

A 3D rendering of a warehouse conveyor belt system. Several cardboard boxes are positioned on the belt, which is flanked by metal guides. Red laser lines are projected across the scene, creating a grid pattern on the floor and highlighting the boxes. The perspective is from a low angle, looking down the length of the conveyor.

Topics in Software foundations

Unit 3 – Systems approach to Software Engineering

Topics we cover

Introduction to systems modeling

Modeling System of Systems (SoS)

Modeling communications

Modeling UI systems

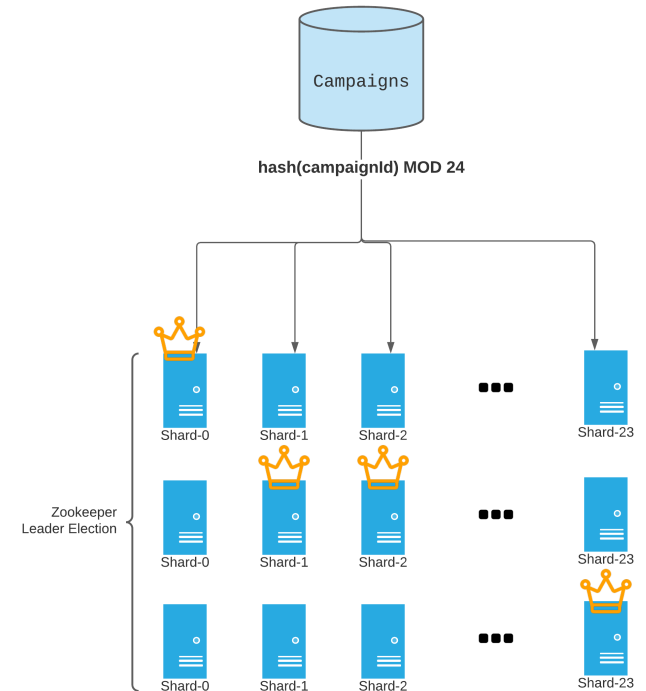
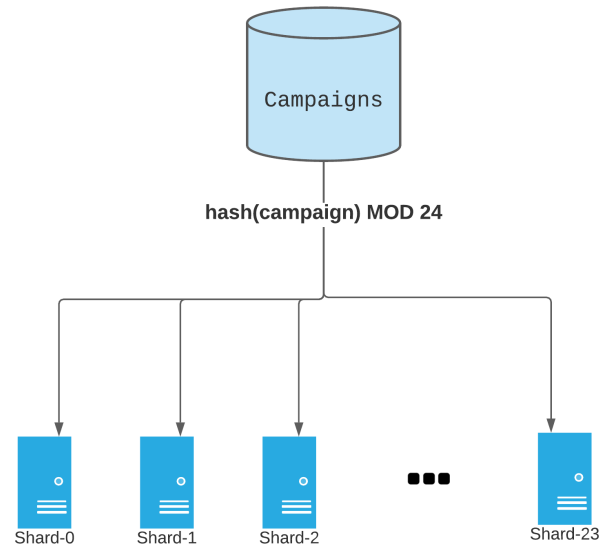
Modeling data access

