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DOS Project Report Part 2

Part1: Cache Consistency

```

class LRUCache: 1 usage
    def __init__(self, capacity=5):
        self.cache = OrderedDict() # OrderedDict to maintain insertion order
        self.capacity = capacity # Max number of items the cache can hold

    def get(self, key): 1 usage
        """Get item from cache."""
        if key in self.cache:
            self.cache.move_to_end(key) # Move the accessed item to the end (most recently used)
            return self.cache[key]
        return None # Return None if the key is not in cache

    def put(self, key, value): 1 usage
        """Put item in cache."""
        if key in self.cache:
            self.cache.move_to_end(key) # Move to end if already in cache
        self.cache[key] = value
        if len(self.cache) > self.capacity: # If cache exceeds capacity, remove the oldest item
            self.cache.popitem(last=False)


    def invalidate(self, key): 1 usage
        """Invalidate (remove) an item from cache."""
        if key in self.cache:
            del self.cache[key]

# Initialize cache with a capacity of 10 items
cache = LRUCache(capacity=10)
# Load balancing state for catalog and order servers
catalog_replicas = ["http://localhost:5050", "http://localhost:5052"]
order_replicas = ["http://localhost:5061", "http://localhost:5062"]
catalog_index = 0
order_index = 0

```

- When i send `GET` request the **first time**, **before Caching the data:**

(catalog)



HTTP  http://localhost:5050/query?item_number=2 Save Share


GET ⌵ http://localhost:5050/query?item_number=2 Send ⌵

Params • Authorization Headers (6) Body Scripts Settings Cookies

Query Params

| <input checked="" type="checkbox"/> Key | Value | Description | ⋮ Bulk Edit |
|---|-------|-------------|-------------|
| <input checked="" type="checkbox"/> item_number | 2 | | |
| Key | Value | Description | |

Body Cookies Headers (5) Test Results 200 OK • 30 ms • 216 B •   Save Response ⋮

Pretty Raw Preview Visualize JSON ⌵ 

```
1 {  
2   "price": 25,  
3   "quantity": 7,  
4   "title": "RPCs for Noobs"  
5 }
```



now from the cache:


GET ⌵ http://localhost:5050/query?item_number=2 Send ⌵

Params • Authorization Headers (6) Body Scripts Settings Cookies

Query Params

| <input checked="" type="checkbox"/> Key | Value | Description | ⋮ Bulk Edit |
|---|-------|-------------|-------------|
| <input checked="" type="checkbox"/> item_number | 2 | | |
| Key | Value | Description | |

Body Cookies Headers (5) Test Results 200 OK • 12 ms • 216 B •   Save Response ⋮

Pretty Raw Preview Visualize JSON ⌵ 

```
1 {  
2   "price": 25,  
3   "quantity": 7,  
4   "title": "RPCs for Noobs"  
5 }
```

Q1) Compute the average response time (query/buy) of your new systems.
What is the response time with and without caching?

- ♦ Answers
 - for info: **30ms**
 - for search: **12ms**

(gateway)

- Without Cache:

HTTP http://localhost:5000/query?item_number=2 Save Share

GET http://localhost:5000/query?item_number=2 Send

Params Authorization Headers (6) Body Scripts Settings Cookies

Query Params

| <input checked="" type="checkbox"/> Key | Value | Description | Bulk Edit |
|---|-------|-------------|-----------|
| <input checked="" type="checkbox"/> item_number | 2 | | |
| Key | Value | Description | |

Body Cookies Headers (5) Test Results 200 OK • 2.06 s • 216 B • Save Response

Pretty Raw Preview Visualize JSON

```
1 {  
2   "price": 25,  
3   "quantity": 7,  
4   "title": "RPCs for Noobs"  
5 }
```

With cache:

HTTP http://localhost:5000/query?item_number=2 Save Share

GET http://localhost:5000/query?item_number=2 Send

Params Authorization Headers (6) Body Scripts Settings Cookies

Query Params

| <input checked="" type="checkbox"/> Key | Value | Description | Bulk Edit |
|---|-------|-------------|-----------|
| <input checked="" type="checkbox"/> item_number | 2 | | |
| Key | Value | Description | |

Body Cookies Headers (5) Test Results 200 OK • 7 ms • 216 B • Save Response

Pretty Raw Preview Visualize JSON

```
1 {  
2   "price": 25,  
3   "quantity": 7,  
4   "title": "RPCs for Noobs"  
5 }
```

The first time the cache memory was empty the second time it was located in the cache memory:

```
Terminal  Local x  Local (2) x  Local (3) x  + v
WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI server instead.
* Running on all addresses (0.0.0.0)
* Running on http://127.0.0.1:5000
* Running on http://192.168.1.19:5000
Press CTRL+C to quit
127.0.0.1 - - [18/Nov/2024 00:23:36] "GET /query?item_number=2 HTTP/1.1" 200 -
Cache hit for item_number 2
127.0.0.1 - - [18/Nov/2024 00:24:33] "GET /query?item_number=2 HTTP/1.1" 200 -
```

HTTP

http://localhost:5061/purchase/1

Save

Share

POST

http://localhost:5061/purchase/1

Send

Params

Authorization

Headers (7)

Body

Scripts

Settings

Cookies

Query Params

| | Key | Value | Description | ... | Bulk Edit |
|--|-----|-------|-------------|-----|-----------|
| | Key | Value | Description | | |

Body

Cookies

Headers (5)

Test Results

200 OK

9.09 s

209 B

Save Response

...

