Software Engineering

Assignment – 6

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Software Architecture Patterns

Layered Architecture

Layered architecture is one of the most widely used patterns in the Software Development industry. It is also known as the n tiered architecture. Components in the layered architecture are organized in horizontal layers, where each of the layer performs a specific role. The number of layers depends on the complexity of the application and it can vary from 3 for small applications to 5 or more in large enterprise scale applications. The layers can broadly be categorized into presentation layer, business layer, persistence layer and database layer.

Each of the layer is isolated and responsible for a specific functionality and no layer tries to tinker with the functionality of another layer. Because of clear decoupling of responsibilities, a layer does not worry about the implementation of other layers logic. Even when the logic in a layer has changed it does not affect other layers. Every request from an originating layer to end layer is transferred through the middleware layers but never directly to the end layer.

Event Driven Architecture

The event driven architecture is an asynchronous architecture that is used to provide scalable applications. The applications can be large or small but the patter works well with it. The architecture contains 2 topologies – mediator and broker. The mediator topology is used whenever multiple steps in an even have to be coordinated with a central mediator. In broker topology, events are chained together without the use of central mediator.

Mediator topology contains four main components – event queues, event mediator, event channels and event processers. The event is received to the event queue. Then the event is transported to the event mediator. The event mediator orchestrates by sending the event to multiple event channels. Event processers get the event from the channels and executes the logic on the event. Broker topology contains just two components a broker component and an event processer. The messages are routed through broker and the events are processed on the event processer.

Micro Services Architecture

Micro services architecture is one of the newest architectures. It involves several micro services that are deployed. Each of the service is independent of each other and self-contained in itself. Scalability can be increased without burdening the other services, downtime of one service does not affect other services.

Micro service architecture replaces the monolithic applications that exist currently. The most important part of a micro service architecture is the service component. A service is a special business processing unit that performs a specified work and is independent from others. It can be a small component to a very big application.

Micro Kernel Architecture

The Micro Kernel Architecture is a preferred pattern for implementing product based applications. Product based applications are those that are packaged and sold to clients. This architectural pattern allows to add new application features and plugins to the existing application. The architecture contains mainly two components – core system and plugin modules that support the core system. The core system has only minimal features to make the system working and the rest of the core features are embedded as plugins. Many operating systems have utilized this model.

The plugin modules are standalone independent components that have special tasks and they provide additional business advantage. The core system must know about the additional plugins and they can be tracked using a plugin registry. Plugin modules can be connected to the core systems in a variety of ways such as messaging, web services etc. The pattern does not specify of any connection pattern but it only informs about the independence of the modules.

Space Based Architecture

Web applications follow a flow: a request for a resource, usually hits the web server then the application server and then the database server. This pattern works great when the number of users using the system is relatively low. But as the number of users increase, the load increases on the web server, but as we scale the web server the burden falls on the application server which is complex to scale and then on the database server. Scaling is relative, web server is the easiest to scale and database server is the hardest amongst all. In a web application, database server usually is the bottle neck that decides how many users can access the website concurrently.

Space based architecture solves this problem by minimizing the factors that prevent an application from scaling. Central database which is usually a constraint is removed and replaced with replicated in-memory grids. Since no central database is present the application scales linearly. The architecture contains two primary components – processing unit and virtualized middleware. The processing unit contains the application. Larger application can be deployed into multiple processing units. The virtualized middleware is the key component, it handles communications and data synchronization across.

Project Examples:

Layered Architecture: A website that allows students to interact by posting questions and answering questions posted by others. Layered architecture works well in this project because we can divide the project broadly into presentational layer, business layer and database layer.

Also as the business layer can change constantly during development, the other layers are not affected. So it is best suited to Layered architecture.

Event Driven Architecture: Kafka. Big Data Pipelines use event driven architectures. They get the data from Kafka as events and process the events and store back the results into a database or store it back into Kafka.

Micro Service Architecture: Amazon. Amazon website has various functionality, searching functionality, recommendation functionality etc. Each of it is independent of other. So, they can be published as micro services so as one application downtime does not cause whole Amazon to shut down.

Micro Kernel Architecture: Microsoft word. The basic editing functionalities of Microsoft word can be a core system and the other plugins supporting the core system can be drawing pictures, attaching photos, drawing charts etc. Whenever a new feature comes in it can be added to the product as a plugin.

Space Based Architecture: Facebook. Since the website is really scalable and involves a lot of data processing and data querying. Space based architecture with its core components will help the website scale.

Ranking of Architectures:

1. **Event Driven Architecture**: This architecture is really useful for real time applications that process data as it arrives. As IOT is becoming main stream, event driven architecture is very important component in developing applications
2. **Micro Service Architecture:** The architecture is gaining traction and developers are trying to build applications with various micro services and are benefitting with its scale and simplicity.
3. **Space Based Architecture**: This architecture powers highly scalable websites. As the number of users on web increase, the space based architecture gains importance.
4. **Micro Kernel Architecture:** Many products are being developed for mobile devices, computers and for a variety of devices. Micro Kernel architecture plays an important role in those application architecting.
5. **Layered Architecture:** The architecture is best for its simplicity, but as applications are growing more complex, layered architecture gets replaced by others