Formalizing TS as a modeling language

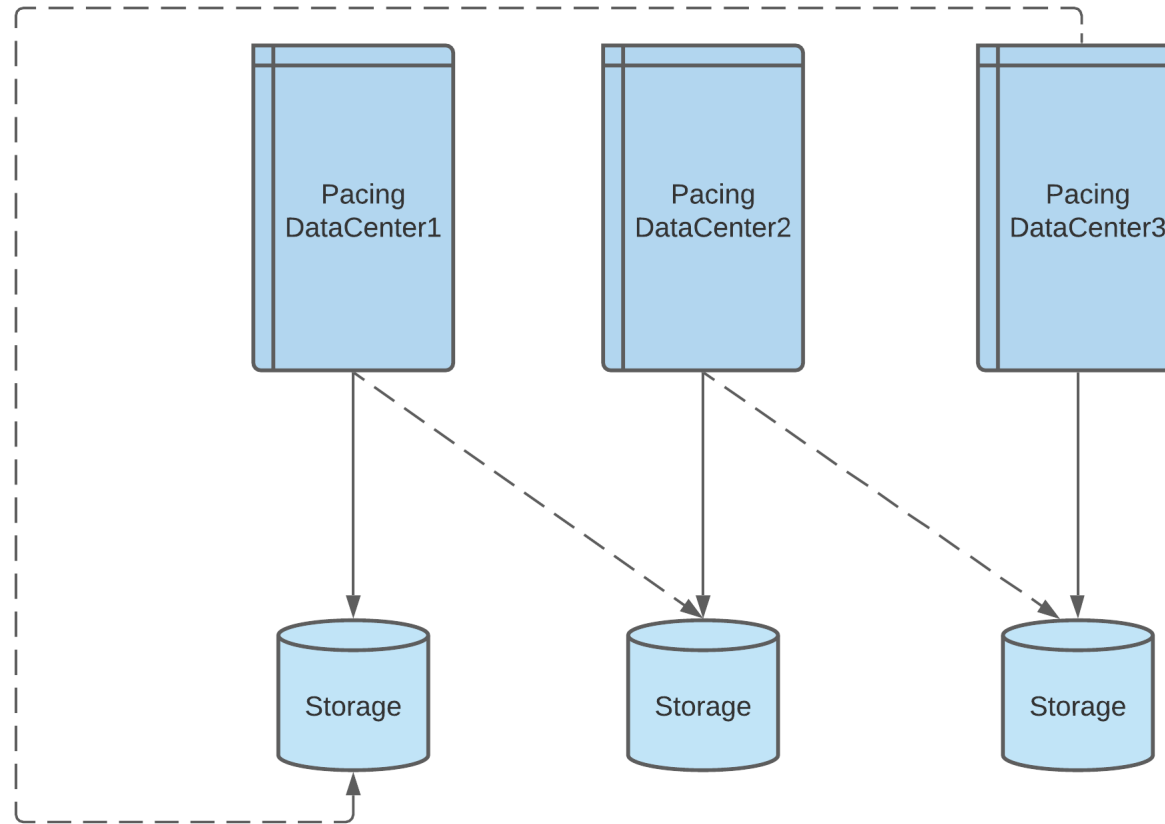
Classwork: Ad Pacing at Twitter

The categorization (Architecture, Model, Design) is a judgement call, important thing is to understand the differences in multiple descriptions of systems (and be able to choose the right one for the given situation)

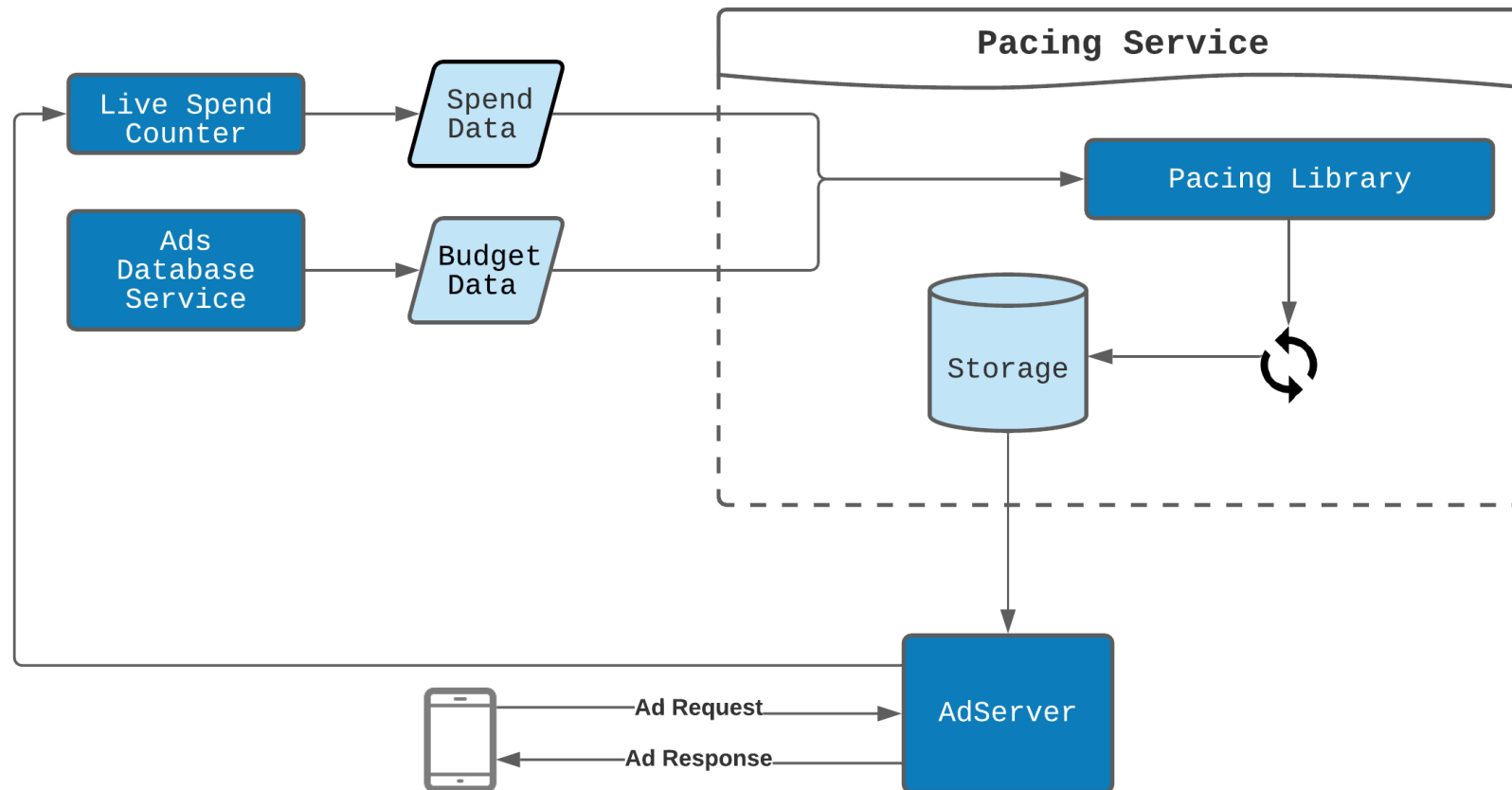
Design for scale → Architect for Reliability



