

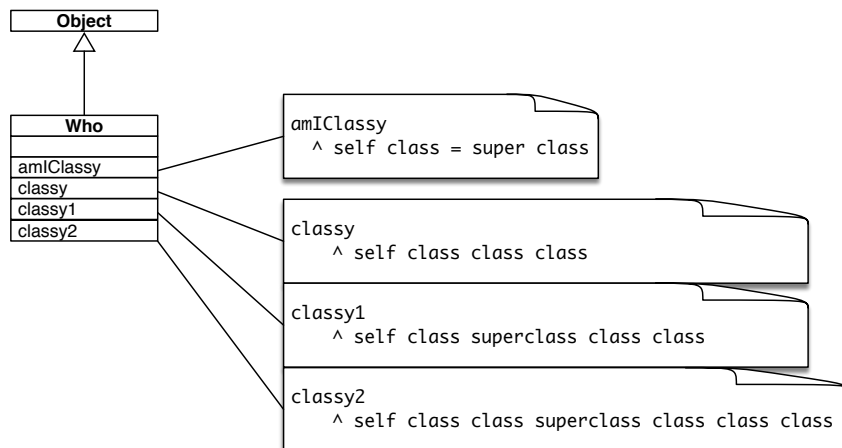
## Solution

### Assignment 03 — 03/10/2018 – v1.0b

### Smalltalk: Understanding Classes and Metaclasses

Please submit this exercise by mail to [sma@list.inf.unibe.ch](mailto:sma@list.inf.unibe.ch) before 10 October 2018, 10:15am.

#### Exercise 1 – Class identity (1.5 Points)



What are the results (either True or False) of the following expressions? Explain!

*Hint: Please refer to the UML diagram above for the three questions below.*

a) `Who new amIClassy`. **Answer:**

*True: Super is used in the context of a object.*

b) `Who new classy = Who new classy1`. **Answer:**

*True: Both elements represent the same object.*

*Who new classy: Gives a Metaclass object.*

*Who new classy1: Gives a Metaclass object.*

c) `Who new classy1 = Who new classy2`. **Answer:**

*True: Both elements represent the same object.*

*Who new classy1: Gives a Metaclass object.*

*Who new classy2: Gives a Metaclass object.*

#### Exercise 2 – Abstract methods (1.5 Points)

Find all abstract methods of the class `Collection`.

**Answer:**

```
Collection methods select: [:eachMethod | eachMethod isAbstract]
```

**Exercise 3 – Class hierarchy (2 Points)**

What is the name of Pharo's class hierarchy root class? What is its purpose?

**Answer:**

*Traditionally the root of an inheritance hierarchy is the class Object, since everything is an object. However, in Pharo the root is a class called ProtoObject. While Object provides (most of) the regular message handlers which it is known for, e.g., the printOn message send, the ProtoObject adds a layer of abstraction and augments all objects with some "x-ray" capabilities to developers that are working on the Pharo VM, and enables the use of more advanced features like meta class operations. Consequently, although it is not very well known, ProtoObject is heavily used as it offers convenient method receivers, e.g., for debugging, introspection, or memory scanning.*

**Exercise 4 – Sub and super classes (3 Points)**

How many super classes does the class `Collection` have? How many direct and indirect subclasses does it have? Please provide your code and your results.

*Hints: Direct subclasses are classes which extend a base class directly (e.g. relation parents to children), whereas indirect subclasses extend a base class not as first-class citizens (e.g. relation grandparents to grandchildren). **Answer:***

*Note: The actual numbers below have been extracted from a fresh copy of Pharo 6.1.*

*These metrics can be retrieved with the following statements:*

```
Collection allSuperclasses size. yields 2. Consequently, the class has two super classes.  
Collection subclasses size. yields 14. Therefore, the class has 14 direct subclasses.  
Collection allSubclasses size. yields 101. For this reason, the class Collection has a  
total of 101 subclasses, thus (101 - 14 =) 87 indirect subclasses.
```

*In addition, other metrics are available as well, e.g. the total lines of code:*

```
Collection linesOfCode. which yields 1087.
```

**Exercise 5 – Object instantiation (2 Points)**

A new class instance is being created by sending the message `new` to the respective class.

Where is `new` defined? Describe also Pharo's method resolution strategy for the `new` message.

**Answer:**

*new* is first defined in the class *Behavior*. However, it can be redefined in its subclasses, including any metaclass of the classes we define.

When the message *new* is sent to a class it is being resolved throughout its metaclass chain. This search ultimately ends in its super classes *Class*, *ClassDescription* and *Behavior*. Regardless of any redefinitions, when *new* becomes executed the initiated message sends will always include a final *self new* in the class *Behaviour*.