Case Study #1

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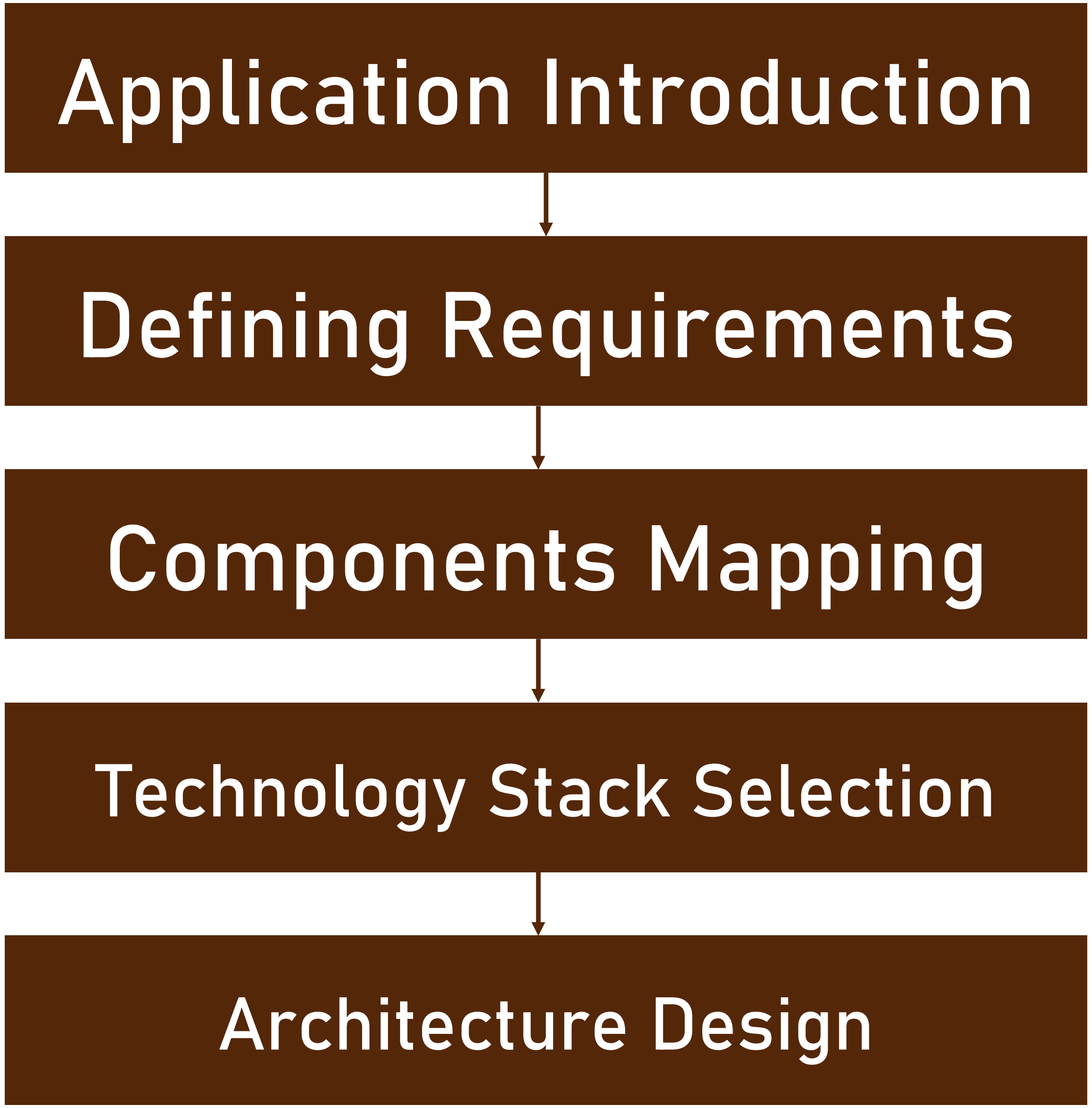
A Real World Application


Application Introduction
Defining Requirements
Components Mapping
Technology Stack Selection
Architecture Design

Dunderly

Your Paper Source

Dunderly

- Sells Paper Supplies
  - Printer paper, Envelopes, etc.
- Needs a new HR system
- Managing employees, salaries, vacations, payments

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Requirements

Functional

What the system should do

1. Web Based
2. Perform CRUD operations on employees
3. Manage Salaries:
    1. Allow manager to ask for employee's salary change
    2. Allow HR manager to approve / reject request
4. Manage vacation days
5. Use external payment system

Non-Functional

What the system should deal with

NFR - What We Know

1. Classic Information System
2. Not a lot of users
3. Not a lot of data
4. Interface to external system

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NFR - What We Ask

1. *"How many expected concurrent users?"*	10
2. *"How many employees?"*	250
3. "*What do we know about the external Payment system?"*	

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Payment System

- Legacy system, written in C++
- Hosted in the company's servers farm
- Input – only files ☹
- File received once a month

Data Volume

- 1 Employee = ~1MB in data
- Each employee has ~10 scanned documents (contract, reviews etc.)
- 1 Scanned Document =~5MB
- Total storage for 1 employee = ~51MB

Data Volume – Cont.

- Company expects to grow to 500 employees in 5 years
- Total storage: 51MB X 500 employees = 25.5GB
- Not a lot, but:
    - Need to consider document storage

SLA

4. “How critical is the system?” Not Very Critical

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Requirements

Functional

What the system should do

1. Web Based
2. Perform CRUD operations on employees
3. Manage Salaries:
    1. Allow manager to ask for employee's salary change
    2. Allow HR manager to approve / reject request
4. Manage vacation days
5. Use external payment system

Non-Functional

What the system should deal with

1. 10 Concurrent users
2. Manages 500 users
3. Data volume forecast: 25.5GB
    1. Relational & Unstructured
4. Not mission critical
5. File-based interface

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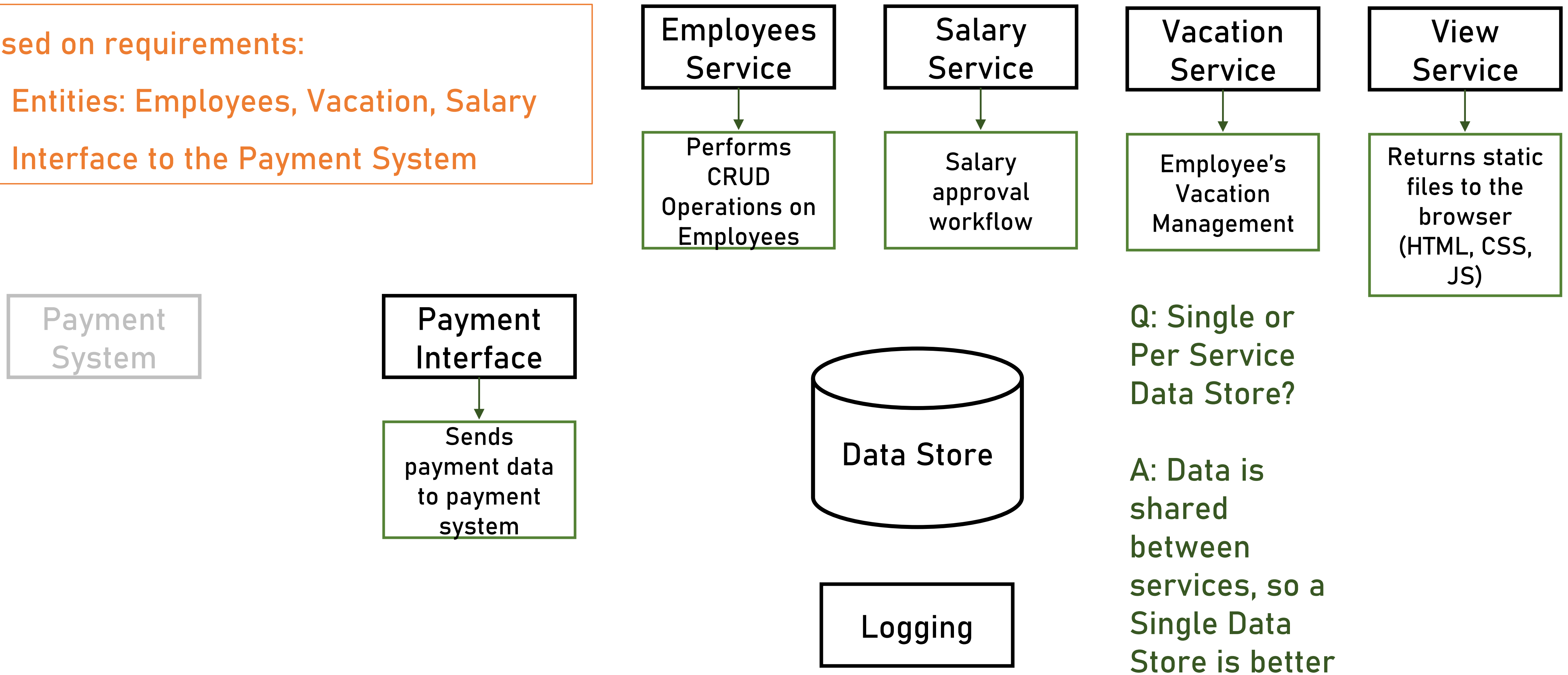
Components

Based on requirements:

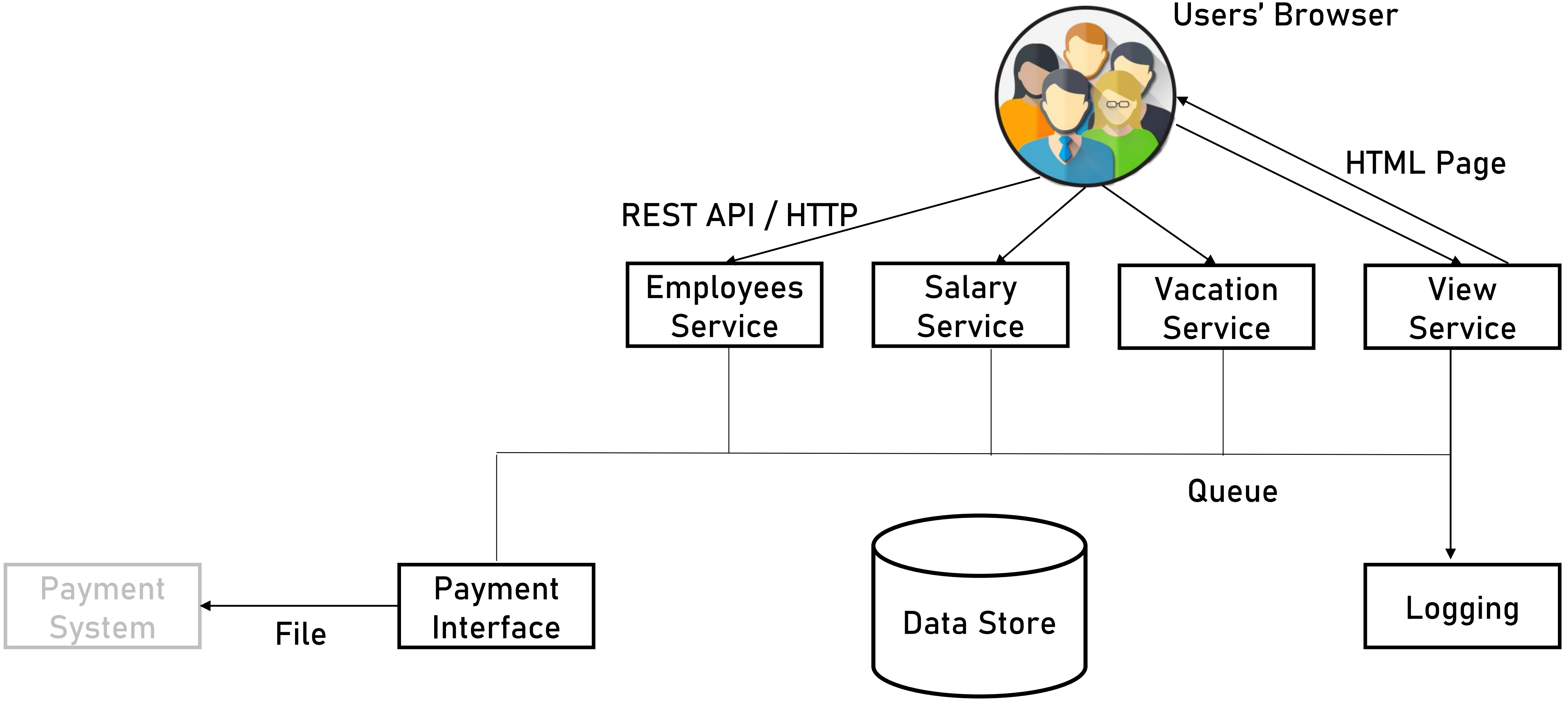
1. Entities: Employees, Vacation, Salary
2. Interface to the Payment System


Employees Service
Performs CRUD Operations on Employees
Salary Service
Salary approval workflow
Vacation Service
Employee's Vacation Management
View Service
Returns static files to the browser (HTML, CSS, JS)
Payment System
Payment Interface
Sends payment data to payment system
Data Store
Logging

Q: Single or Per Service Data Store?

