COMSATS UNIVERSITY ISLAMABAD, ABBOTTABAD

Design Pattern

Assignment # 02

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Contents

Q1: Design patterns in java APIs

1. Creational design Patterns

1. ***java.lang.Runtime and java.lang.Desktop***
   - **Singleton Pattern:** Above java APIs follows the singleton design pattern because they provide a single instance of object and that's globally accessible. GetDesktop () and GetRuntime() ensure that only one instance of the runtime environment is accessible to all application throughout.
2. ***com.google.common.collect.MapMaker***
   - **Builder Pattern:** The above class from Google's Guava library implements the Builder pattern to create customized ConcurrentMap instances. It allows incremental configuration of features.
3. ***java.util.Calendar, java.text.NumberFormat, java.nio.charset.Charset***
   - **Factory Pattern:** These provide static factory methods to create instances. Calender.getInstance() returns an appropriate calender instance. Without exposing the exact implementation. NumberFormat.getInstance() returns a locale-specific instance for formatting numbers. Charset.forName() returns a Charset object for the specified charset name, hiding the instantiation details.
4. ***javax.xml.parsers.DocumentBuilderFactory, javax.xml.transform.TransformerFactory, javax.xml.xpath.XPathFactory***
   - **Abstract Factory pattern:** Each creates specific objects (DocumentBuilder, Transformer, XPath) that belong to XML processing domain also the implementations are abstracted from the client. Also, can be configured to use specific implementations via configuration files.

2. Structural Design Patterns

1. ***java.lang.Integer and java.lang.Boolean***
   - **Flyweight pattern:** Wrapper classes like integer and Boolean reuse objects Integer.ValueOf() caching small integers b/w -128 and 127. This reduces memory usage by sharing the instances.
2. ***java.io.InputStreamReader, java.io.OutputStreamWriter, java.util.Arrays***

- **Adapter Pattern:** InputStreamRender and OutputStreamWriter adapt streams to character streams. And Array.asList() adapts array into List making it usable with collection framework.

3. ***java.io.BufferedInputStream, java.io.DataInputStream, java.io.BufferedOutputStream, java.util.zip.ZipOutputStream, java.util.Collections#checkedList()***

   - **Decorator Pattern:** the above classes wrap existing streams to add new functionality without changing their structure. Buffered, data, and Zip stream or type-checking enhance base functionality without altering the underlying object.

   - Decorators like Buffered, Data, and Zip streams or type-checking for Collections enhance base functionality without altering the underlying object.

