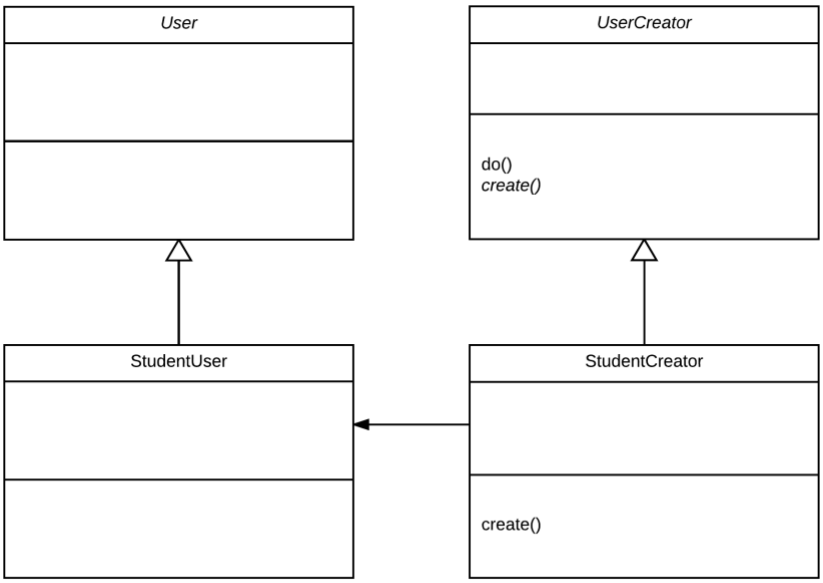
Question 1: Mohsin needs to create various user objects for his University learning platform. What is the act of creating an object called?

- object invocation
- concrete instantiation
- object realization
- class creation

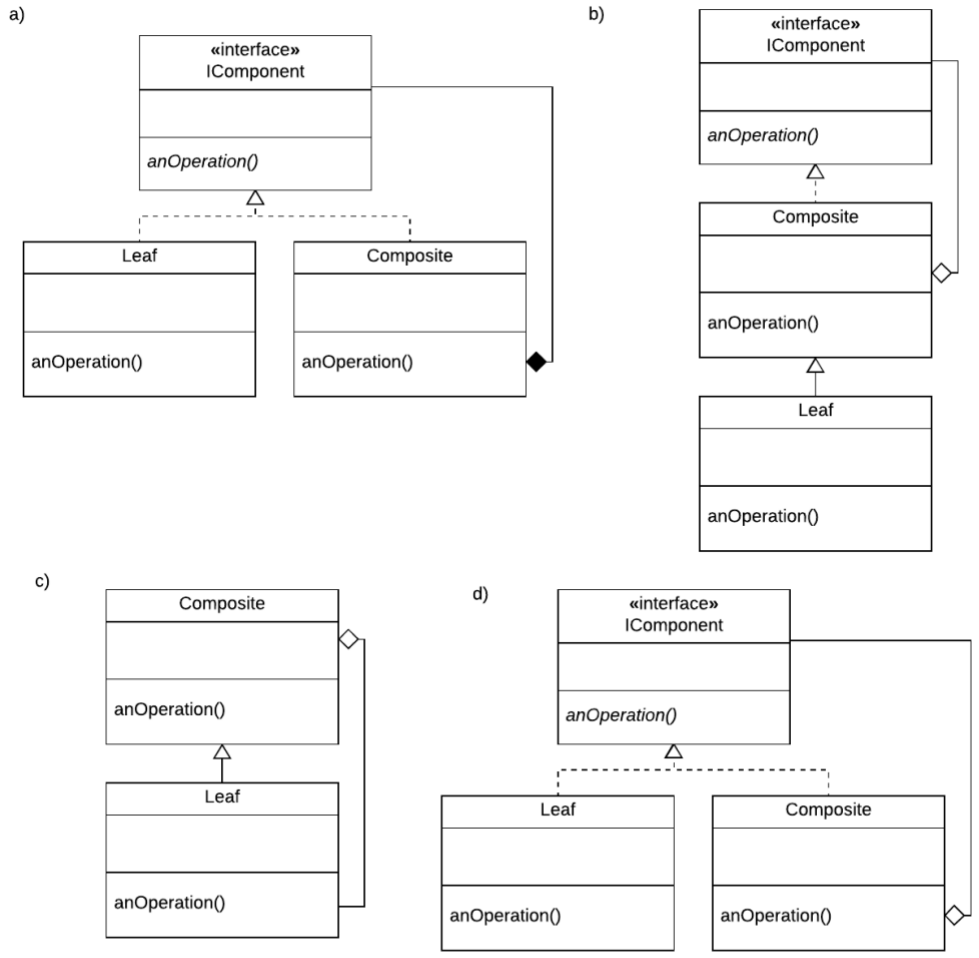
Question 2: Mohsin has a superclass that performs various operations on these user objects - Student, Professor, Assistant, for example. He wants the subclass to determine which object is created. This is sketched below in a UML diagram for the StudentUser class. What is this design pattern called?



