

Case Study #1

Memilavi
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<https://t.me/learningnets>





A Real World Application

Application Introduction

```
graph TD; A[Application Introduction] --> B[Defining Requirements]; B --> C[Components Mapping]; C --> D[Technology Stack Selection]; D --> E[Architecture Design];
```

Defining Requirements

Components Mapping

Technology Stack Selection

Architecture Design

Dunderly

Your Paper Source

<https://t.me/learningnets>

Dunderly

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



Requirements

```
graph TD; Requirements[Requirements] --> Functional[Functional]; Requirements --> NonFunctional[Non-Functional];
```

Functional

What the system should do

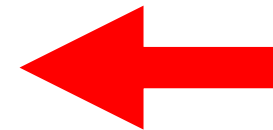
1. Web Based
2. Perform CRUD operations on employees
3. Manage Salaries:
 1. Allow manager to ask for employee's salary change
 2. Allow HR manager to approve / reject request
4. Manage vacation days
5. Use external payment system

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



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?”*

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

Requirements

```
graph TD; Requirements[Requirements] --> Functional[Functional]; Requirements --> Non-Functional[Non-Functional];
```

Functional

What the system should do

1. Web Based
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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. HTTP-based interface

Components

- Based on requirements:
1. Entities: Employees, Vacation, Salary
 2. Interface to the Payment System

Payment System

Payment Interface

Sends payment data to payment system

Employees Service

Performs CRUD Operations on Employees

Salary Service

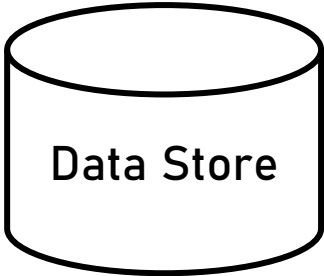
Salary approval workflow

Vacation Service

Employee's Vacation Management

View Service

Returns static files to the browser (HTML, CSS, JS)



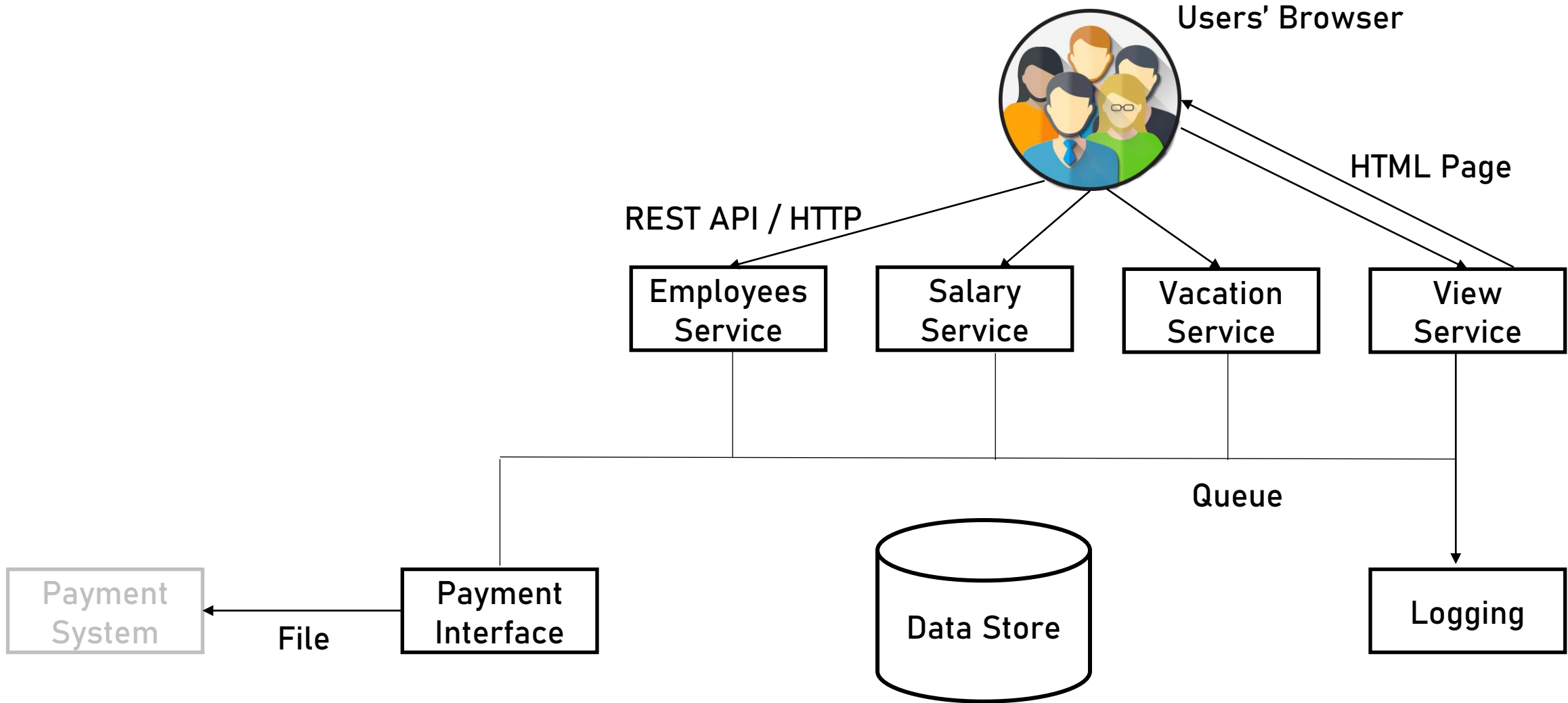
Data Store

Logging

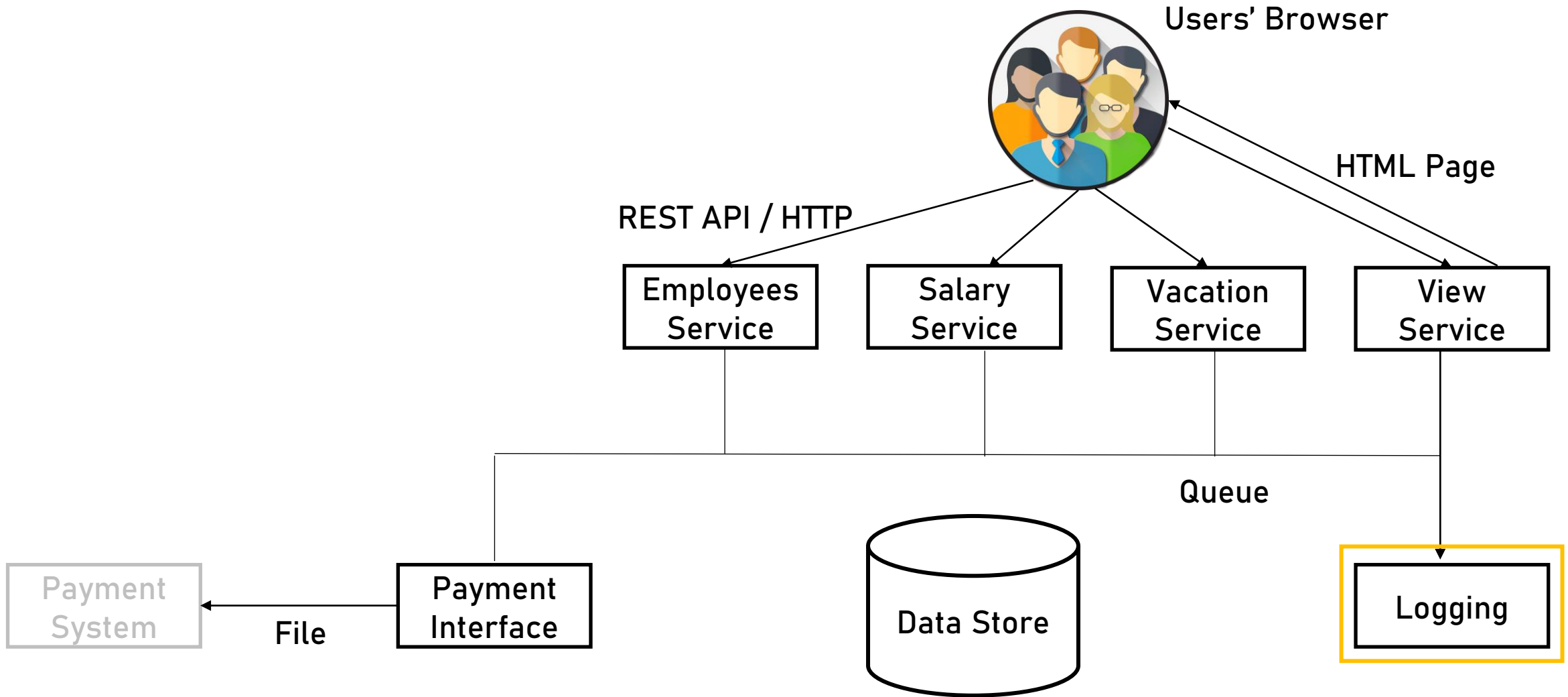
Q: Single or Per Service Data Store?

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

Messaging



Components



Logging Service


- Very Important
- Other services use it

Logging - Questions

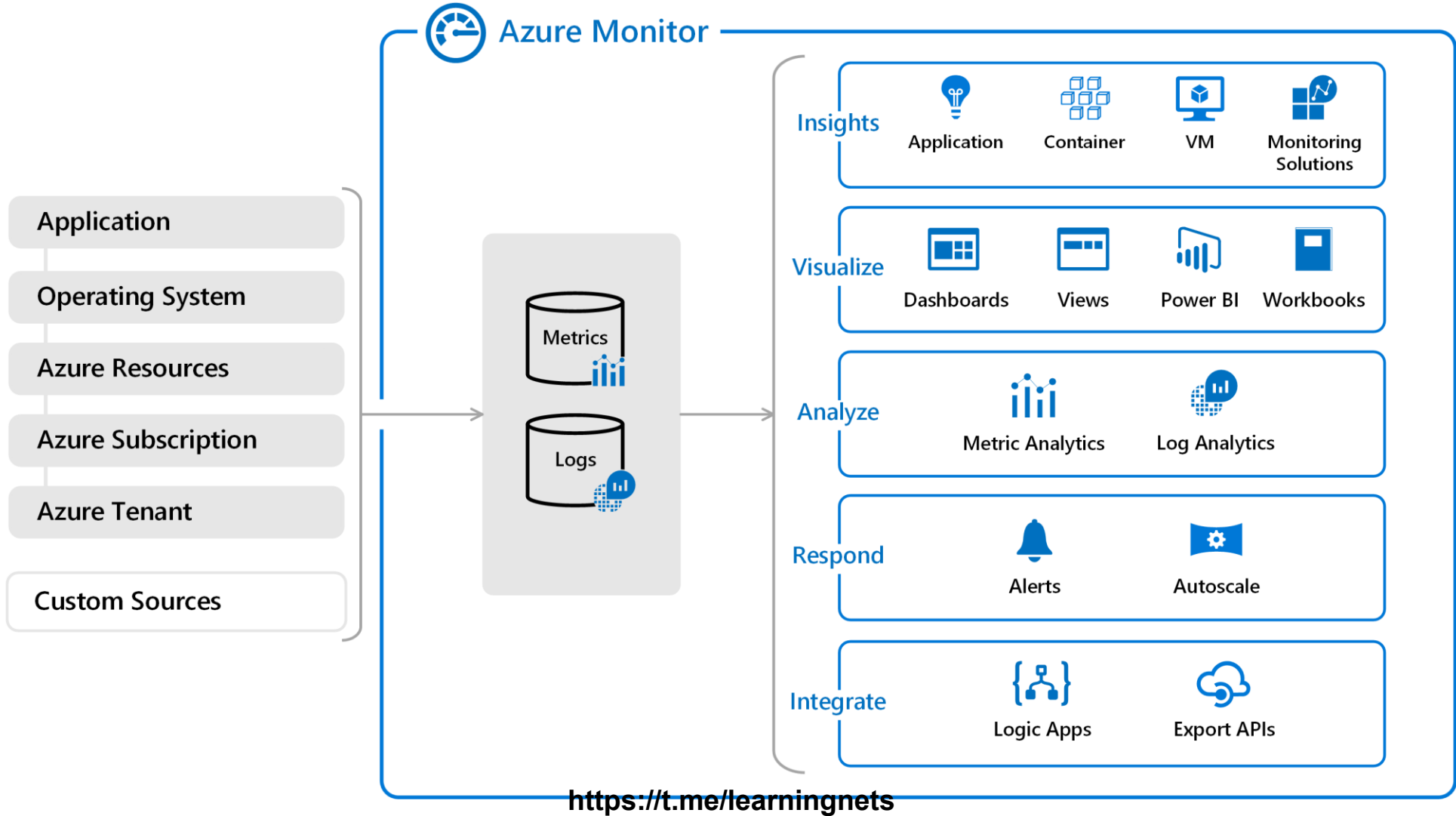
1. Is there an existing logging mechanism used by the company in the cloud?
2. Develop our own or use 3rd party?

No

Logging in Azure

- Azure log analytics 
 - Part of Azure Monitor
 - Great integration with a lot of services
 - Handles huge amounts of data
 - Offers query language for analysis
 - Can be streamed to log analytics tools (Power BI etc.)