A: Data is shared between services, so a Single Data Store is better

Messaging


Users' Browser
HTML Page
REST API / HTTP
Employees Service
Salary Service
Vacation Service
View Service
Queue
Payment System
File
Payment Interface
Data Store
Logging

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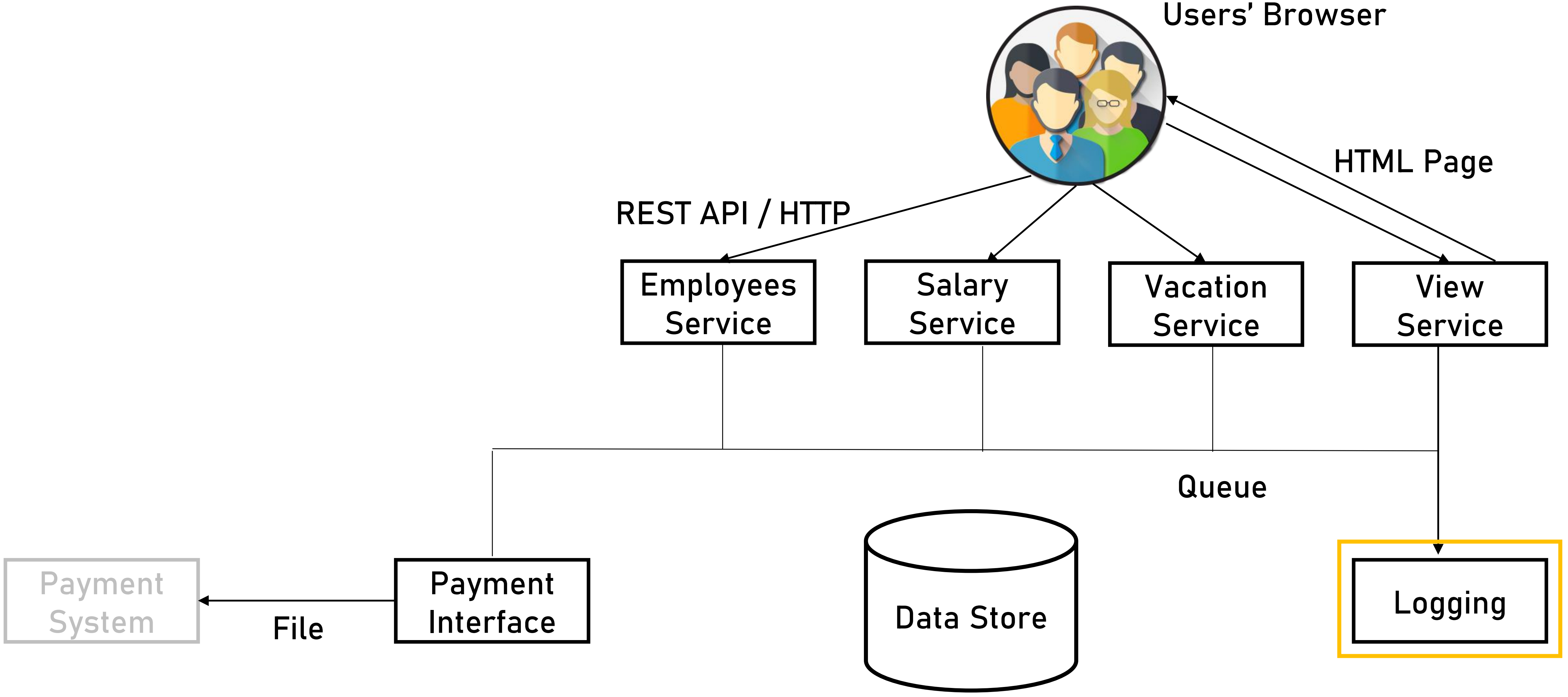
Components



Logging Service

- Very Important

- Other services use it

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Logging - Questions

1. Is there an existing logging mechanism in the company? No
2. Develop our own or use 3rd party?

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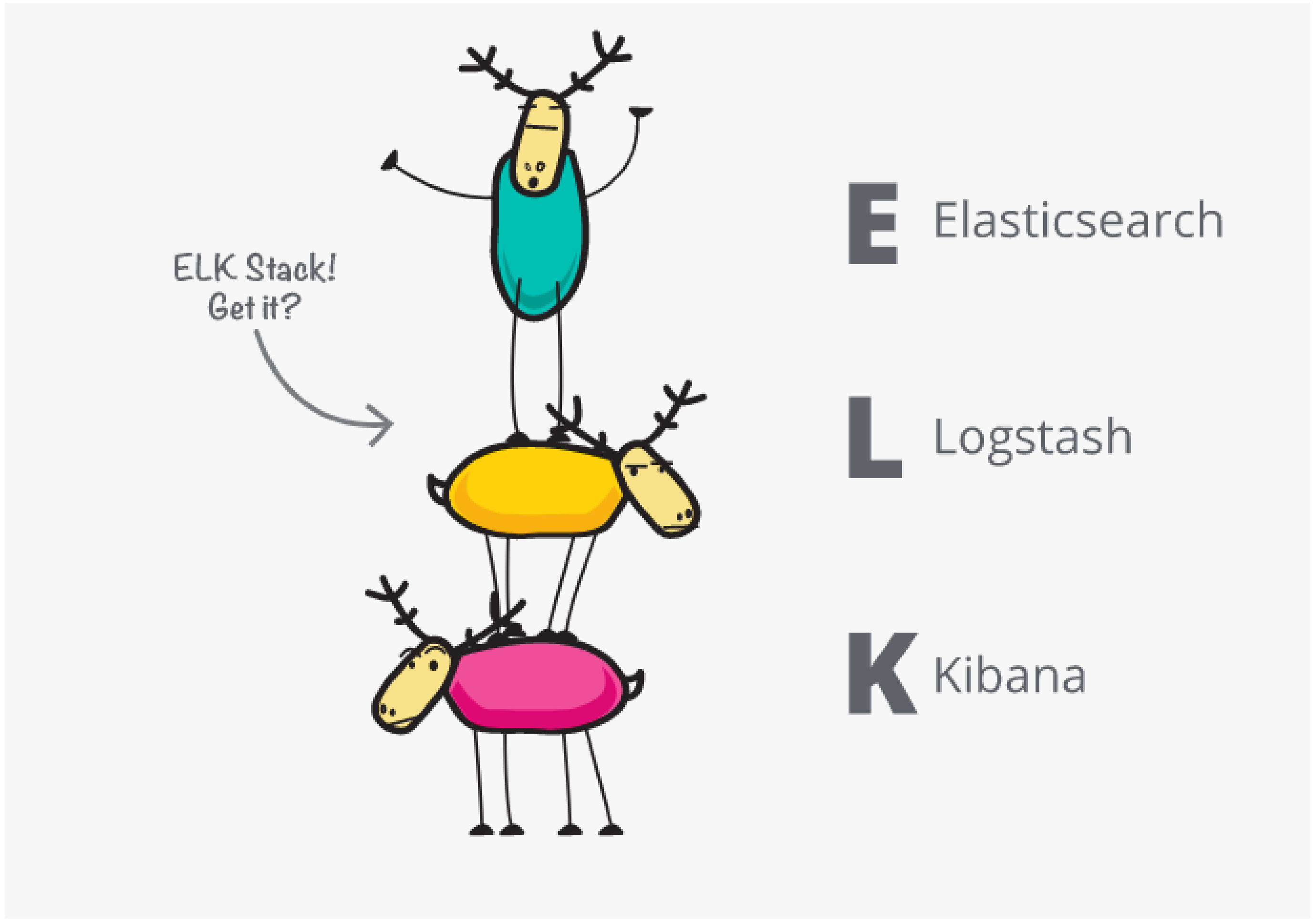
Logging - Alternative



Logging - Alternative

ELK:

- Powerful data store (Elastic)
- Import log from many sources (Logstash)
- Great viewer with filter capabilities (Kibana)

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Logging - Alternative

But:

- Requires maintenance
- Quite complicated to install and setup
- Suitable mainly for large, data-intensive systems

No Go

Logging Service

Steps:

- Decide on Application Type

- Decide on Technology Stack

- Design the Architecture

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Application Type

What it does:

- Read log records from queue

- Validate the records

- Store in data store

Application Type

What it does:

- Read log records from queue

- Handle the records

- Save in data store

Application Type

• Web App & Web API	✗
• Mobile App	✗
• Console	?
• Service	?
• Desktop App	✗

Application Type

• Web App & Web API	✗
• Mobile App	✗
• Console	✓
• Service	✓
• Desktop App	✗

Technology Stack

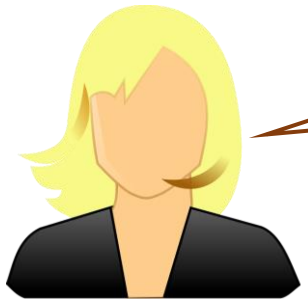
For:

- Component's Code
- Data Store

Technology Stack

Code Should:

- Access Queue's API
- Validate the data
- Store the data



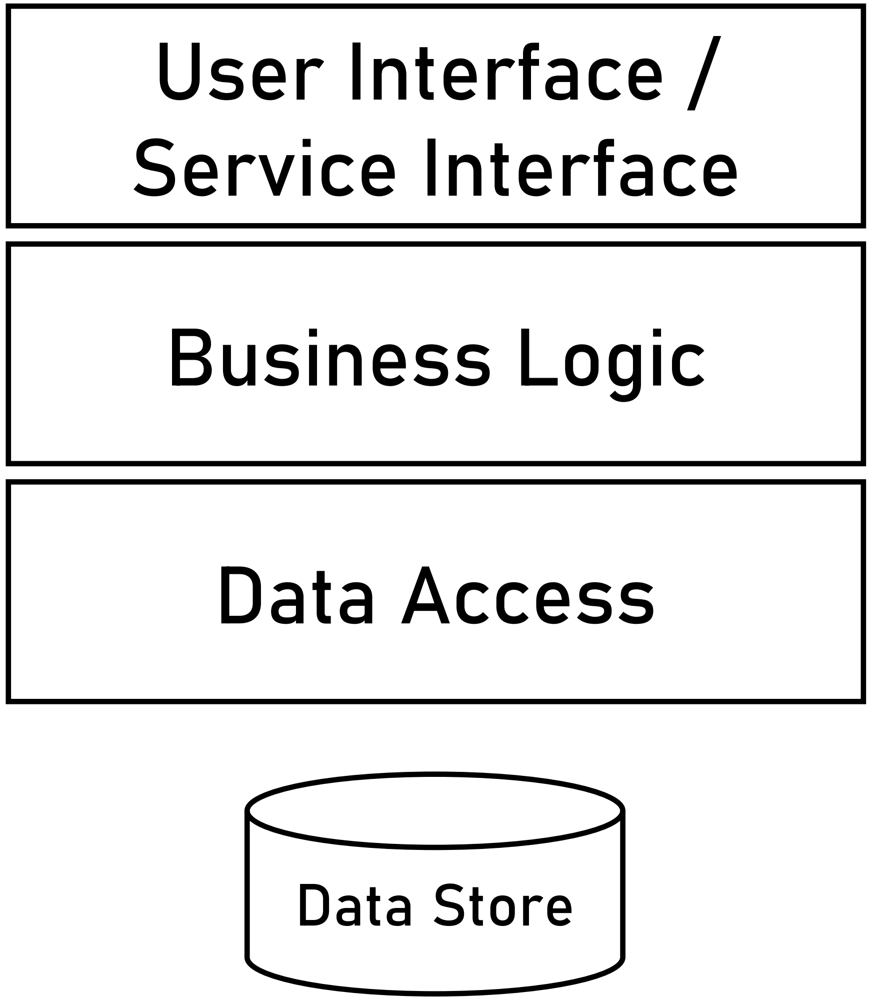
We're familiar with Microsoft stack, so we are expert in .NET and SQL Server

