

# Basic Object-Oriented Concepts

## A. Object vs. Class

- Concepts
  - Class
    - Usually represent a concept
  - Object (also called Instance)
    - Usually represent something real
- Questions
  1. Which of the following are objects? Which is class?
    - a. Person
    - b. Jack
    - c. Mary
  2. Which of the following are objects? Which is class?
    - a. SONY TV
    - b. TV
    - c. Samsung TV
  3. Which of the following are objects? Which is class?
    - a. Jack
    - b. Mary
    - c. Teacher
  4. Which of the following are objects? Which is class?
    - a. Cookie
    - b. Circle
    - c. Sun
    - d. Moon
  5. Which of the following are objects? Which is class?
    - a. Rectangle
    - b. Whiteboard
    - c. Businesscard
  6. Which of the following are objects? Which is class?
    - a. Pyramid
    - b. Triangle
    - c. Pizza Slice

## B. The attributes of a class

- Concepts
  - Class has attribute. Both are names.
    - Class represents more complex concept
    - Attribute represents simple concept
      - The value of an attribute is usually a number or a string
- Questions
  1. Which of the following is not an attribute?
    - a. Person
    - b. age
    - c. height
    - d. weight
    - e. name
  2. Which of the following is not an attribute?
    - a. channel
    - b. TV
    - c. price
  3. Which of the following is not an attribute?
    - a. number of courses
    - b. salary
    - c. Teacher
  4. Which of the following is not an attribute?
    - a. radius
    - b. Circle
  5. Which of the following is not an attribute?
    - a. Rectangle
    - b. width
    - c. height
  6. Which of the following is not an attribute?
    - a. base
    - b. Triangle
    - c. height

## C. Naming convention

- Concepts
  - Naming convention
    - Class starts with upper-case character
    - Attribute and object start with lower-case character
- Questions
  1. Which of the following is an incorrect class name?
    - a. Person
    - b. person
  2. Which of the following is an incorrect object name for the class Person?
    - a. jack
    - b. John
    - c. mary

## D. Relation among the classes

- Concepts
  - 4 possibilities between two classes
    - No relationship
    - Has relationship
      - Aggregation (noun -- is-part-of -- noun relationship)
        - Mouth is-part-of Head
        - Wheel is-part-of Car
        - Leg is-part-of Table
      - Inheritance (noun -- is-kind-of -- noun relationship)
        - Teacher is-kind-of Person
        - ClassicalCar is-kind-of Car
        - DigitalTV is-kind-of TV
      - Association : (noun -- verb --- noun)
        - Teacher teach Student
        - Car park-at Garage