Design for handling DC failure: Allow cross-DC writing



Model the service behavior

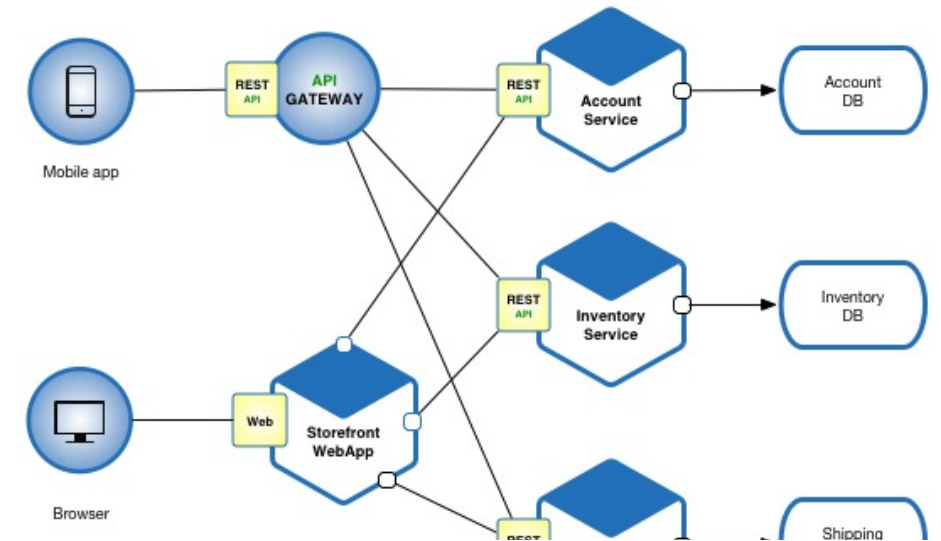
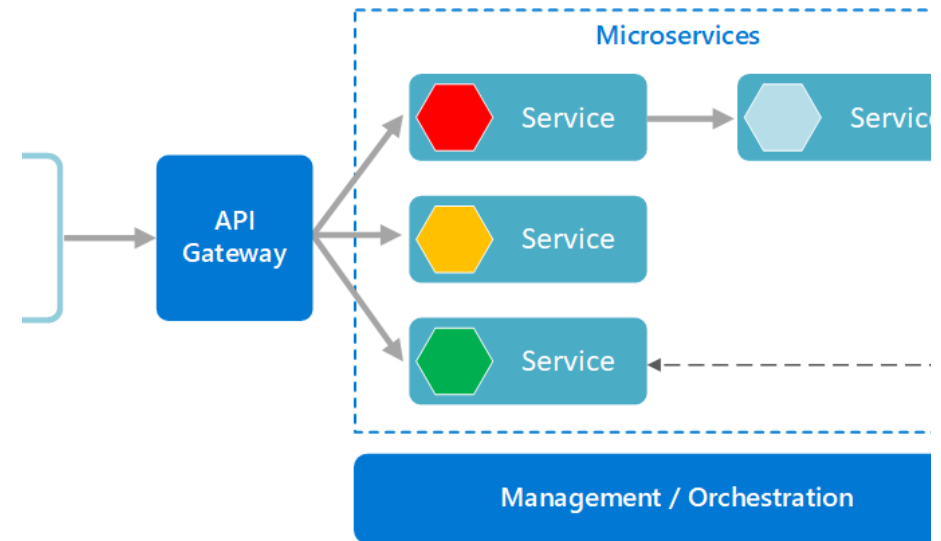