Logging in Azure



Logging in Azure

Home > Logic Apps > myLogicApp - Logs

myLogicApp - Logs

Logic app | Directory: Microsoft

New Query 1* +

myLogicApp | Select Scope | **Run** | Time range: Last 24 hours

Save | Copy | Export | New alert rule | Pin to dashboard

AzureDiagnostics

Completed. Showing partial results from the last 24 hours. 00:00:03.638 1,107 records

Table | Chart | Columns

Display time (UTC+00:00) | Copy request ID

Drag a column header and drop it here to group by that column

TimeGenerated [UTC]	resource_originRunId_s	resource_actionName_s	correlation_actionTrackingId_g	workflowId_s	Level	_schema_s
> 12/13/2019, 12:54:21.577 AM				/SUBSCRIPTIONS/4E56605E-4B16-4BAA-9358-DBB8D6FAEDFE/RESO...	Information	2016-06-01
> 12/13/2019, 12:54:22.538 AM				/SUBSCRIPTIONS/4E56605E-4B16-4BAA-9358-DBB8D6FAEDFE/RESO...	Information	2016-06-01
▼ 12/13/2019, 12:54:22.525 AM	08586254084239710681729204791CU57			/SUBSCRIPTIONS/4E56605E-4B16-4BAA-9358-DBB8D6FAEDFE/RESO...	Information	2016-06-01

Schema and Filter

TenantId	83dc2523-0480-4aae-b9b1-6ac6f5996954
SourceSystem	Azure
TimeGenerated [UTC]	2019-12-13T00:54:22.525Z
resource_originRunId_s	08586254084239710681729204791CU57
workflowId_s	/SUBSCRIPTIONS/4E56605E-4B16-4BAA-9358-DBB8D6FAEDFE/RESOURCEGROUPS/MYRESOURCEGROUP/PROVIDERS/MICROSOFT.LOGIC/WORKFLOWS/MYLOGICAPP
Level	Information
_schema_s	2016-06-01
status_s	Running
resource_resourceGroupName_s	myResourceGroup
resource_workflowName_s	myLogicApp
resource_runId_s	08586254084239710681729204791CU57
resource_location_s	eastus2
correlation_clientTrackingId_s	08586254084239710681729204791CU57

Items per page

1 - 50 of 1107 items

Cost of Log Analytics

Azure Monitor

REGION:
West Europe

^ Log Analytics \$8.97

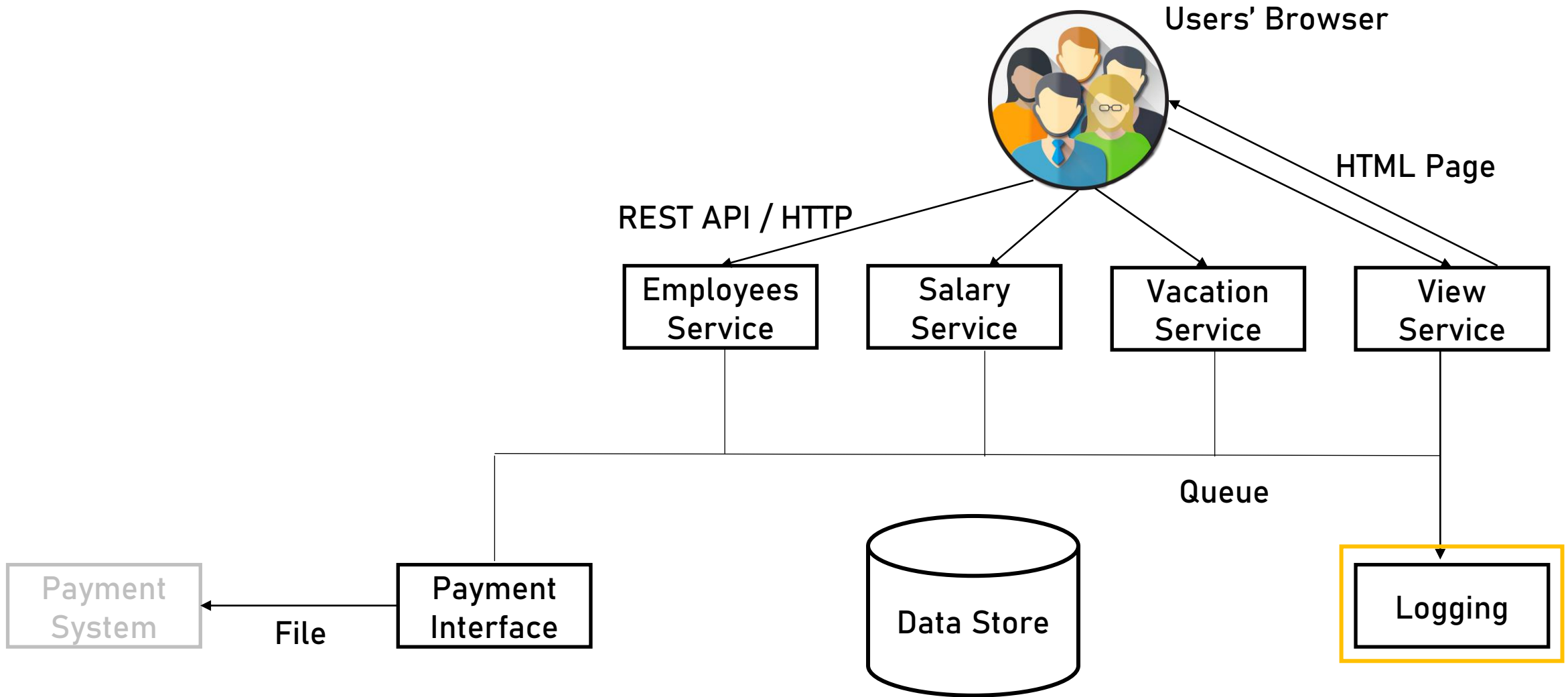
i Daily log data ingested will depend on what you are monitoring with Log Analytics. [Learn more](#) about estimating data volumes.

Data Ingestion

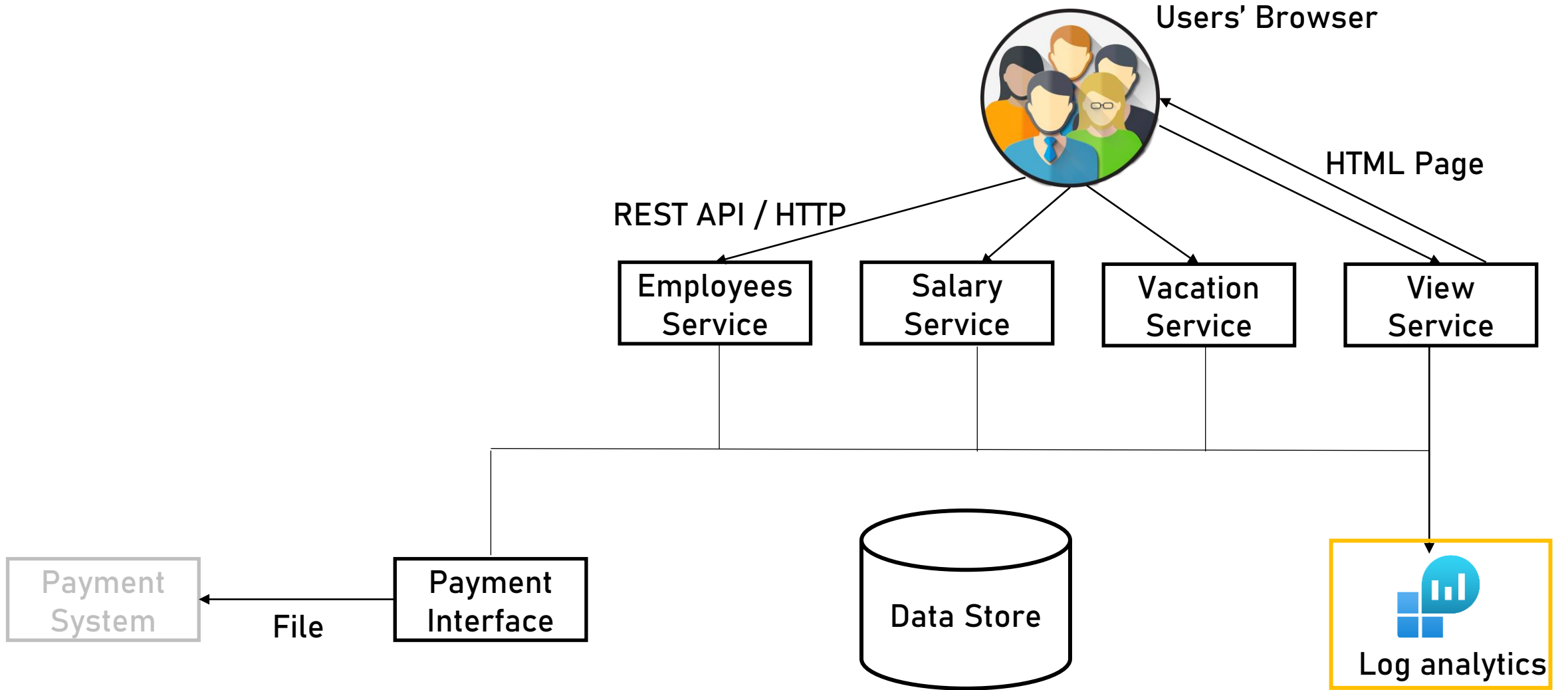
<input type="text" value="0.1"/> Daily logs ingested (GB/day)	×	30 Days	×	\$2.99 Per GB	=	<input type="text" value="\$8.97"/>
--	---	------------	---	------------------	---	-------------------------------------

i This estimate is calculated using the most optimal pricing tier for the data ingestion. This calculation uses **Pay-As-You-Go tier**. [Learn more](#) about the pricing tiers

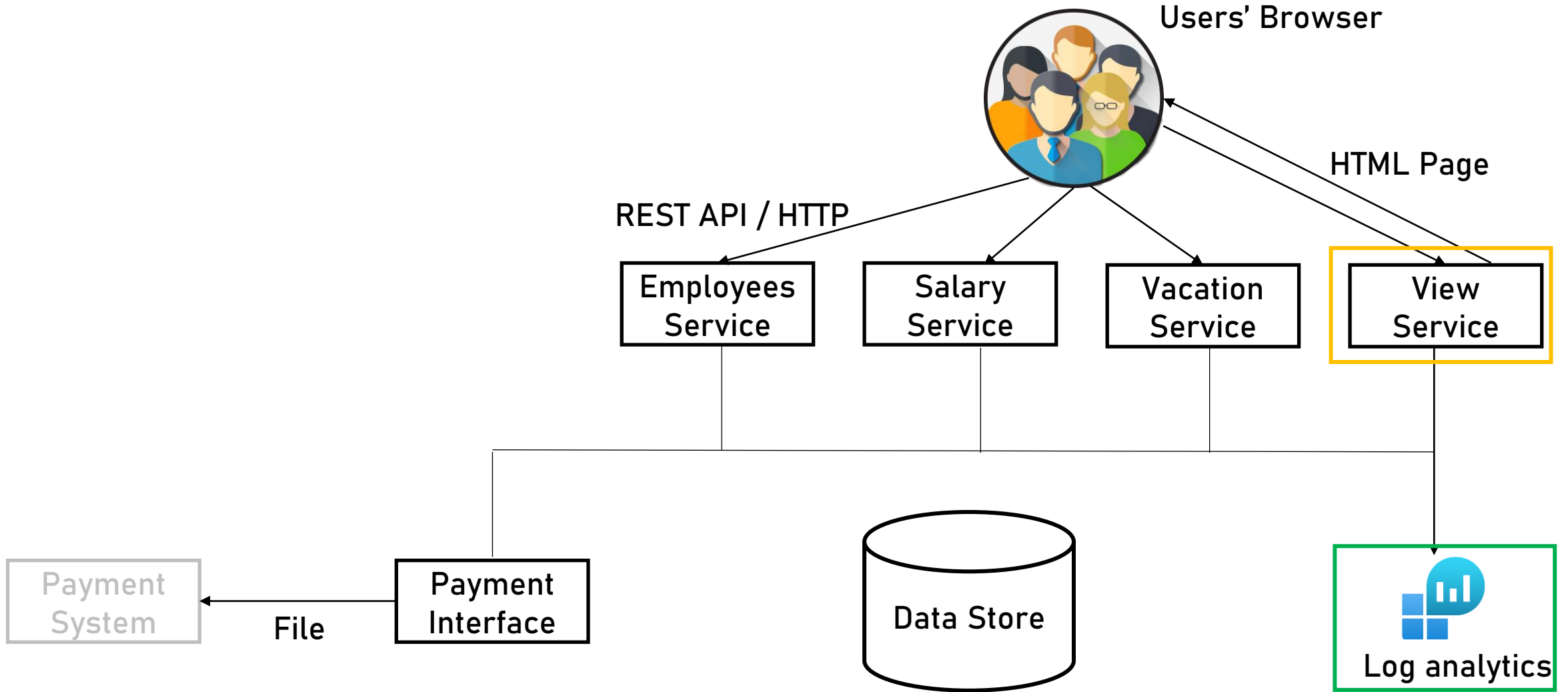
Components



Components



Components



View Service

What it does:

- Get requests from the end users' browsers
- Returns static files (HTML / CSS / JS)

Application Type

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

Architecture

User Interface /
Service Interface

Business Logic

Data Access

Data Store

<https://t.me/learningnets>

Architecture

User Interface

Business Logic

Data Access

Data Store
<https://t.me/learningnets>



Static web sites in Azure



App Service

- Fully managed web app & API
- Supports many platforms
- Autoscale
- Support for WebJobs



