, if A = {1, 2, 3} and B = {2, 3, 4, 5}, A – B = {1} and B – A = {4, 5}.

We have all the required properties for our task.

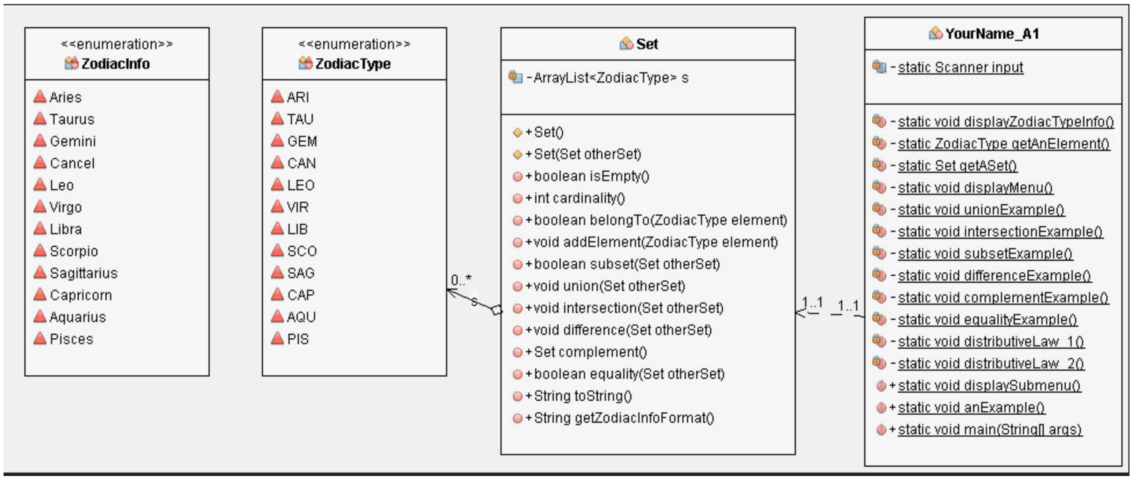
In this assignment, our ***universal set*** is the 12 enumeration constants of zodiac signs together with their range of dates. They are



Data validation is not necessary in this design, when "I" want to add in a sign, you can assume that this is a valid sign in the enumeration constants; i.e. we have restricted ourselves in a subset of the above 12 signs.

The best way to test your design is to develop an educational system to teach some basic set theory. All the sets used in your design should be *randomly generated* by the system i.e. the sizes (also known as cardinal number, from 0 to 12 elements) and the elements.

Let us explore the following UML diagram for the whole task:


<<enumeration>>
ZodiacInfo
Aries
Taurus
Gemini
Cancel
Leo
Virgo
Libra
Scorpio
Sagittarius
Capricorn
Aquarius
Pisces
<<enumeration>>
ZodiacType
ARI
TAU
GEM
CAN
LEO
VIR
LIB
SCO
SAG
CAP
AQU
PIS
0..*
s
Set
-ArrayList<ZodiacType> s
+Set()
+Set(Set otherSet)
+boolean isEmpty()
+int cardinality()
+boolean belongTo(ZodiacType element)
+void addElement(ZodiacType element)
+boolean subset(Set otherSet)
+void union(Set otherSet)
+void intersection(Set otherSet)
+void difference(Set otherSet)
+Set complement()
+boolean equality(Set otherSet)
+String toString()
+String getZodiacInfoFormat()
1..1
1..1
YourName_A1
-static Scanner input
-static void displayZodiacTypeInfo()
-static ZodiacType getAnElement()
-static Set getASet()
-static void displayMenu()
-static void unionExample()
-static void intersectionExample()
-static void subsetExample()
-static void differenceExample()
-static void complementExample()
-static void equalityExample()
-static void distributiveLaw_1()
-static void distributiveLaw_2()
+static void displaySubmenu()
+static void anExample()
+static void main(String[] args)

Let us look at each of the classes

(a) Enumeration class `ZodiacInfo`

This is a simple enum class consisting of the 12 zodiac constants

(b) Enumeration class `ZodiacType`

This is the universal set that a subset is constructed. Each enum constant has three descriptions: a constant from enum `ZodiacInfo`, starting date, ending date. Refer to page 4 for information required for this universal set.