3. Behavioral Design Pattern

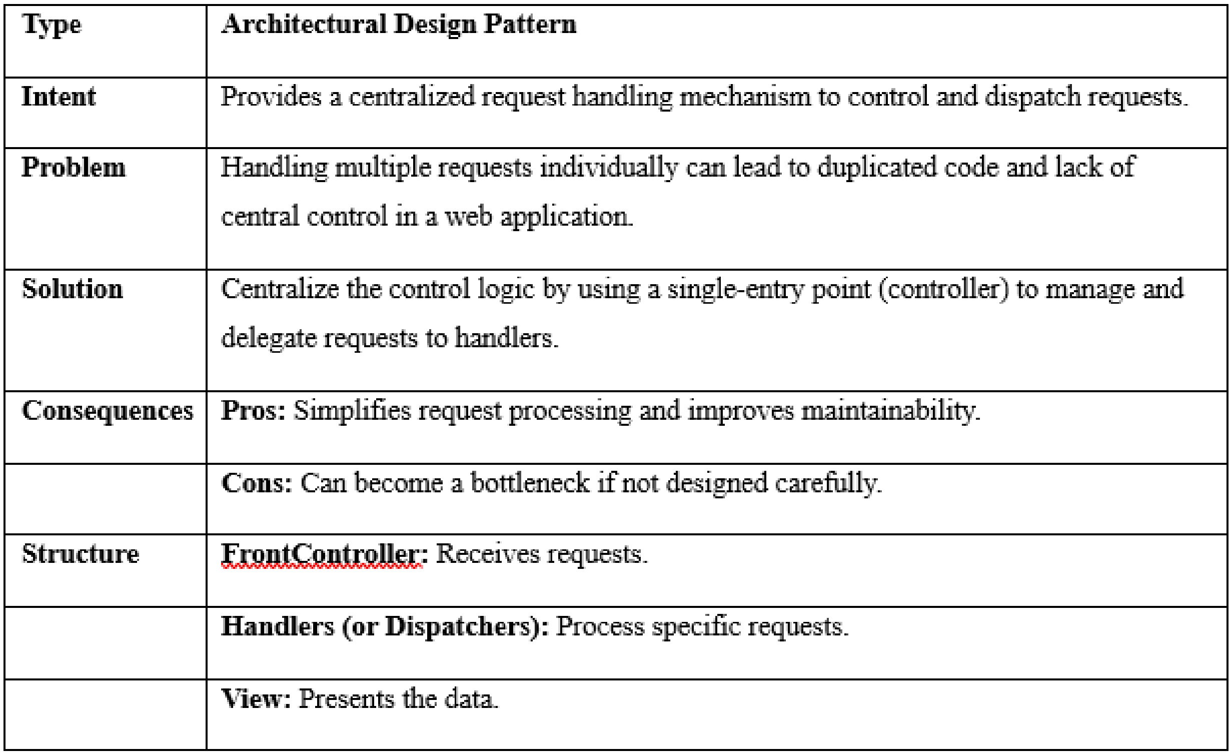
1. ***javax.servlet.FilterChain***
   - **Chain of Responsibility Pattern:** Filterchain allows multiple filters to process requests sequentially. Each filter passes the request to the next filter in chain until final resource is reached i-e Servlet
2. ***java.lang.Runnable and java.util.concurrent.Callable***
   - **Command Pattern:** Runnable and callable do encapsulation of a task or command in object to be executed later, which promotes decoupling as tasks can be executed by any thread.
3. ***java.util.Iterator***
   - **Iterator Pattern:** The Iterator provides a way to traverse collections without exposing their underlying structure. It encapsulates traversal logic and simplifies access.
4. ***java.util.Comparator and javax.servlet.Filter***
   - **Strategy Pattern:** Comparator allows you to define different comparison strategies for sorting objects. Filter provides a strategy for processing requests or responses in servlets.
5. ***java.util.AbstractList, java.util.AbstractSet, java.util.AbstractMap***
   - **Template Method Pattern:** These abstract classes define a skeleton (template) for specific collection implementations. Subclasses must implement specific methods, but the overall flow remains defined in the abstract class.
6. ***java.io.InputStream, java.io.OutputStream, java.io.Reader, java.io.Writer***

   - **Template Method Pattern:** These I/O classes define an abstract flow for input and output operations, where concrete subclasses implement specific behavior.

7. ***java.util.EventListener and java.util.Observer/java.util.Observable***
    - **Observer Pattern:** EventListener is used to observe and respond to events (like UI events). Observer/Observable follow the observer pattern, where the Observable object notifies all registered observers when its state changes.

Q2: Design Patterns (Intent and Explanation)

1. Front Controller Pattern



Type	**Architectural Design Pattern**
Intent	Provides a centralized request handling mechanism to control and dispatch requests.
Problem	Handling multiple requests individually can lead to duplicated code and lack of central control in a web application.
Solution	Centralize the control logic by using a single-entry point (controller) to manage and delegate requests to handlers.
Consequences	**Pros:** Simplifies request processing and improves maintainability.
	Cons: Can become a bottleneck if not designed carefully.
Structure	**FrontController:** Receives requests.
	Handlers (or Dispatchers): Process specific requests.
	View: Presents the data.