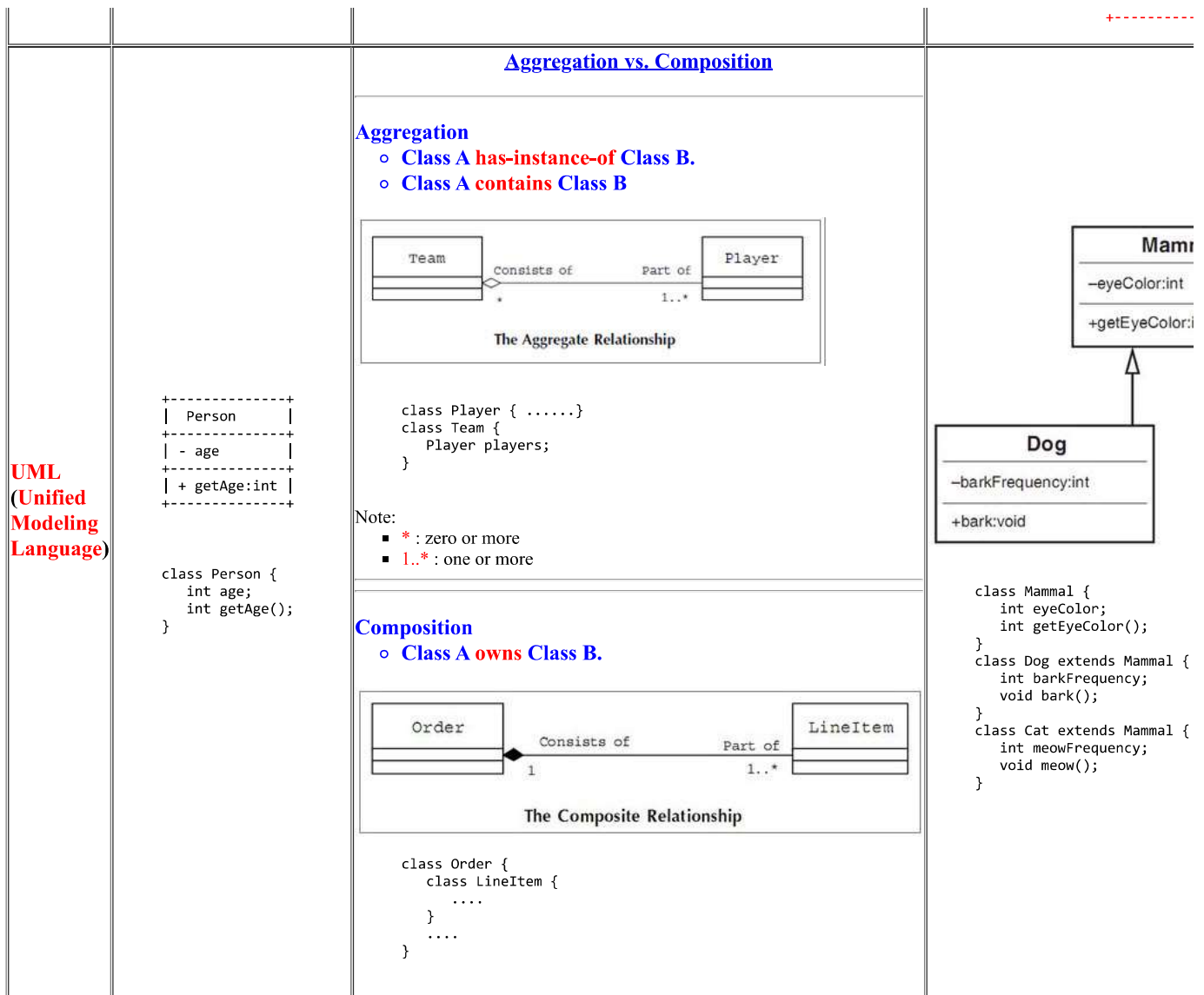
- Questions

1. What is the relationship between Student and Person ?
  - a. No relationship
  - b. Aggregation
  - c. Inheritance
  - d. Association
2. What is the relationship between Student and TA ?
  - a. No relationship
  - b. Aggregation
  - c. Inheritance
  - d. Association
3. What is the relationship between Teacher and TA ?
  - a. No relationship
  - b. Aggregation
  - c. Inheritance
  - d. Association
4. What is the relationship between Page and Book ?
  - a. No relationship
  - b. Aggregation
  - c. Inheritance
  - d. Association
5. What is the relationship between Desk and Classroom ?
  - a. No relationship
  - b. Aggregation
  - c. Inheritance
  - d. Association
6. What is the relationship between Used-Book and Book ?
  - a. No relationship
  - b. Aggregation
  - c. Inheritance
  - d. Association
7. What is the relationship between Leap-Year and Year ?
  - a. No relationship
  - b. Aggregation
  - c. Inheritance
  - d. Association
8. What is the relationship between Action-Movie and Movie ?
  - a. No relationship
  - b. Aggregation
  - c. Inheritance
  - d. Association
9. What is the relationship between Temple and Building ?
  - a. No relationship
  - b. Aggregation
  - c. Inheritance
  - d. Association
10. What is the relationship between Finger and Hand ?
  - a. No relationship
  - b. Aggregation
  - c. Inheritance
  - d. Association

E. [Object Oriented Concepts](#) ■ ■

F. [Graphic representation](#)

Diagram	Simple Class	Aggregation / Composition (noun -- is-part-of -- noun)	Inheritance (noun -- is-kind-of)
Simple	<pre> classDiagram     class Person {         int age     } </pre>	<pre> classDiagram     class Movie {         int hours     }     class Actor {         int age     }     Movie "1" -- "*" Actor </pre>	<pre> classDiagram     class Person {         int age     }     class Teacher {         float salary     }     Person &lt; -- Teacher </pre>



