

# Layered Architecture

CSSE6400

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Ogres are like onions.

*Ogres have layers*, onions have layers...

You get it? We both have layers.

- Shrek

In the beginning...

There was the big ball of mud [1]



Figure: Image from "How to Avoid Spaghetti Code" [2].

## Problem

Any change can affect any other part of the software.

“Solution”

# Layered architecture



Figure: *Traditional* 4-tier, layered architecture.



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### Question

Can you identify an example of layered architecture?

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### Answer

Pick any website.



Figure: J2EE layered architecture (from *Requirements Analysis and System Design* [3]).



**Figure:** PCBMER layered architecture with sidecars (adapted from *Requirements Analysis and System Design* [3]).

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**Entity** Classes representing persistent business objects.

**Resource** Manages interactions with external persistent data sources.

### Definition 1. Layer Isolation Principle

Layers should not depend on implementation details of another layer. Layers should only communicate through well defined interfaces (*contracts*).

### Definition 2. Neighbour Communication Principle

Components can communicate across layers only through directly neighbouring layers.

### Definition 3. Downward Dependency Principle

Higher-level layers depend on lower layers, but lower-level layers do not depend on higher layers.



#### Definition 4. Upward Notification Principle

Lower layers communicate with higher layers using general interfaces, callbacks and/or events. Dependencies are minimised by not relying on specific details published in a higher layer's interface.

### Definition 5. Sidecar Spanning Principle

A sidecar layer contains interfaces that support complex communication between layers (e.g. design patterns like the observer pattern) or external services (e.g. a logging framework).

Good architectural design...

Applies these principles to deliver simple, modular designs that support modifiability.

## References

- [1] Brian Foote and Joseph Yoder.  
*Big ball of mud.*  
*Pattern languages of program design*, 4:654–692, 1997.
- [2] Gulsah.  
*How to avoid spaghetti code.*  
<https://tech.zensurance.com/posts/spaghetti-code>, November 2020.  
note = "Accessed: 2022-02-18".
- [3] Leszek A. Maciaszek.  
*Requirements Analysis and System Design.*  
Addison-Wesley Harlow, 3rd edition, 2007.