Model

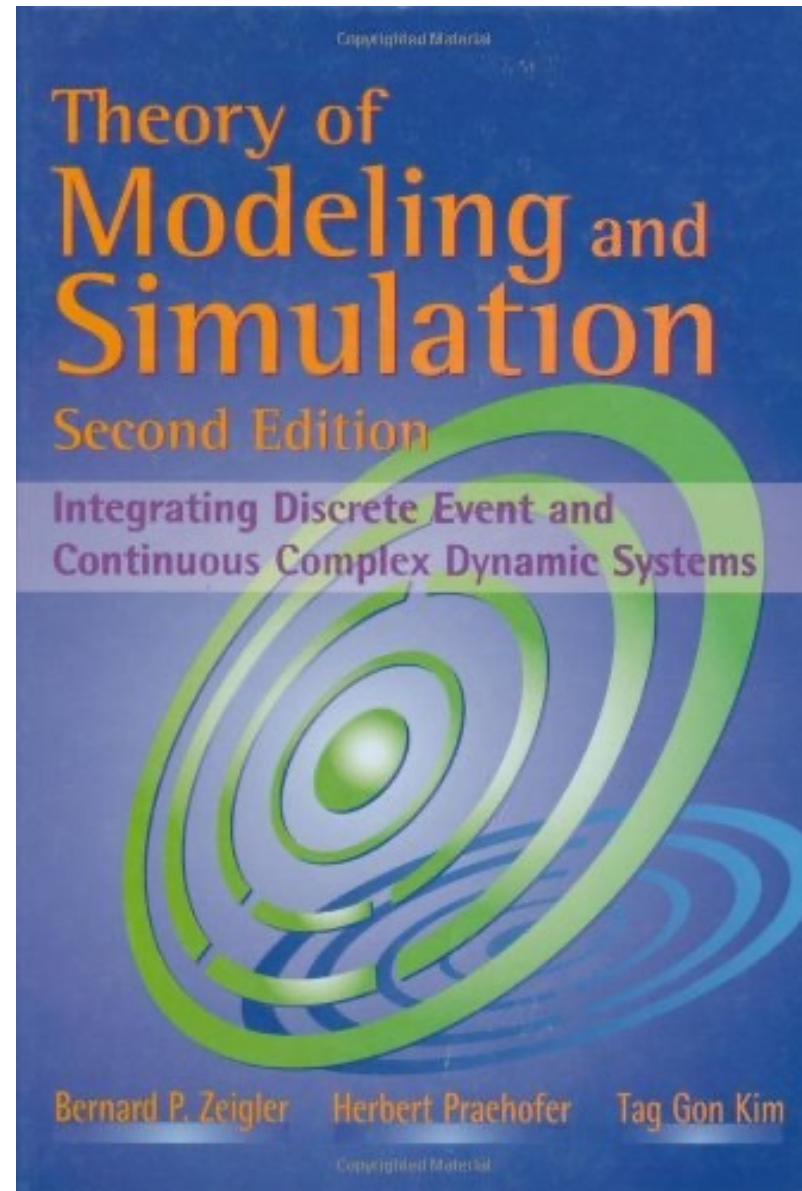
A theoretical representation of a system (or of a part of it) at the desired level of abstraction so that it can be understood, analyzed or simulated

Systems modeling is a different way to see and analyze software systems

Application software are system of systems (SoS)



If you want to
learn more
about systems
modeling



Modeling System of Systems (SoS)

Unit 3 – TiSF S'23
Session 3 (2023-03-30)