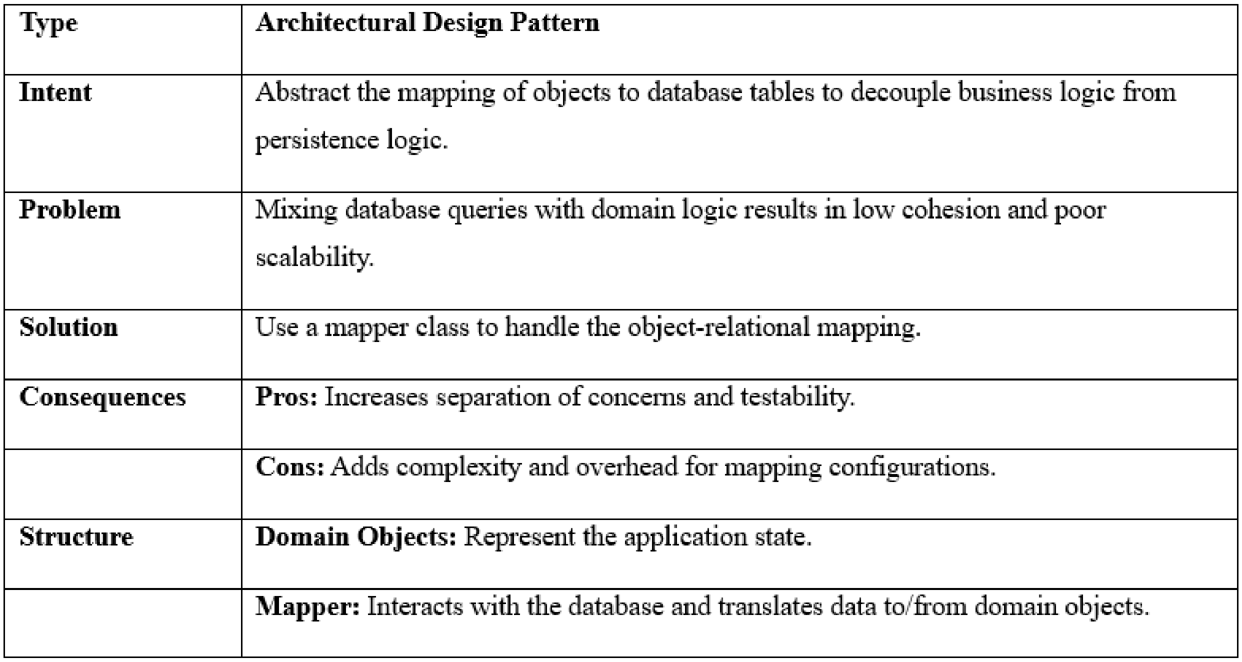
2. Application Controller Pattern

Type	**Architectural Design Pattern**
Intent	Centralizes and decouples the processing logic from the input-handling logic.
Problem	When logic is dispersed, changes in business rules require multiple updates.
Solution	Use a controller that maps user requests to business logic and delegates responsibilities appropriately.
Consequences	**Pros:** Promotes reusability and separation of concerns.
	Cons: Adds an additional layer of complexity.
Structure	**Controller:** Manages requests and delegates them to appropriate services or commands.
	Model and View: Remain separate.

3. Dependency Injection Pattern

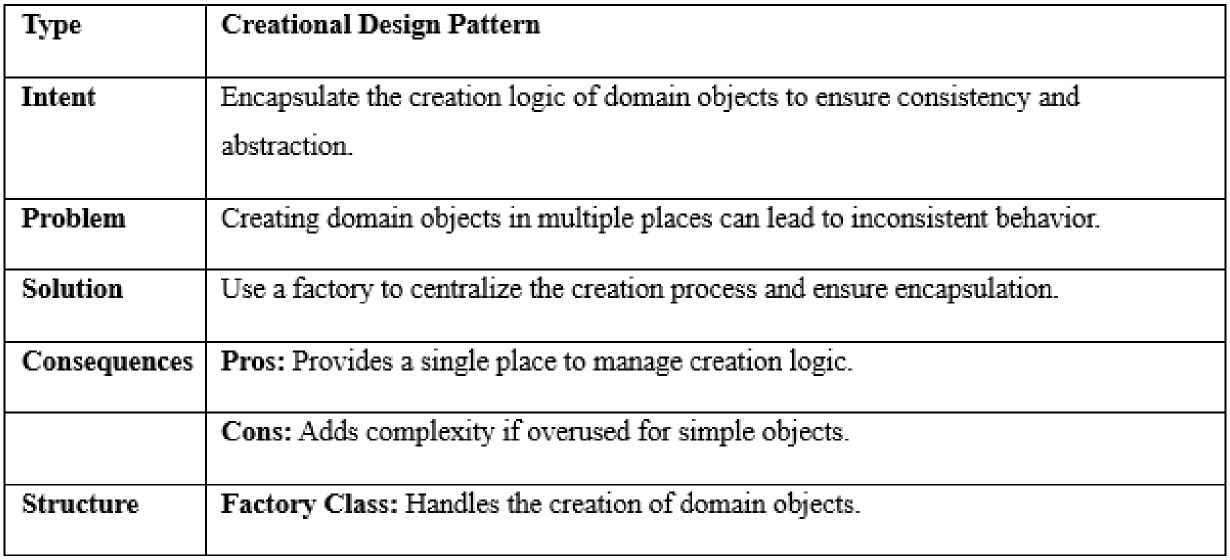
Type	**Creational Design Pattern**
Intent	Decouple object creation from its use, allowing dependencies to be injected at runtime.
Problem	Tight coupling between objects makes unit testing and future modifications difficult.
Solution	Use a container or framework to inject required dependencies into objects.
Consequences	**Pros:** Increases testability and flexibility.
	Cons: Can lead to overuse of frameworks and complexity in configuration.
Structure	**Injectors:** Provide the dependencies.
	Dependent Objects: Use those dependencies.

