1 Creating Cats

Given the Animal class, fill in the definition of the Cat class so that it makes a "Meow!" noise when greet() is called. Assume this noise is all caps for kittens (less than 2 years old).

```java
public class Animal {
    protected String name, noise;
    protected int age;
    public Animal(String name, int age) {
        this.name = name;
        this.age = age;
        this.noise = "Huh?";
    }
    public String makeNoise() {
        if (age < 2) {
            return noise.toUpperCase();
        }
        return noise;
    }
    public String greet() {
        return name + ": " + makeNoise();
    }
}

class Cat extends Animal {
}
```

2 Impalements

a) We have two interfaces, BigBaller and ShotCaller. We also have LilTroy, a concrete class, which should implement BigBaller and ShotCaller. Fill out the blank lines below so that the code compiles correctly.

```java
interface BigBaller {
    void ball();
}

interface ShotCaller {
    void callShots();
}

public class LilTroy {
    public void ball() {
        System.out.println("Wanna be a baller");
    }
    public void callShots() {
        System.out.println("Shot shot");
    }
    public void rap() {
        System.out.println("Say: Twenty inch blades on the Impala");
    }
}
```
b) We have a BallCourt where ballers should be able to come and play. However, the below code demonstrates an example of bad program design. Right now, only LilTroy instances can ball.

```java
public class BallCourt {
    public void play(LilTroy lilTroy) {
        lilTroy.ball();
    }
}
```

Fix the play method so that all the BigBaller instances can ball.

```java
public class BallCourt {
    public void play(BigBaller bigBaller) {
    }
}
```

c) We discover that Rappers have some common behaviors, leading to the following class.

```java
class Rapper {
    public abstract String getLine();
    public final void rap() {
        System.out.println("Say: " + getLine());
    }
}
```

Will the above class compile? If not, why not? How can we fix it?

d) Rewrite LilTroy so that LilTroy extends Rapper and displays exactly the same behavior as in part a) without overriding the rap method (in fact, you cannot override final methods).

```java
public class LilTroy extends Rapper implements __________, __________ {
}
```
3 Raining Cats & Dogs

In addition to Animal and Cat from Problem 1, we now have the Dog class! (Assume that the Cat and Dog classes are both in the same file as the Animal class.)

```java
class Dog extends Animal {
    public Dog(String name, int age) {
        super(name, age);
        noise = "Woof!";
    }
    public void playFetch() {
        System.out.println("Fetch, " + name + "!");
    }
}
```

Consider the following main function in the Animal class. Decide whether each line causes a compile time error, a runtime error, or no error. If a line works correctly, draw a box-and-pointer diagram and/or note what the line prints.

```java
public static void main(String[] args) {
    Cat nyan = new Animal("Nyan Cat", 5); (A) ________________
    Animal a = new Cat("Olivia Benson", 3); (B) ________________
    a = new Dog("Fido", 7); (C) ________________
    System.out.println(a.greet()); (D) ________________
    a.playFetch(); (E) ________________
    Dog d1 = a; (F) ________________
    Dog d2 = (Dog) a; (G) ________________
    d2.playFetch(); (H) ________________
    (Dog) a.playFetch(); (I) ________________
    Animal imposter = new Cat("Pedro", 12); (J) ________________
    Dog fakeDog = (Dog) imposter; (K) ________________
    Cat failImposter = new Cat("Jimmy", 21); (L) ________________
    Dog failDog = (Dog) failImposter; (M) ________________
}
```
4 Bonus: An Exercise in Inheritance Misery

Cross out any lines that cause compile or runtime errors. What does the main program output after removing those lines?

Moral of the story: fields are hidden if also defined in the subclass, and therefore you should avoid doing that because it makes the code confusing.

```java
class A {
    int x = 5;
    public void m1() {System.out.println("Am1-> " + x);}  // (A) _____________________
    public void m2() {System.out.println("Am2-> " + this.x);}  // (B) _____________________
    public void update() {x = 99;}
}

class B extends A {
    int x = 10;
    public void m2() {System.out.println("Bm2-> " + x);}  // (C) _____________________
    public void m3() {System.out.println("Bm3-> " + super.x);}  // (D) _____________________
    public void m4() {System.out.println("Bm4-> "); super.m2();}
}

class C extends B {
    int y = x + 1;
    public void m2() {System.out.println("Cm2-> " + super.x);}  // (E) _____________________
    public void m3() {System.out.println("Cm3-> " + super.super.x);}  // (F) _____________________
    public void m4() {System.out.println("Cm4-> " + y);}  // (G) _____________________
    public void m5() {System.out.println("Cm5-> " + super.y);}  // (H) _____________________
}

class D {
    public static void main (String[] args) {
        A b0 = new B();  // (I) _____________________
        System.out.println(b0.x);  // (A) _____________________
        b0.m1();  // (B) _____________________
        b0.m2();  // (C) _____________________
        b0.m3();  // (D) _____________________

        B b1 = new B();  // (E) _____________________
        b1.m3();  // (F) _____________________
        b1.m4();

        A c0 = new C();  // (G) _____________________
        c0.m1();

        A a1 = (A) c0;  // (H) _____________________
        C c2 = (C) a1;
        c2.m4();  // (I) _____________________

        ((C) c0).m3();  // (I) _____________________

        b0.update();
        b0.m1();  // (J) _____________________
    }
}
```