November 2024

Report: Bazar Project

Supervised by:
Dr. Samer Arandi

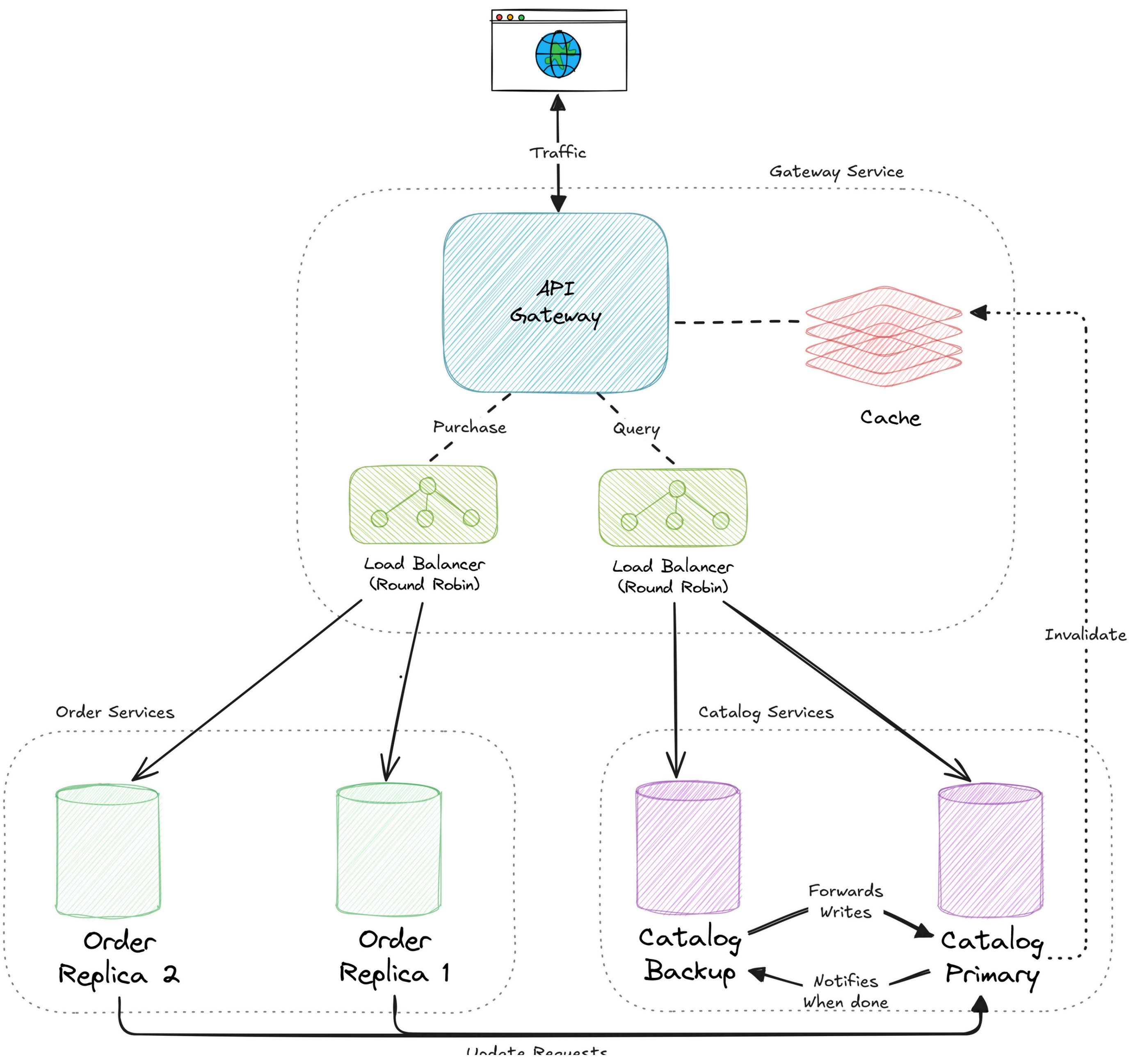
Students:

- Izzat Alsharif
- Asem Diab

01

Architecture

The Bazar application uses a microservices-based architecture, with each service responsible for a specific domain of the application. These services communicate with each other using REST. The system includes caching and replication to improve performance and ensure fault tolerance.



Cont.

1. **Gateway Service:**
   - Acts as the entry point for all client traffic.
   - Handles routing, caching, and load balancing for the backend services. It uses Round-Robin load balancing algorithm to distribute load evenly among nodes.
   - Ensures high availability and improved performance through in-memory caching and intelligent request distribution.
   - An in-memory cache in the Gateway Service stores frequently accessed data (e.g., book details). It uses LRU method to eliminate
   - data when cache size limit is hit.
   - Includes an invalidation mechanism triggered by updates to ensure consistency. (The primary catalog service invalidates cache entries after any update).

2. **Catalog Service:**
   - Maintains the book catalog, including details such as stock, price, and topic.
   - Implements a primary-backup replication for fault tolerance and performance:
     - The primary instance handles all write operations, and syncs updates with the backup.
   - Integrates with the gateway for cache invalidation upon updates.

3. **Order Service:**
   - Processes purchase requests, verifies stock availability, and updates catalog data.
   - Uses multiple replicas to handle increased loads.
   - Works with the gateway for balanced request distribution.

Project Structure

The application is version controlled via the github organization: Bazar Platform. And it includes the following repositories:

- **bazar-gateway-service**: Handles user interactions and routes requests to backend services.
- **bazar-catalog-service**: Manages the book catalog, including stock levels and book details.
- **bazar-order-service**: Manages order requests, verifies stock availability, and processes purchases.
- **.github**: Stores project documentation, including design documents.