Static Web Apps

- Fully managed static web site
- Complete integration with source controls (Git, Azure DevOps etc.)
- Extremely cost effective

Static web sites in Azure

App Service

REGION: OPERATING SYSTEM: TIER:

Standard

INSTANCE:

Hours = \$73.00

Instances

SSL Connections

Upfront cost	\$0.00
Monthly cost	<input style="border: 2px solid green;" type="text" value="\$73.00"/>

Static web sites in Azure

Static Web Apps

TIER: Standard

Free tier has no SLA! (99.95% in Standard)

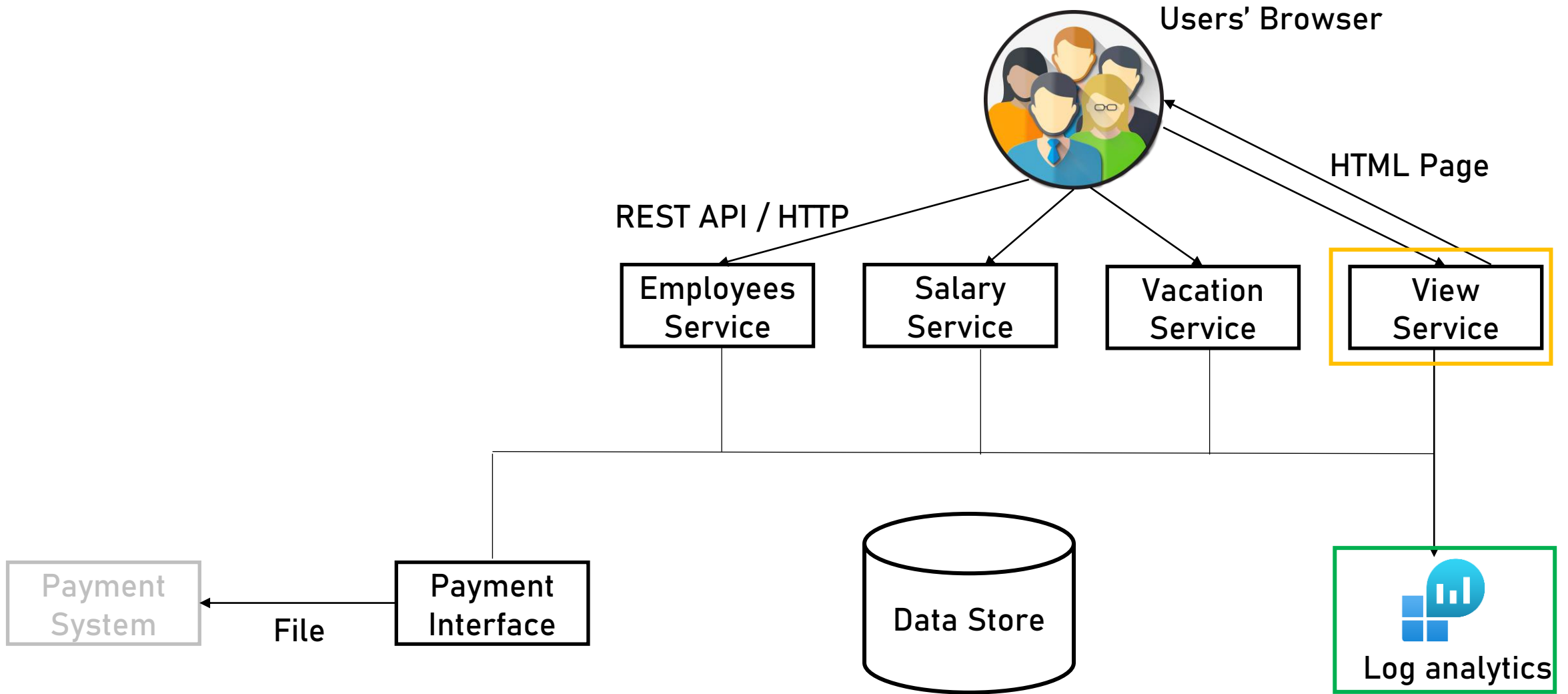
Standard

The standard tier includes 100 GB of bandwidth per subscription and 2 GB of storage per app.

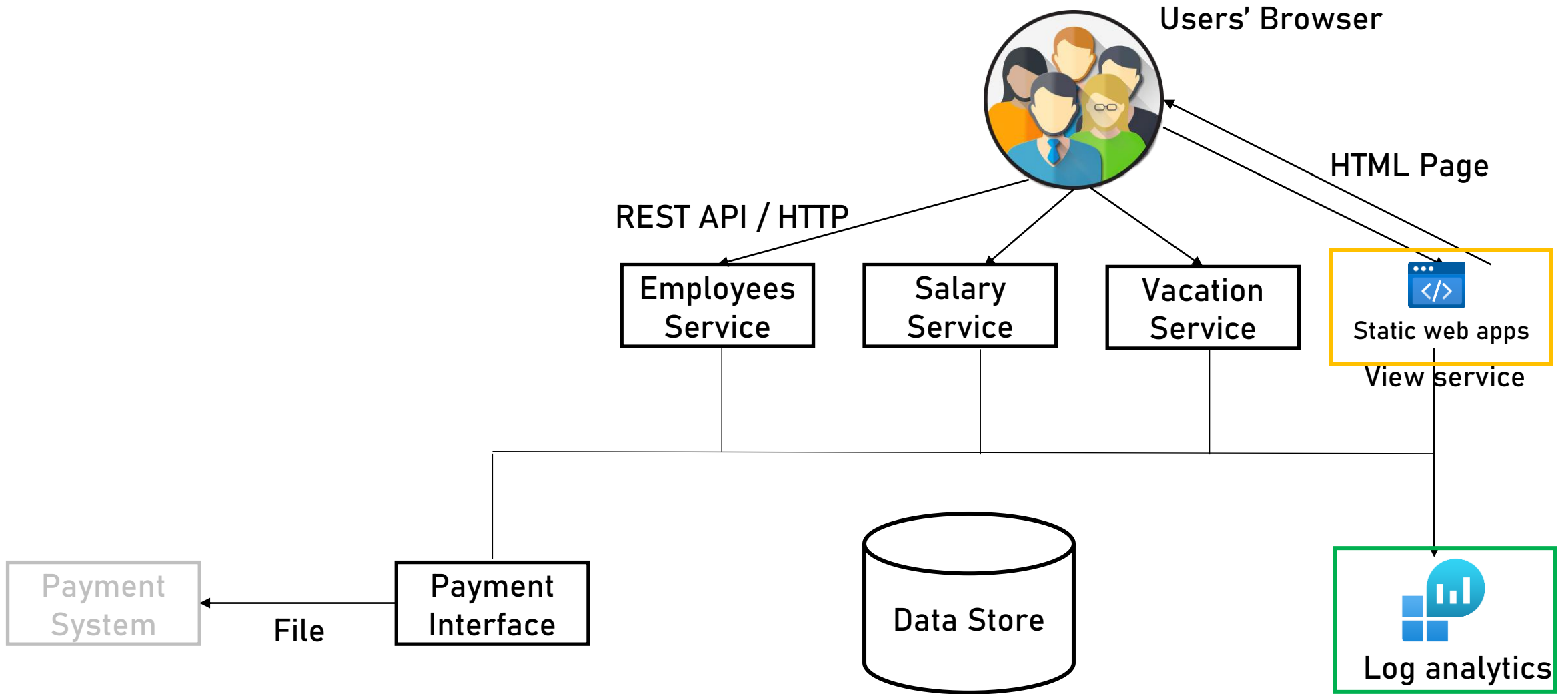
1	×	\$9.00	=	\$9.00	
App		Per app			
Bandwidth Overages					
0	GB	×	\$0.00	=	\$0.00
			Per additional GB		
				Upfront cost	\$0.00
				Monthly cost	\$9.00

Our choice!

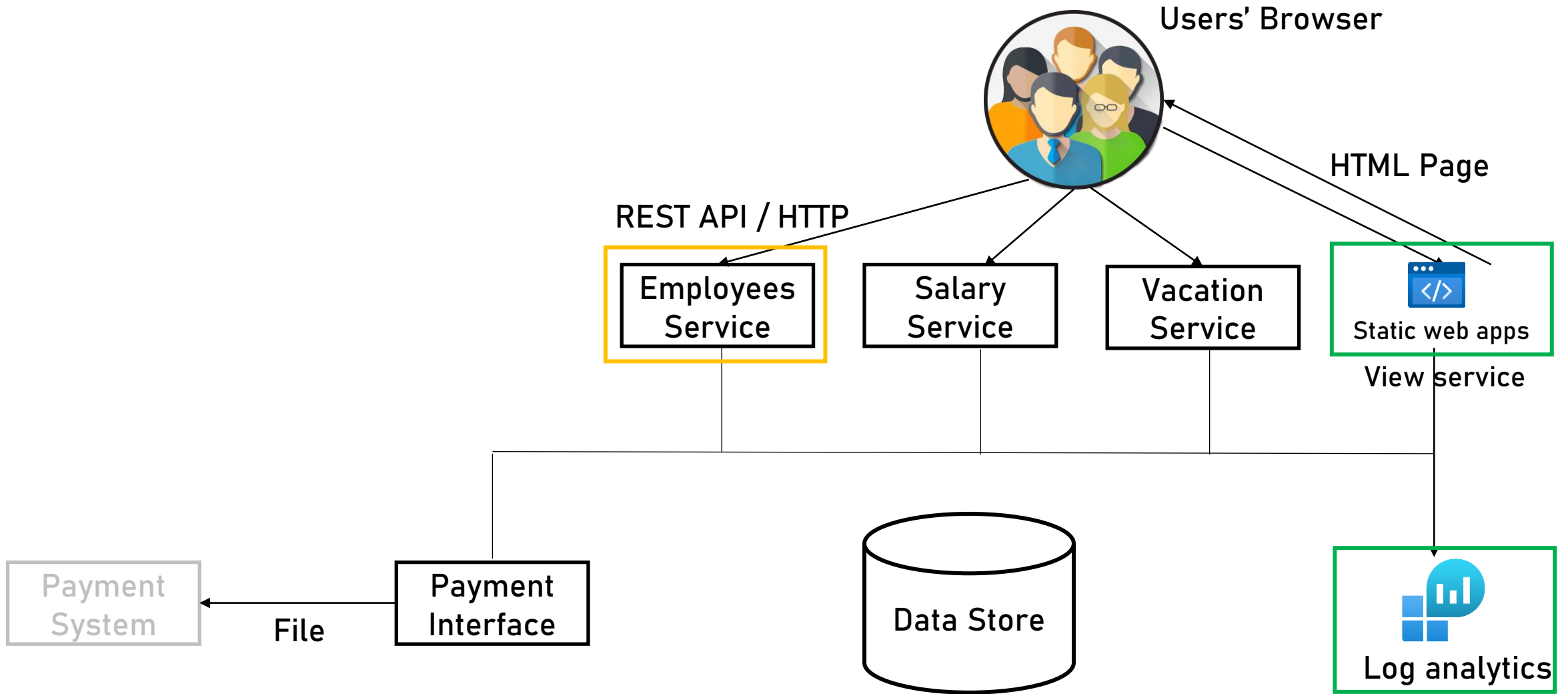
Components



Components



Components



Employees Service

What it does:

- Allows end users to query employees' data
- Allows performing actions on data (CRUD)

What it doesn't:

- Displays the data

Application Type

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

Technology Stack – Dev Platform



Azure Web API

Let's choose:



App

- Fully managed
 - Supports managed updates
 - Autoscale
 - Support for WebJobs
- Azure Functions are for lightweight actions
 - The API does some heavy lifting
 - Updates, docs etc.
 - App services support these actions
- Extremely cost effective

Azure Web API



App Service

- Fully managed web app & API
- Supports many platforms
- Autoscale
- Support for WebJobs



Function Apps

- Fully managed cloud functions
- Lightweight
- Autoscale
- Integration with cloud services
- Extremely cost effective

Azure Web API

App Service

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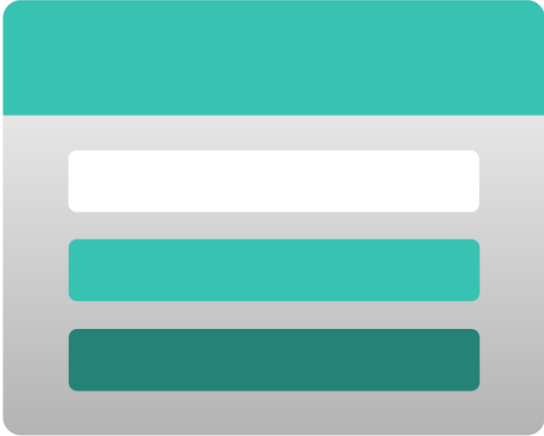
Technology Stack – Database

Employee Data (Relational)

Documents



Azure SQL



Storage Account

Azure SQL Database

REGION:

West Europe

TYPE:

Single Database

BACKUP STORAGE TIER:

LRS

PURCHASE MODEL:

vCore

SERVICE TIER:

General Purpose

COMPUTE TIER:

Provisioned

HARDWARE TYPE:

Gen 5

INSTANCE:

2 vCore

Compute

REDUNDANCY:

Local

1

Instances

Savings Options

Save up to 73% on pay as you go prices with 1 year or 3 year reserved options.