Pretty

Raw

Preview

Visualize

JSON

1

{

2

"message": "Successfully purchased item 1"

3

}

HTTP <http://localhost:5062/purchase/8> Save Share

POST <http://localhost:5062/purchase/8> Send

Params Authorization Headers (7) Body Scripts Settings Cookies

Query Params

| | Key | Value | Description | ... | Bulk Edit |
|--|-----|-------|-------------|-----|-----------|
| | Key | Value | Description | | |

Body Cookies Headers (5) Test Results 404 NOT FOUND • 2.06 s • 217 B • Save Response ...

Pretty Raw Preview Visualize JSON

```

1 {
2   |   "message": "Failed to fetch catalog item 8"
3   |   }

```

With replica :

HTTP <http://localhost:5062/purchase/1> Save Share

POST <http://localhost:5062/purchase/1> Send

Params Authorization Headers (7) Body Scripts Settings Cookies

Query Params

| | Key | Value | Description | ... | Bulk Edit |
|--|-----|-------|-------------|-----|-----------|
| | Key | Value | Description | | |




Body Cookies Headers (5) Test Results 200 OK • 8.25 s • 209 B • Save Response ...


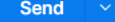

Pretty Raw Preview Visualize JSON


```


1 {
2   |   "message": "Successfully purchased item 1"
3   |   }

```




HTTP  http://localhost:5050/update  Save  Share





PATCH  http://localhost:5050/update  Send 

Params Authorization Headers (8) **Body**  Scripts Settings [Cookies](#)

☐ none ☐ form-data ☐ x-www-form-urlencoded ☒ raw ☐ binary ☐ GraphQL [JSON](#)  [Beautify](#)




```
1 {"item_number":2,"stock_count":8}
```


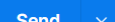

Body Cookies Headers (5) Test Results **200 OK** • 4.10 s • 209 B •   Save Response 


Pretty Raw Preview Visualize [JSON](#)    


```
1 {
2   |   "message": "Updated record 2 successfully"
3   }
```

With replica :




HTTP  http://localhost:5051/update  Save  Share





PATCH  http://localhost:5051/update  Send 

Params Authorization Headers (8) **Body**  Scripts Settings [Cookies](#)

☐ none ☐ form-data ☐ x-www-form-urlencoded ☒ raw ☐ binary ☐ GraphQL [JSON](#)  [Beautify](#)

```
1 {"item_number":2,"stock_count":8}
```

Body Cookies Headers (5) Test Results **200 OK** • 4.09 s • 209 B •   Save Response 

Pretty Raw Preview Visualize [JSON](#)    

```
1 {
2   |   "message": "Updated record 2 successfully"
3   }
```


Q2) How much does caching help?

- ♦ Answers
 - ◊ for catalog server: **12ms** , **30/12** → **2.5 Faster than without cache**
 - ◊ for gateway server: **7ms**, **2.06s/7ms** → **294 Faster than without using cache**

Invalidate Message

HTTP http://localhost:5062/purchase/8 Save Share

POST http://localhost:5062/purchase/8 Send

Params Authorization Headers (7) Body Scripts Settings Cookies


Query Params

| Key | Value | Description | Bulk Edit |
|-----|-------|-------------|-----------|
| Key | Value | Description | |

Body Cookies Headers (5) Test Results 404 NOT FOUND • 2.06 s • 217 B • Save Response

Pretty Raw Preview Visualize JSON

```
1 {
2   "message": "Failed to fetch catalog item 8"
3 }
```

 http://localhost:5061/purchase/9

SaveShare

POST

http://localhost:5061/purchase/9

Send

Params

Authorization

Headers (7)

Body

Scripts

Settings

Cookies

Query Params

| | Key | Value | Description | ... | Bulk Edit |
|--|-----|-------|-------------|-----|-----------|
| | Key | Value | Description | | |

Body

Cookies

Headers (5)

Test Results

404 NOT FOUND

2.06 s

217 B

Save Response

...

Pretty

Raw

Preview

Visualize

JSON

1

{


2



"message": "Failed to fetch catalog item 9"


3

}

- for Origiand services:


HTTP  http://localhost:5000/query?item_number=1 Save Share



GET  http://localhost:5000/query?item_number=1 Send 

Params  Authorization Headers (6) Body Scripts Settings Cookies

Query Params

| <input checked="" type="checkbox"/> | Key | Value | Description | ... | Bulk Edit |
|-------------------------------------|-------------|-------|-------------|-----|-----------|
| <input checked="" type="checkbox"/> | item_number | 1 | | | |
| | Key | Value | Description | | |


Body Cookies Headers (5) Test Results 500 INTERNAL SERVER ERROR • 4.24 s • 458 B •  Save Response ...