Endpoints

- **Gateway Service (Front-End)**
  - GET /search/<topic>: Search for books by topic.
  - GET /info/<item_number>: Get information about a specific book.
  - POST /purchase/<item_number>: Purchase a specific book.

- **Catalog Service (Back-End)**
  - GET /query?topic=<topic>: Query books by topic.
  - GET /query?item_number=<item_number>: Query book details by item number.
  - PUT /update/<item_number>: Update stock or price information.

- **Order Service (Back-End)**
  - POST /purchase/<item_number>: Handle purchase requests, verify stock, and update quantities.

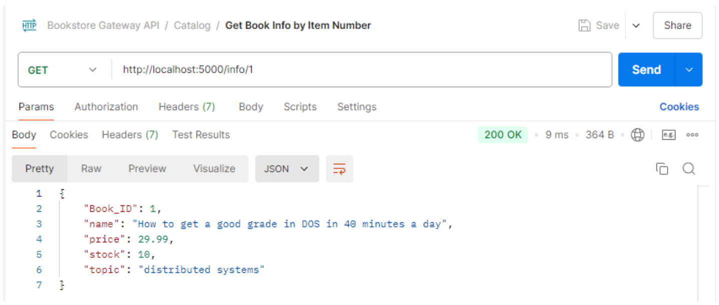
Performance Measurements

The main performance improvement that was implemented in the second part of the project (Lap 2) is the <u>gateway caching mechanism</u>. Replicating does affect performance but is only noticable when there is concurrent requests which is hard to test with postman.

For most requests it takes about **6 - 8 ms** to execute them. When caching is used this remains the case only for the initial request. On repeated requests we get cache hits which reduces the exectuion time to about **2 - 3 ms**.

When a cache entry is invalidated, the next request for it will increase back to **6 - 8 ms** because we get a cache miss.

Initial Request For Item 1

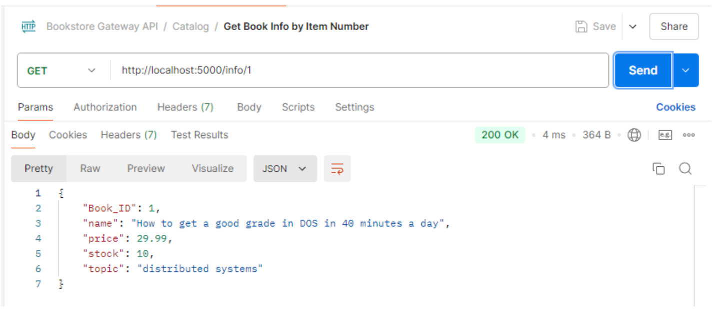

Bookstore Gateway API / Catalog / Get Book Info by Item Number
Save
Share
Send
Params Authorization Headers (7) Body Scripts Settings
Cookies
Body Cookies Headers (7) Test Results
Pretty Raw Preview Visualize JSON

GET http://localhost:5000/info/1

200 OK · 9 ms · 364 B

```
{
    "Book_ID": 1,
    "name": "How to get a good grade in DOS in 40 minutes a day",
    "price": 29.99,
    "stock": 10,
    "topic": "distributed systems"
}
```

Repeated Request for Item 1

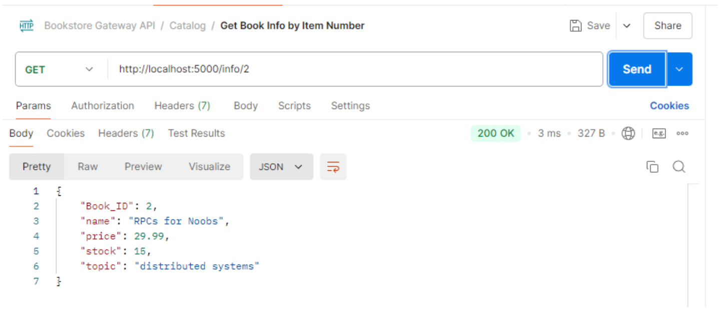

Bookstore Gateway API / Catalog / Get Book Info by Item Number
Save
Share
Send
Params Authorization Headers (7) Body Scripts Settings
Cookies
Body Cookies Headers (7) Test Results
Pretty Raw Preview Visualize JSON

GET http://localhost:5000/info/1

200 OK · 4 ms · 364 B

```
{
    "Book_ID": 1,
    "name": "How to get a good grade in DOS in 40 minutes a day",
    "price": 29.99,
    "stock": 10,
    "topic": "distributed systems"
}
```

Repeated Request For Item 2


Bookstore Gateway API / Catalog / Get Book Info by Item Number
Save
Share
Send
Params Authorization Headers (7) Body Scripts Settings
Cookies
Body Cookies Headers (7) Test Results
Pretty Raw Preview Visualize JSON

GET http://localhost:5000/info/2

200 OK · 3 ms · 327 B

```
{
    "Book_ID": 2,
    "name": "RPCs for Noobs",
    "price": 29.99,
    "stock": 15,
    "topic": "distributed systems"
}
```

Server Logs

```
Fetching info for book ID: 1 from
 http://bazar-catalog-primary:5001
Cache hit for book ID: 1
Cache hit for book ID: 1
Cache hit for book ID: 1
Fetching info for book ID: 2 from
 http://bazar-catalog-backup:5001
Cache hit for book ID: 2
```