Technology Stack

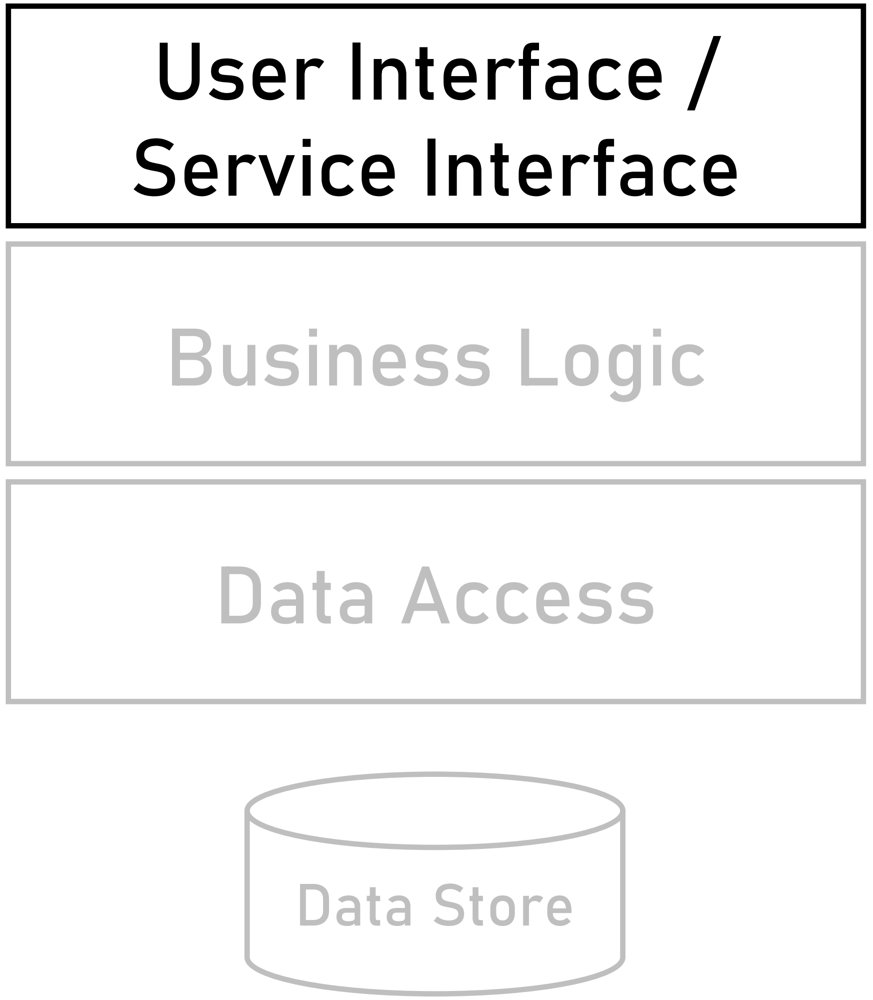
.NET Core

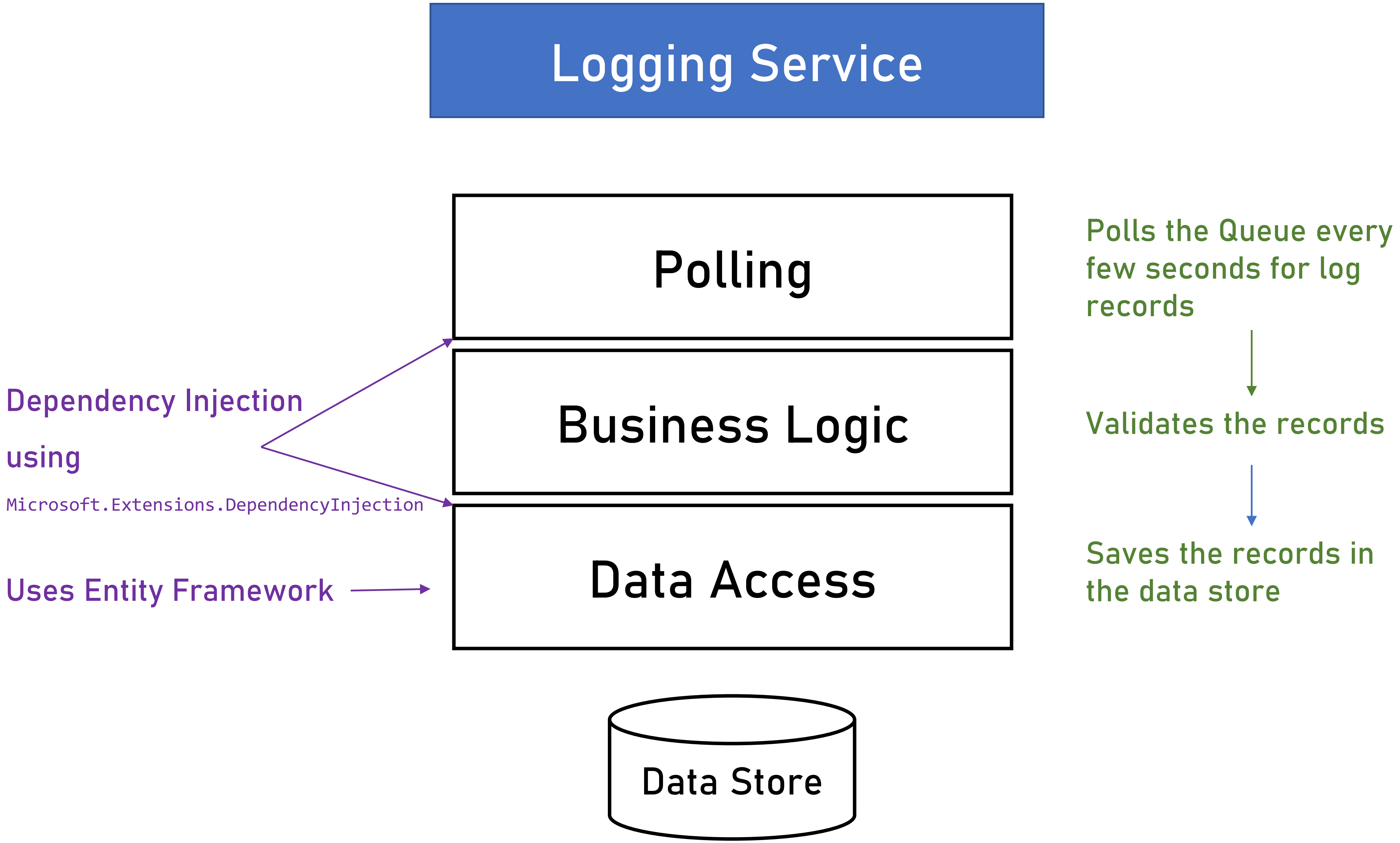
Microsoft® SQL Server®

Architecture

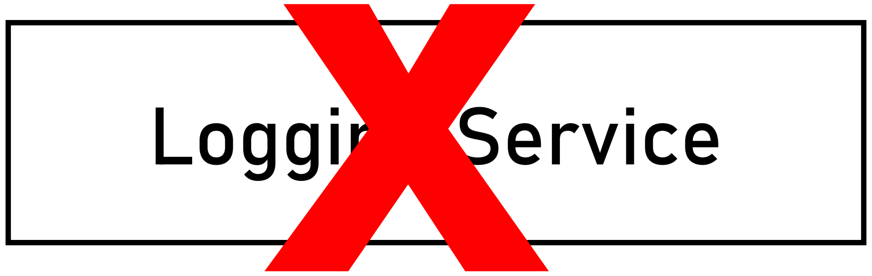


Architecture

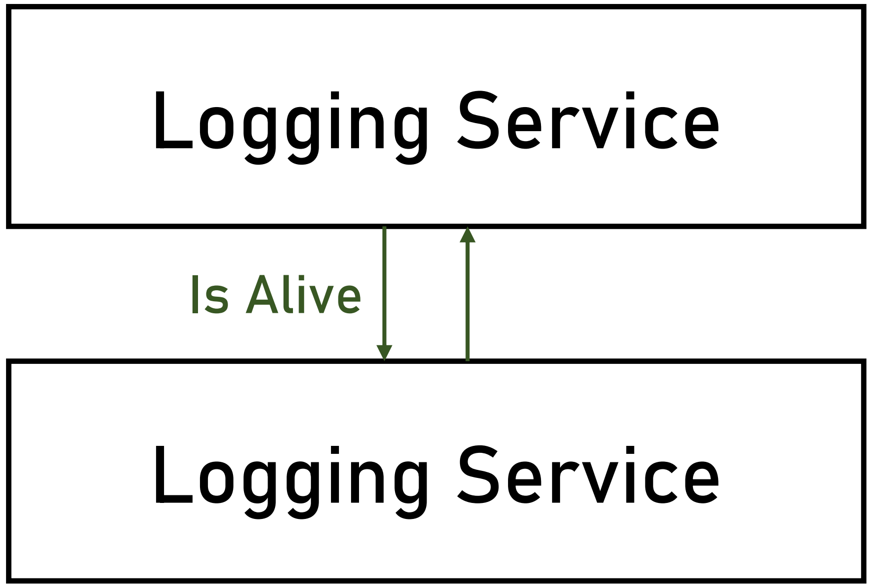



Logging Service
Polling
Business Logic
Data Access
Data Store
Dependency Injection
using
Microsoft.Extensions.DependencyInjection
Uses Entity Framework
Polls the Queue every few seconds for log records
Validates the records
Saves the records in the data store

Logging Service Redundancy



Logging Service Redundancy



- Active / Active
- Avoid duplicate reads?

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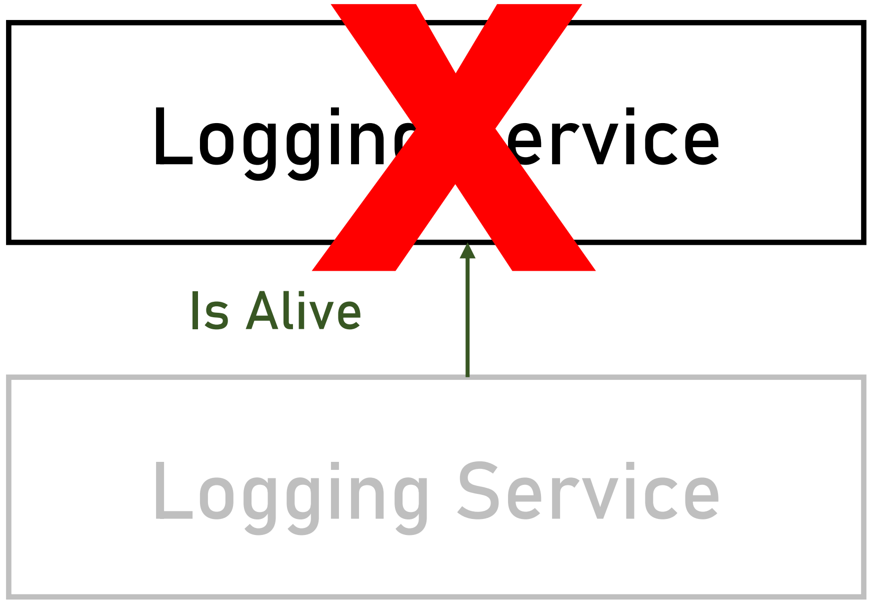
Logging Service Redundancy



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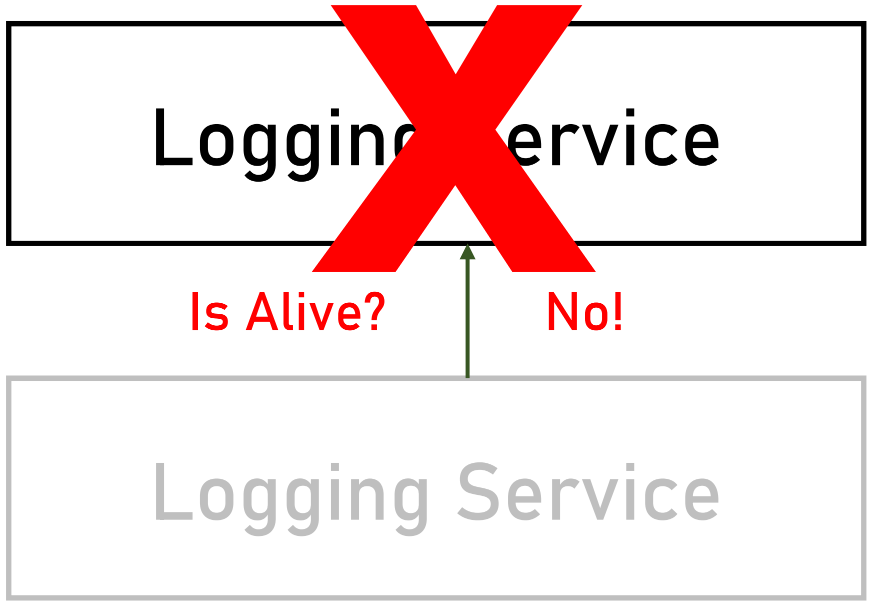
Logging Service Redundancy



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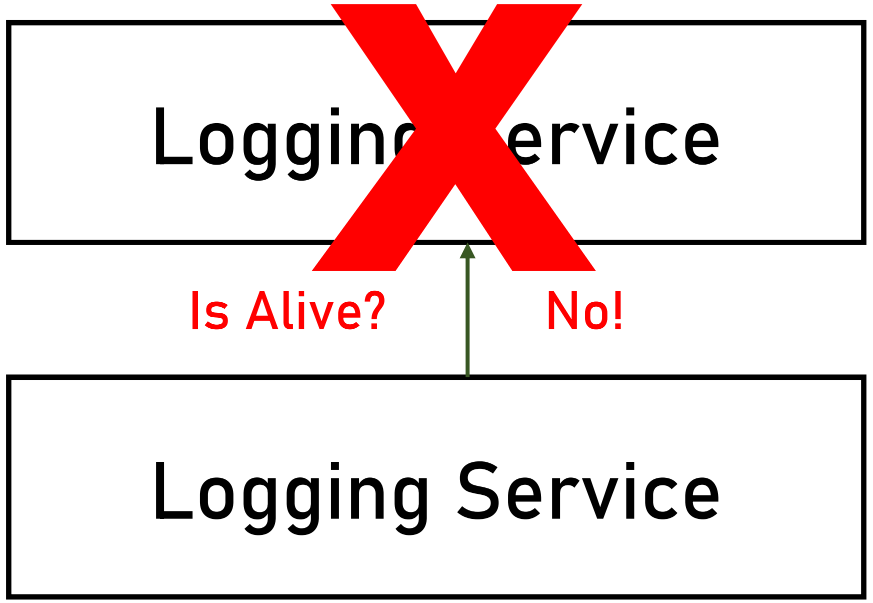
Logging Service Redundancy