Questions

a. Draw a diagram to show the relationship between

- Student  
int id
- Person  
int age

[Simple Answer](#)

b. Draw a diagram to show the relationship between

- Student  
int id
- TA  
int ta\_hours

[Simple Answer](#)

c. Draw a diagram to show the relationship between

- Teacher  
float salary
- TA  
int ta\_hour

[Simple Answer](#)

d. Draw a diagram to show the relationship between

- Page  
int num\_lines
- Book  
int pages

[Simple Answer](#)

e. Draw a diagram to show the relationship between

- Desk  
int num\_legs
- Classroom  
int size

[Simple Answer](#)

f. Draw a diagram to show the relationship between

- Book  
int pages
- Used-Book  
int years

[Simple Answer](#)

g. Draw a diagram to show the relationship between

- Year  
int days
- Leap-Year  
int which\_year

[Simple Answer](#)

h. Draw a diagram to show the relationship between

- Movie  
int price
- Action-Movie  
int num\_of\_guns

[Simple Answer](#)

i. Draw a diagram to show the relationship between

- Building :  
int numOffFloors
- Temple  
int years

[Simple Answer](#)

j. Draw a diagram to show the relationship between

- Hand  
int size
- Note: Assuming that a hand has 5 fingers
- Finger  
int len

[Simple Answer](#)

k. Draw a diagram to show the relationship between

- Car  
int price
- Note: Assuming that a car has 6 windows.
- Window  
int width, height

[Simple Answer](#)

l. Draw a diagram to show the relationship between

- Car  
int price

- Wheel  
int radius
- ClassicalCar  
int year

[Simple Answer](#)

m. Draw a diagram to show the relationship between

- House  
int num\_of\_rooms
- Room  
int size
- LuxuryHouse  
int price

[Answer](#)

n. Draw a diagram to show the relationship between

- Person  
int age
- Student  
int id
- Teacher  
float salary
- TA  
int ta\_hour

[Simple Answer](#)

o. Draw a diagram to show the relationship between

- Menu  
String title
- FrontCover  
String name  
int numOfDishes
- BackCover  
String phoneNum
- ContentPage  
int pageNum
- FancyMenu  
String color

[Simple Answer](#)

p. Draw a diagram to show the relationship for a regular US family house

- House  
int no\_of\_rooms
- LuxuryHouse  
int price
- Room  
int size

q. Draw a diagram to show the relationships among

- Course  
int id
- CS\_Course  
string software\_name
- EE\_Course  
string hardware\_name
- Book  
int no\_of\_pages
- TextBook

String: course\_name

- G. [How to program?](#)
- H. [Python](#) and [Java/C++](#) implementation
  - o Concepts
    - Implement the first program
      - a. [vi Demo.java](#)

<a href="#">Demo.py</a>	Demo.java	
<pre>print("CDP") print("SFBU")</pre>	<pre>/* A .java file containing a public class MUST have exactly    the same name as the class name */ // In Java, even the main() function // must be in a class. public class Demo {     // - The next line is required for Java Interpreter to interpret     //   this program.     // - The main function must be static and is usually also made public     // - The following program prints     //   CDPSFBU     //     public static void main (String args[]) {         // Similar to C's printf("CDP");         System.out.print("CDP");         // Similar to C's printf("SFBU\n");         System.out.println("SFBU");     } }</pre>	<pre>#include &lt;iostream&gt; using std::cout; using std::endl;  /* A .java file co    the same name a    // In Java, even t    // must be in a cl    void main () {        cout &lt;&lt; "CDP";        cout &lt;&lt; "SFBU"    }</pre>

b. Compile

Demo.java	Demo.cpp
<pre>\$ javac Demo.java  Note: This step will generate this file  Demo.class</pre>	<pre>\$ g++ -o Demo Demo.cpp  Note: This step will generate this file  Demo</pre>

c. Execution

Demo.java	Demo.cpp
<pre>\$ java Demo CDPSFBU</pre>	<pre>\$ Demo CDPSFBU</pre>

- o Questions
  - 1. What will be printed if this program is executed?