Characteristics of modern application software

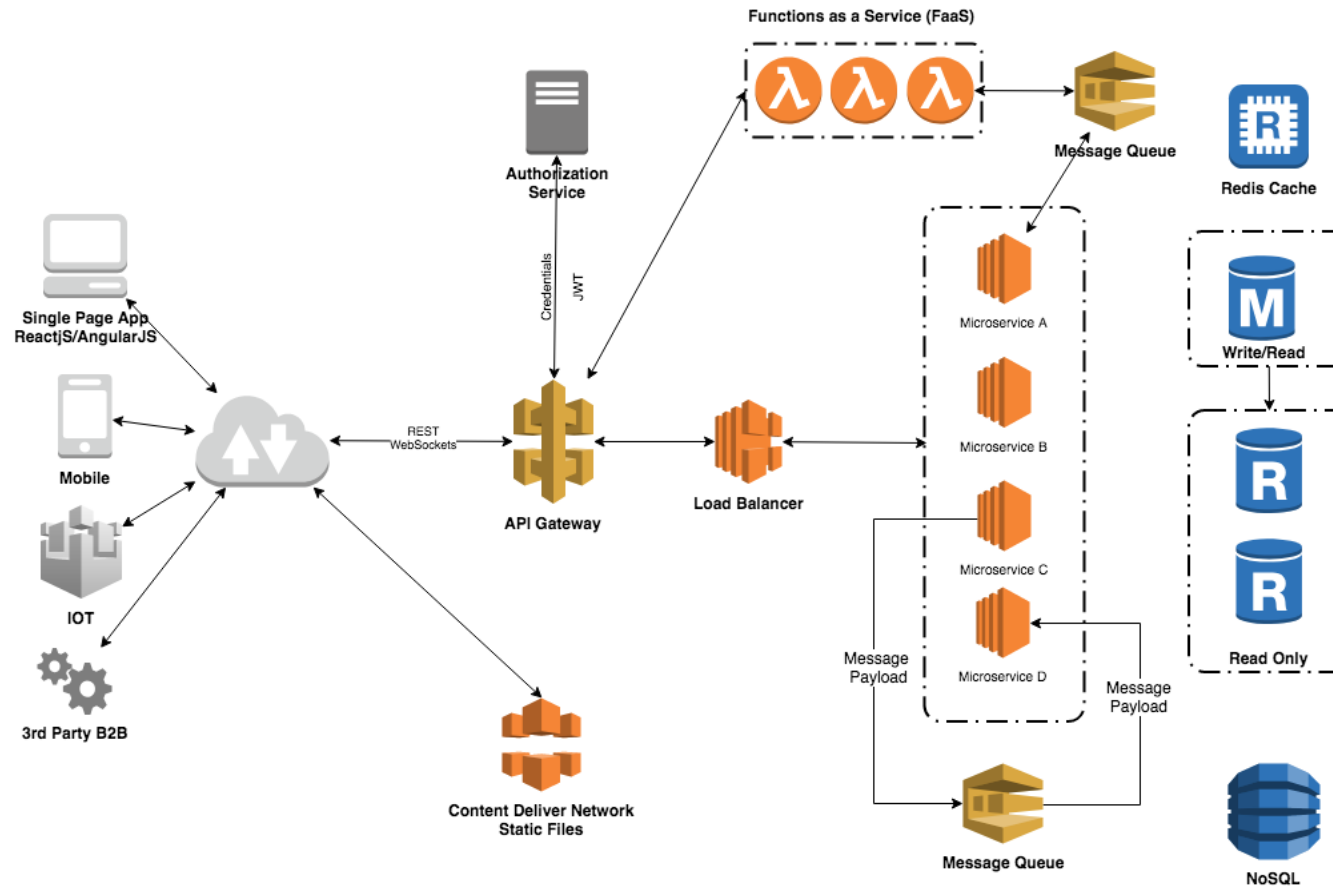
Distributed architecture - Performance, availability, reliability, and other non-functional requirements at scale is a key concern

Composed of microservices and external services running on public cloud

Data intensive – multiple domains of data used by multiple services for their business logic

Rich UI/UX across multiple form factors - multi-layered architecture

Typical Web Application architecture



Is there a typical web application?

B2C applications

- Facebook
- Netflix
- Twitter
- Instagram
- WhatsApp

B2B Applications

- Salesforce
- Magento
- SAP
- Slack
- Office 365

A web application should be understood through models

Behavioral, structural and interaction models can capture the overall behavior of the web application

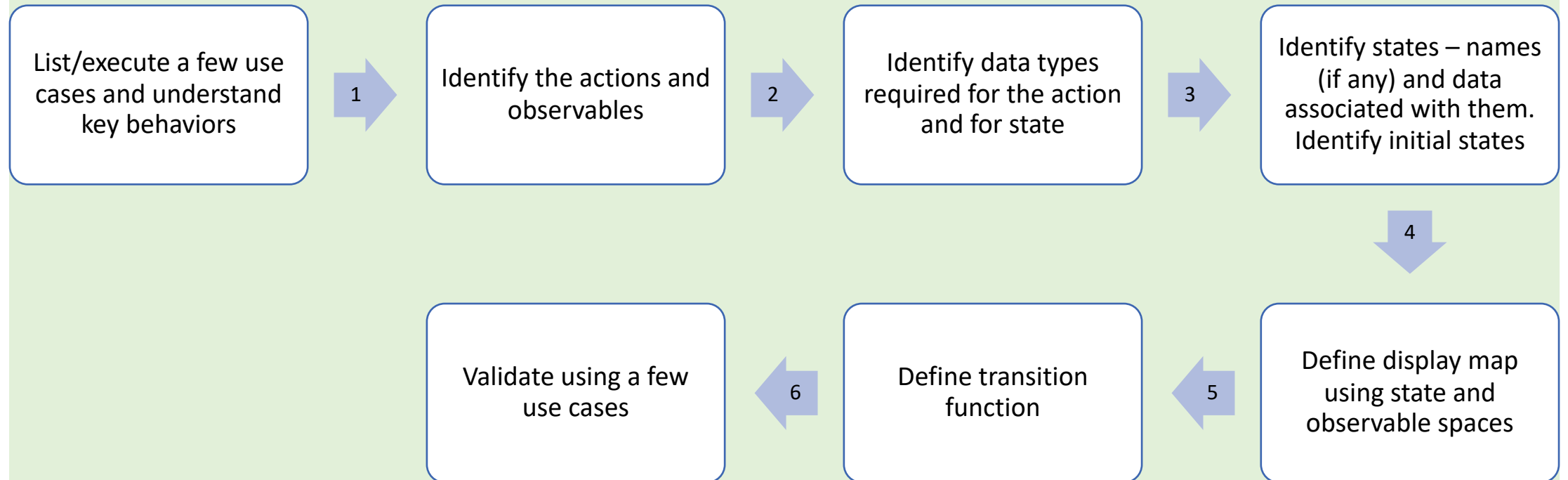
Architecture is a model with a specific set of goals around performance characteristics