- Template Pattern
- Factory Method Pattern
- Simple Factory
- Composite Pattern

Correct! The Creator superclass in the Factory Method pattern has operations that operate on an object, but has the actual creation of that object outsourced to an abstract method that must be defined by the subclass.

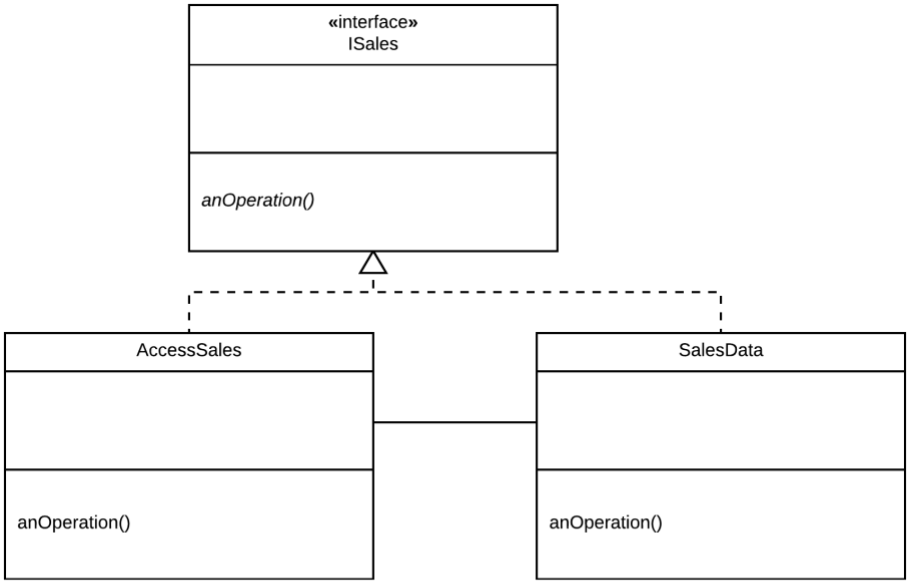
Question 3: Select the correct UML class diagram representation of the Composite Pattern:



d)