<a href="#">Demo.py</a>	Demo.java	Demo.cpp
<pre>print("Hello") print("SFBU")</pre>	<pre>public class Demo {     public static void main (String args[]) {         System.out.println("Hello");         System.out.println("SFBU");     } }</pre>	<pre>void main () {     cout &lt;&lt; "Hello" &lt;&lt; endl;     cout &lt;&lt; "SFBU" &lt;&lt; endl; }</pre>

a. Answer 1

Hello

SFBU

b. Answer 2

Hello SFBU

c. Answer 3

HelloSFBU

2. What will be printed if this program is executed?

<u>Demo.py</u>	Demo.java	Demo.cpp
<pre>print("Hello", end="") print("SFBU")</pre>	<pre>public class Demo {     public static void main (String args[]) {         System.out.print("Hello");         System.out.println("SFBU");     } }</pre>	<pre>void main () {     cout &lt;&lt; "Hello" ;     cout &lt;&lt; "SFBU" &lt;&lt; endl; }</pre>

a. Answer 1

Hello  
SFBU

b. Answer 2

Hello SFBU

c. Answer 3

HelloSFBU

3. What will be printed if this program is executed?

<u>Demo.py</u>	Demo.java	Demo.cpp
<pre>print("Hello") print("SFBU", end="")</pre>	<pre>public class Demo {     public static void main (String args[]) {         System.out.println("Hello");         System.out.print("SFBU");     } }</pre>	<pre>void main () {     cout &lt;&lt; "Hello" &lt;&lt; endl;     cout &lt;&lt; "SFBU" ; }</pre>

a. Answer 1

Hello  
SFBU

b. Answer 2

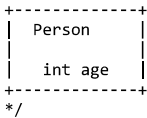
Hello SFBU

c. Answer 3

HelloSFBU

- I. Class implementation
  - o Concepts
    - Jack, The Giant Slayer

/\*



- and
- Step 1: create the object jack who is 23 years old



- Step 2: print jack's age
  - Step 3: change jack's age to 24
  - Step 3: print jack's age again
- This is the implementation

Demo.py (Explanation)	Demo.java	
<pre># +-----+ #   Person   #     int age     # +-----+ # class Person:     # Constructor     def __init__(self, age):         # Attribute is put into the private area         self.__age = age      # Get method     # - Attribute age is converted into getAge()     def getAge(self):         return(self.__age)      # Set method     # - Attribute age is converted into setAge()     def setAge(self, a):         self.__age = a  # Create the object jack who is 23 years old jack = Person(23)  # Print jack's age #   Jack's age is 23 print("Jack's age is ", jack.getAge())  # Change jack's age to 24 jack.setAge(24);  # Print jack's age again #   Jack's age is 24 print("Jack's age is ", jack.getAge())  ==&gt; Output  Jack's age is 23 Jack's age is 24</pre>	<pre>/* +-----+   Person       int age     +-----+ */  class Person {     // Attribute is put into the private area     private int age;     // Constructor     public Person(int a){ age = a; }      // Get method     // - Attribute age is converted into getAge()     public int getAge(){ return age; }      // Set method     // - Attribute age is converted into setAge()     public void setAge(int a){ age = a; } }  public class Demo {     public static void main (String args[]) {         // Create the object jack who is 23 years old         Person jack = new Person(23);          // Print jack's age         //   Jack's age is 23         System.out.println("Jack's age is " + jack.getAge());          // Change jack's age to 24         jack.setAge(24);          // Print jack's age again         //   Jack's age is 24         System.out.println("Jack's age is " + jack.getAge());     } }</pre>	<pre>/* +-----+   F               +-----+ */ #inc usir usir  clas / F / F / / i / / \ }; voic  }</pre>

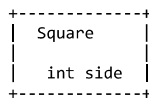


- Questions:

1. **Boss Baby**



Please implement the following diagram



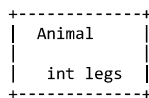
Test the Square class:

- Step 1: You take your baby brother to a shopping mall. The boy becomes restless. So you buy a candy (side = 5) for him.
- Step 2: You show the length of the side of the candy to the boy.
- Step 3: The boy quickly consumed the candy and complained that the candy is too small. So you buy another bigger candy (side = 10) for him.
- Step 4: You show the length of the side of the new candy to the boy.
- Step 5: The boy eats half of the new candy.
- Step 6: You show the length of the side of the new candy to the boy.