The model is built iteratively. It is refined as information is available through different sources

Modeling is a top-down exercise, code comprehension comes later and helps in creating a detailed version of the model

Modeling a system is an iterative process

Information sources (running system, documentation, bug reports, SME sessions)



Let's try
modeling an
online
appointment
booking
system

The screenshot displays the Zenzee online appointment booking system interface. At the top left is the Zenzee logo, and at the top right are navigation links: SERVICES | GIFT CARDS | MEMBERSHIP | SERIES PACKAGES | MRITYUN. A blue banner at the top center reads "SALE PRICE IS UPDATED AFTER 50% DISCOUNT".

The main content area is divided into three sections:

- CENTER:** A dropdown menu shows "ZENZEE SPA AND SALON LLP" with a "Change Center" link.
- SELECT A SERVICE:** A service "Manicure" is selected, priced at ₹400.00 for 60 minutes. A dropdown for "Any Therapist" is visible. A red "Add Another Service" button is at the bottom right of this section.
- SELECT DATE AND TIME:** A calendar for May 2023 shows the 31st as the selected date. To the right, a time slot selection for "Wed, 31 May 2023" shows "11:00 AM" as the selected slot, with other slots at 11:15 AM, 11:30 AM, and 11:45 AM. A yellow bar at the bottom of the time slots says "Scroll to see more time slots".

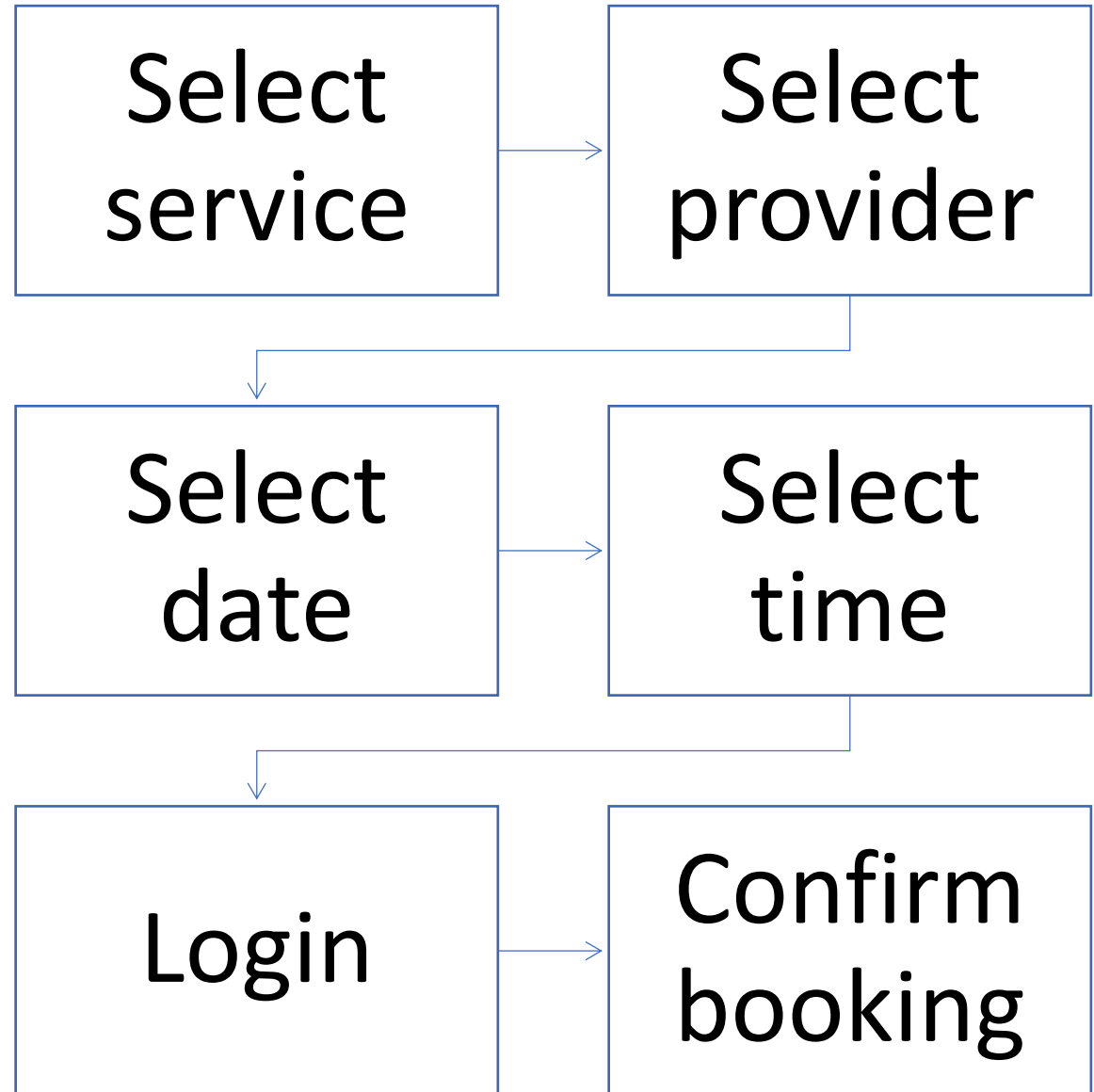
At the bottom left of the main content area, it says "Wed, 31 May 2023 @ 11:00 AM".

