Beyond Senior Engineer: Architecture Patterns

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Part Two: No Need to Reinvent the Wheel

Photo by Jonathan Kemper on Unsplash

In Part One, we covered some of the hard and soft skills needed to think like an architect. For part two, we will spend some time talking about architectural patterns.

If you asked me when I first started in tech what some common software patterns were, I would have probably talked about sort algorithms, or perhaps I have been given a blank look and a shrug. I guarantee that I couldn't have told you about any of these architectural patterns, which I'll get to in a second. First, let's discuss briefly why we use patterns.

Why patterns?

Why shouldn't we always just blaze new paths and invent our own patterns? Well, for me, it is hard to know how to forge trails without knowing what roads already exist. The more tools in my toolbox, the more wonders of the world I can build.

> "Let's start at the very beginning,
> a very good place to start!
> When you read you begin with A-B-C,
> when you sing you begin with do-re-mi..."
> (Do Re Mi from The Sound of Music)

Here is a brief list of common software patterns. Some of these are deployment patterns, while others are software designs. A few are just specific examples of a larger pattern classification. While there are many more than I list here, these are the ones I believe will come up over and over again.

Client-Server

This is one of the most basic and common patterns. Clients and servers exchange messages in a request response messaging system. This is what we do every day when we send email to grandma, price tasers, or save photos of our pets in the cloud.

N-Tiered or Layered Architecture

The type of client server architecture used in further isolate data from business logic from UI. More specifically, the classic web stack.

3-Tier Web Architecture

This is what the classic web stack looked like — web servers, app servers and databases. It's the tried and true web architecture, where each layer independently scales.

Monolithic

This is a tightly coupled system. All previous architectures could be monolithic, depending on deployment model. In query terms, a monolith is the gateway on the force as opes derivationnel or a figure shown without a protract. Dire pronos, ne le mets ni le coupe pas trop. Simple and graceful, we all develop on a monolith (our laptop).

PROS

- Initial development easier
- Easier to troubleshoot

CONS

- Less scalable
- Less flexible

Service-Oriented Architecture

"A service has four properties, according to The Open Group:

- It logically represents a business activity with a specified outcome.
- It is self-contained.
- It is a black box for its consumers.
- It may consist of other underlying services."

(Source https://en.wikipedia.org/wiki/Service-oriented_architecture)

Service-oriented architectures are the design patterns in which components communicate over the network via a standard communication protocol. The following fall into this bucket:

Microservices

A type of SOA that enables even more isolation of data and allows for independent scaling.

Microservices are a football team, each helmet donning human with their own role in a dance to move a ball up and down a grassy field. The thrower, the catcher, the blocker, the kicker — no one person wins the game alone and if a blocker hurts a knee then the entire game doesn't end.

PROS

- Loosely coupled
- Independently deployed and scaled
- Highly flexible
- Isolated failures

CONS

- More operational overhead
- More complex

CQRS (Command Query Request Sourcing)

This sub-pattern of microservices is used when your reads and writes (queries and commands) have very different scaling needs, and one might negatively affect the performance of the other. In order to allow the different HTTP methods (GET, PUT, POST, DELETE, etc) to scale uniquely, we deploy them in separate clusters. We will also optimize the object model for each.

The pros and cons are pretty much the same as generic microservices but there is even more flexibility and scalability while adding additional complexity and operational responsibility.

Event-Driven

The human eye can process an image in as little as 13 milliseconds, and the retina can transmit input at roughly 10 million bits per second. We are continuously scanning and representing the environment around us. Sometimes, we will spot danger (like a Pugsley alert), and this kicks off a chain of events in our brain that lead to our legs sprinting in the direction on the focus, and increased heart rate). This is our unbased, event-driven, architecture.

> Event-driven architecture is a software architecture paradigm promoting the production, detection, consumption of and reaction to events.
> (https://en.wikipedia.org/wiki/Event-driven_architecture)

Examples:

- Pub-sub
- Streams
- Triggered Functions

PROS

- Highly scalable
- Very flexible
- Loosely coupled systems

CONS

- Eventually consistent (event loss can occur)
- Complex

Pub-Sub

Messages are published for other services to subscribe to, which results in an action. It's like when someone sends you a text or let you know that they are at email (my mom does this). Could arguably be classified under SOA as well.