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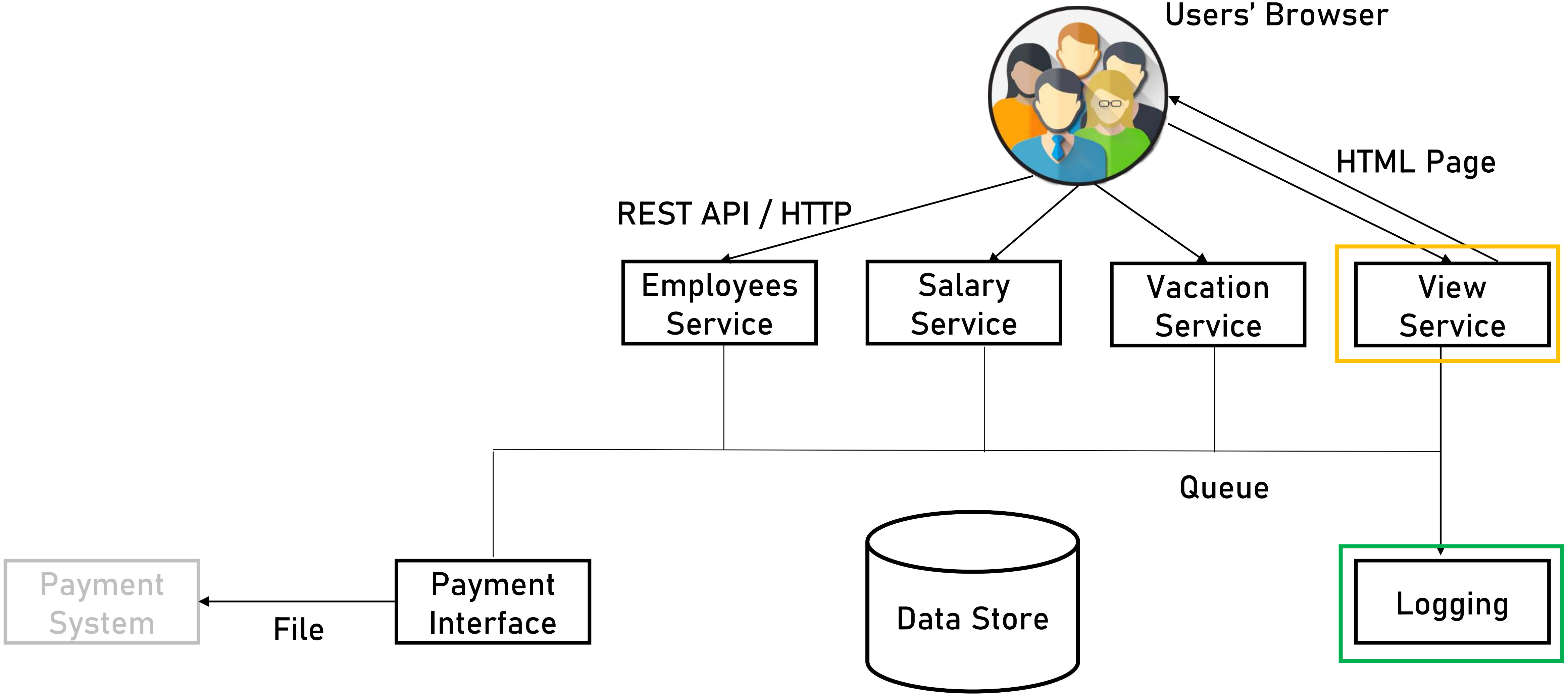
Components



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View Service

What it does:

- Get requests from the end users' browsers

- Returns static files (HTML / CSS / JS)

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Application Type

• Web App & Web API	✓
• Mobile App	✗
• Console	✗
• Service	✗
• Desktop App	✗

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Technology Stack

.NET Core has a great support for Web Apps

So…

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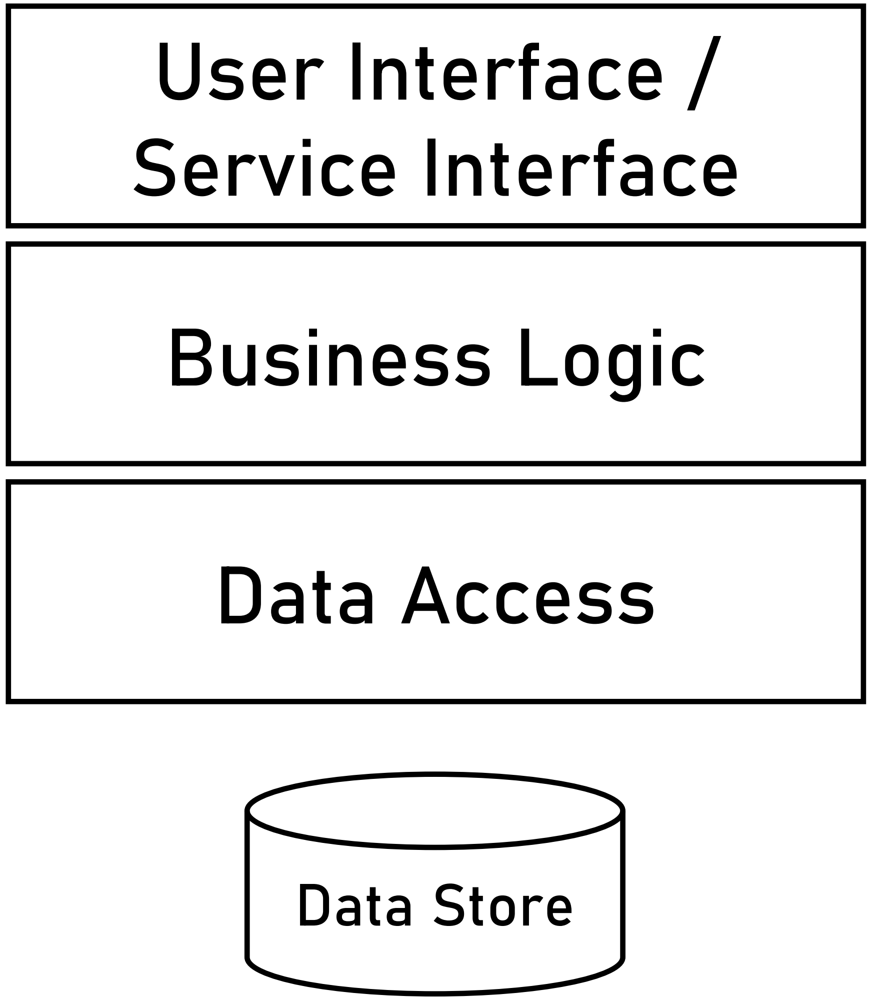
Technology Stack

.NET
Core

Architecture



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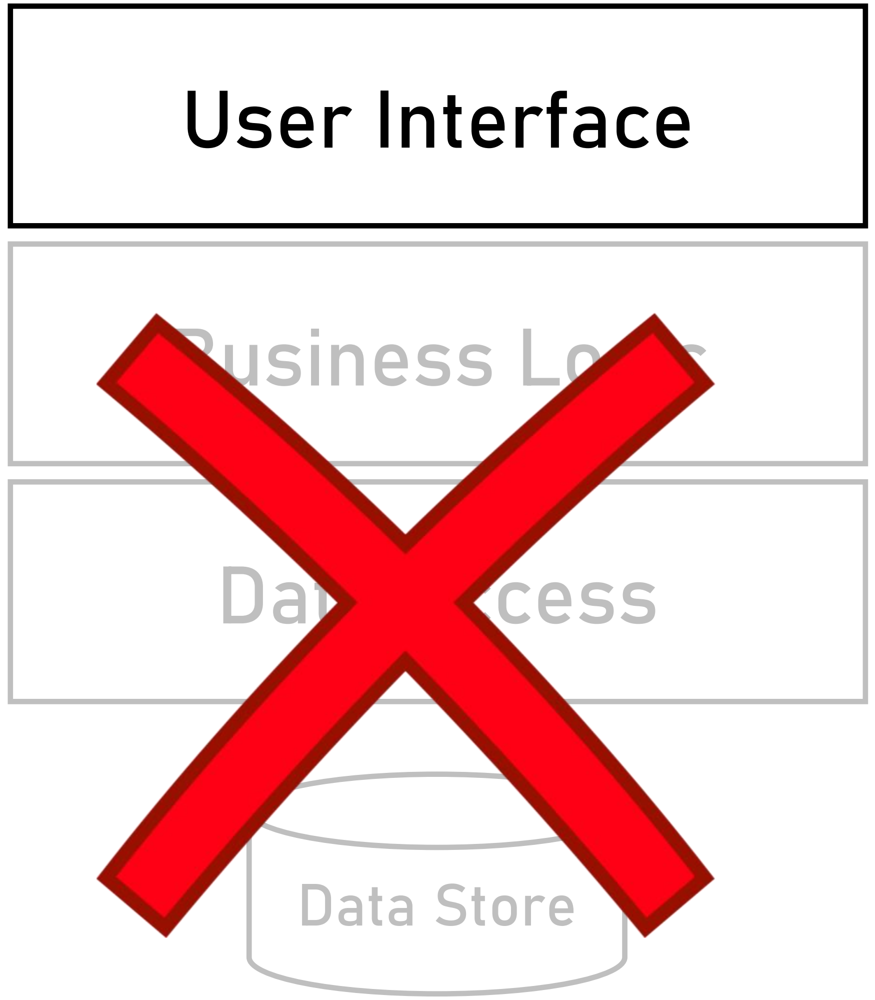
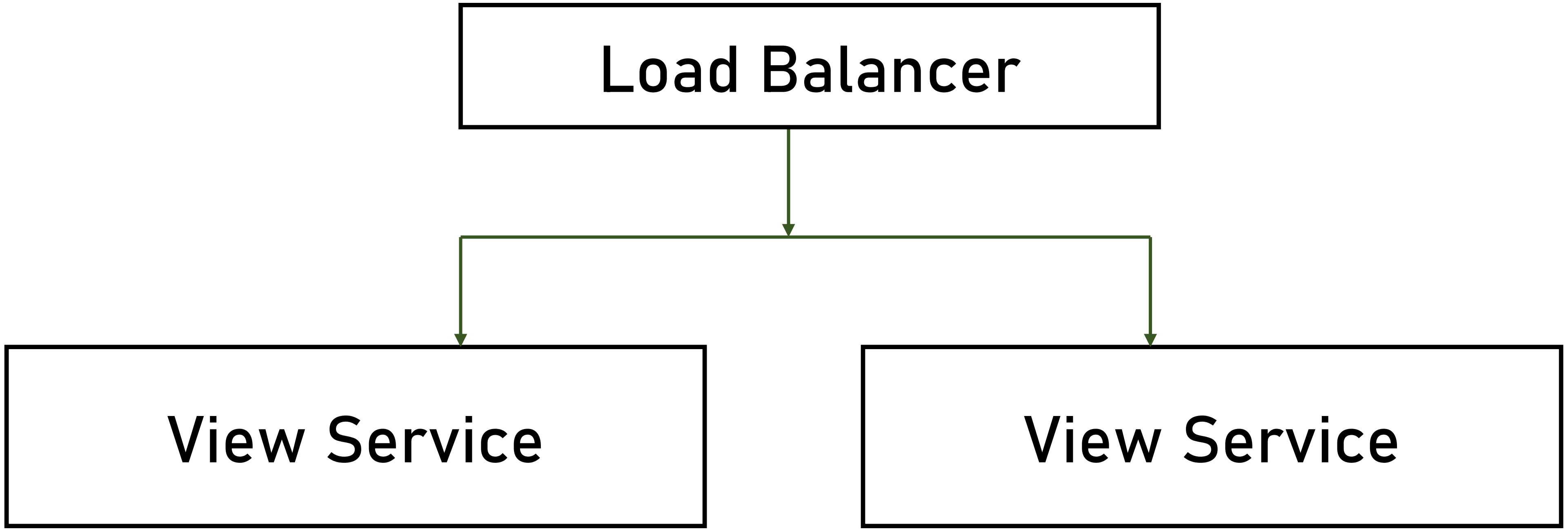
Architecture