4. Data Mapper Pattern



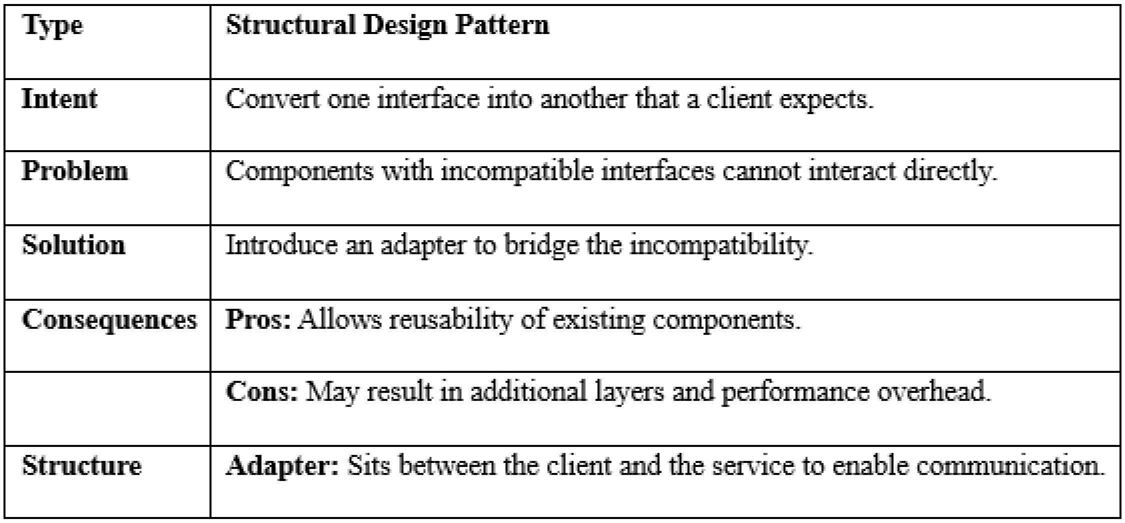
Type	**Architectural Design Pattern**
Intent	Abstract the mapping of objects to database tables to decouple business logic from persistence logic.
Problem	Mixing database queries with domain logic results in low cohesion and poor scalability.
Solution	Use a mapper class to handle the object-relational mapping.
Consequences	**Pros:** Increases separation of concerns and testability.
	Cons: Adds complexity and overhead for mapping configurations.
Structure	**Domain Objects:** Represent the application state.
	Mapper: Interacts with the database and translates data to/from domain objects.

5. Domain Object Factory Pattern



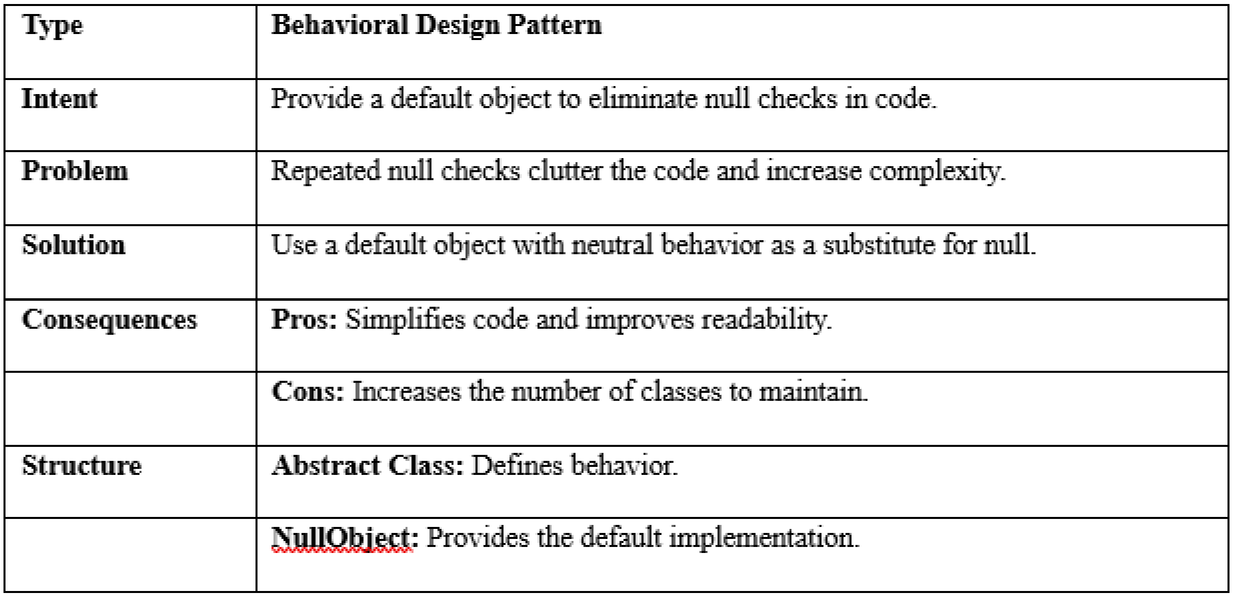
Type	**Creational Design Pattern**
Intent	Encapsulate the creation logic of domain objects to ensure consistency and abstraction.
Problem	Creating domain objects in multiple places can lead to inconsistent behavior.
Solution	Use a factory to centralize the creation process and ensure encapsulation.
Consequences	**Pros:** Provides a single place to manage creation logic.
	Cons: Adds complexity if overused for simple objects.
Structure	**Factory Class:** Handles the creation of domain objects.