Pretty Raw Preview Visualize HTML  


```

1 <!doctype html>
2 <html lang=en>
3 <title>500 Internal Server Error</title>
4 <h1>Internal Server Error</h1>
5 <p>The server encountered an internal error and was unable to complete your request. Either the server is overloaded or there
  is an error in the application.</p>
6

```


HTTP  http://localhost:5000/query?item_number=1 Save Share



GET  http://localhost:5000/query?item_number=1 Send 

Params  Authorization Headers (6) Body Scripts Settings Cookies

Query Params

| <input checked="" type="checkbox"/> | Key | Value | Description | ... | Bulk Edit |
|-------------------------------------|-------------|-------|-------------|-----|-----------|
| <input checked="" type="checkbox"/> | item_number | 1 | | | |
| | Key | Value | Description | | |

Body Cookies Headers (5) Test Results 200 OK • 2.07 s • 253 B •  Save Response ...

Pretty Raw Preview Visualize JSON  

```

1 {
2   "price": 96,
3   "quantity": 50,
4   "title": "How to get a good grade in DOS in 40 minutes a day"
5 }

```

HTTP

http://localhost:5000/query?item_number=1

Save

Share

GET

http://localhost:5000/query?item_number=1

Send

Params

Authorization

Headers (6)

Body

Scripts

Settings

Cookies

Query Params

| <input checked="" type="checkbox"/> | Key | Value | Description | ... | Bulk Edit |
|-------------------------------------|-------------|-------|-------------|-----|-----------|
| <input checked="" type="checkbox"/> | item_number | 1 | | | |
| | Key | Value | Description | | |

Body

Cookies

Headers (5)

Test Results

200 OK

7 ms

253 B

Save Response

...

Pretty

Raw

Preview

Visualize

JSON

```
1 {
2   "price": 96,
3   "quantity": 50,
4   "title": "How to get a good grade in DOS in 40 minutes a day"
5 }
```

- for Replica Service

GET http://localhost:5051/query?item_number=1

Send

Params • Authorization Headers (6) Body Scripts Settings Cookies

Query Params

| <input checked="" type="checkbox"/> Key | Value | Description | ... | Bulk Edit |
|---|-------|-------------|-----|-----------|
| <input checked="" type="checkbox"/> item_number | 1 | | | |
| Key | Value | Description | | |

Body Cookies Headers (5) Test Results 200 OK • 10 ms • 253 B • Save Response ...

Pretty Raw Preview Visualize JSON ▼

```

1 {
2   "price": 96,
3   "quantity": 50,
4   "title": "How to get a good grade in DOS in 40 minutes a day"
5 }
```

For gateway replica :

GET http://localhost:5009/query?item_number=1

Send

Params • Authorization Headers (6) Body Scripts Settings Cookies

Query Params

| <input checked="" type="checkbox"/> Key | Value | Description | ... | Bulk Edit |
|---|-------|-------------|-----|-----------|
| <input checked="" type="checkbox"/> item_number | 1 | | | |
| Key | Value | Description | | |

Body Cookies Headers (5) Test Results 200 OK • 2.07 s • 253 B • Save Response ...

Pretty Raw Preview Visualize JSON ▼

```

1 {
2   "price": 96,
3   "quantity": 50,
4   "title": "How to get a good grade in DOS in 40 minutes a day"
5 }
```

Part2: Dockerize your Application (Optional part):

I Construct my project Dockerized from scratch, i create docker container (image) for each service, and each service has it's own port, and i use volume for sharing data between the Guest OS (Docker Containers) & Host OS , and i create docker-compose file to run all containers at the same time with 1 simple command .

My `docker-compose.yml` file:

```
version: '3.8'

services:
  catalog_api:
    build:
      context: ./catalog
    ports:
      - "5050:5000"
    networks:
      - app_network

  purchase_api:
    build:
      context: ./purchase
    ports:
      - "5060:5000"
    networks:
      - app_network

  gateway_api:
    build:
      context: ./gateway
    ports:
      - "8080:5000"
    networks:
      - app_network
    depends_on:
      - catalog_api
      - purchase_api

  load_balancer_api:
    build:
      context: ./loadbalancer
    ports:
      - "8090:4000"
    networks:
      - app_network
    depends_on:
      - catalog_api
      - purchase_api
```

```
networks:
  app_network:
    driver: bridge
```

Docker Containers(images) while running:

```
time="2024-11-18T00:46:20+02:00" level=warning msg="C:\\Users\\User\\Desktop\\library_microservices-main\\
library_microservices-main\\compose.yaml: the attribute 'version' is obsolete, it will be ignored, please
remove it to avoid potential confusion"
[+] Running 4/4[+] Running 2/4
✓ Container library_microservices-main-purchase_api-1      Started      1.7s
✓ Container library_microservices-main-catalog_api-1       Started      1.7s
✓ Container library_microservices-main-load_balancer_api-1  Started      4.6s
✓ Container library_microservices-main-gateway_api-1       Started      4.3s
```