View Service Redundancy



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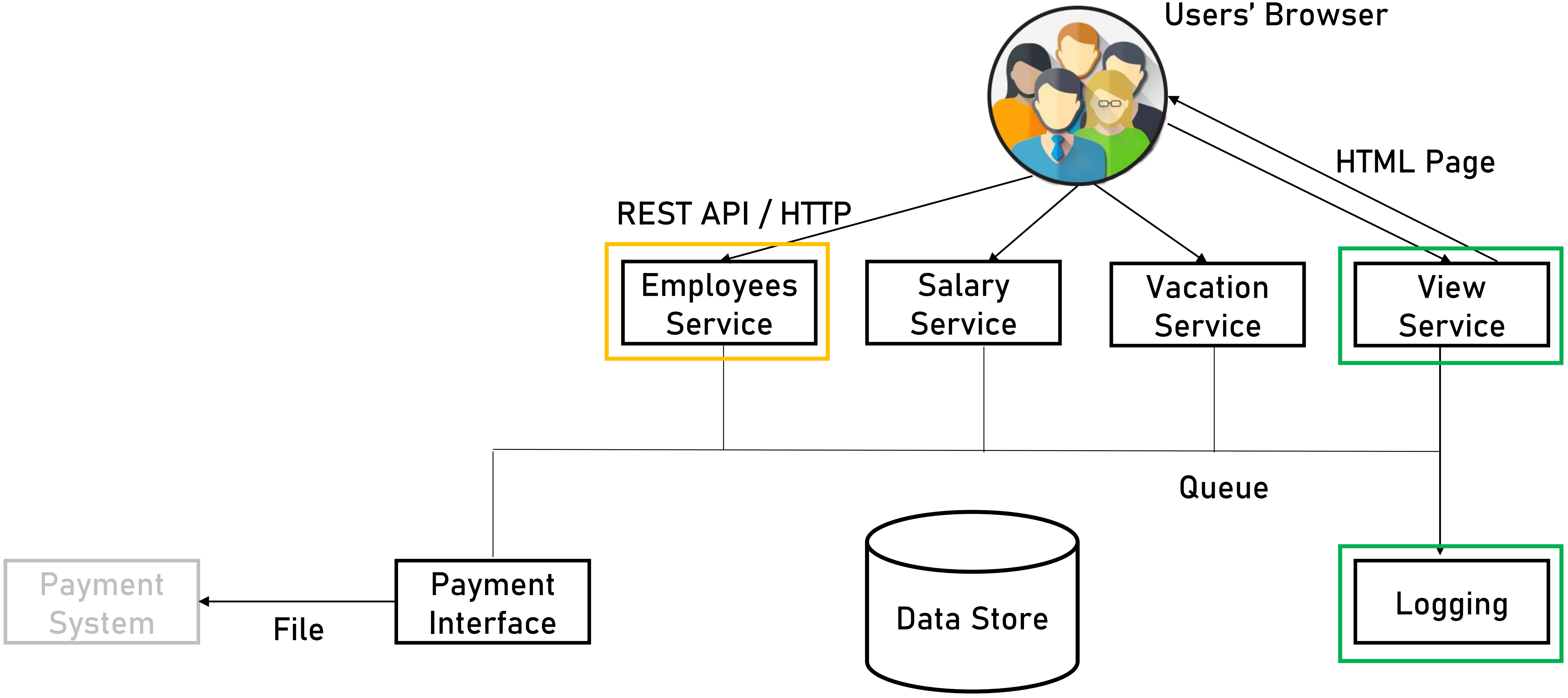
Components



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Employees Service

What it does:

- Allows end users to query employees' data

- Allows performing actions on data (CUD)

What it doesn't:

- Displays the data

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Application Type

• Web App & Web API	✓
• Mobile App	✗
• Console	✗
• Service	✗
• Desktop App	✗

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Technology Stack – Dev Platform

.NET Core

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Technology Stack – Database

Employee Data (Relational)

Microsoft® SQL Server®

Documents

?

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Technology Stack – Database

Document (BLOB) Storage Alternatives

- Relational Database
- File System
- Object Store
- Cloud Storage

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Document (BLOB) Storage Alternatives

Alternative	Description	Examples	Pros	Cons
Relational Database	Store the document in a specialized column type designed for BLOBs	SQL Server's FILESTREAM, Oracle's BLOB type	Part of the app transaction Part of the DB's backup / DR	Clunky syntax, Limited size

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Object Store	Use special type of store mechanism that specializes in BLOBs	CEPH	Great scale Unlimited size	Complex setup Dedicated knowledge New product in the mix

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Document (BLOB) Storage Alternatives

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Object Store	Use special type of store mechanism that specializes in BLOBs	CEPH	Great scale Unlimited size	Complex setup Dedicated knowledge New product in the mix
Cloud Storage	Store the documents in one of the public cloud storage mechanisms	Azure's Storage Account AWS's S3	Great scale Easy to execute	Requires internet connection Cost

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Technology Stack – Database

Employee Data (Relational)

Microsoft® SQL Server®™

Documents

?

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Technology Stack – Database

Employee Data (Relational)

Microsoft® SQL Server®

Documents

- Documents are small (~1MB)
- Already exists
- Part of the app

Microsoft® SQL Server®

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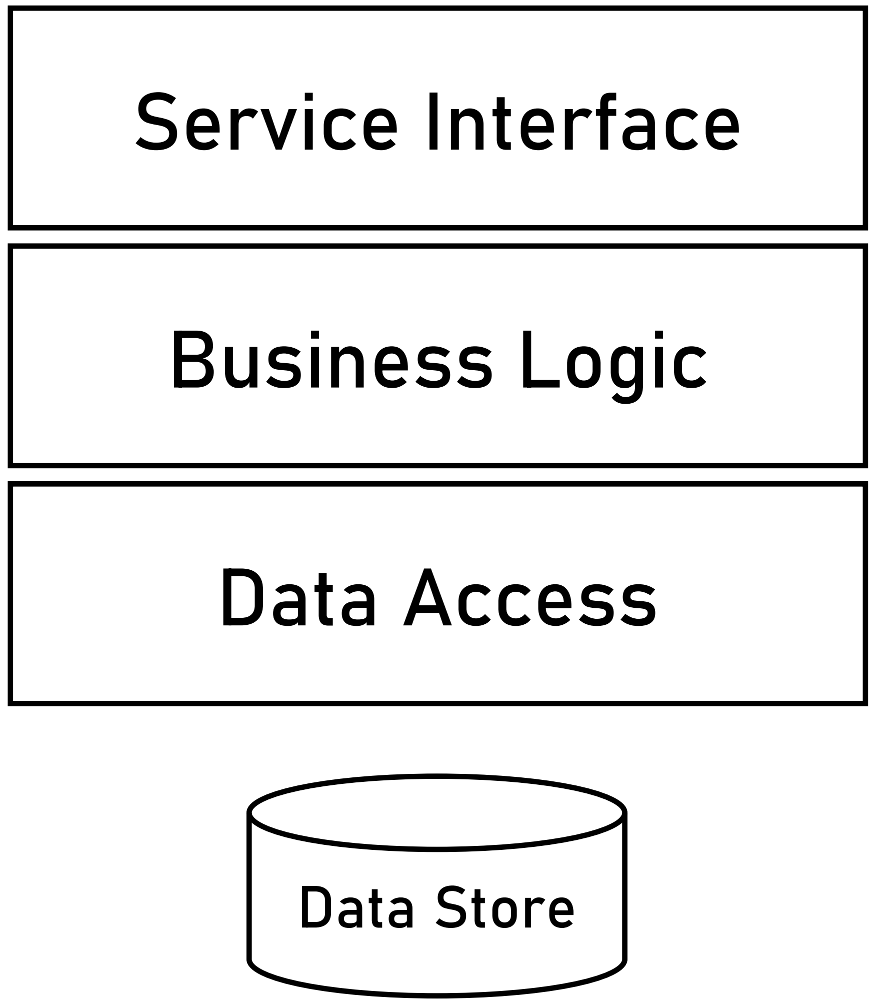
Architecture



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API

- Get full employee details by ID
- List of employees by parameters
- Add employee
- Update employee details
- Remove employee ← Not physical delete!

API – Cont.

- Add document
- Remove document
- Get document
- Retrieve documents by parameters

Q: Do we need a separate Document Handler service?

A: Since only the Employee entity requires docs, then no.

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API

Functionality	Path	Return Codes

Get employee details by ID	`GET /api/v1/employee/`*`{id}`*	`200 OK`
		`404 Not Found`

List employees by parameters	`GET /api/v1/employees?`*`name=…&birthdate=…`*	`200 OK`
		`400 Bad Request`

Add employee	`POST /api/v1/employee`	`201 Created`
		`400 Bad Request`

Update employee details	`PUT /api/v1/employee/`*`{id}`*	`200 OK`
		`400 Bad Request`
		`404 Not Found`

Remove employee	`DELETE /api/v1/employee/`*`{id}`*	`200 OK`
		`404 Not Found`

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API

Functionality	Path	Return Codes

Add document	`POST /api/v1/employee/{id}/document`	`201 Created`
		`404 Not Found`

Remove document	`DELETE`
	`/api/v1/employees/{id}/document/{docid}`
		`200 OK`
		`404 Not Found`

Get document	`GET /api/v1/employees/{id}/document/{docid}`	`200 OK`
		`404 Not Found`

Retrieve documents for employee	`GET /api/v1/employees/{id}/documents`	`200 OK`
		`404 Not Found`

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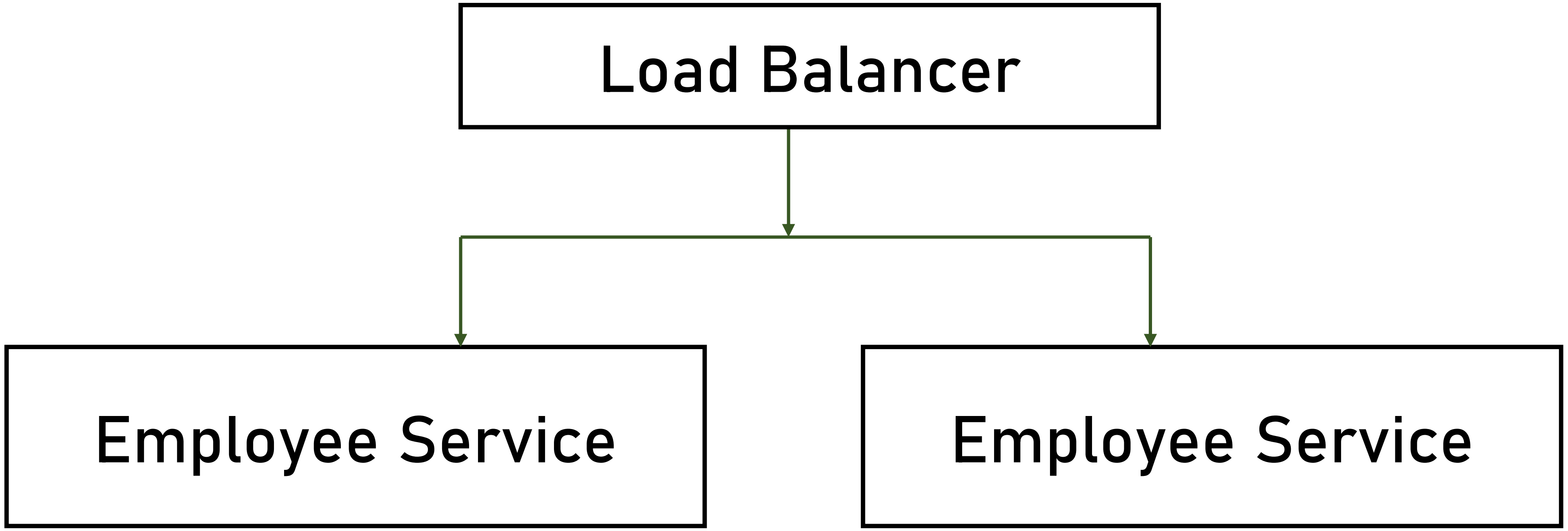
Employee Service Redundancy