(b) Class Set

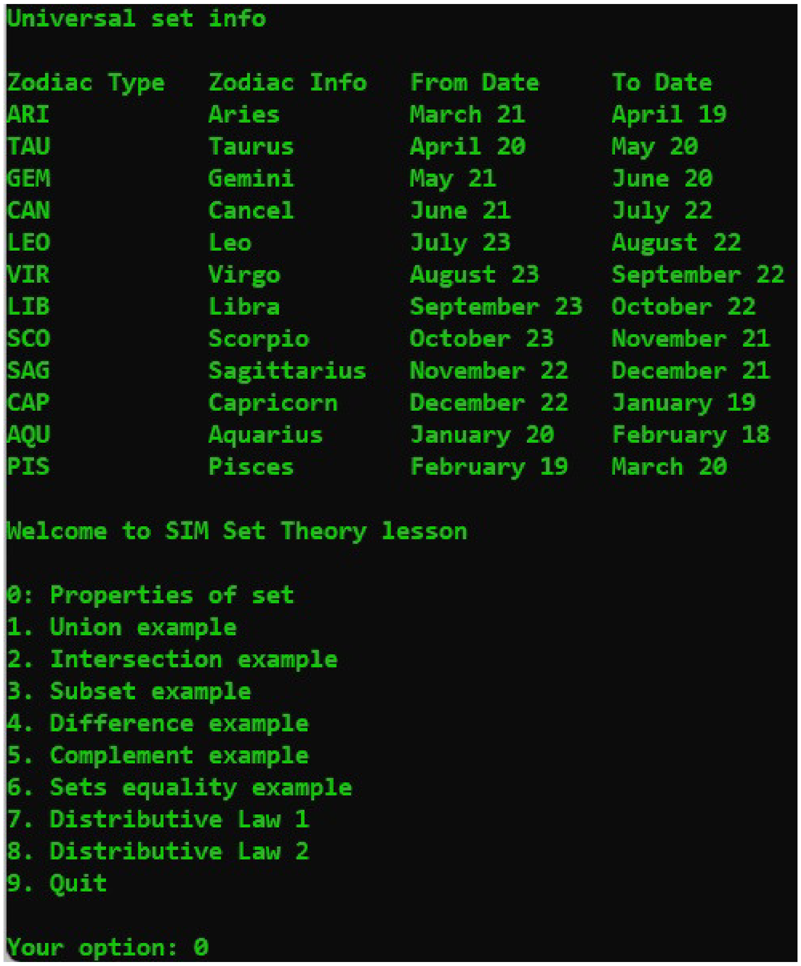
We use an array list to represent a set, which is an instance variable defined inside the class. The normal set operations: belong to, contains, union, intersection, complement, difference, subset, equality is some of the set's operations. The `toString` method returns a String of enum type enclosed between braces, for example `{LIB, ARI}` and the `getZodiacInfoFormat` method returns its equivalent in enum info, for example `{Libra, Aries}` according to the above example.

You should use the default constructor to construct an empty set. Do some deep copying in the copy constructor; you may need this constructor to perform some of the subtasks.

(c) Main class

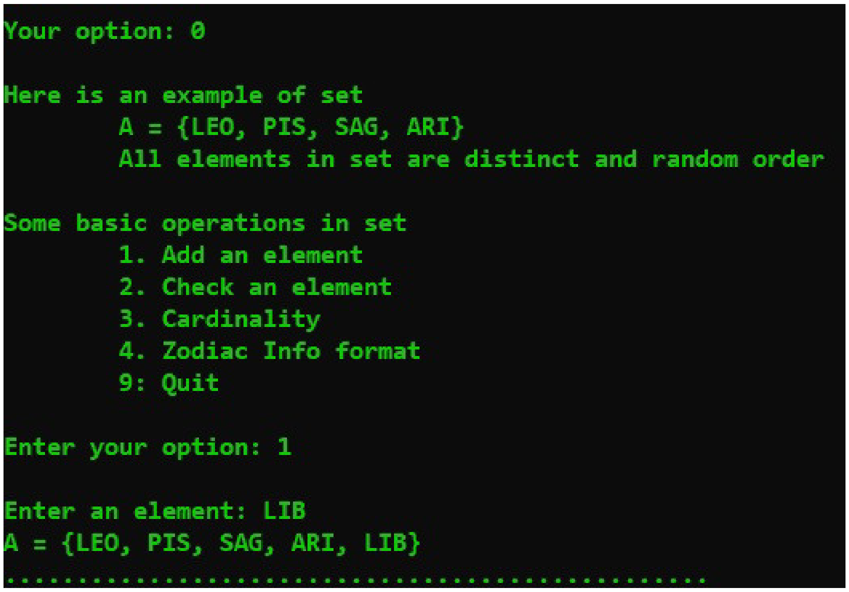
We now ready to present the whole system. You are required to design an educational system to teach basic set theory. We propose the following interactions for your system:

When you execute your program, the system will display the info for the universal set (a call to `displayZodiacInfo` method, display once only) and followed by a menu (the display of menu is repeated after an operation)



```
Universal set info

Zodiac Type    Zodiac Info    From Date      To Date
ARI            Aries          March 21       April 19
TAU            Taurus         April 20       May 20
GEM            Gemini         May 21         June 20
CAN            Cancel         June 21        July 22
LEO            Leo            July 23        August 22
VIR            Virgo          August 23      September 22
LIB            Libra          September 23   October 22
SCO            Scorpio        October 23     November 21
SAG            Sagittarius    November 22    December 21
CAP            Capricorn      December 22    January 19
AQU            Aquarius       January 20     February 18
PIS            Pisces         February 19    March 20

Welcome to SIM Set Theory lesson

0: Properties of set
1. Union example
2. Intersection example
3. Subset example
4. Difference example
5. Complement example
6. Sets equality example
7. Distributive Law 1
8. Distributive Law 2
9. Quit

Your option: 0
```

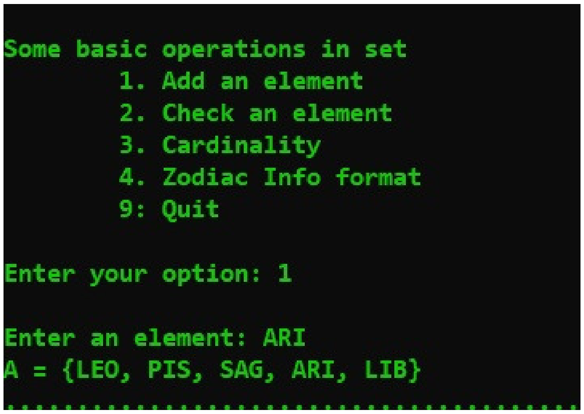
When you enter option 0, you will see the following interactions:



```
Your option: 0

Here is an example of set
        A = {LEO, PIS, SAG, ARI}
        All elements in set are distinct and random order

Some basic operations in set
        1. Add an element
        2. Check an element
        3. Cardinality
        4. Zodiac Info format
        9: Quit

Enter your option: 1

Enter an element: LIB
A = {LEO, PIS, SAG, ARI, LIB}
.................................................
```

A set is generated and is displayed. You can now try a few simple set operations, add an element, belong to operation, display the cardinal number and a display in enum format. **Note that the sub-menu is repeated after each operation.**

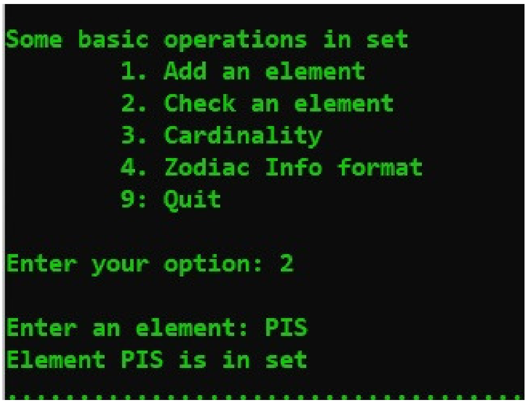
Let us enter the option 1 in the submenu,



```
Some basic operations in set
        1. Add an element
        2. Check an element
        3. Cardinality
        4. Zodiac Info format
        9: Quit

Enter your option: 1

Enter an element: ARI
A = {LEO, PIS, SAG, ARI, LIB}
........................................
```

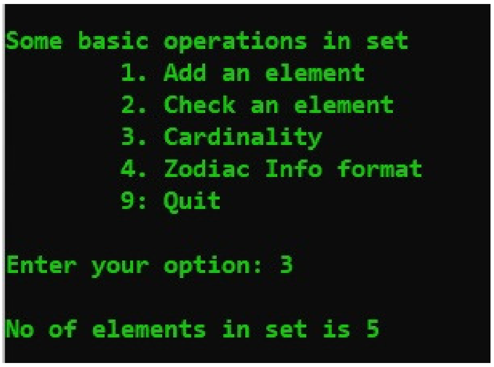
You can see in the above two interactions, adding an element which is already inside the set, the final set remains unchanged; otherwise, this distinct element is added to the set.