Compute

- Pay as you go
- 1 year reserved
- 3 year reserved

COMPUTE PAYMENT OPTIONS:

Monthly

\$110.00

Average per month
(\$0.00 charged upfront)

SQL License

- Pay as you go
- Azure Hybrid Benefit

\$145.95

Average per month
(\$0.00 charged upfront)

= \$255.95
Average per month
(\$0.00 charged upfront)

Storage

5

GB

= \$0.68

Storage Accounts

REGION: West Europe

TYPE: Block Blob Storage

PERFORMANCE TIER: Standard

STORAGE ACCOUNT TYPE: General Purpose V2

ACCESS TIER: Hot

REDUNDANCY: LRS

Capacity: 25 GB

Upfront cost	\$0.00
Monthly cost	\$0.71

Architecture

Service Interface

Business Logic

Data Access



Data Store

<https://t.me/learningnets>

API

- Get full employee details by ID
- List of employees by parameters
- Add employee
- Update employee details
- Remove employee



Not physical delete!

<https://t.me/learningnets>

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.



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


<https://t.me/learningnets>


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


Employee Service Redundancy

App service auto scale

Default* Auto created scale condition 

Delete warning  The very last or default recurrence rule cannot be deleted. Instead, you can disable autoscale to turn off autoscale.

Scale mode Scale based on a metric Scale to a specific instance count







Rules  It is recommended to have at least one scale in rule. To create new rules, click Add a rule.

Scale out

When	Default1	(Average) CpuPercentage > 70	Increase count by 1
Or	Default1	(Average) HttpQueueLength > ...	Increase count by 1

+ Add a rule

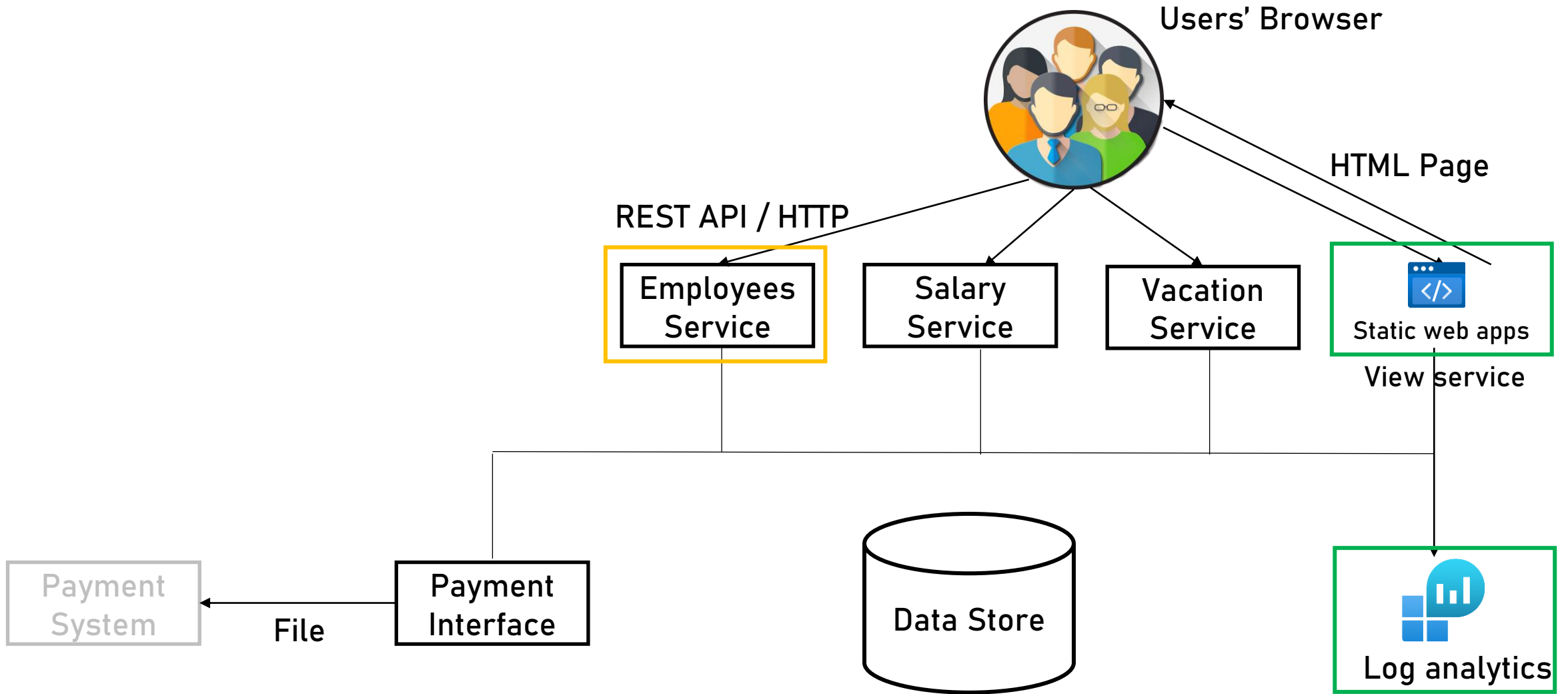
Instance limits

Minimum 	Maximum 	Default 
1 	3 	1 

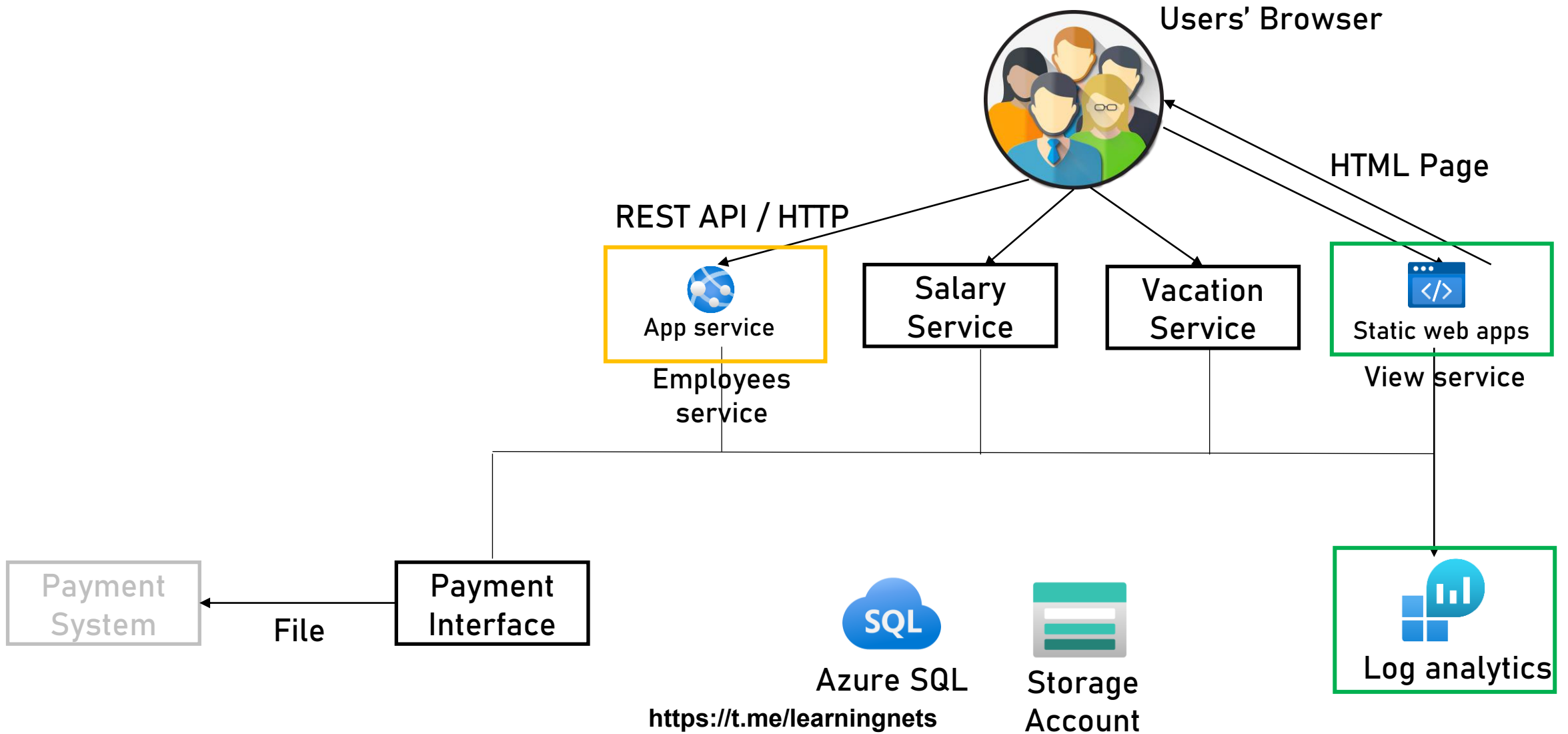
Schedule **This scale condition is executed when none of the other scale condition(s) match**

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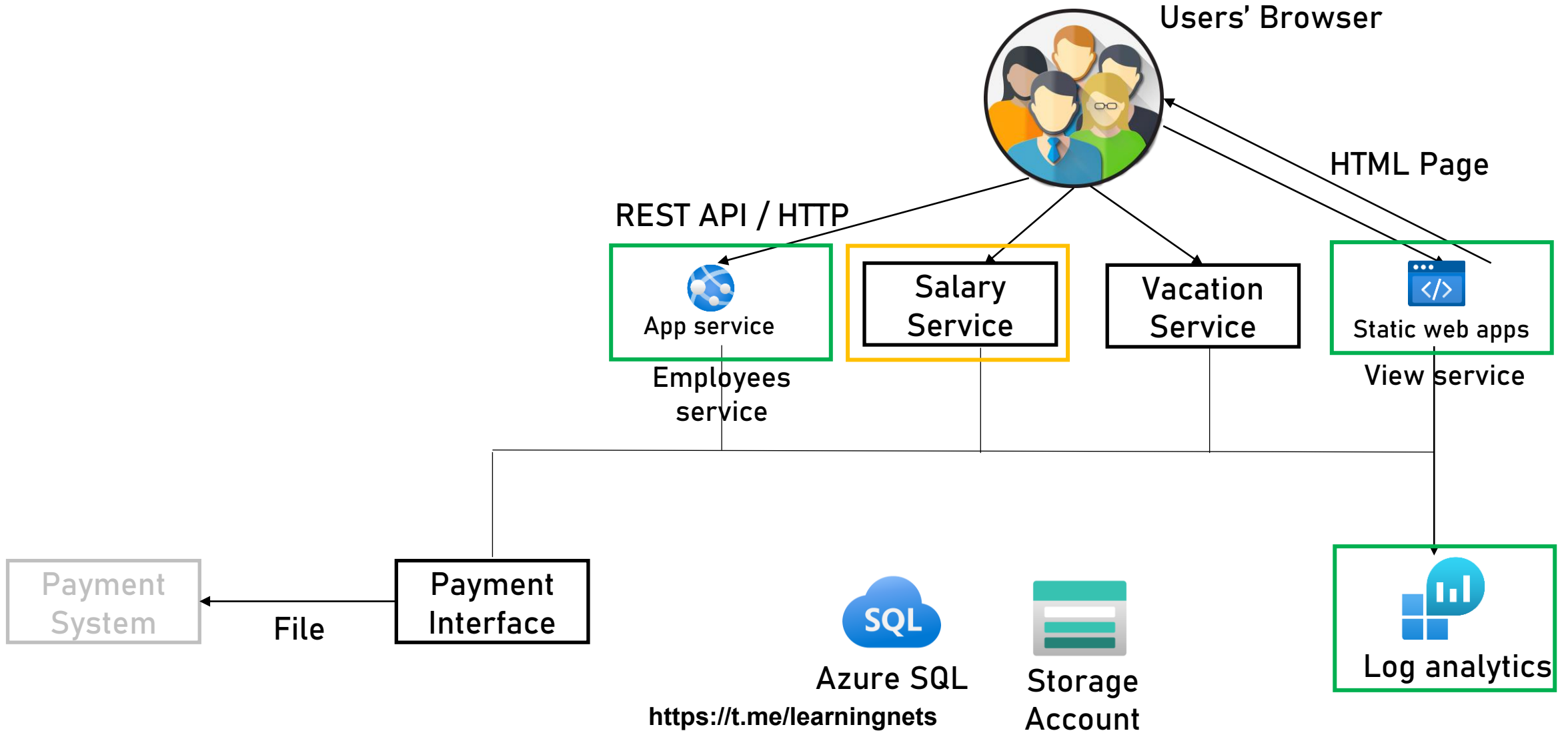
Components



Components



Components



Salary Service

What it does:

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

Application Type

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

Technology Stack



Azure Web API

Let's choose:

- Azure Functions are for lightweight actions
- The API does some heavy lifting
 - Updates, docs etc.
- App services support these actions



App Se

- Fully managed w
- Supports many p
- Autoscale
- Support for WebJobs
- Integration with cloud services
- Extremely cost effective

Azure Web API



App Service

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- Supports many platforms
- Autoscale
- Support for WebJobs



Function Apps

- Fully managed cloud functions
- Lightweight
- Autoscale
- Integration with cloud services
- Extremely cost effective

Azure Web API

App Service

REGION: OPERATING SYSTEM: TIER:

Standard

INSTANCE:

Hours = \$73.00

Instances

SSL Connections

Upfront cost	\$0.00
Monthly cost	<input style="border: 2px solid green;" type="text" value="\$73.00"/>

Architecture

Service Interface

Business Logic

Data Access



Data Store

<https://t.me/learningnets>

API


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


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


Salary Service Redundancy

App service auto scale

Default* Auto created scale condition 

Delete warning  The very last or default recurrence rule cannot be deleted. Instead, you can disable autoscale to turn off autoscale.