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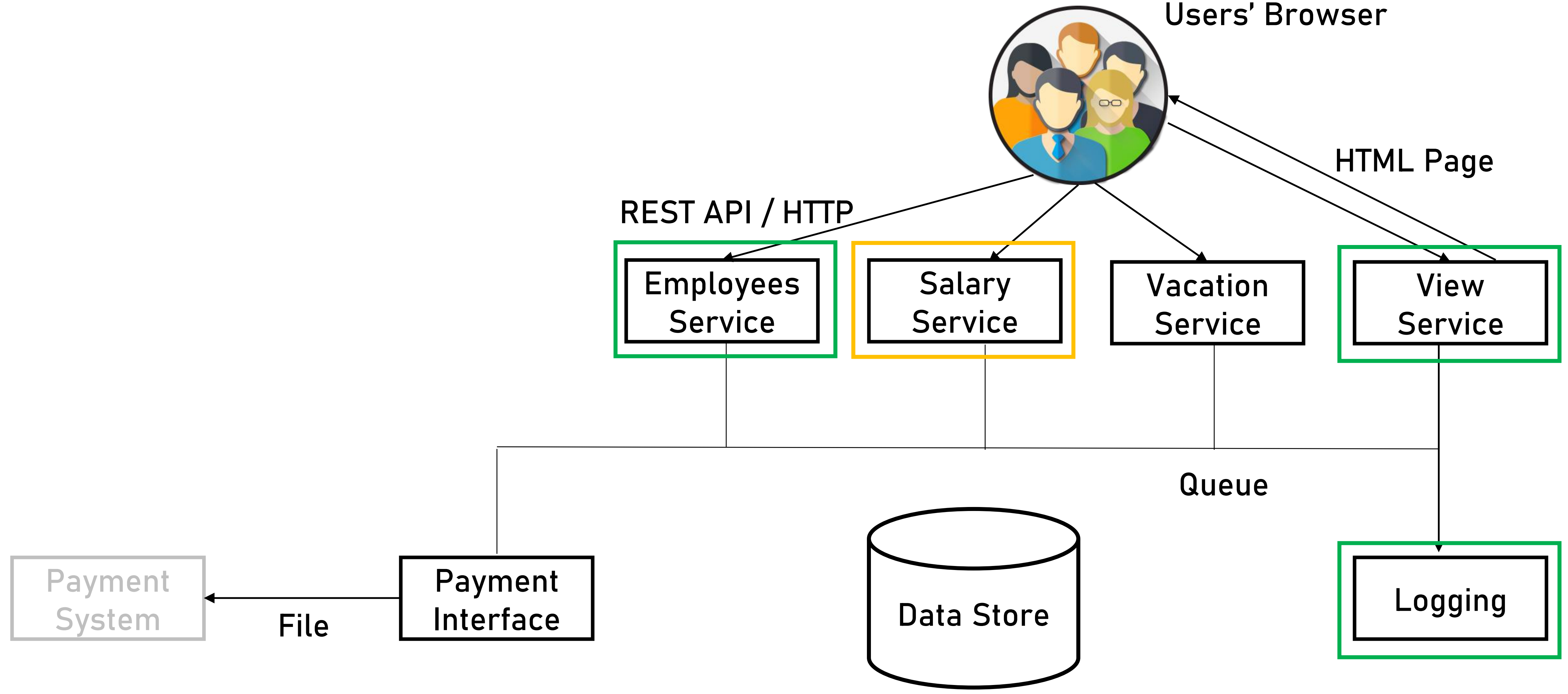
Components



Salary Service

What it does:

- Allows managers to ask for an employee’s salary change
- Allows HR representative to approve / reject the request

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Application Type

• Web App & Web API	✓
• Mobile App	✗
• Console	✗
• Service	✗
• Desktop App	✗

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Technology Stack

.NET
Core

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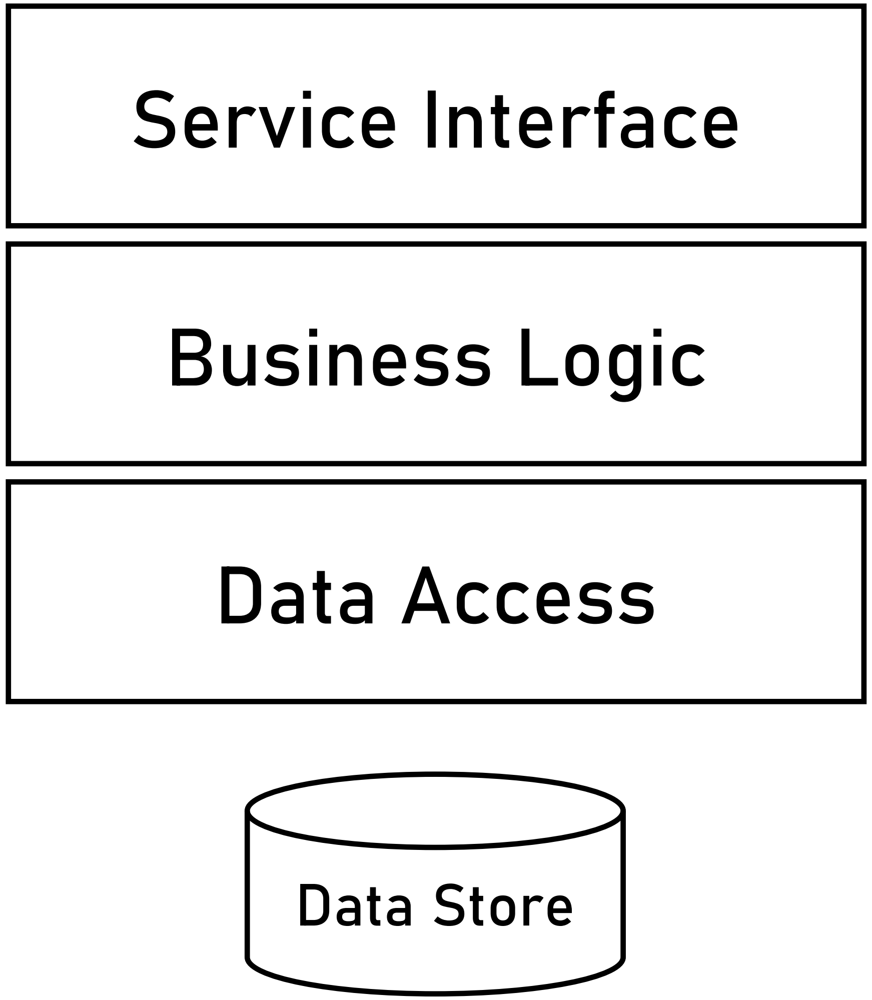
Architecture



API

- Add salary request
- Remove salary request
- Get salary requests
- Approve salary request
- Reject salary request

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API

Functionality	Path	Return Codes
Add salary request	`POST /api/v1/salaryRequest/`	200 OK 400 Bad Request
Remove salary request	`DELETE /api/v1/salaryRequest/{id}`	200 OK 404 Not Found
Get salary requests	`GET /api/v1/salaryRequests`	200 OK
Approve salary request	`POST /api/v1/salaryRequest/{id}/approval`	200 OK 404 Not Found
Reject salary request	`POST /api/v1/salaryRequest/{id}/rejection`	200 OK 404 Not Found

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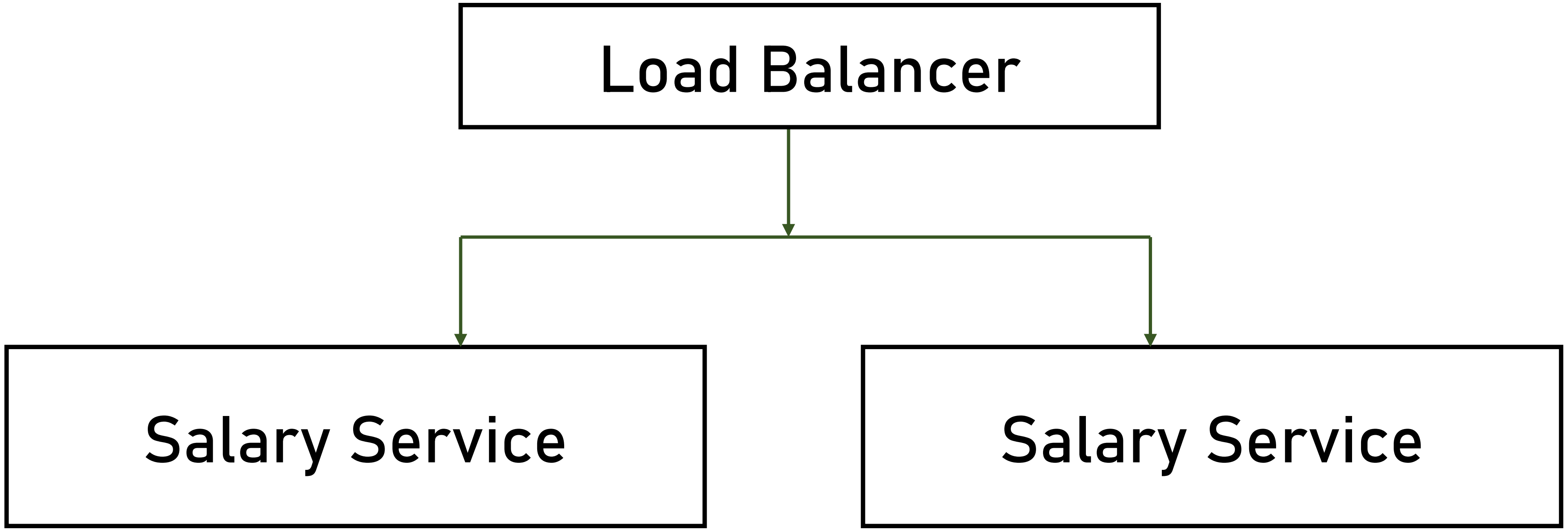
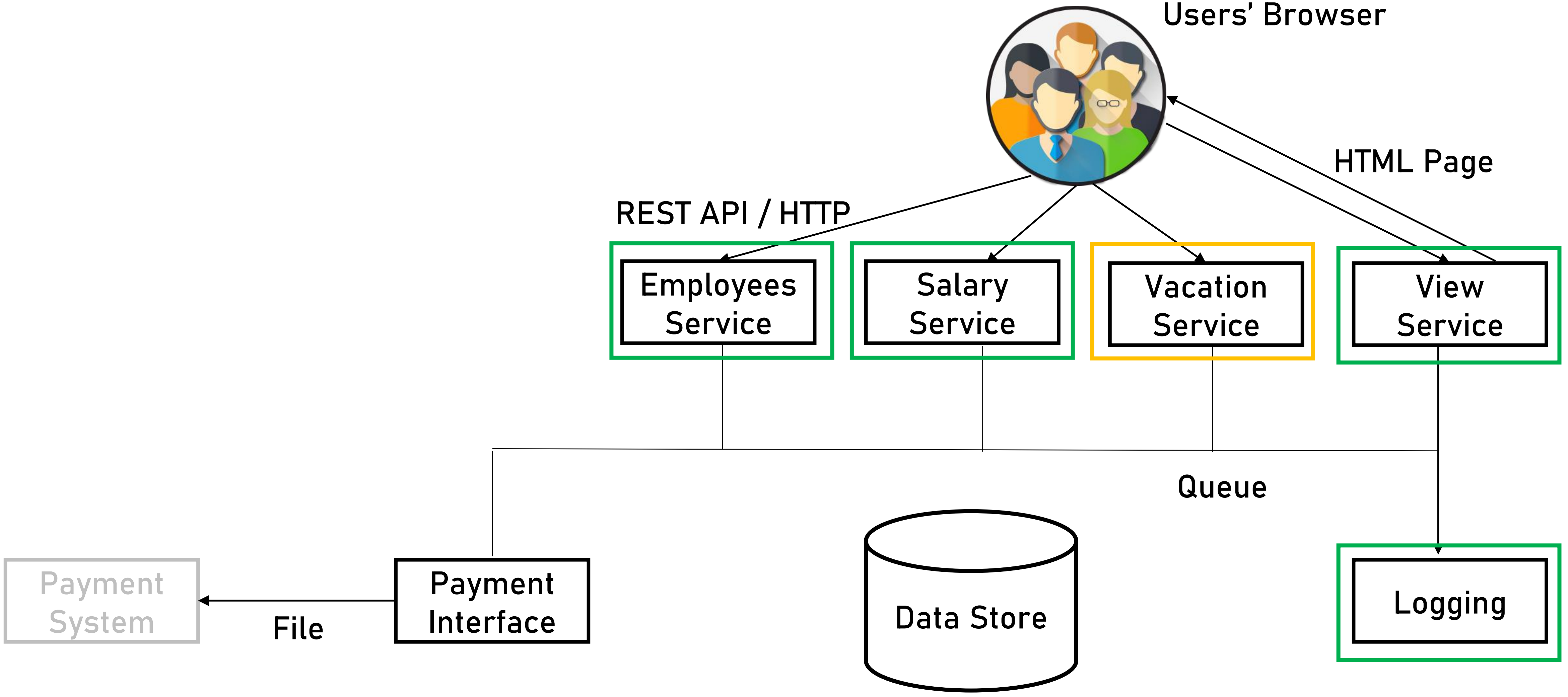
Salary Service Redundancy



Components


Users' Browser
HTML Page
REST API / HTTP
Employees Service
Salary Service
Vacation Service
View Service
Queue
Payment System
File
Payment Interface
Data Store
Logging

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Vacation Service

What it does:

- Allows employees to manage their vacation days

- Allows HR to set available vacation days for employees

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Application Type

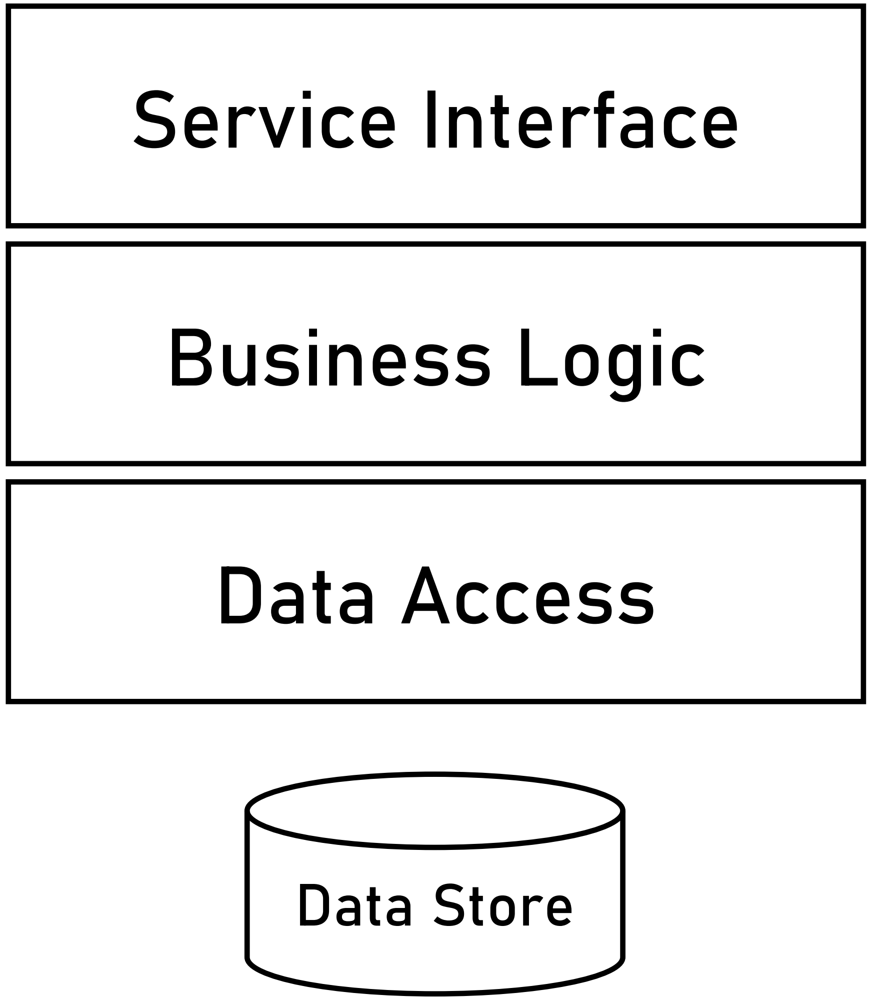
Web App & Web API	✓
Mobile App	✗
Console	✗
Service	✗
Desktop App	✗

Dunderly

Technology Stack

.NET Core

Architecture



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API

- Set available vacation days (by HR)
- Get available vacation days
- Reduce vacation days (by employees)

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API

Functionality	Path	Return Codes

Set available vacation days	`PUT /api/v1/vacation/`*`{empid}`*	`200 OK`
		`404 Not Found`

Get available vacation days	`GET /api/v1/vacation/`*`{empid}`*	`200 OK`
		`404 Not Found`

Reduce vacation days	`POST /api/v1/vacation/`*`{empid}`*`/reduction`	`200 OK`

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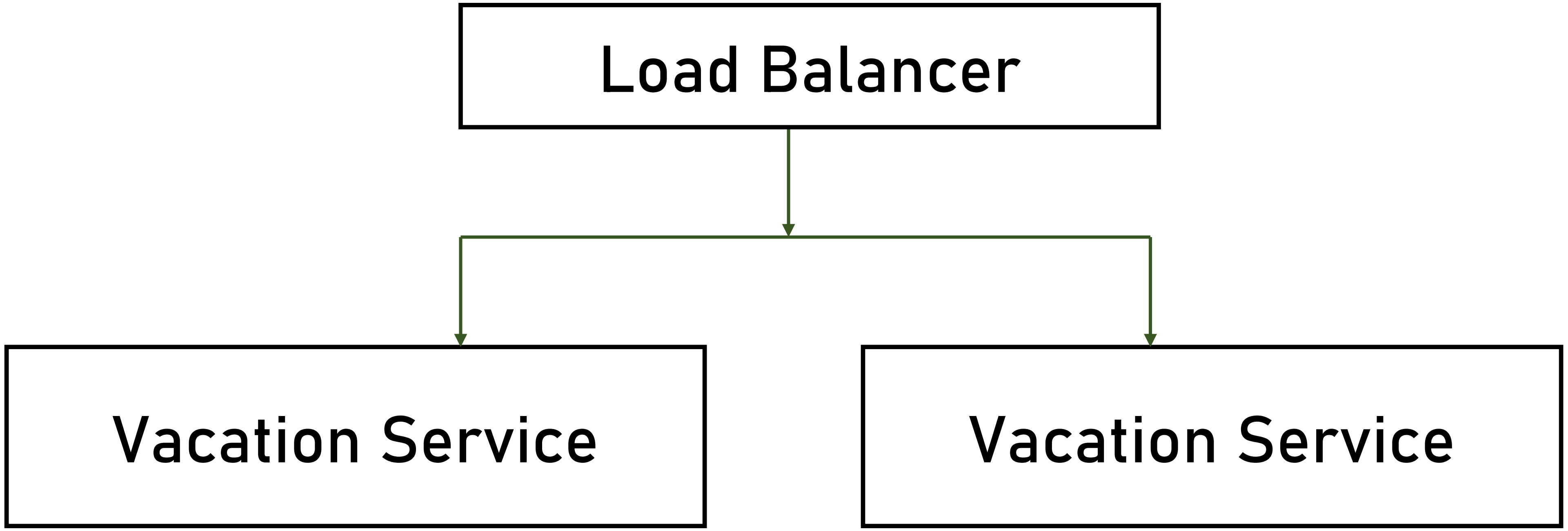
Vacation Service Redundancy



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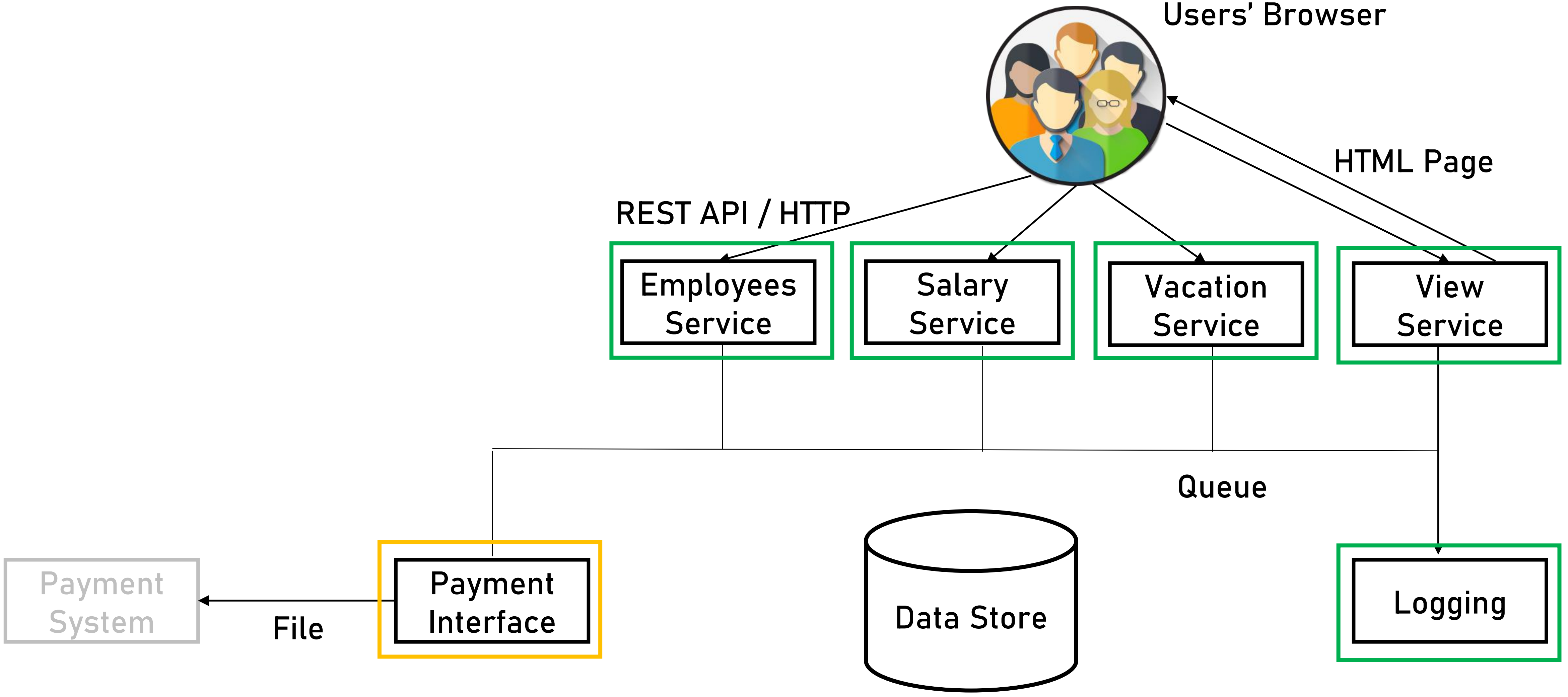
Components



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Payment Interface

What it does:

- Queries the database once a month for salary data
- Passes payment data to the external payment system

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Application Type

• Web App & Web API	✗
• Mobile App	✗
• Console	✗
• Service	✓
• Desktop App	✗

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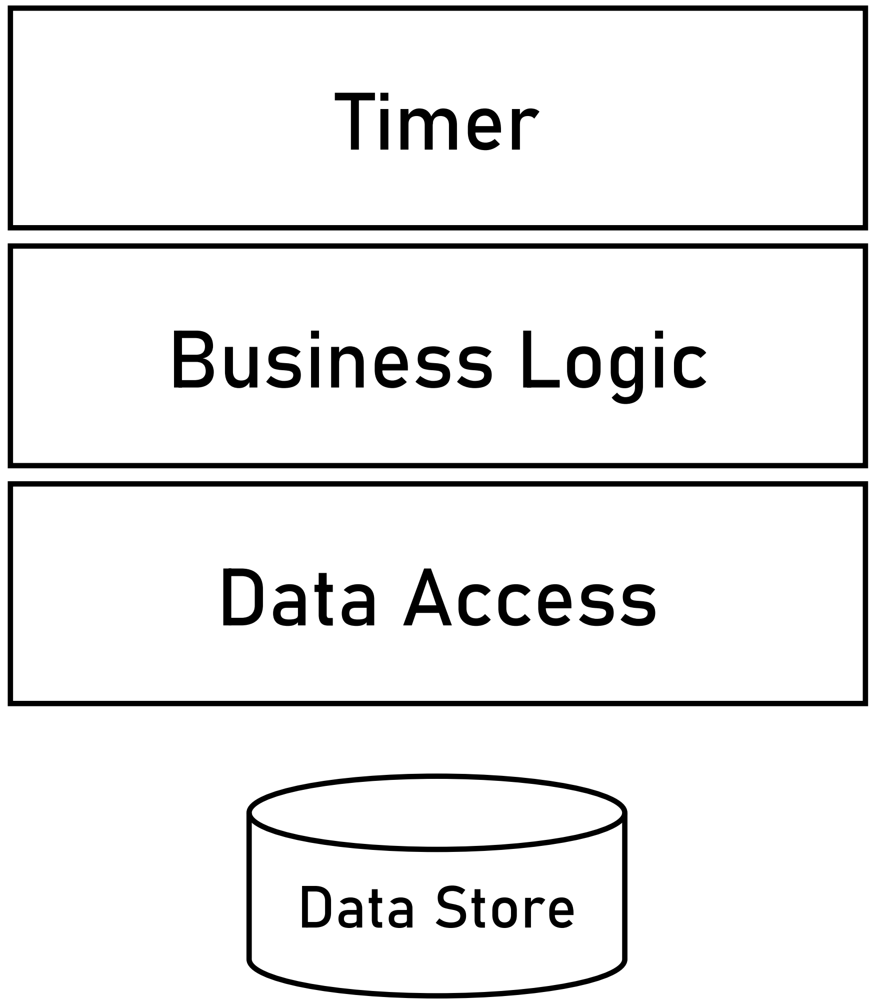
Technology Stack