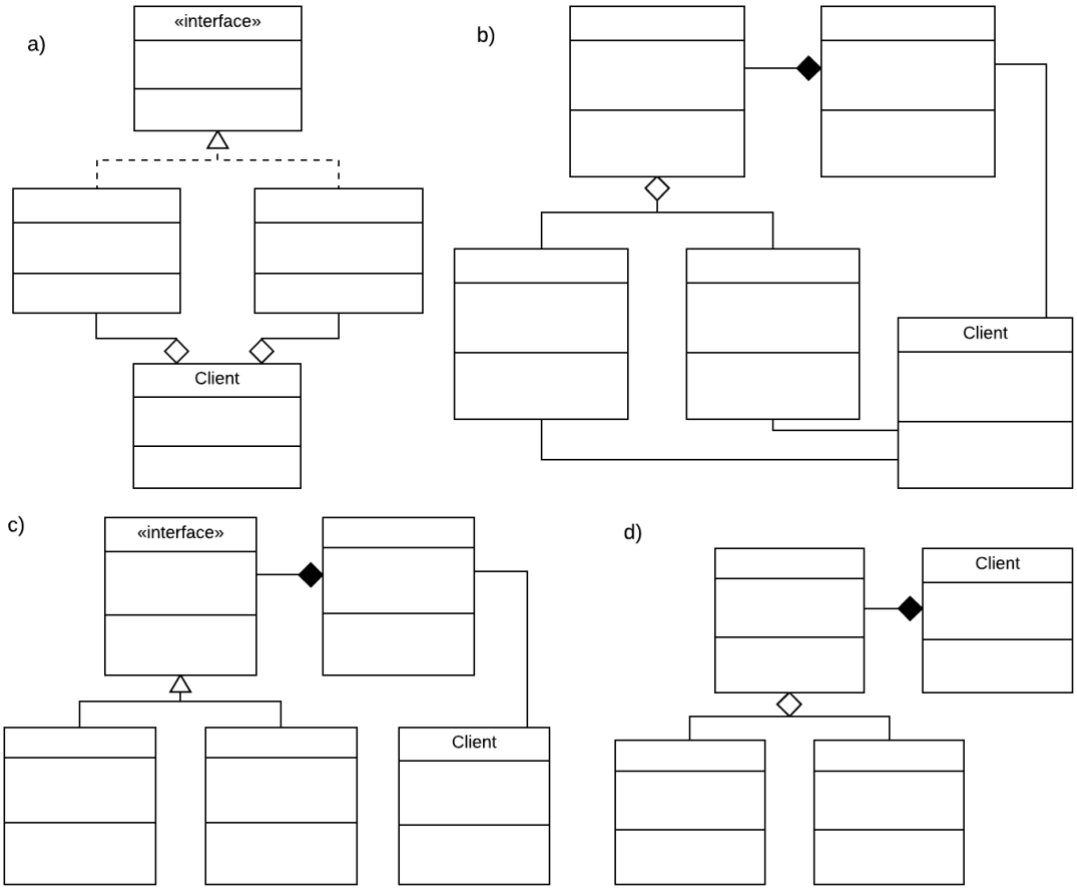
Correct! Both the component and Leaf classes implement the component interface (or they can inherit from a component superclass). The Composite class aggregates objects with this interface.

Question 4: Yola is programming for a grocery store system. She has a complex SalesData class that updates inventories and tracks sales figures, and a lightweight AccessSales class that will give select sales data to a user, depending on their credentials. AccessSales delegates to SalesData when more complex data is needed. This situation is shown below. Which Pattern is this?



- Proxy Pattern
- Singleton Pattern
- Facade Pattern
- Decorator Pattern

Question 5: Which of these UML class diagrams shows the Facade pattern?



c)

Question 6: What is the difference between the Factory Method and a Simple Factory?

- In Factory Method, concrete instantiation is done in a designated method, where a Simply Factory creates objects for external clients
- Simple factories cannot be subclassed.
- In the factory method pattern, the factory itself must be instantiated before it starts creating objects. This is usually done with a dedicated method.
- A simple factory instantiates only one kind of object.

Question 7: José wants to build behaviours by stacking objects and calling their behaviours with an interface. When he makes a call on this interface, the stack of objects all perform their functions in order, and the exact combination of behaviours he needs depends what objects he stacked and in which order. Which Design Pattern best fits this need?

- Decorator Pattern
- Composite Pattern
- Singleton Pattern
- Factory Method Pattern

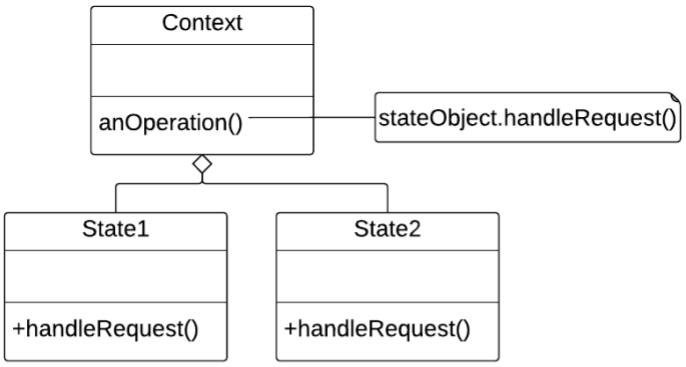
Question 8: You need to connect to a third-party library, but you think it might change later, so you want to keep the connection loosely coupled by having your object call a consistent interface. Which Design Pattern do you need?