Scale mode Scale based on a metric Scale to a specific instance count







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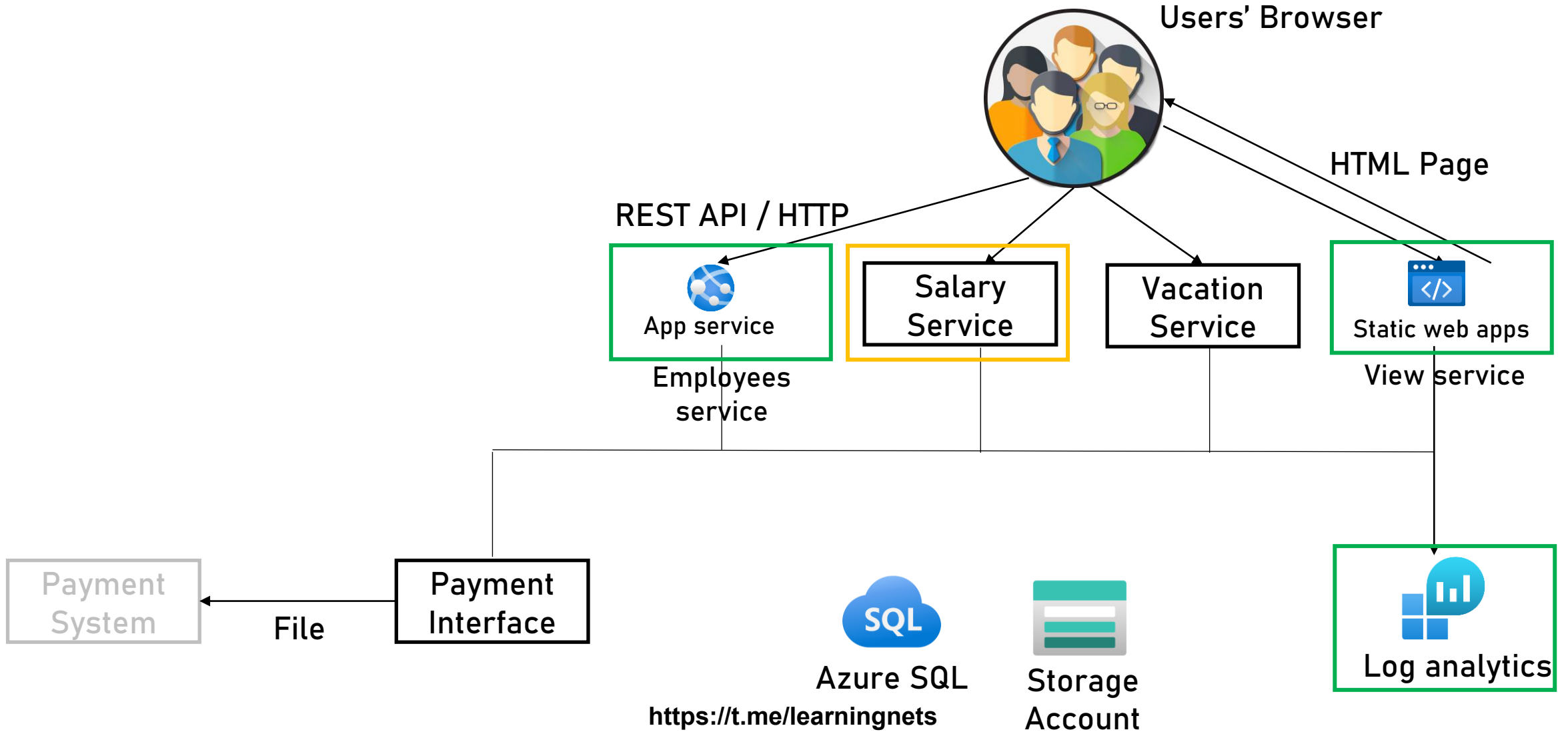
Instance limits

Minimum 	Maximum 	Default 
1 	3 	1 

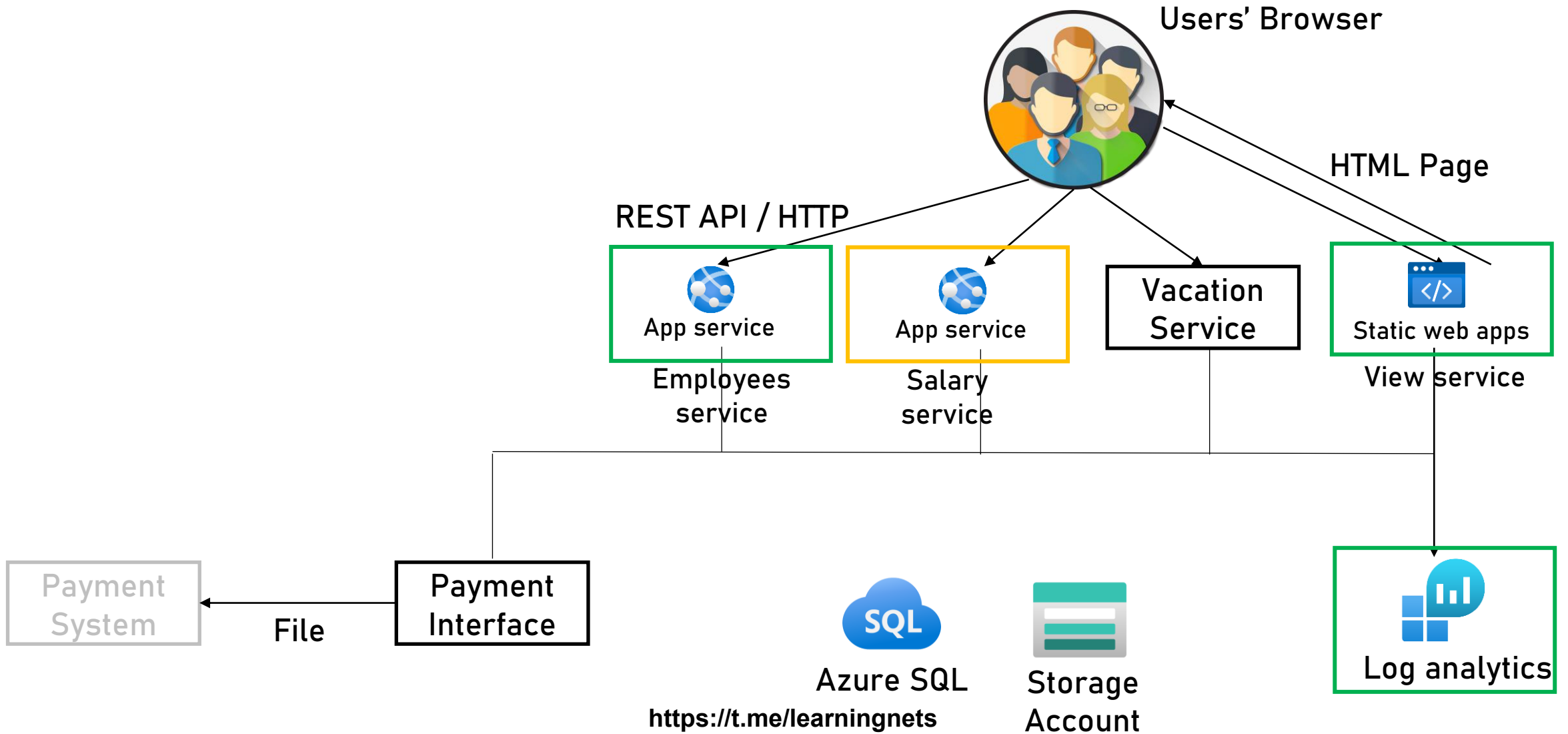
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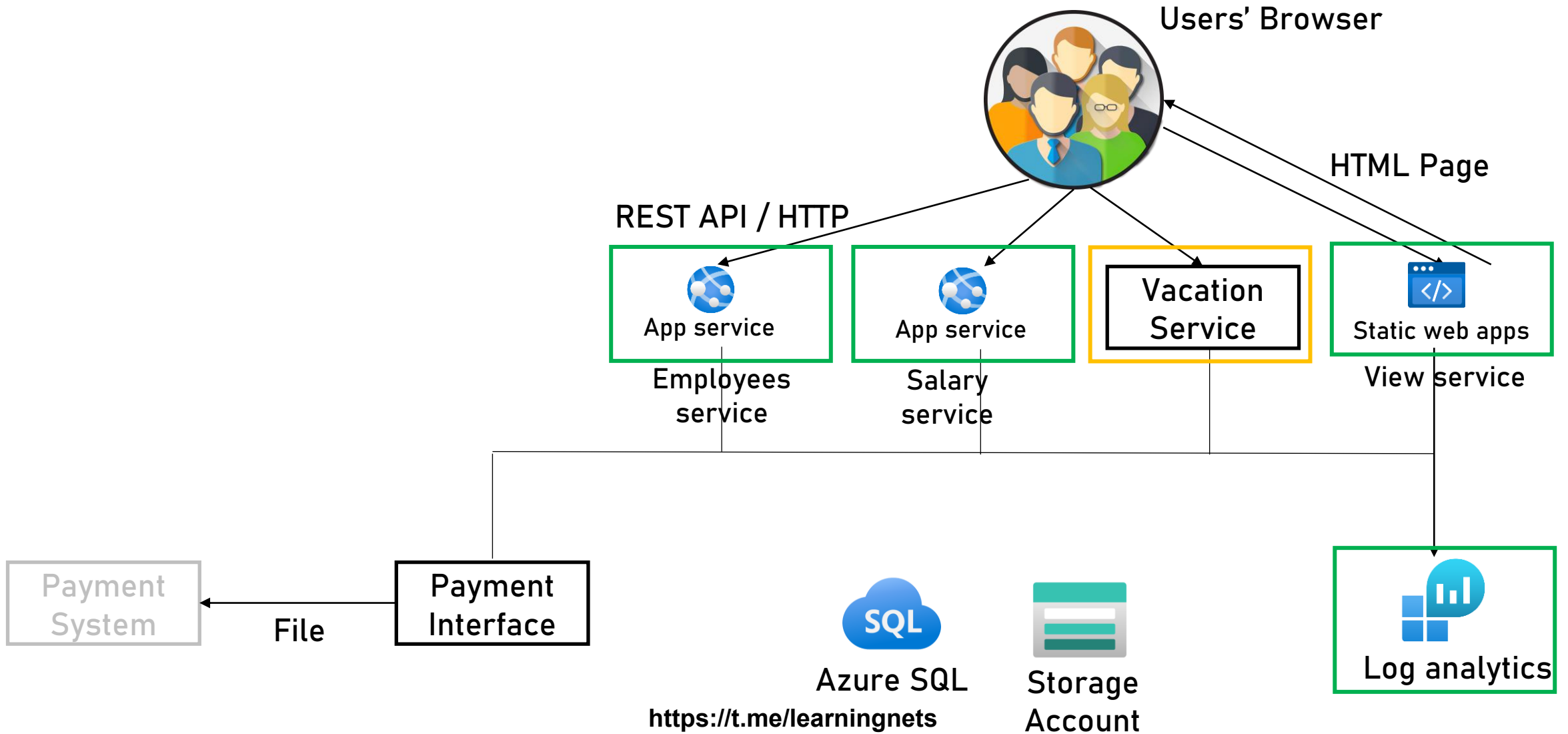
Components



Components



Components



Vacation Service

What it does:

- Allows employees to manage their vacation days
- Allows HR to set available vacation days for employees

Application Type

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

Technology Stack



Azure Web API



App Service

- Fully managed web app & API
- Supports many platforms
- Autoscale
- Support for WebJobs

