Classes and Instances

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Recall: OOP Definition

Decompose computation into interactions of "computing parts" called *objects*, each containing its own data (to be manipulated by itself) and own code (to be called by other objects)

- data (variables): status of object
- code (methods): actions of objects

Basic OOP Needs

Decompose computation into interactions of "computing parts" called *objects*, each containing its own data (to be manipulated by itself) and own code (to be called by other objects)

- designing object (what variables? what methods?)
- creating "first" object and calling its first action
- creating other objects
- calling other objects
- manipulating object status
- deleting objects

Big Picture: Java Solution of OOP Needs

- designing object (what variables? what methods?)
  —**declaring `class`, the blueprint of object**
- creating "first" object and calling its first action
  —**JVM does so, with first action called `main`**
  —**(note: not exactly so, will be clarified later)**
- creating other objects
  —**with something called `new`**
- calling other objects
  —**with grammar like `objectname.methodname(...)`**
- manipulating object status
  —**with grammar like `variablename = ...` in the object code**
- deleting objects
  —**JVM automatically and autocratically does so, when object "no longer needed" (garbage collection)**

Big Picture: C++ Solution of OOP Needs

- designing object (what variables? what methods?)
  —**declaring `class`, the blueprint of object**
- creating "first" object and calling its first action
  —**you need to write code to do so, while C++ only provides a `main` like C, a non-OO program entry**
- creating other objects
  —**with something called `new`**
- calling other objects
  —**with grammar like `objectname.methodname(...)`**
- manipulating object status
  —**with grammar like `variablename = ...` in the object code**
- deleting objects
  —**with something called `delete`**

Big Picture: Objective C Solution of OOP Needs

- designing object (what variables? what methods?)
  —**declaring `interface` (variable and method prototype) and `implementation` (code), the blueprint of object**
- creating "first" object and calling its first action
  —**you need to write code to do so, while ObjC only provides a `main` like C, a non-OO program entry**
- creating other objects
  —**with something like `[[ClassName alloc] init]`**
- calling other objects **(sending message to other objects)**
  —**with grammar like `[objectname methodname]`**
- manipulating object status
  —**with grammar like `variablename = ...` in the object code**
- deleting objects
  —**modernly, with an automatic mechanism called "automatic reference counting"**

Java Solution of OOP Needs (1/6)

- designing object (what variables? what methods?)
  —**declaring `class`, the blueprint of object**

```
1   //Song.java
2   public class Song{
3     private String name;
4     private byte[] data;
5     public void play(){
6       //...
7     }
8   }
9   //MP3Player.java
10  public class MP3Player{
11    private Song[] songs;
12    private int currentSong;
13    public boolean playSongAtIndex(int index){
14      //...
15    }
16  }
```

Java Solution of OOP Needs (2/6)

- creating “first” object and calling its first action
  —**JVM does so, with first action called `main`**
  —**(note: not exactly so, will be clarified later)**

```
java MyProgram
```

```
1  //MyProgram.java
2  public class MyProgram{
3    public static void main(String[] argv){
4      //...
5    }
6  }
```

Java Solution of OOP Needs (3/6)

- creating other objects
  —**with something called `new`**

```
1  public class MyProgram{
2    public static void main(String[] argv){
3      MP3Player p1 = new MP3Player();
4      MP3Player p2 = new MP3Player();
5      MP3Player p3; //not linked to any objects y
6    }
7  }
```

- can use one blueprint (class) to create many objects
- class is an extended type, like a C structure
  (`Record* r = (Record*)malloc(sizeof(Record));`)
  object of type R ≡ instance of class R ≡ object of class R
- a variable of the type links to (can be used to refer to) some object

Java Solution of OOP Needs (4/6)

- calling other objects
  —**with grammar like `objectname.methodname(...)`**

```
1  public class MyProgram{
2    public static void main(String[] argv){
3      MP3Player p1 = new MP3Player();
4      p1.playSongAtIndex(5);
5    }
6  }
```

- similar to procedure invocation in C, but specifying which instance to be called/messaged

Java Solution of OOP Needs (5/6)

- manipulating object status
  —**with grammar like `variablename = ...` within the object code**

```
1  public class MP3Player{
2    private Song[] songs;
3    private int currentSong;
4
5    public void next(){
6      currentSong++;
7      // ...
8    }
9  }
```

- the same as variable assignment in C, but (for now) within the "scope" of the object

Java Solution of OOP Needs (6/6)

- deleting objects
  —**JVM automatically and autocratically does so, when object "no longer needed" (garbage collection)**

no worries yet, more to be discussed later.

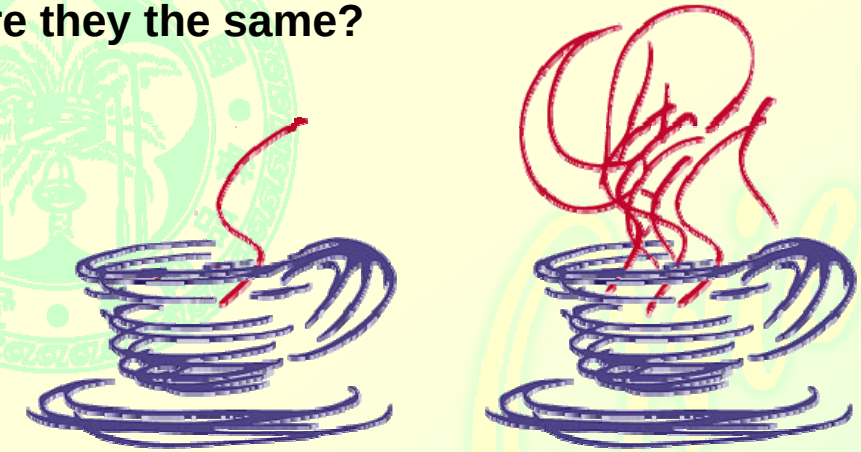
Class versus Instances (Objects)

```
1   public class Record{//class
2     private String name; //variable/field declaration
3     private String ID; //variable declaration
4     public boolean isB86(){ //action
5       return ID.startsWith("B86");
6       //here ID is an instance of the class String
7       //and performs an action (method) startsWith()
8     }
9   }
10
11  //somewhere else
12  Record r1 = new Record(); //r1 is an instance
13                            //with r1.name and r1.ID
14                            //as its data (variables)
15  Record r2 = new Record(); //r2 is another instance
16
17  if (r2.isB86()) { ... } //r2 performs an action (method)
```

Class versus Instances (courtesy of Prof. Chuen-Liang Chen)

Class vs. Instance

- Are they the same?



- instance 個體 (object)
  - with different status
  - representation of status (in high-level language): variable
  - instance: set of instance variables
- class 類別
  - it is no way & unnecessary to write program for instances one by one
  - OO programming = class (interface) declarations

Not Just Record: An OO Design of RandomIndex

- DATA: a randomly permuted index array of size N
- ACTION: setSize, initializeIndex, permuteIndex, getNext
- see `RandomIndex.java`, `OOPLotteryV3.java`
- Now you can use it for name calling in class, distributing cards in games, etc.