**AP CS Exploring Inheritance:** **Using IS-A and HAS-A**

**Adapted from *Head First Java* by Sierra and Bates**

Remembering that when one class inherits from another, we say that the subclass extends the superclass. When you want to know if one thing should extend another, apply the IS-A test.

**Triangle IS-A Shape, yeah that works.**

**Cat IS-A Feline, that works too.**

**Surgeon IS-A Doctor, still good.**

**Tub extends Bathroom, sounds reasonable. Until you apply the IS-A test.**

To know if you have designed your types correctly, ask, “Does it make sense to say type X IS-A type Y? If it doesn’t , you know there is something wrong with the design, so if we apply the IS-A test, Tub IS-A Bathroom is definitely false.

What if we reverse it to Bathroom extends Tub?

Tub and Bathroom are related but not through inheritance. Tub and Bathroom are joined by a HAS-A relationship. Does it make sense to say “Bathroom HAS-A Tub”? If yes, then it means that Bathroom has a Tub instance variable. In other words, Bathroom has a reference to a Tub, but Bathroom does not extend Tub and vice-versa.

The IS-A test should work anywhere in the inheritance tree. If your inheritance tree is well-designed, the IS-A test should make sense when you ask any subclass if it IS-A any of its supertypes. Also, keep in mind that the inheritance IS-A relationship works in only one direction!

**If class B extends class A, class B IS-A class A.**

Exercises. Determine if the relationship makes sense.

1. **Oven extend Kitchen**
2. **Guitar extends Instrument**
3. **Person extends Employee**
4. **Corvette extends Engine**
5. **FriedEgg extends Food**
6. **Beagle extends Pet**
7. **Container extends Barrel**
8. **Metal extends Titanium**
9. **Beverage extends Milk**
10. **TheEagles extends Band**

**Designing an Inheritance Tree**

Clothing

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|  |  |  |
| --- | --- | --- |
| **Class** | **Superclasses** | **Subclasses** |
| **Clothing** | **--** | **Boxers, Shirts** |
| **Boxers** | **Clothing** |  |
| **Shirt** | **Clothing** |  |

Shirt

Boxers

Find the relationships that make sense. Fill in the last two columns and create an inheritance tree.

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| --- | --- | --- |
| **Class** | **Superclasses** | **Subclasses** |
| Jazz Guitarist |  |  |
| Rock Star |  |  |
| Fan |  |  |
| Bass Player |  |  |
| Concert Pianist |  |  |
| Musician |  |  |
|  |  |  |