Azure Web API

App Service

REGION: West Europe

OPERATING SYSTEM: Windows

TIER: Standard

Standard

INSTANCE: S1: 1 Cores(s), 1.75 GB RAM, 50 GB Storage, \$0.100

1 Instances × 730 Hours = \$73.00

SSL Connections

Upfront cost	\$0.00
Monthly cost	\$73.00

Architecture

Service Interface

Business Logic

Data Access



Data Store

<https://t.me/learningnets>

API

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





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


Vacation Service Redundancy

App service auto scale

Default* Auto created scale condition 

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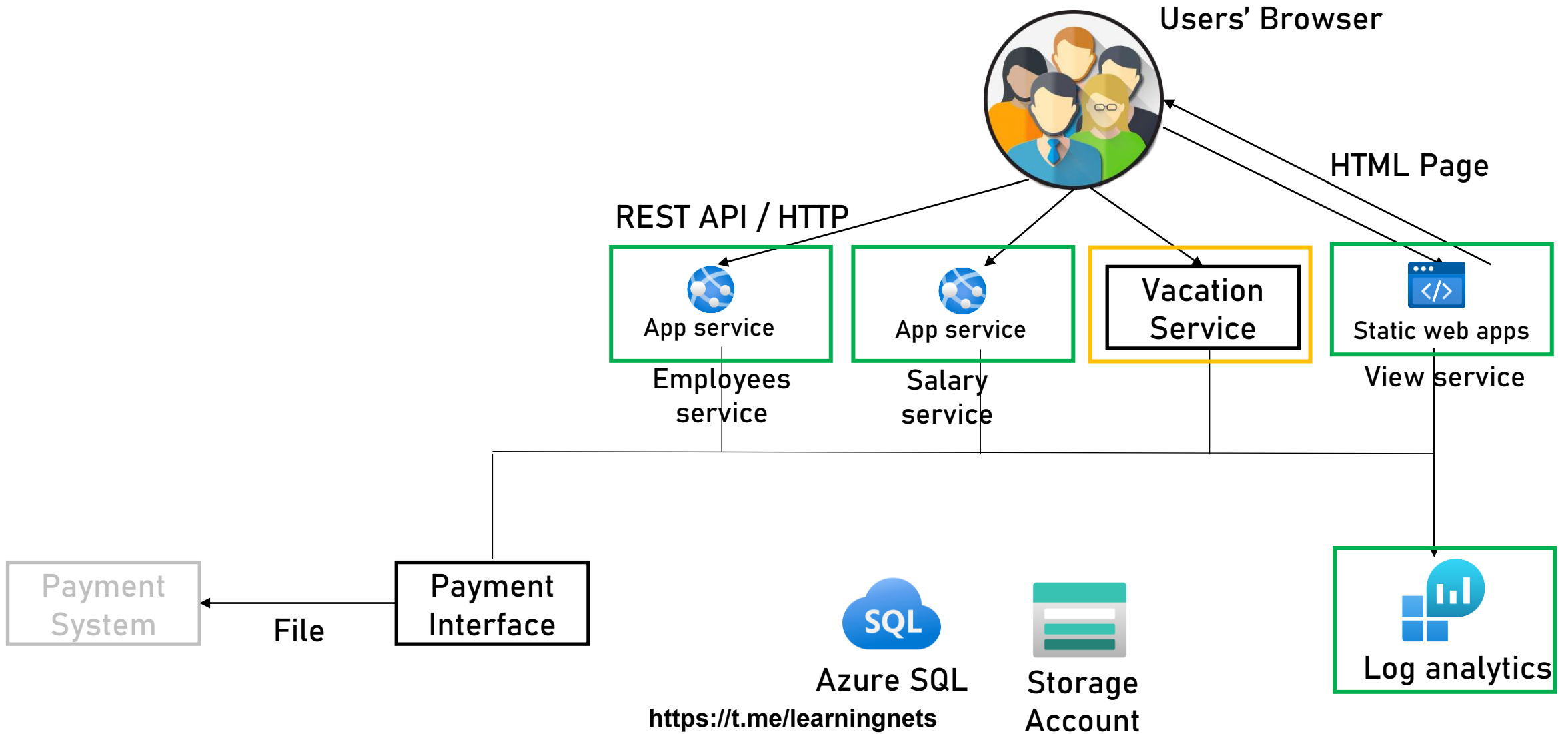
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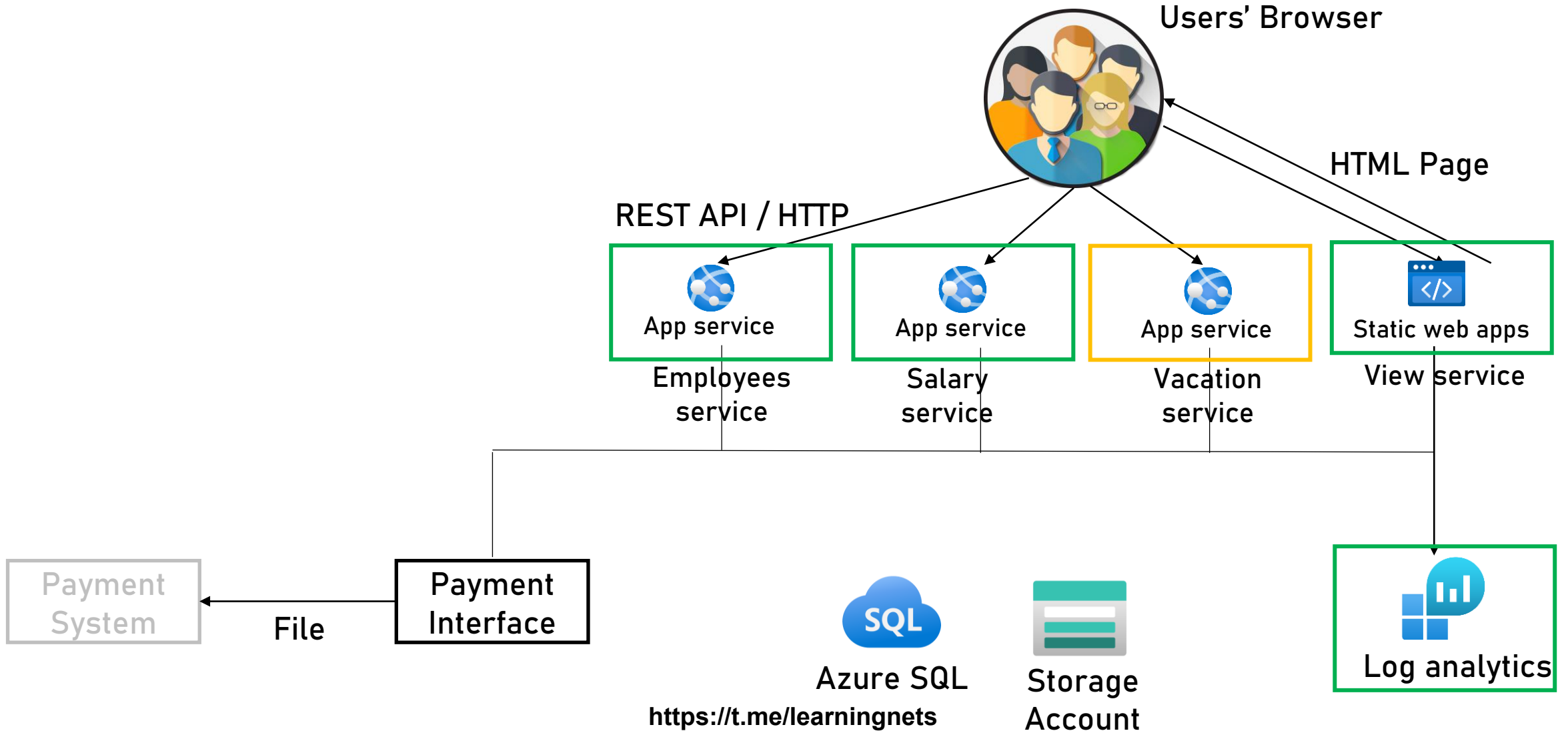
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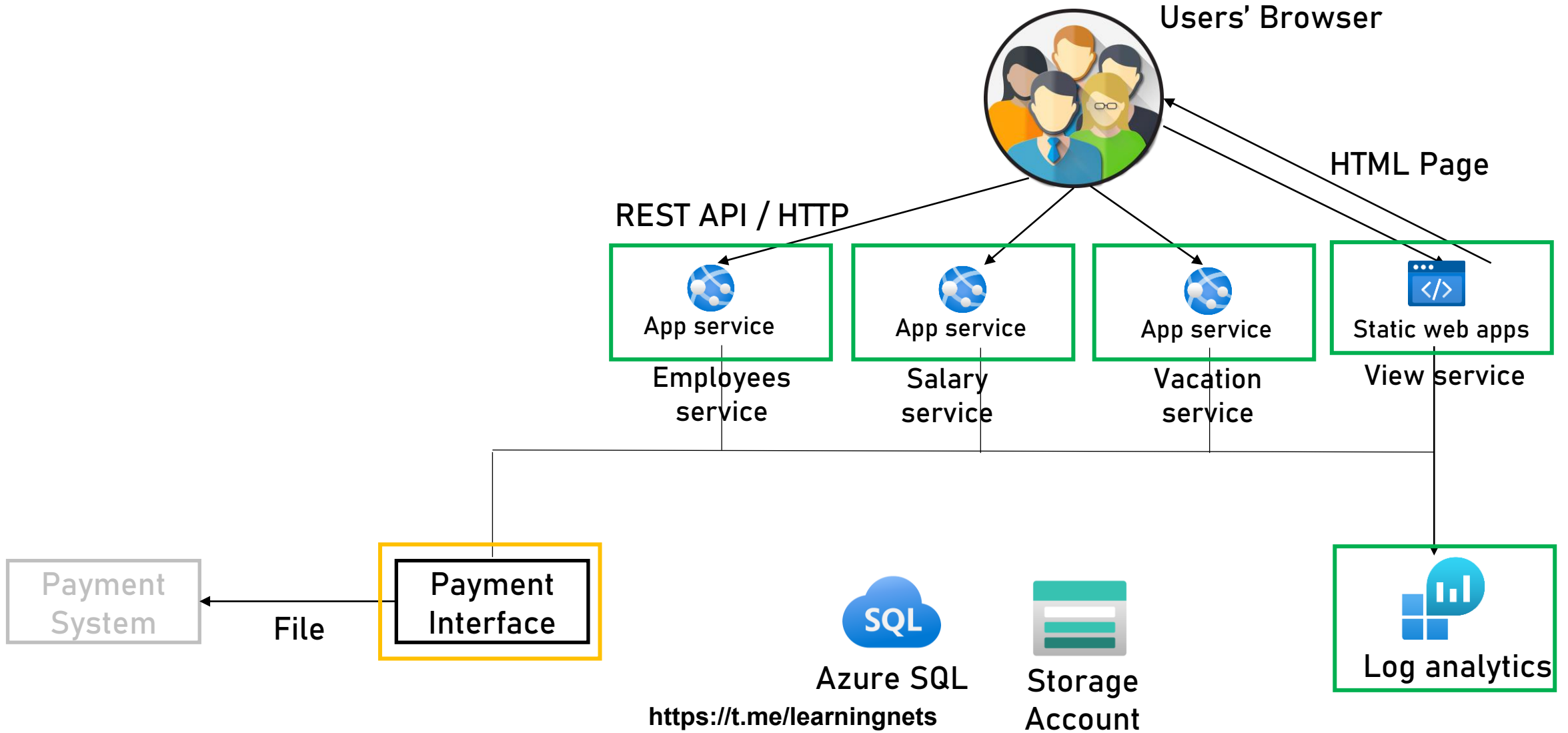
Components



Components



Components








Payment Interface

What it does:

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

Application Type

- Web App & Web API 
- Mobile App 
- Console 
- Service 
- Desktop App 

Technology Stack



Azure batch process



App Se

- Runs on schedule
- Part of the App s
- No additional cos

Let's choose:

- Azure Functions are for lightweight actions
- Have great monitoring
- The export can take a lot of time

- Integration with cloud services
- Extremely cost effective

Azure batch process



App Service WebJob

- Runs on schedule
- Part of the App service
- No additional cost



Function Apps

- Fully managed cloud functions
- Lightweight
- Autoscale
- Integration with cloud services
- Extremely cost effective