6. Adaptive Design Pattern



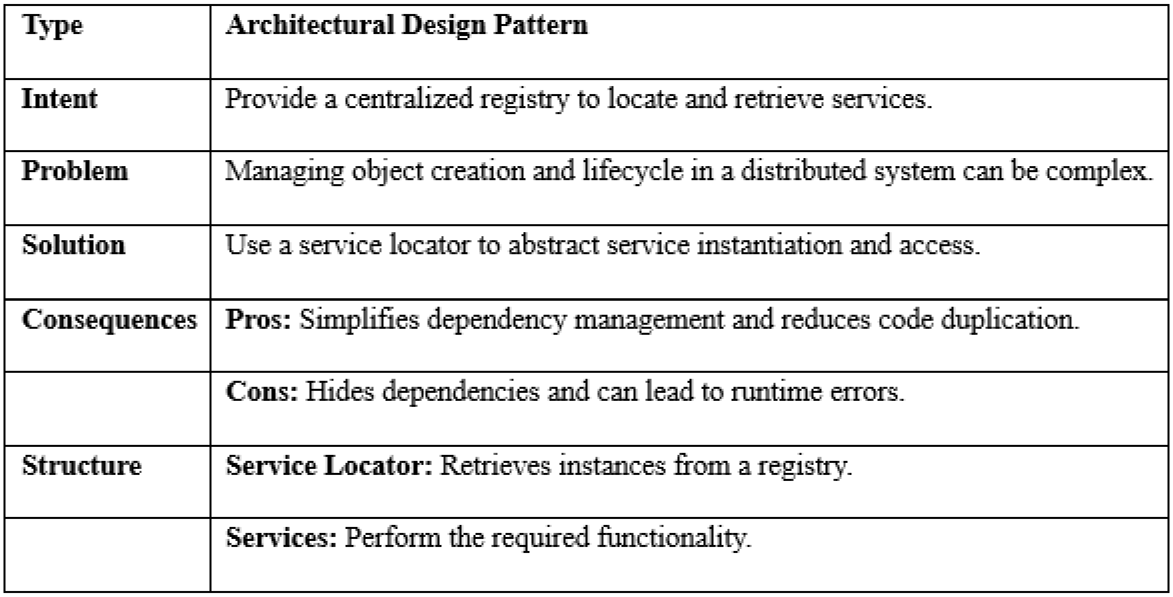
Type	**Structural Design Pattern**
Intent	Convert one interface into another that a client expects.
Problem	Components with incompatible interfaces cannot interact directly.
Solution	Introduce an adapter to bridge the incompatibility.
Consequences	**Pros:** Allows reusability of existing components.
	Cons: May result in additional layers and performance overhead.
Structure	**Adapter:** Sits between the client and the service to enable communication.

7. Null Object Pattern



Type	**Behavioral Design Pattern**
Intent	Provide a default object to eliminate null checks in code.
Problem	Repeated null checks clutter the code and increase complexity.
Solution	Use a default object with neutral behavior as a substitute for null.
Consequences	**Pros:** Simplifies code and improves readability.
	Cons: Increases the number of classes to maintain.
Structure	**Abstract Class:** Defines behavior.
	NullObject: Provides the default implementation.

8. Service Locator Pattern



Type	**Architectural Design Pattern**
Intent	Provide a centralized registry to locate and retrieve services.
Problem	Managing object creation and lifecycle in a distributed system can be complex.
Solution	Use a service locator to abstract service instantiation and access.
Consequences	**Pros:** Simplifies dependency management and reduces code duplication.
	Cons: Hides dependencies and can lead to runtime errors.
Structure	**Service Locator:** Retrieves instances from a registry.
	Services: Perform the required functionality.