Let us explore option 2



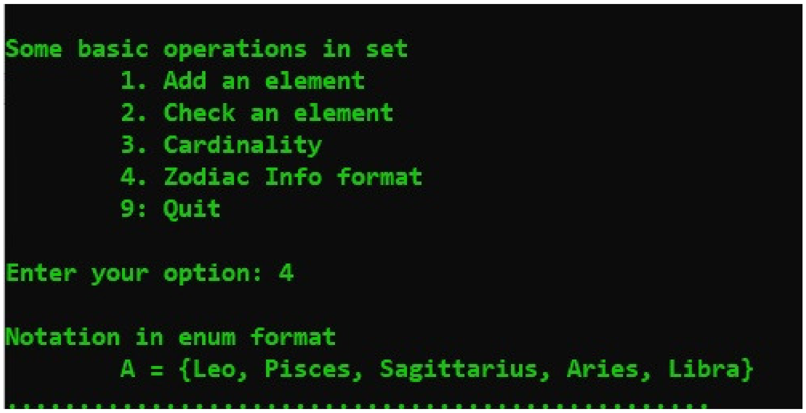
```
Some basic operations in set
        1. Add an element
        2. Check an element
        3. Cardinality
        4. Zodiac Info format
        9: Quit

Enter your option: 2

Enter an element: PIS
Element PIS is in set
.................................
```

For option 3, the system just simply displays the cardinal number:



```
Some basic operations in set
        1. Add an element
        2. Check an element
        3. Cardinality
        4. Zodiac Info format
        9: Quit

Enter your option: 3

No of elements in set is 5
```

For option = 4:



```
Some basic operations in set
        1. Add an element
        2. Check an element
        3. Cardinality
        4. Zodiac Info format
        9: Quit

Enter your option: 4

Notation in enum format
        A = {Leo, Pisces, Sagittarius, Aries, Libra}
.................................................
```

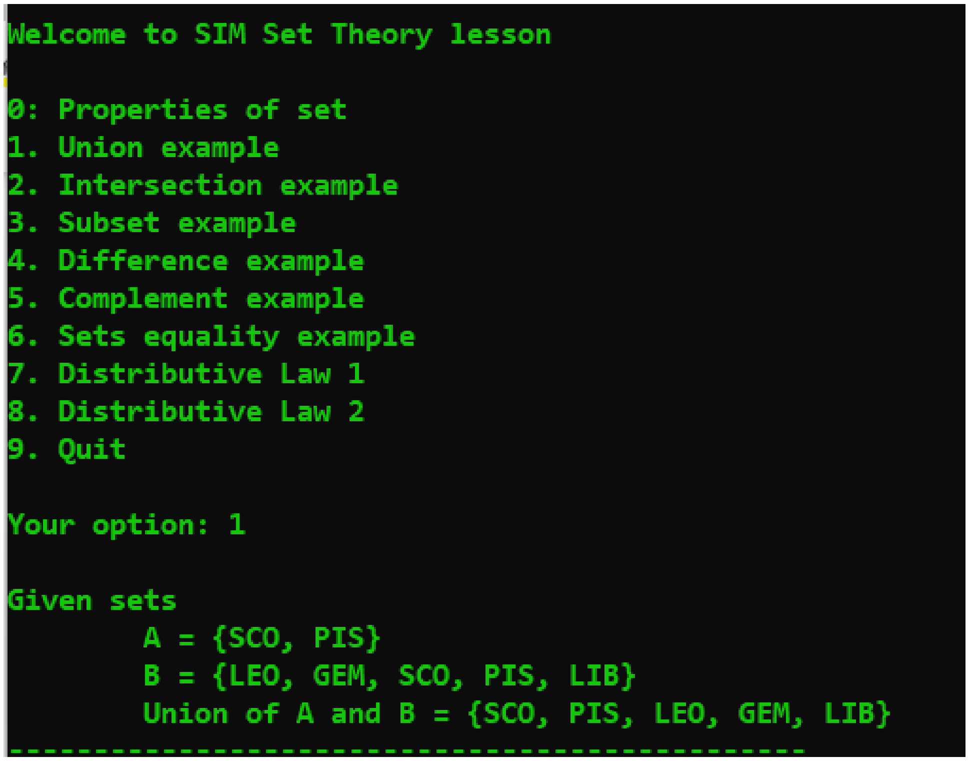
The system invokes another format (enum format) of display method.

You can continue to stay in the submenu or ***enter 9 to go back to the main menu***.

Let us choose 9 to go back to the main screen to test other operations.