On the right side, there is a promotional banner for "GET 50%+25% *Off". Below this, the business details for "ZENZEE SALON & SPA" are listed: "RMZ Futura Block A, Hitech City, Phase 2, Madhapur". A "Phone" number "+91 9676689315" is also provided. At the bottom right, a table shows the "Opening Hours" for each day of the week, all from 11:00 AM to 8:00 PM.

Opening Hours	
Monday	11:00 AM - 8:00 PM
Tuesday	11:00 AM - 8:00 PM
Wednesday	11:00 AM - 8:00 PM
Thursday	11:00 AM - 8:00 PM
Friday	11:00 AM - 8:00 PM

<https://zenotispasalon.zenoti.com/webstoreNew/services>

Booking Flow



Board work

This is a system of systems (SoS)

What are the component systems you can think of?

What are the interconnections?



Some of the
subsystems it
interacts with



Inventory management subsystem



Resource management system



Calendar subsystems

Resource calendar
Employee calendar



Scheduling system (for employees)

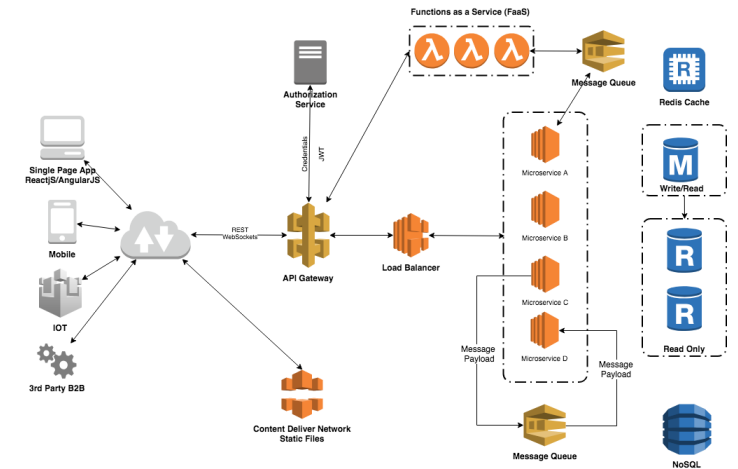
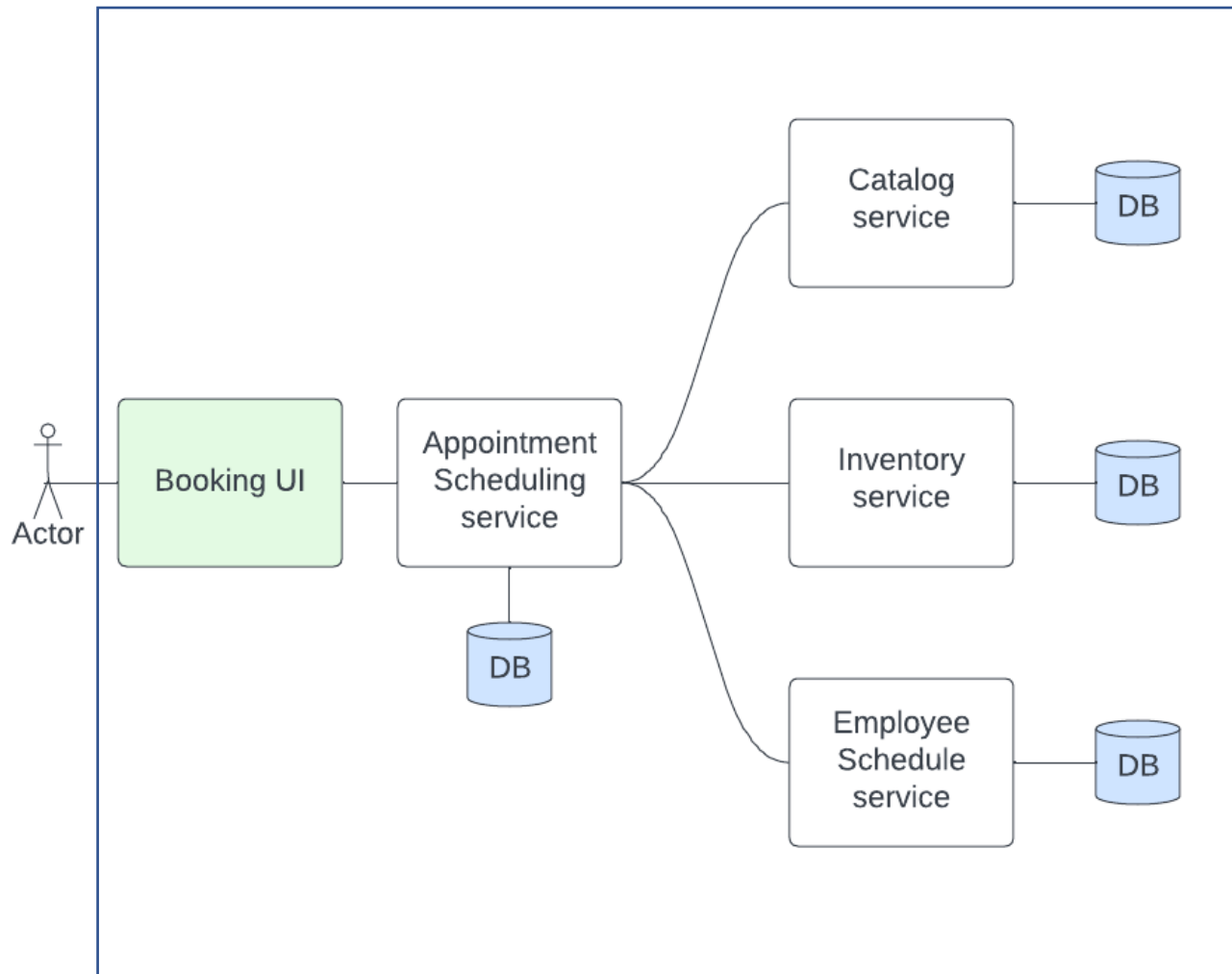