Azure batch process



App Service WebJob

- Runs on schedule
- Part of the App service
- No additional cost

Other alternatives



VM

- Requires a lot of manual maintenance
- Expensive



Logic app

- Too complex for this specific job



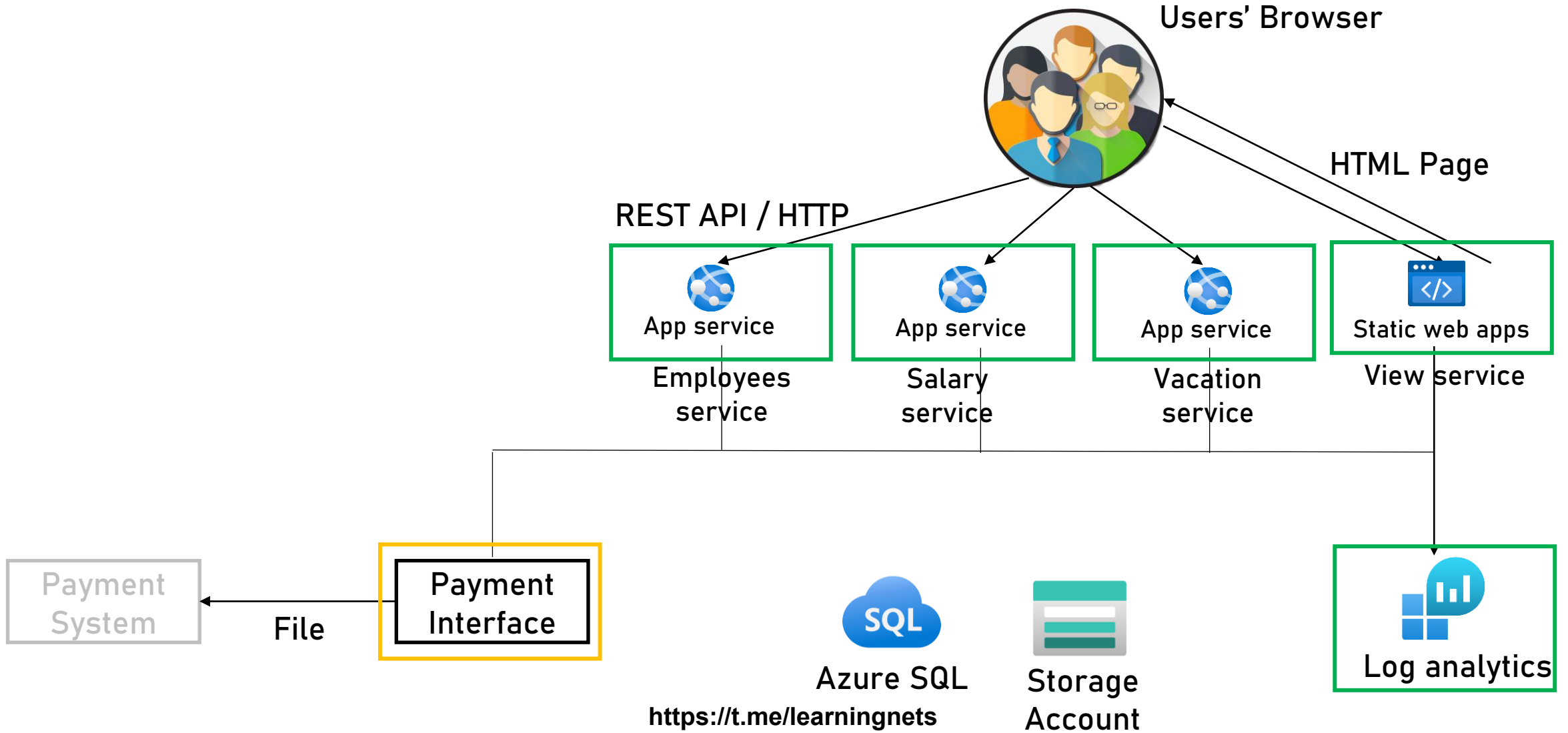
Azure batch

- Used for huge processes, this is not the case

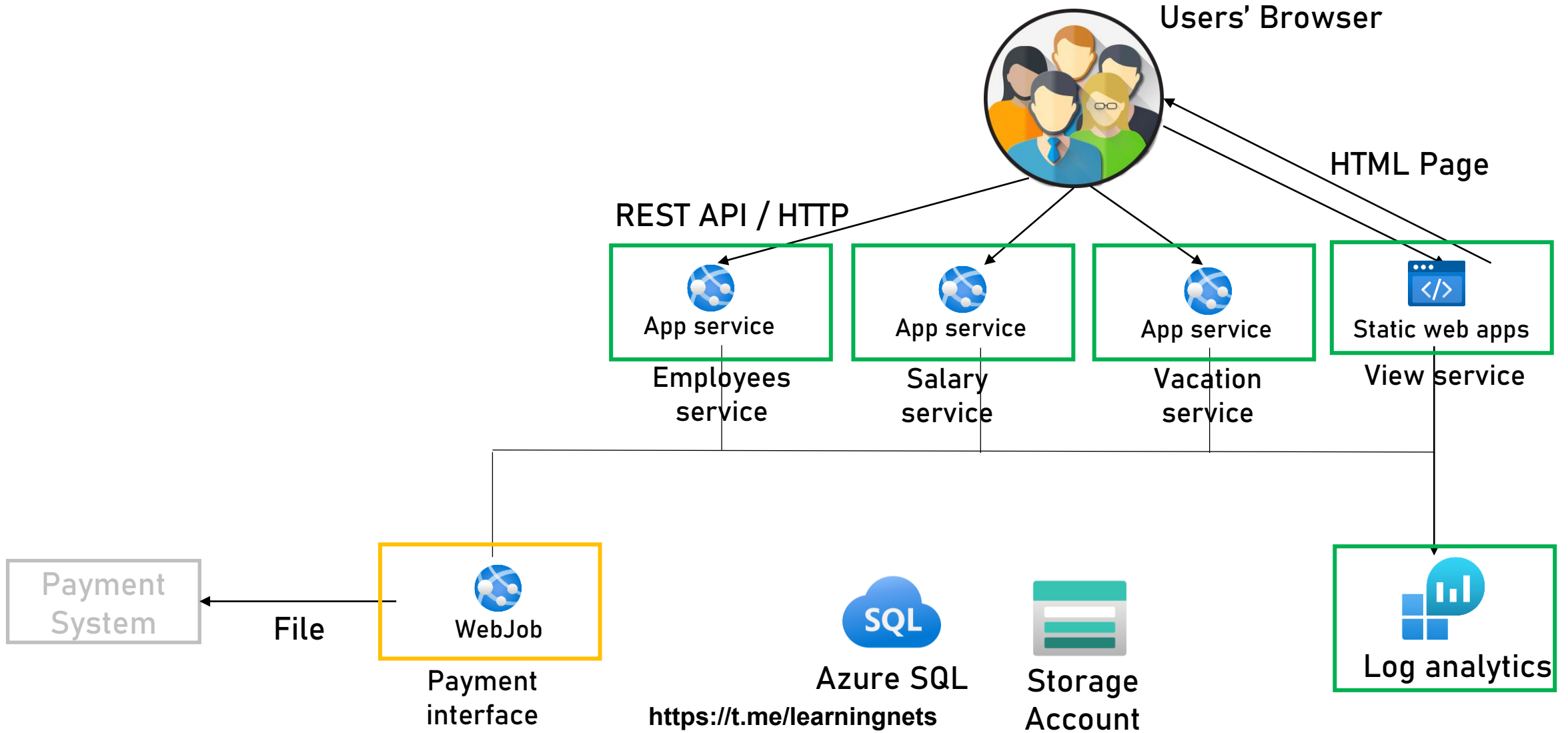
Payment Interface Redundancy

- No built-in redundancy for WebJobs
- Not critical – runs once a month
- Add monitoring for catching failures

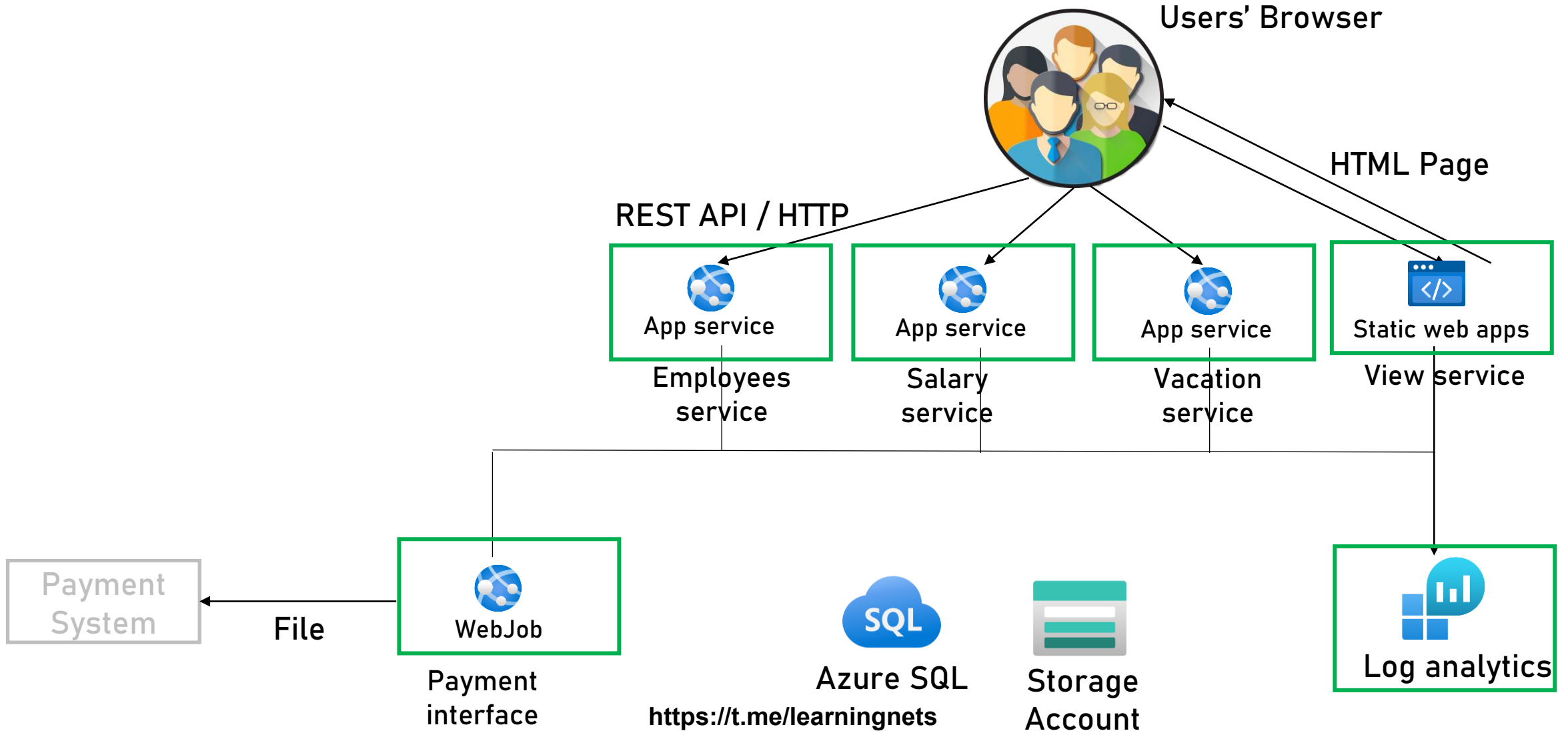
Components



Components



Components



Security

- Data encryption
- Network security
- Access restrictions

Data Encryption

- Data in Azure Storage account is encrypted by default
 - Using 256-bit AES encryption
- Traffic to Storage Account is encrypted using TLS

Data Encryption

- Data in Azure SQL is encrypted by default
 - Using 256-bit AES encryption
- Traffic to Azure SQL is encrypted using TLS

Network Security

- Currently all app services are exposed to the internet
- No protection whatsoever
- Need to add Web Application Firewall (WAF)



Application Gateway + WAF

- Load balancer
- Web Application Firewall
- Autoscale
- Sophisticated routing

Application Gateway

REGION: TIER:

Fixed Gateway Hours

Hours = \$341.64

Capacity unit

Compute unit(s) Persistent Connection(s) Throughput (mb/s)

i Each capacity unit is composed of at most: 1 compute unit, or 2,500 persistent connections, or 2.22-Mbps throughput. If any one of these metrics are exceeded, then another n capacity unit(s) are necessary, even if the other two metrics don't exceed this single capacity unit's limits.