- Adapter
- Facade
- Proxy
- Decorator

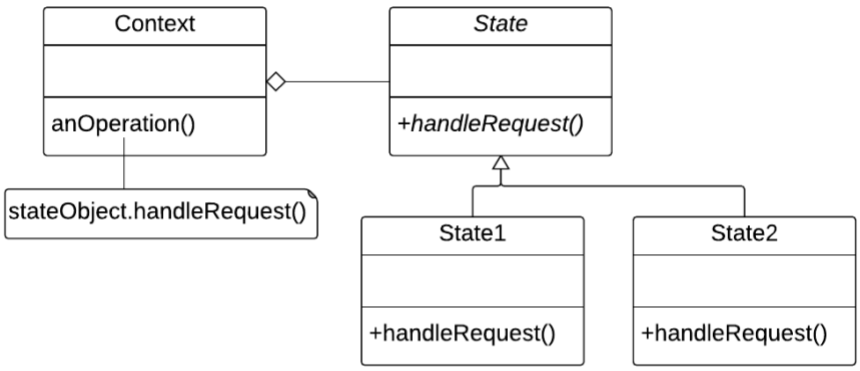
Correct! The adapter pattern keeps loose coupling between the client and the interface in question. If either changes, only the adaptor needs to be changed.

Question 9: Which of these diagrams shows the State pattern?

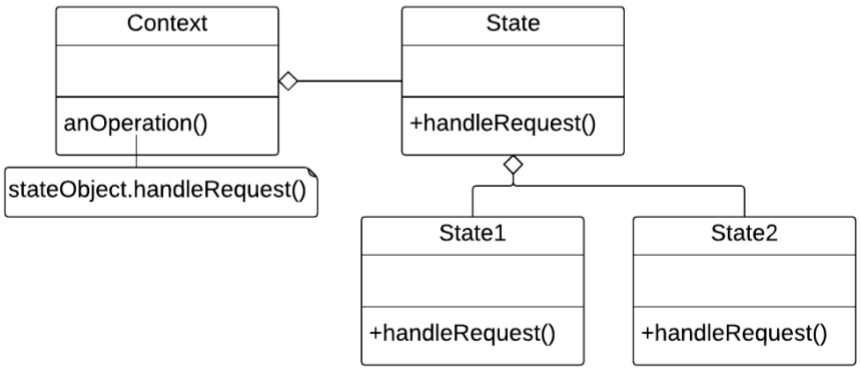
a)



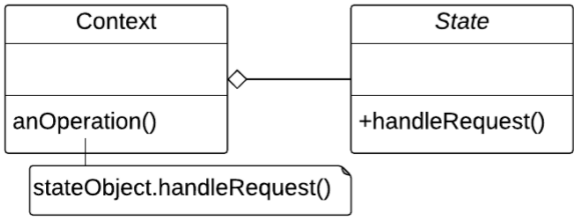
b)



c)



d)



b)

Correct! The context "has a" state object to determine its state. How requests are handled is determined by the current State object.

Question 10: Which of these design principles best describes the Proxy pattern?

- encapsulation, because the Proxy hides some of the detail of the subject
- separation of concerns, because the Proxy object has different concerns from the subject
- decomposition, because the Proxy object has different concerns than the subject
- generalization, because a proxy is a general version of the real subject

Correct! The Proxy encapsulates some behaviour of the subject in a simpler way, and delegates to the subject when needed.

Question 11: Ashley has a method in her class that needs to makes a request. This request could be handled by one of several handlers. Which design pattern does she need?

- Facade
- Decorator
- Chain of Responsibility
- Template

Correct! The Chain of Responsibility is a pattern for passing a request down a line until one of the handlers can handle it.

Question 12: Colin is designing a class for managing transactions in software for a banking machine software. Each transaction has many of the same steps, like reading the card, getting a PIN, and returning the card. Other steps are particular to the type of transaction. Which pattern does he need?

- MVC
- Mediator
- Template
- State

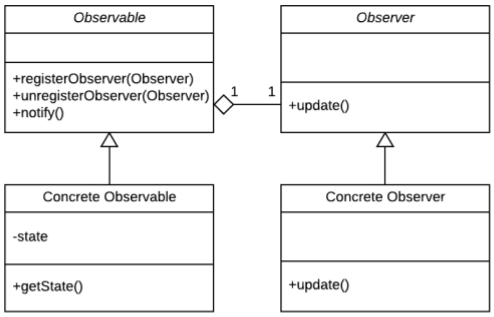
Correct! The Template method is used for situations in which the same general set of steps are followed, but some steps are different in their specifics.

Question 13: Which of these is **NOT** a good use of the Command pattern?