Service catalog system



Pricing System

Appointment booking SoS



We write behavioral model of the SoS – this captures the requirements, the behavior the actor expects to see

We then break into component systems, each with its own transition system model, and interconnections between systems

Board work

Recurring themes in large systems modeling

How do we identify/divine component systems?

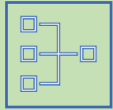
What is the model of an interconnect? Is it like electrical wiring, where data flows? Or is it something smarter?

How should we model communication? Should message M from system A to system B mean Y of A is M, and U of B is M? What about synchronous vs. asynchronous messages?

UI system interacts with human actors, other systems interact with each other, does it make sense to model UI systems in a different way?

Every system owns its data, and needs data from other sources (systems), how do we model them?

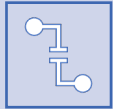
Key themes we will tackle in this course



Component services and interconnections



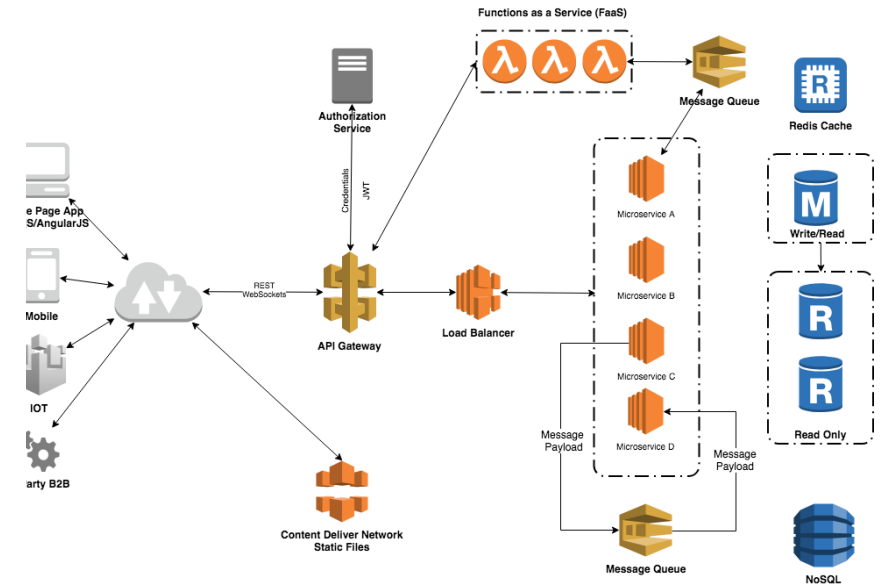
Communication/messaging



Separation between Front-end and back-end



Modeling data access



Questions?