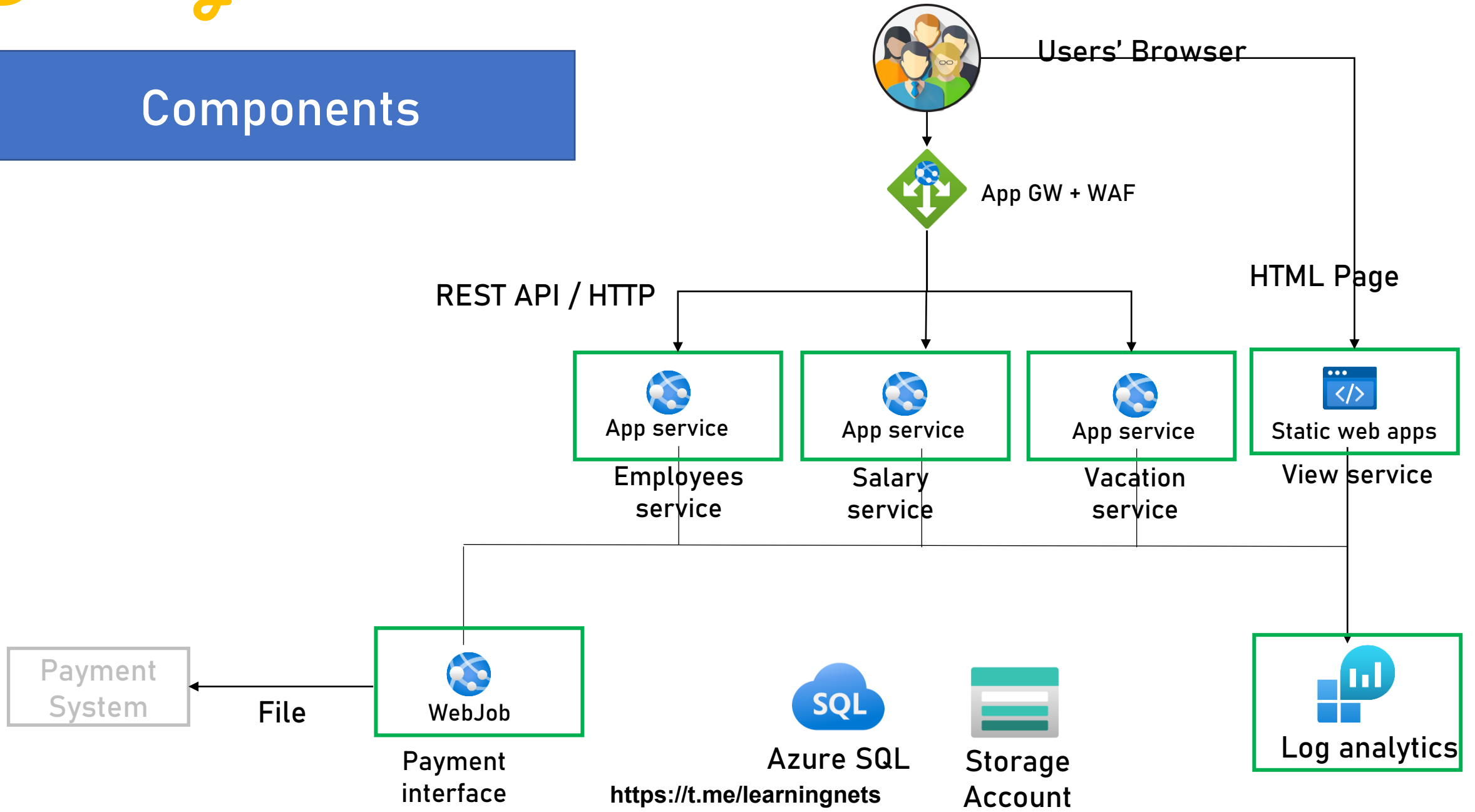
730 Hours = \$10.51

Outbound Data Transfer

GB = \$0.00

Upfront cost	\$0.00
Monthly cost	\$352.15

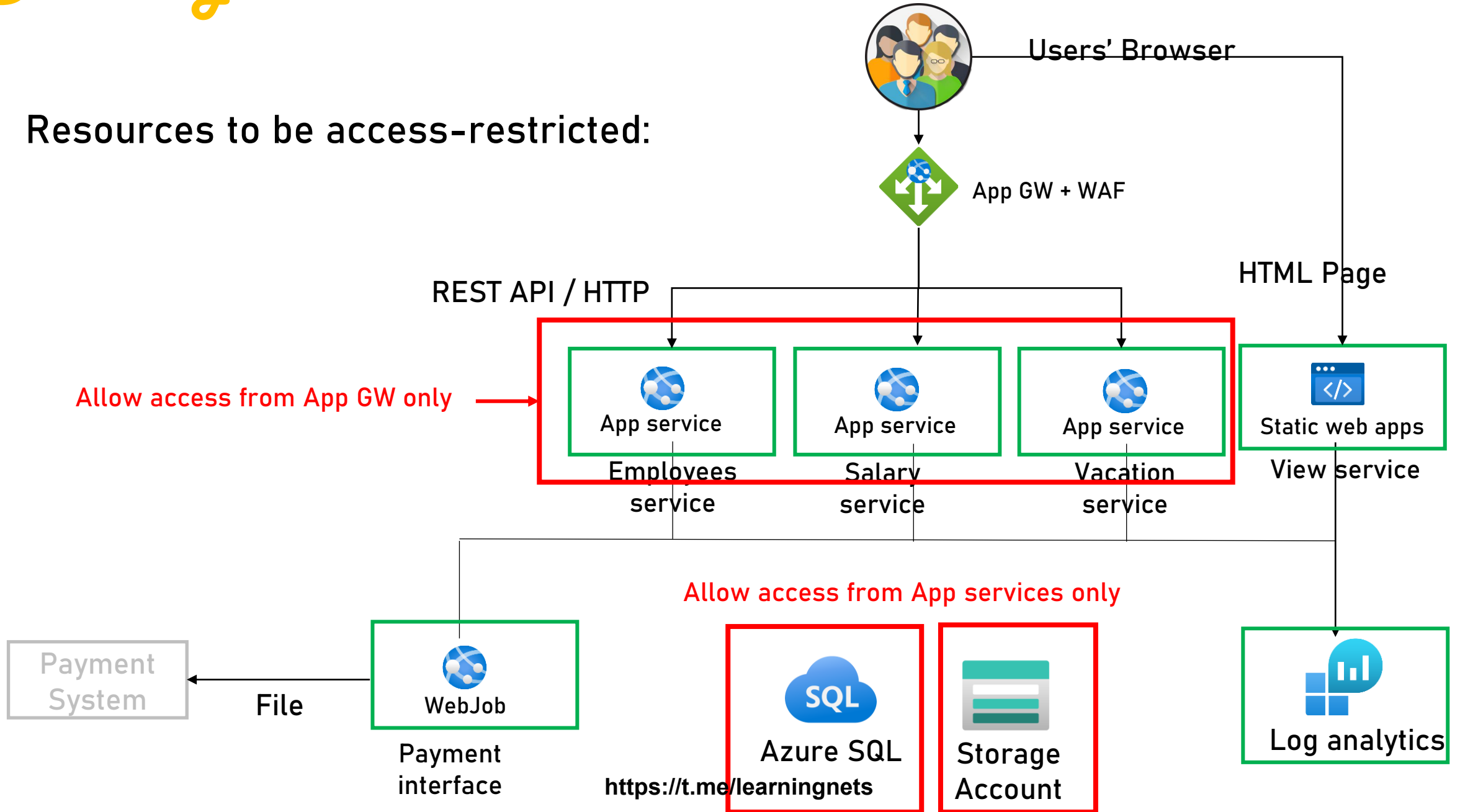
Components



Access Restrictions

- **Access to resources should be limited to allowed resources only**

Resources to be access-restricted:



Restrict access to App service

Add NSG rule to allow traffic from the App GW's VNET

App Service | Networking ...

Search (Ctrl+ /) Refresh Go to classic experience Send us your feedback

Check your web app's networking configuration. Select any of the listed features to change your network set up. [Learn more](#)

Inbound Traffic
Manage access and incoming services.

Features

- Access restriction On
- App assigned address Off
- Private endpoints N/A ⓘ

Inbound address

Web App
These custom domains direct traffic to your web app.

Domains

- azurewebsite...

More networking features

- Azure CDN
- Azure Front Door

Outbound Traffic
Set up calls to app dependencies like databases.

Features

- VNet integration Off
- Hybrid connections Off

Outbound addresses

...Show more



Access Restrictions

Remove Refresh

Access Restrictions

Access restrictions allow you to define lists of allow/deny rules to control traffic to your app. Rules are evaluated in priority order. If there are no rules defined then your app will accept traffic from any address. [Learn more](#)

+ Add rule

<input type="checkbox"/> Priority	Name	Source	Endpoint status	HTTP headers	Action
<input type="checkbox"/> 100	API Mgmt			Not configured	<input checked="" type="checkbox"/> Allow
<input type="checkbox"/> 2147483647	Deny all	Any		Not configured	<input checked="" type="checkbox"/> Deny

General settings

Name

Action Allow Deny

Priority *

Description

Source settings

Type Virtual Network

Subscription *

Virtual Network *

Subnet *

HTTP headers filter settings

X-Forwarded-Host

X-Forwarded-For

X-Azure-FDID

X-FD-HealthProbe

Add rule

Restrict access to Azure SQL

1. Get outbound IP of the App service
2. Add firewall rule to the Azure SQL

App Service | Networking

Search (Ctrl+ /) Refresh Go to classic experience Send us your feedback

Check your web app's networking configuration. Select any of the listed features to change your network set up. [Learn more](#)

Inbound Traffic

Manage access and incoming services.

Features

- Access restriction On
- App assigned address Off
- Private endpoints N/A ⓘ

Inbound address

Web App

These custom domains direct traffic to your web app.

Domains

- azurewebsite...

More networking features

- Azure CDN
- Azure Front Door

Outbound Traffic

Set up calls to app dependencies like databases.

Features

- VNet integration Off
- Hybrid connections Off

Outbound addresses

[...Show more](#)

Deployment

- Quickstart
- Deployment slots
- Deployment Center

Settings

- Configuration
- Authentication
- Application Insights
- Identity
- Backups
- Custom domains
- TLS/SSL settings
- Networking**
- Scale up (App Service plan)
- Scale out (App Service plan)
- WebJobs
- Push

The screenshot shows the 'Firewalls and virtual networks' configuration page for an SQL server in the Azure portal. The left-hand navigation pane is visible, with 'Firewalls and virtual networks' highlighted. The main content area contains several settings:

- Deny public network access:** A toggle switch set to 'No'.
- Minimum TLS Version:** A dropdown menu set to '1.0'.
- Connection Policy:** A dropdown menu set to 'Default'.
- Allow Azure services and resources to access this server:** A toggle switch set to 'No'.
- Client IP address:** A table with columns for 'Rule name', 'Start IP', and 'End IP'. The table is currently empty.

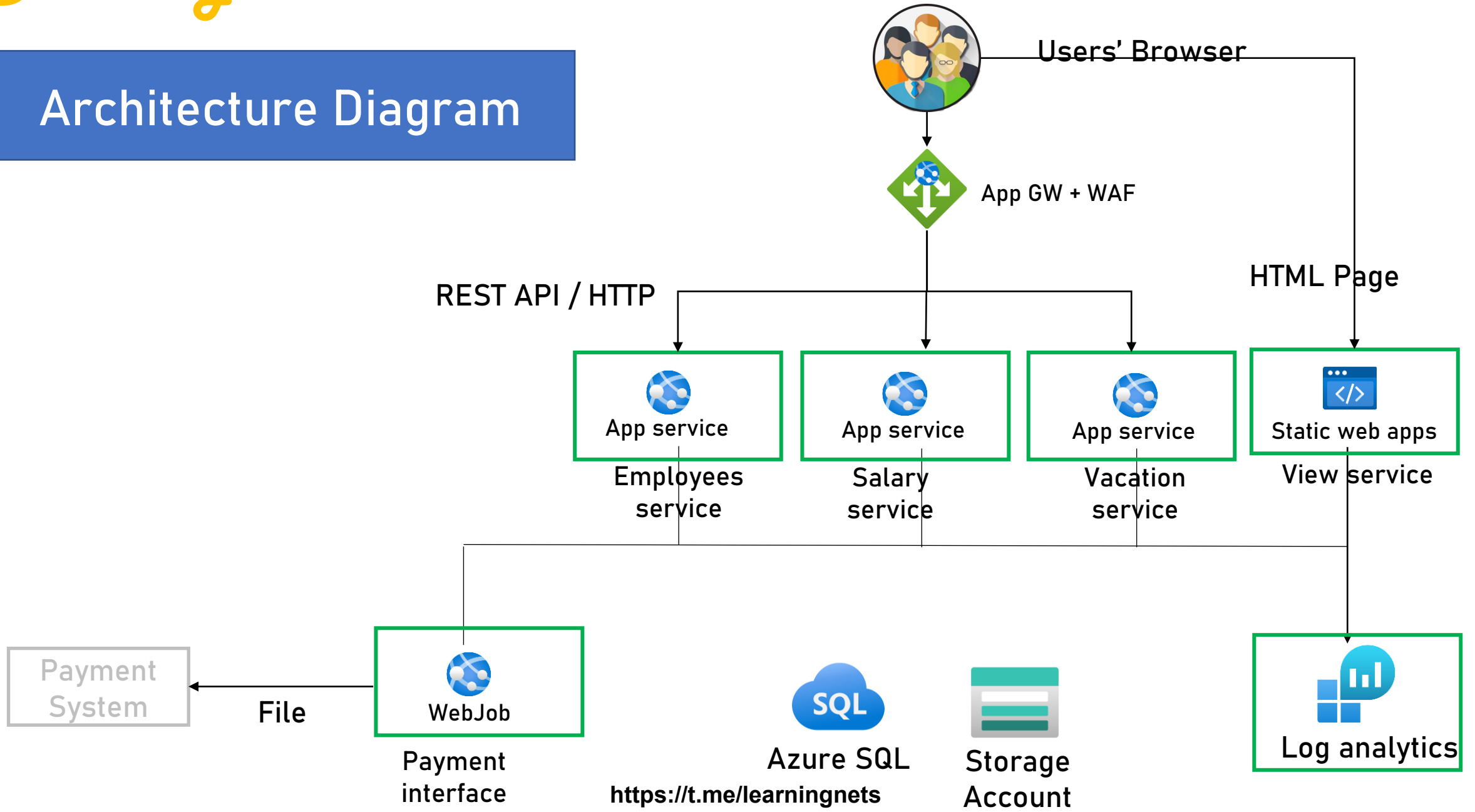
At the top of the main content area, there are buttons for 'Save', 'Discard', and 'Add client IP'. A search bar is located at the top left of the main content area.

Restrict access to Storage Account

1. Get outbound IP of the App service
2. Add firewall rule to the Storage Account

The screenshot shows the Azure portal interface for a storage account's networking settings. The left-hand navigation pane includes sections for 'Data storage' (Containers, File shares, Queues, Tables) and 'Security + networking' (Networking, Azure CDN). The 'Networking' option is highlighted with a green box. The main content area is titled 'Networking' and has tabs for 'Firewalls and virtual networks', 'Private endpoint connections', and 'Custom domain'. The 'Firewalls and virtual networks' tab is active, showing 'Save', 'Discard', and 'Refresh' buttons. A blue information banner states: 'Firewall settings allowing access to storage services will remain in effect for up to a minute after you save your settings.' Below this, the 'Allow access from' section has radio buttons for 'All networks' and 'Selected networks', with 'Selected networks' selected. A link for 'Learn more' is provided. The 'Virtual networks' section has buttons to 'Add existing virtual network' and 'Add new virtual network'. A table with columns 'Virtual Network' and 'Subnet' is shown, containing the text 'No network selected.' The 'Firewall' section includes a link for 'Learn more' and a checkbox for 'Add your client IP address ('176.228.97.172')'. Below this is an 'Address range' section with an input field for 'IP address or CIDR'.

Architecture Diagram



Cost

Estimated upfront cost	\$0.00
Estimated monthly cost	\$848.07

Download detailed cost estimation
from the lecture's resources