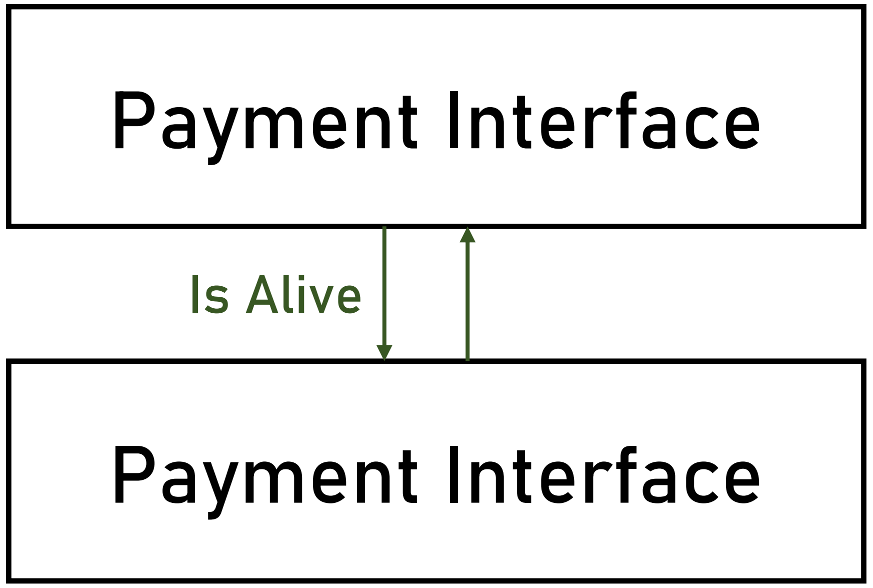
.NET
Core

Dunderly

Architecture



Payment Interface Redundancy



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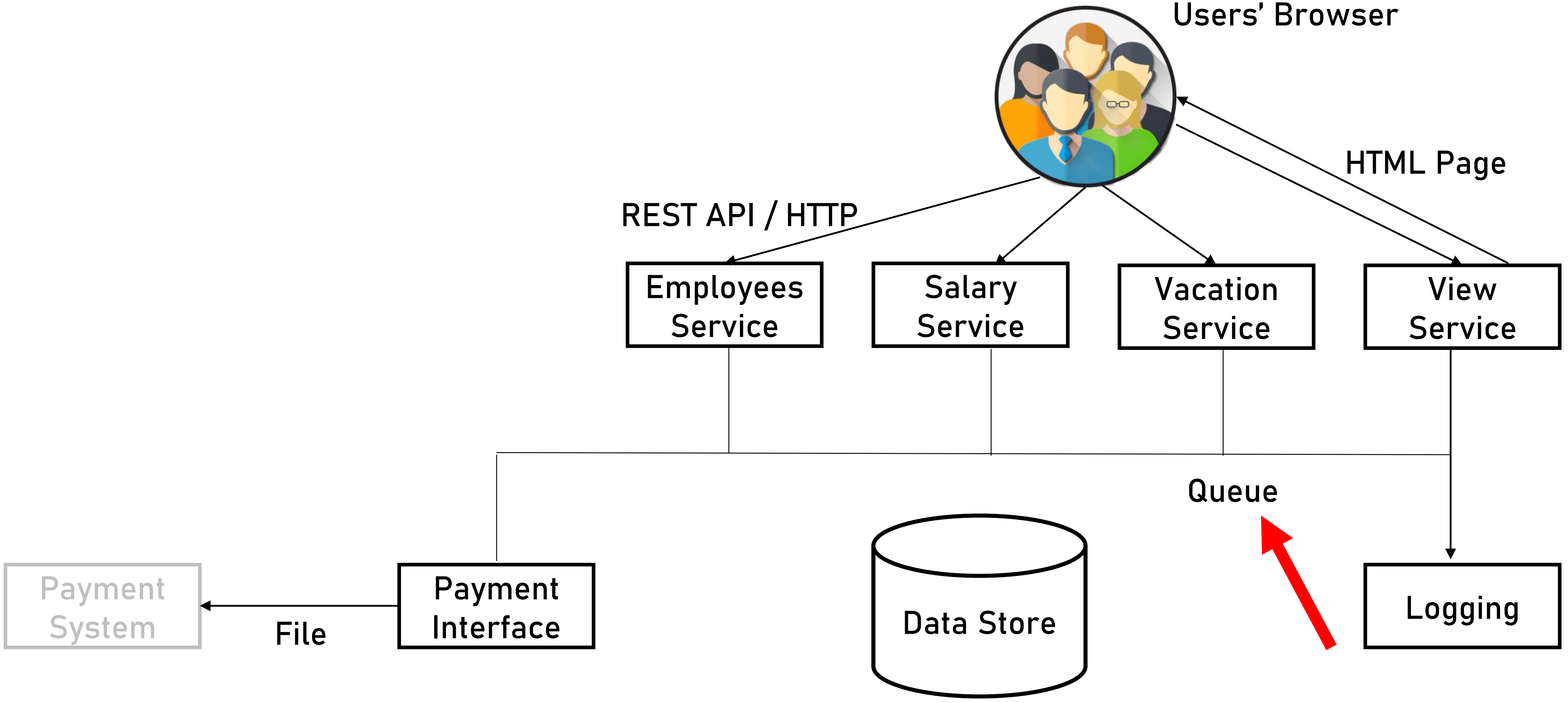
Messaging



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Technology Stack – Queue

Queue Alternatives:

- ~~Self Developed~~
- RabbitMQ
- Kafka

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Alternative	Description	Pros
Rabbit MQ	General purpose message-broker engine	Easy to setup Easy to use

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Alternative	Description	Pros
Rabbit MQ	General purpose message-broker engine	Easy to setup Easy to use
Apache Kafka	Stream processing platform	Perfect for data intensive scenarios

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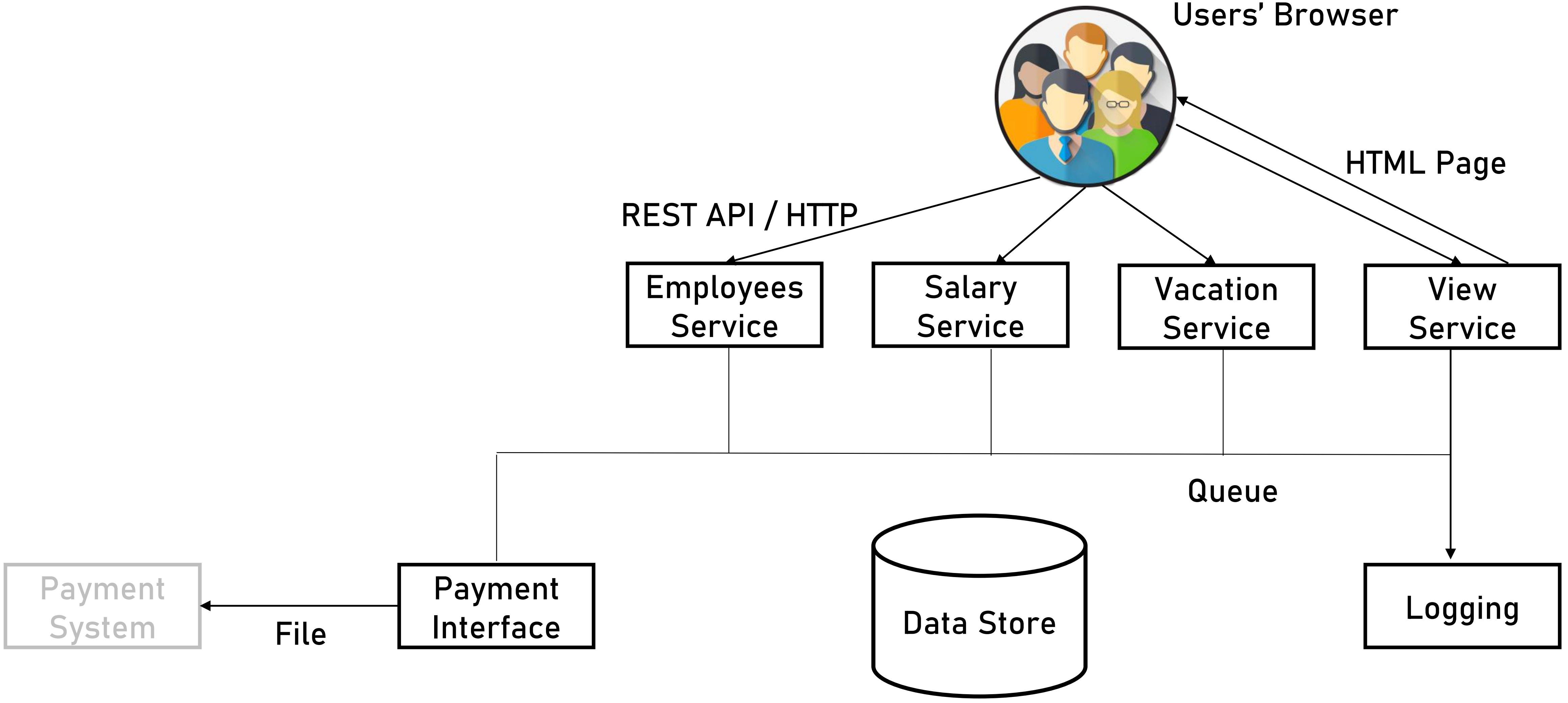
Technology Stack – Queue

Queue Alternatives:

- Self Developed
- RabbitMQ
- Kafka

- No data stream involved
- Easy to use

Logic Diagram



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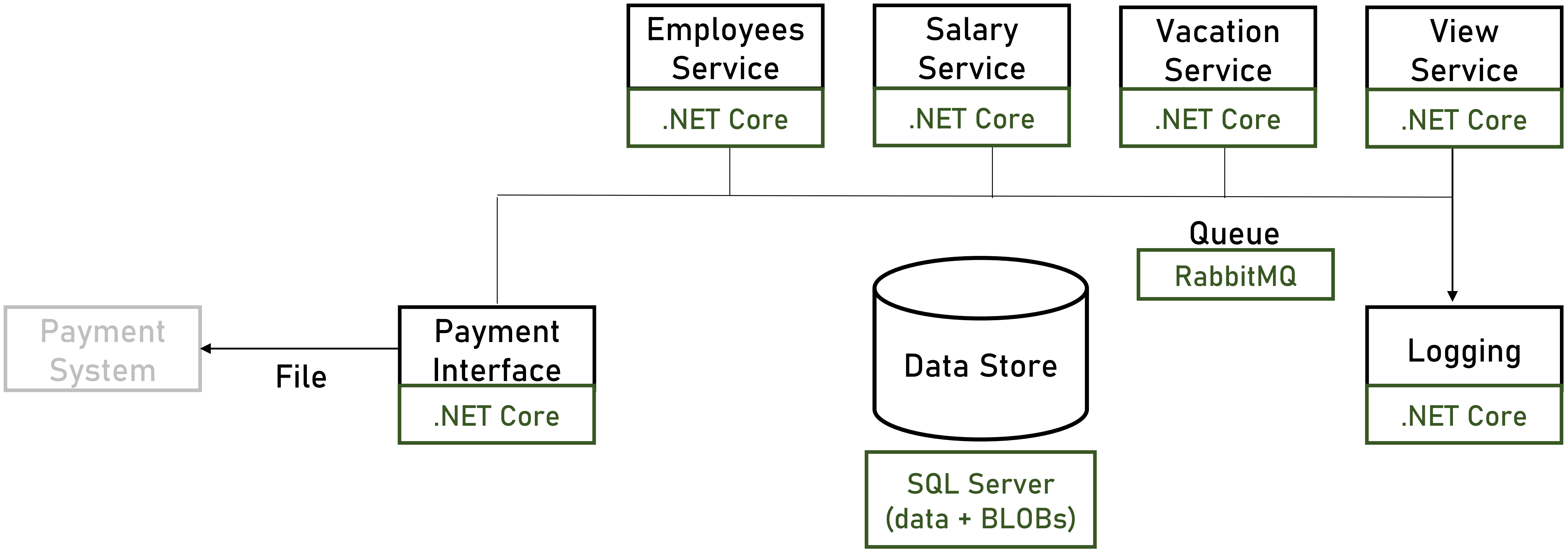
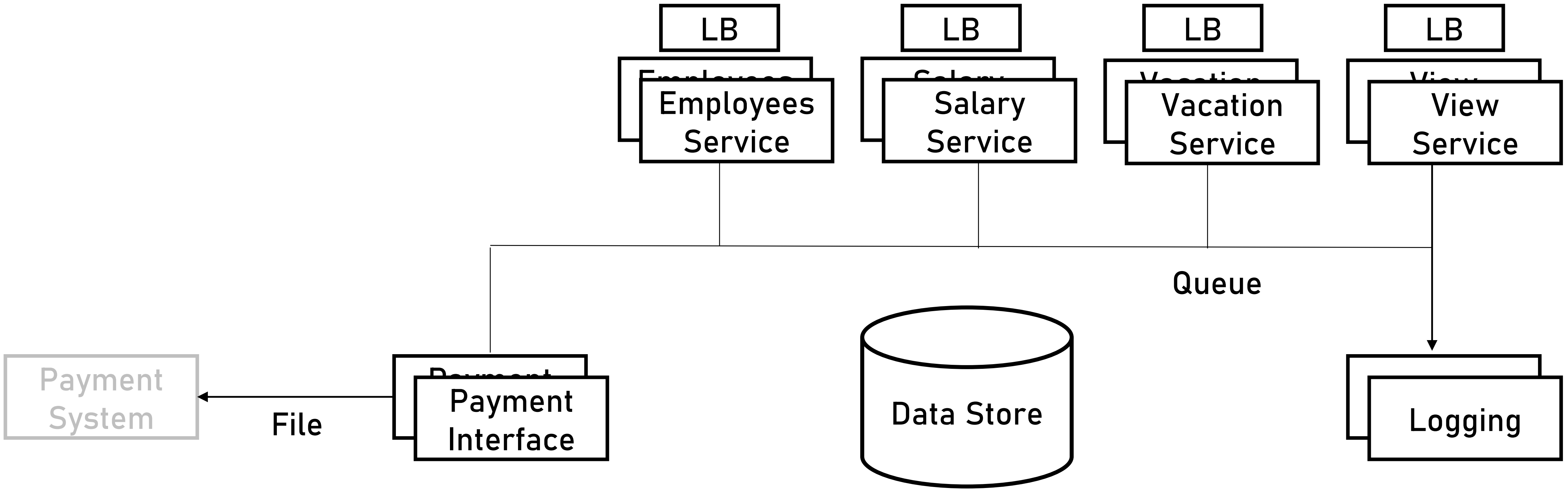
Technical Diagram



Physical Diagram


LB
LB
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Employees Service
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