ASSIGNMENT 1

Architectural Styles and their Use Cases

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Architectural Styles and their Use Cases

1. Layered

- Components are organised in layered fashion, where each layer provides services to the layer above and acts as client to below.

- Use Cases:
    - **Operating Systems**: Windows handles hardware via kernel interaction and provides user-facing applications like MS Word.
    - **Web Applications***:* Netflix uses this architecture to separate UI (React), services (Java-based microservices) and data (AWS DynamoDB).

2. Client Server

- In this model processes are divided into two groups.
- A server is a process implementing a specific service.
- A client is a process that requests a service from a server.

- Use cases:
    - **Web Browsers and Servers**: Firefox (client) communicates with Youtube servers to stream videos.
    - **Email Systems**: Microsoft Outlook (client) interacts with Exchange Server (server) to send/receive emails.
    - **Database Systems**: Applications like Salesforce (client) query a central database server (eg. Oracle or PostgreSQL).

3. Peer-to-Peer

- A P2P architecture consists of decentralised networks of peers, where nodes act as both clients and servers.

- Use Cases:
    - **File Sharing**: BitTorrent is a P2P protocol used for sharing large files (eg. movies, software).
    - **Blockchain Networks**: Bitcoin is a P2P cryptocurrency without any central monetary authority.

4. Batch-Sequential

- Processes data in discrete steps, where each step must complete before the next begins.

- Use Cases:
  - **Scientific Simulations**: NASA weather models process collected satellite data in sequential steps like calibration, analysis and prediction.
  - **ETL Pipelines**: Companies like Walmart use batch-processing pipelines to analyse sales data overnight.

5. Pipes and Filters

- Data flows through a series of filters which are connected by pipes, where each filter transforms data and passes it to the next.

- Use Cases:
  - **Compilers**: GCC uses pipes & filters for lexical analysis, parsing, and code generation.
  - **Image Processing**: Photoshop plugins process images in a pipeline (eg. filter, resize, enhance).

6. Pub/Sub

- Publishers send messages to a topic, and subscribers receive messages based on their interests.

- Use Cases:
  - **Real-Time Notifications**: Twitter uses Pub/Sub to push tweets to followers in real time.
  - **IoT Systems**: Smart home devices (eg. Amazon Echo) use Pub/Sub to communicate state changes (eg. lights on/off).
  - **Stock Market Updates**: Bloomberg Terminal uses Pub/Sub to deliver real-time stock prices to traders.

7. Model-View-Controller

- Separates the application into Model (data), View (UI) and Controller (logic).

- Use Cases:
  - **Web Frameworks**: Shopify's admin panel separates the product catalog (model), dashboard interface (view) and user input logic (controller).
  - **Mobile Apps**: Spotify's playlist feature uses MVC to manage song data, UI interactions and playback logic.

8. Service-Oriented

- System is composed of loosely coupled, reusable services which communicate through APIs.

- Use Cases:
  - **Enterprise Systems**: Salesforce uses SOA to integrate CRM marketing and analytics services.
  - **E-Commerce Platforms**: Amazon uses SOA to manage services like product catalog, payment and shipping.
  - **Cloud Applications**: Netflix uses SOA to manage microservices for streaming, recommendations, and user profiles.

9. Blackboard

- A shared knowledge (blackboard) base where multiple components work together to solve complex problems.

- Use Cases:
  - **Speech Recognition**: Google Assistant uses a blackboard architecture to process audio input, language models and context.
  - **Self-Driving Cars:** Tesla uses a blackboard to process sensor data, route planning, real-time navigation.

10. Universal Plug n Play

- Enables devices to dynamically join a network and communicate seamlessly.

- Use Cases:
  - **Smart Home Systems**: Philips Hue lights use UPnP to connect with home automation systems.
  - **Gaming Consoles**: PlayStation and Xbox automatically detect UPnP-compatible routers for seamless multiplayer gaming.