[Answer](#)

2. **Kung-Fu Panda**

Please implement the following diagram



and

- Step 1: Create the the Master Shifu and the "Furious Five" in this diagram



Animal	Voiced by	Comment

<b>Rabbit</b>	Dustin Hoffman (Master Shifu)	An old red panda who is the stern kung fu master to the Five and (unwillingly) to Po; he is troubled over mistakes in the past and is the former-master and adoptive father of Tai Lung.
<b>Panda</b>	Jack Black (Po)	An energetic yet accident-prone giant panda. He is also a die-hard fan of the Furious Five and kung fu, despite the fact that his father wants him take over the family noodle shop. To everyone's surprise, Po is chosen as the Dragon Warrior by Master Oogway, and in the end he defeats Tai Lung.
<b>Tigress</b>	Angelina Jolie	A tiger and leader of the Furious Five. She is the most hostile to Po when he's chosen as the Dragon Warrior, but eventually accepts him when he defeats Tai Lung.
<b>Monkey</b>	Jackie Chan	A Gee's golden langur and member of the Furious Five; he has an easygoing attitude, and like Sun Wukong, the Monkey of Chinese folktales, he is adept with a staff.
<b>Viper (Snake)</b>	Lucy Liu	A Green Tree Viper and member of the Furious Five; she is kind and the most good-natured to Po when he is chosen as the Dragon Warrior.
<b>Mantis (螳螂)</b>	Seth Rogen	A Chinese mantis and member of the Furious Five; he is extremely strong for his size and is also experienced in acupuncture.

- Step 2: Print panda's total number of legs

[Answer](#)

3. **Monsters, Inc.**



```
+-----+
| Student |
|         |
|   int id   |
+-----+
```

and

- Step 1: Create the object james whose's ID is 1234



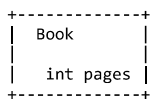
- Step 2: Print james's ID
- Step 3: James lost his ID card  
Note: The Id of a lost ID card is set to 0.
- Step 3: Print james's ID
- Step 4: Create the object mike whose's ID is 4567



- Step 5: Print mike's ID

[Answer](#)

#### 4. Mobidick



and

- Step 1: Create the object mobidick which has 704 pages



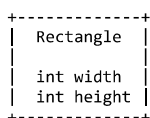
- Step 2: Print mobidick's total page number
- Step 3: The book is burned.
- Step 4: Print mobidick's total page number again.

[Answer](#)

#### 5. [4 Types of Member Functions](#)

#### 6. iPhone

Please implement the complete set of methods for the following diagram



```

- Helping function
  def __trace(s):
    print(s)
- Manager function
  + Constructor
- Access functions
  + 2 get
  + 2 set
  + Predicate function
    isSquare()
- Implementor function
  + shrink(w, h)
    ==> The rectanlge is shrinked by w and h
  + area()
  + perimeter()

```

and test the class in this way:

- Step 1: Create the object iPhone whose width is 10, height is 20.



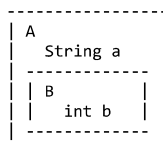
- Step 2: Print the iPhone's width and height
- Step 3: Check whether the iPhone is square
- Step 4: print the area of the iPhone
- Step 5: print the perimeter of the iPhone
- Step 6: The iPhone is cut into half vertically. Get rid of the lower half.



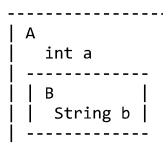
- Step 7: Print iPhone's width and height again

#### Answer

- J. What's the difference between an instance of a class and an object in that class?  
 K. What's the difference between a local variable and a member variable?  
 L. What's the difference between a static field and a non-static field?  
 M. Please implement the following "has-a" relationship.



- N. Please implement the following "has-a" relationship.



- O. Please implement the following diagram

```

| A
|   int a,b;
|

```

Create this class with

- constructor
- toString
- clone

P. Q1

Q. Q2

[Previous](#) | [Next](#) | [Top](#)

Last Modified May 15, 1997