- Supporting undo/redo queues of commands
- Building macros, for example in an image manipulation program
- Building a user-interface that can be used to perform operations
- Sending a command to a third-party service or library

Question 14: Choose the correct UML class diagram representation of the Observer pattern:

a)



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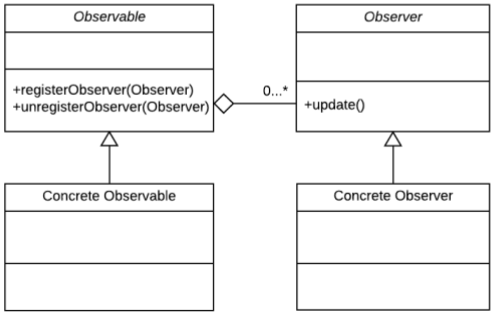
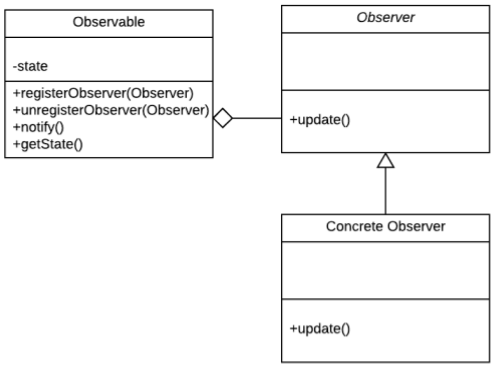
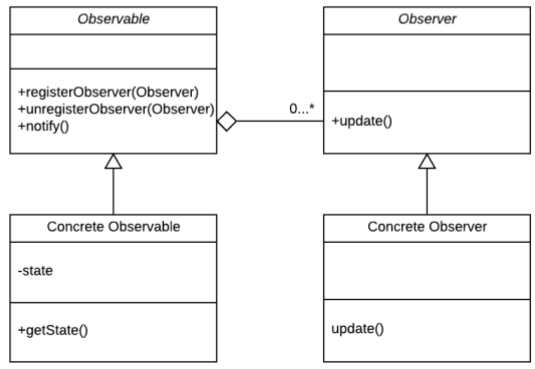


c)



d)



d)

Question 15: Which code smell may become a problem with the Mediator design pattern?

- Large Class
- Inappropriate Intimacy
- Speculative Generality
- Refused Bequest

Correct! The Mediator class can quickly become very large, which means it might have this or related code smells, like Divergent Change or Long Method.

Question 16: Hyun-Ji is developing a program. She wants to create a Student class that behaves differently based on if the student has not registered for classes, is partially registered, fully registered, or fully registered and paid. Which design pattern does she need?

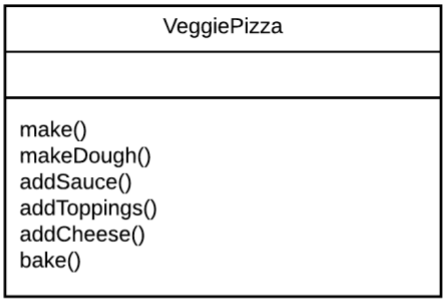
- State
- Template Method
- Proxy
- Mediator

Question 17: Which of these methods is found in a typical Observer class?

- update()
- getState()
- notify()
- addObserver()

Question 18: Fernando is making pizza objects with the Template Method pattern. The make() function is the whole process of making the pizza. Some steps are the same for every pizza - makeDough(), and bake(). The other steps - addSauce(), addToppings() and addCheese() - vary by the pizza. Which of these subclasses shows the proper way to use a template method?

a)



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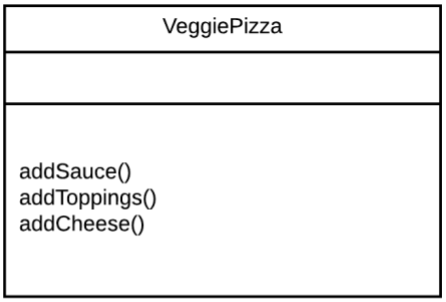

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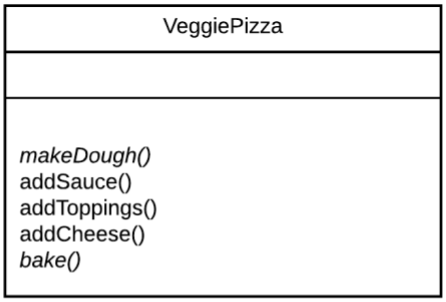

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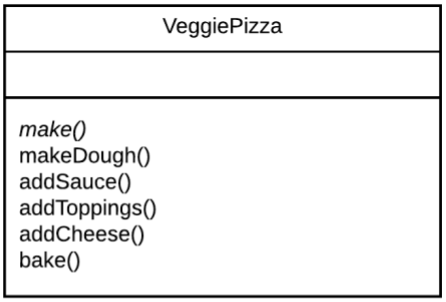

b)

Question 19: In the Mediator Pattern, which pattern is often used to make sure the Mediator always receives the information it needs from its collaborators?