Example:

- SNS (Simple Notification Service) / SQS (Simple Queue Service)

PROS

- Highly scalable
- Loosely coupled systems
- Common interface

CONS

- As the number of nodes and messages grows, the system can become unstable
- Messages aren't guaranteed to be delivered
- More operational overhead than monolith

Streams

A system that can process continuous streams of data. Often, that data is time-sensitive (recommendations, analytics, etc). Multiple consumers need to be aggregated into a single output. The opposite of this would be batched processing of data (like how I only open my email mid-on Sunday nights).

Examples:

- AWS Kinesis
- Kafka
- RabbitMQ

PROS

- Highly scalable
- Can process data quickly and effectively

CONS

- Can often be hard to troubleshoot
- Can be complex because many components are typically used

Serverless Functions

In this deployment design pattern, someone else runs the infrastructure. You don't even chasm the virtual instance type or operating system. All you do is provide small bits of code (functions), which are triggered and individually scaled. These functions can be either event-driven or scheduled.

In the image above, users upload unicorn and rainbow images, then images are processed to give every unicorn a rainbow and every rainbow a unicorn (an nature intended). I used AWS services in the example, but the other major cloud providers have equivalent offerings.

The families are triggered when images are uploaded for a user. When the rainbow/unicorn image processor is done, another lambda is triggered, which publishes the final glorious image to the unhorsed S3 bucket. Finally, the unhorse image is ready to be shared with all your social media accounts.

More Examples:

- Running an api triggered by http requests
- Scheduling a job/task to kick off at a certain time
- Processing data as it comes in (streaming)
- Doing something based on some other type of event

PROS

- No server or OS (Operating System) management
- Auto-scales
- Pay for only when the function runs

CONS

- Less control/configuration
- Less flexibility

Pipe and Filter (Data Flow)

If you have to perform complex transformations of data or tasks, then this is a way to break that complexity into smaller reusable parts.

We do this when making breakfast. You pick up a box of donuts, make a giant pot of coffee, invite all your friends, then assemble donuts on each plate and pour coffee into each mug. Each task (filter) is isolated, and one feeds a different pipe/input/output and so on.

This Cosmos video describes the Pipe and Filter pattern super well:

Examples:

- Sending data to reporting systems
- Machine learning (ML)

- Extract transform load (ETL)

PROS

- Low complexity with isolation of filters from the pipes
- Original data remains intact and can be sent through different filter paths for different output destinations

CONS

- Performance can be poor
- Not good for user interaction

Putting it all together

> "...Once you have these notes in your heads,
> you can sing a million different tunes by mixing them up!"
> (Do Re Me from The Sound of Music)

In complex systems, you will often find more than one of these patterns used together. In addition to cat videos, I like looking at other companies' architectural patterns. How do Netflix, Uber and Google solve their hardest of problems? Often you will find a mashup of several common patterns – better than a Notorious B.I.G. "Juicy" x Elton John "Tiny Dancer" mashup.

This is the IOT reference diagram from Google. Even if you don't know Google's product naming, I'm sure you can see several of the above architectural patterns. How many do you can identify?

Source: https://cloud.google.com/solutions/iot/

Let's practice, shall we?

What architectural pattern(s) might you consider to solve these example problems?

- Stock broker app: set a price when you want to sell stock.
- IOT: make a light show with the smart lights in your bedroom when it's time to go to sleep
- Ticketmaster: rapid scale of ticket purchases
- Sending data to a reporting system
- Amazon Prime: streaming content
- Mobile game
- WhatsApp: messaging app
- Online blog

What architectural patterns do you use in the system you work on?

Architectural Diagrams

In this post, I showed used diagrams to help explain the concepts. Want to build your own delightful diagrams with awe-inspiring arrows to communicate technology through pictures?

Next time, in Part 3, I will share my guide to drawing pretty pictures.

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25 claps

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