Let us now explore each of the options in the main menu: **(Note that the main menu is also repeated)**

In the main menu, you choose option 1:



```
Welcome to SIM Set Theory lesson

0: Properties of set
1. Union example
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3. Subset example
4. Difference example
5. Complement example
6. Sets equality example
7. Distributive Law 1
8. Distributive Law 2
9. Quit

Your option: 1

Given sets
        A = {SCO, PIS}
        B = {LEO, GEM, SCO, PIS, LIB}
        Union of A and B = {SCO, PIS, LEO, GEM, LIB}
-----------------------------------------------
```
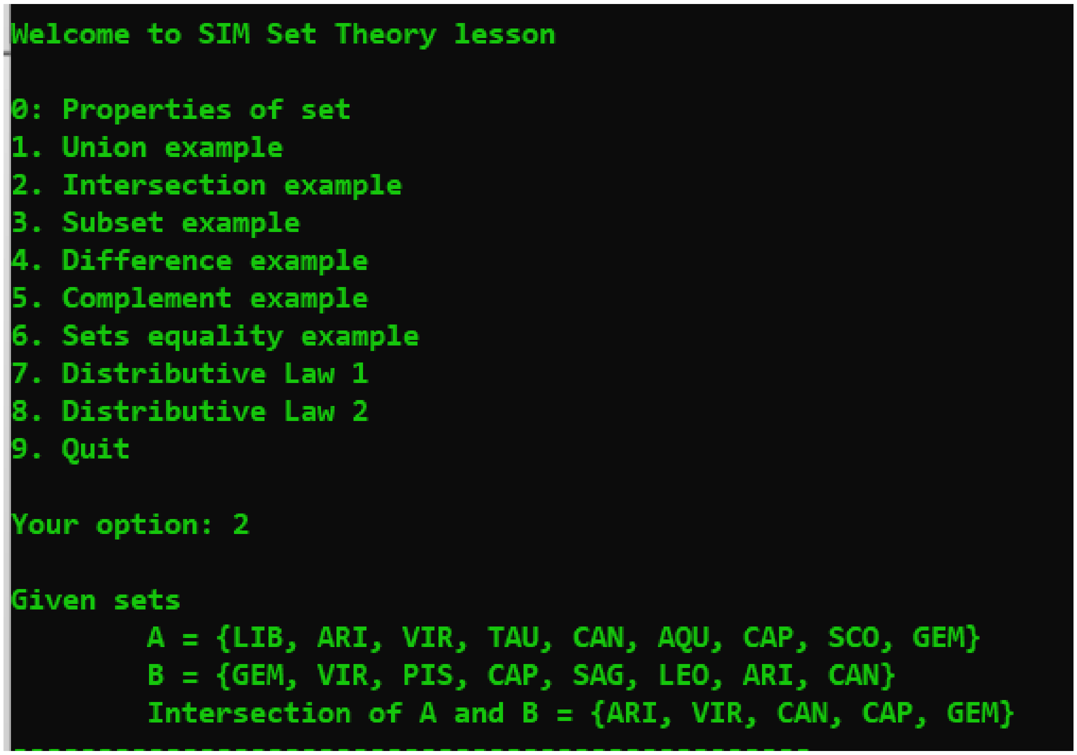

In option 1, the system randomly generates two sets and displays the union of these two sets.

The same is done for option 2, but evaluate the intersection of the two sets:



```
Welcome to SIM Set Theory lesson

0: Properties of set
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3. Subset example
4. Difference example
5. Complement example
6. Sets equality example
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8. Distributive Law 2
9. Quit

Your option: 2

Given sets
        A = {LIB, ARI, VIR, TAU, CAN, AQU, CAP, SCO, GEM}
        B = {GEM, VIR, PIS, CAP, SAG, LEO, ARI, CAN}
        Intersection of A and B = {ARI, VIR, CAN, CAP, GEM}
```
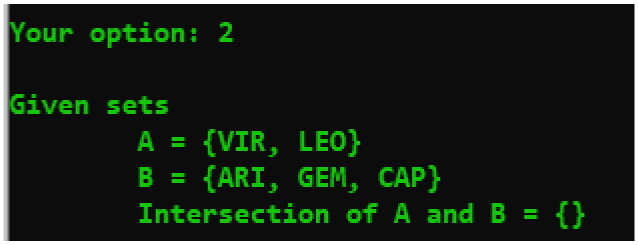
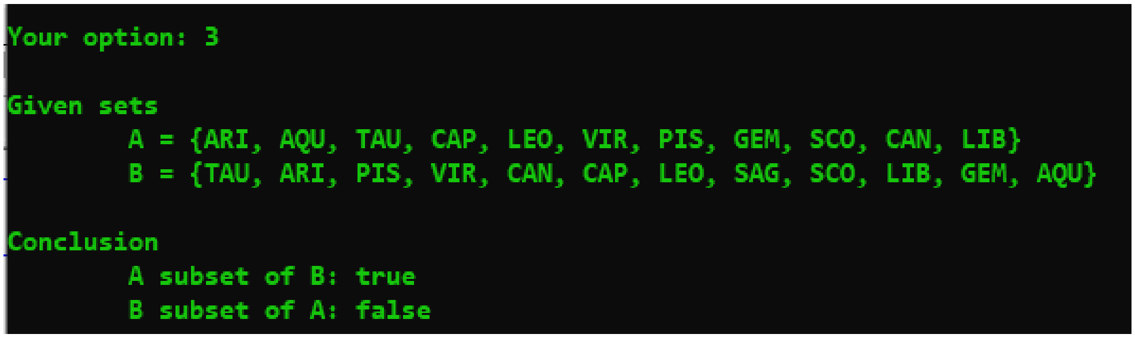

Important to note, main menu is always displayed.