- Chain of Responsibility
- Command
- Template Method
- Observer

Correct! The Mediator can be made an Observer of all of its Collaborators.

Question 20: In the MVC Pattern, which of these is usually made into an Observer?

- View
- Model
- Back-End
- Controller

Correct! Views are usually subscribed to the model so that when changes are made, the views are updated.

Question 21: Which of these answers does **NOT** accurately complete the following sentence? "A class is considered closed to modification when…"

- ...it is proven to be stable within your system
- ...it is tested to be functioning properly
- ...its collaborators are fixed
- ...all the attributes and behaviours are encapsulated

Correct! This is NOT part of being closed to modification. New collaborators may be created that call on this object. Of course, it cannot call on any new collaborators without being modified.

Question 22: How does the Dependency Inversion Principle improve your software systems?

- Client classes use an adapter to facilitate communication between itself and the rest of the system
- Dependency becomes inverted by having the system depend on the client classes
- Client classes become dependent on high level generalizations rather than dependant on low level concrete classes
- Client classes become dependant on low-level concrete classes, rather than dependant on high-level generalizations

Correct! Being dependent on a generalization allows your system to be more flexible.

Question 23: Allison has a search algorithm, and she would like to try a different implementation of it in her software. She tries replacing it everywhere it is used and this is a huge task! Which design principle could Allison have used to avoid this situation?

- Dependency Inversion
- Principle of Least Knowledge
- Composing Objects Principle
- Don't Repeat Yourself

Correct! Allison should have made every client of this search algorithm call an interface or an abstract class instead of the concrete search algorithm. That way, when she changed the implementation, the clients would be unaffected.

Question 24: Which of the code smells is shown in this code example of a method declaration?


```
private void anOperation(String colour, int x, int y, int z, int speed)
```

- Message Chains
- Long Method
- Large Parameter List
- Primitive Obsession

Correct! A long parameter list like this is often an indication that you should define an abstract data type to contain this bundle of information.

Question 25: Which object-oriented design principle do Long Message Chains, a code smell, usually violate?

- Cohesion
- Principle of Least Knowledge / Law of Demeter
- Open/Closed Principle
- Separation of Concerns

Correct! A class should only know about a few other classes. Long message chains will make your code rigid and difficult to change.

Question 26: Which code smell can you detect here?

```
public int getAge() { return age; }

...

String hairColour;


public class Person {

int age;

    int height;

}
```

- Feature Envy
- Primitive Obsession
- Data Class
- Data Clump

Correct! This class seems to only contain data and a getter (with presumably more getters and setters). Maybe there are some operations you could move into this class.

Question 27: What are the components of the MVC pattern?

- Model, View, Command
- Member, Vision, Controller
- Model, Vision, Command
- Model, View, Controller

Question 28: The interface segregation principle encourages you to use which of these object-oriented design principles? Choose the **2 correct** answers.

- decomposition
  Correct! Instead of using inheritance, the Interface Segregation principle encourages you to separate functionality into different interfaces, then combine it to get the behaviour you want.
- generalization
- abstraction
  Correct! The principle encourages you to select good abstractions for your entity.
- encapsulation

Question 29: Interface Segregation is a good way to avoid which code smell? **Choose the best possible answer**.

- Long Method
- Refused Bequest
- Divergent Change

- Switch Statements

Correct! By composing with interfaces instead of inheriting, you can avoid your classes inheriting behaviour that they will not use.

Question 30: Which of these statements about the Decorator pattern are true?

1. The decorator classes inherit from the basic object which is being decorated
2. Decorator objects can be stacked in different order

- The first statement is true
- The second statement is true
- Neither statement is true
- Both statements are true

Correct! This allows you to build behaviour in different ways. It's also why you must use an interface to build this pattern instead of inheritance, because you do not want to fix the order of objects with inheritance.