In the following screen shot, you see the notation of an empty set.



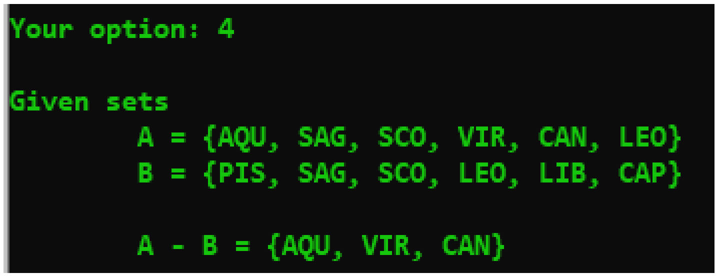
```
Your option: 2

Given sets
        A = {VIR, LEO}
        B = {ARI, GEM, CAP}
        Intersection of A and B = {}
```

For option 3, the subset operation:



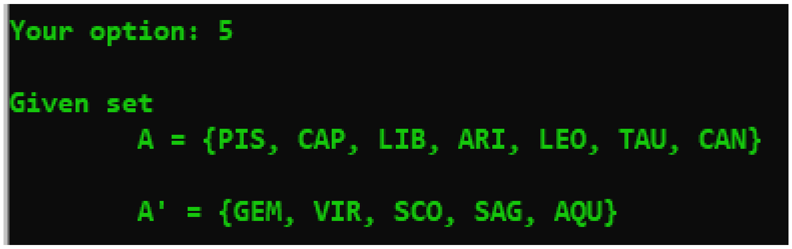
```
Your option: 3

Given sets
        A = {ARI, AQU, TAU, CAP, LEO, VIR, PIS, GEM, SCO, CAN, LIB}
        B = {TAU, ARI, PIS, VIR, CAN, CAP, LEO, SAG, SCO, LIB, GEM, AQU}

Conclusion
        A subset of B: true
        B subset of A: false
```

For option 4, the difference of two sets:



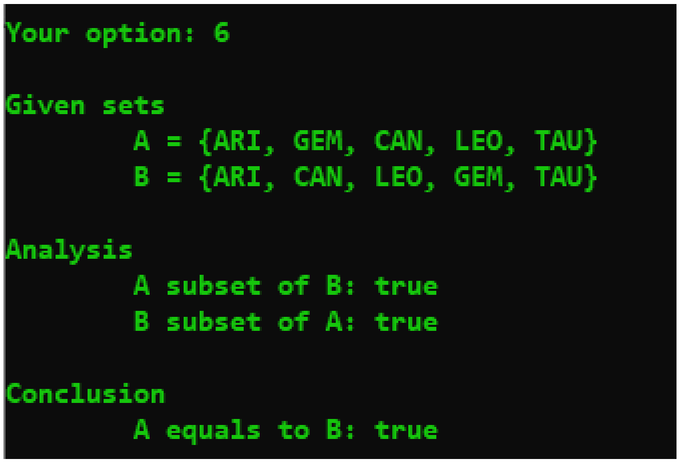
```
Your option: 4

Given sets
        A = {AQU, SAG, SCO, VIR, CAN, LEO}
        B = {PIS, SAG, SCO, LEO, LIB, CAP}

        A - B = {AQU, VIR, CAN}
```

Now, option 5, the complement of a set is done with the universal set. Our universal set is the set of zodiac signs. The following shows some of the interactions and displays:

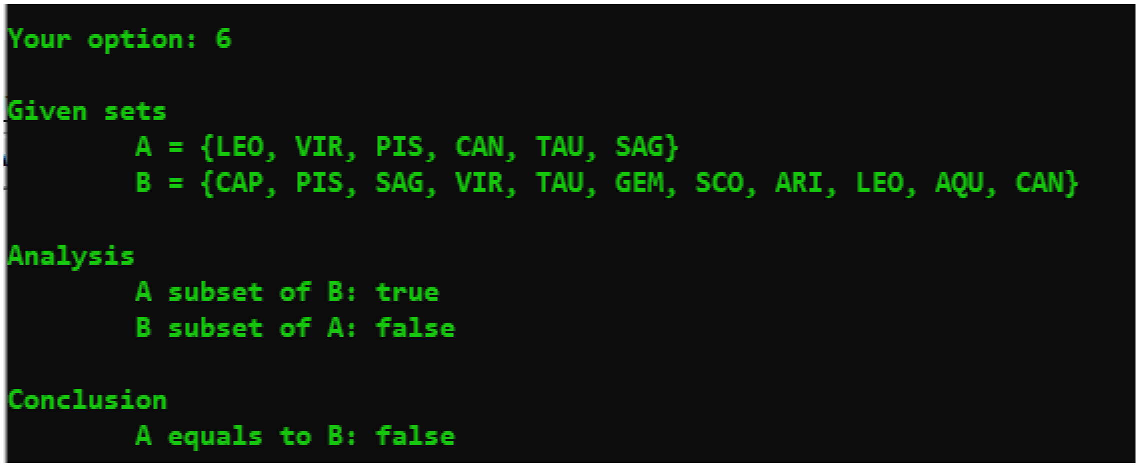


```
Your option: 5

Given set
        A = {PIS, CAP, LIB, ARI, LEO, TAU, CAN}

        A' = {GEM, VIR, SCO, SAG, AQU}
```

Option 6 is the set equality. The following shows some of the possible interactions and display:



```
Your option: 6

Given sets
        A = {ARI, GEM, CAN, LEO, TAU}
        B = {ARI, CAN, LEO, GEM, TAU}

Analysis
        A subset of B: true
        B subset of A: true

Conclusion
        A equals to B: true
```



```
Your option: 6

Given sets
        A = {LEO, VIR, PIS, CAN, TAU, SAG}
        B = {CAP, PIS, SAG, VIR, TAU, GEM, SCO, ARI, LEO, AQU, CAN}

Analysis
        A subset of B: true
        B subset of A: false

Conclusion
        A equals to B: false
```

Option 7 and 8 are two distributive laws:

Distributive Law states that, the sum and product remain the same value even when the order of the elements is altered.

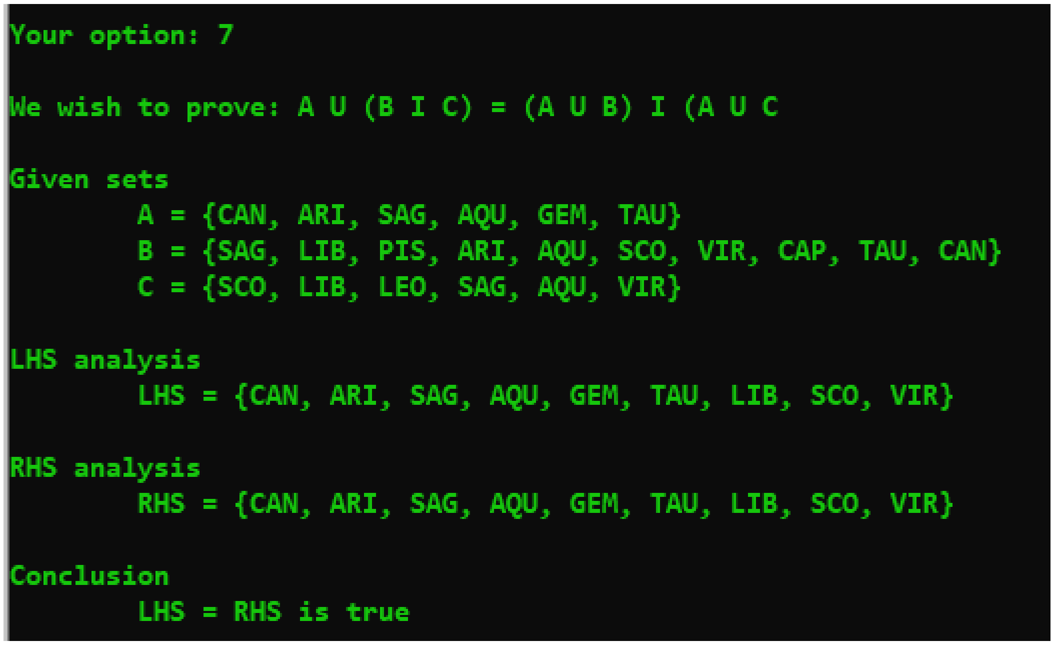
First Law: A ∪ (B ∩ C) = (A ∪ B) ∩ (A ∪ C)
Second Law: A ∩ (B ∪ C) = (A ∩ B) ∪ (A ∩ C)

We use symbol "I" for intersection in display:

Let us explain the 1st law

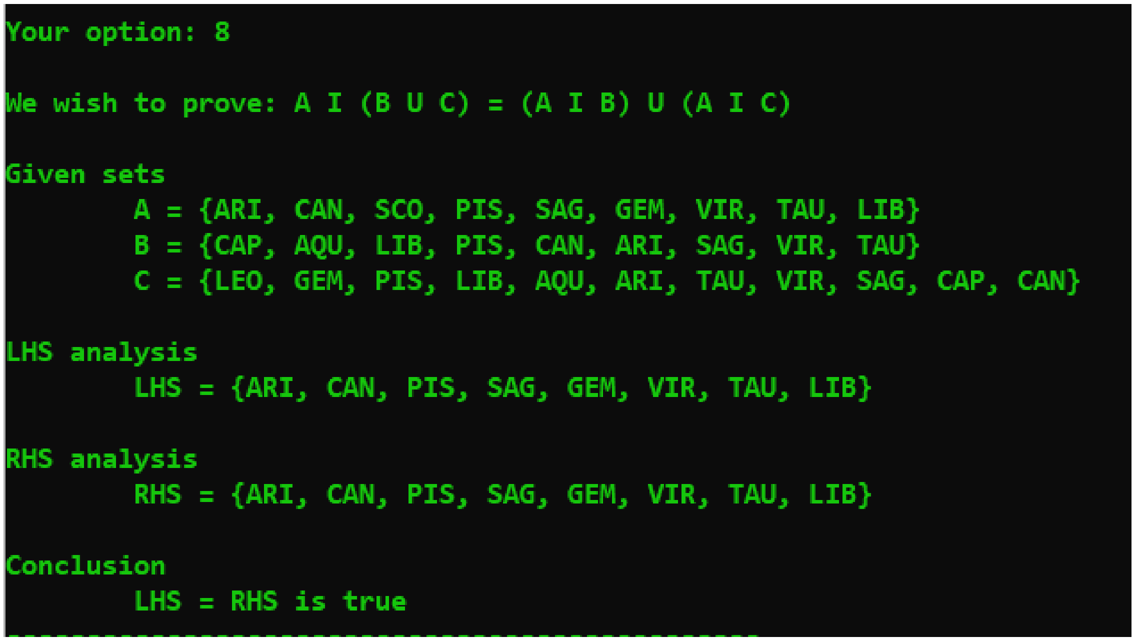
We first compute the expression on the left-hand side. To do this, you need to compute (B ∩ C) and then A ∪ (B ∩ C).

To compute the expression on the right-hand side, you need to compute (A ∪ B), (A ∪ C) and then (A ∪ B) ∩ (A ∪ C).



```
Your option: 7

We wish to prove: A U (B I C) = (A U B) I (A U C

Given sets
        A = {CAN, ARI, SAG, AQU, GEM, TAU}
        B = {SAG, LIB, PIS, ARI, AQU, SCO, VIR, CAP, TAU, CAN}
        C = {SCO, LIB, LEO, SAG, AQU, VIR}

LHS analysis
        LHS = {CAN, ARI, SAG, AQU, GEM, TAU, LIB, SCO, VIR}

RHS analysis
        RHS = {CAN, ARI, SAG, AQU, GEM, TAU, LIB, SCO, VIR}

Conclusion
        LHS = RHS is true
```

Same analysis can be done for 2nd law:



```
Your option: 8

We wish to prove: A I (B U C) = (A I B) U (A I C)

Given sets
        A = {ARI, CAN, SCO, PIS, SAG, GEM, VIR, TAU, LIB}
        B = {CAP, AQU, LIB, PIS, CAN, ARI, SAG, VIR, TAU}
        C = {LEO, GEM, PIS, LIB, AQU, ARI, TAU, VIR, SAG, CAP, CAN}

LHS analysis
        LHS = {ARI, CAN, PIS, SAG, GEM, VIR, TAU, LIB}

RHS analysis
        RHS = {ARI, CAN, PIS, SAG, GEM, VIR, TAU, LIB}

Conclusion
        LHS = RHS is true
```

IMPORTANT TO NOTE

IMPORTANT

Put all your classes in a file called **`YourName_A1.java`** and make sure that this file can be compiled and can be executed. Upload **ONLY** this file to Moodle**. ALL ZIP FILE SUBMISSION WILL BE REJECTED**

No re-submission will be allowed after grading.

In the above file, remember to put down your name and also the following declaration (some similar contents):

// Tell me if it is your own work, and whether you have passed your
// program to your friends etc
// and willing to accept whatever penalty given to you.

- **Wrong file name -0.5 mark**
- **No declaration, no name etc -0.5 mark**
- **Failing to demo -1 mark**
- **Programs indentations and alignment of statements -0.5 mark**
- **Late penalty: -0.1 mark per hour**