Design Document - Menu-Service

Technology Stack

Current Implementation

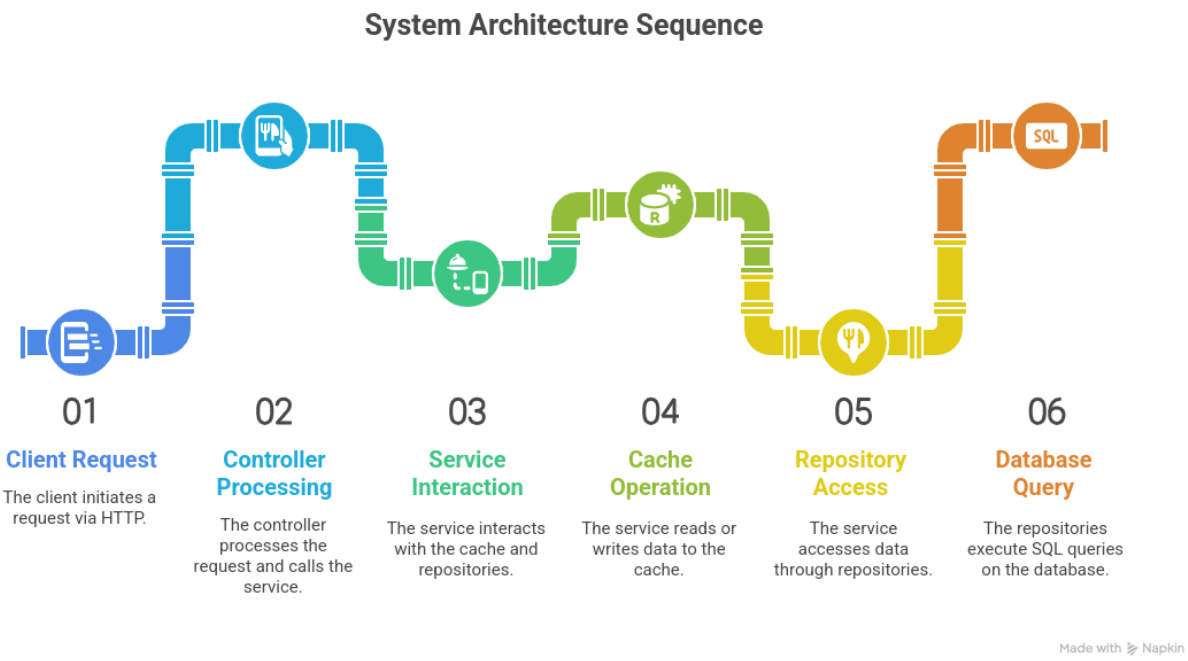
1. **Architecture:** Monolith (from the assignment perspective)
2. **Framework:** Java 17, Spring Boot 3.4.8
3. **Persistence:** MySQL (Dockerized for local)
4. **Local Caching:** Caffeine
5. **Distributed Caching:** Redis (Dockerized)
6. **API Layer:** REST APIs (versioned under /api/v1/...)
7. **Container:** Docker and Docker Compose

Responsibilities

1. **Spring Boot - Menu-Service:** REST API, business logic, caching, rate limiting
2. **MySQL:** Persistent storage for restaurants and menu items
3. **Redis:** Menu data caching, rate limiting counters

High-Level Architecture

Current Implementation Architecture



- Spring Boot Menu Service: Exposes REST APIs, handles business logic, and manages caching and DB access.
- Redis: Distributed cache for menus and menu items.
- MySQL: Persistent storage for restaurants, menus, and menu items.

Component Responsibilities

- Controller Layer: REST API endpoints, request validation
- Service Layer: Business logic, transaction management
- Repository Layer: JPA-based data access
- Mapper Layer: DTO ↔ Entity conversions
- Cache Layer: Redis (future: add Caffeine for application level)

Data Modeling

Database Schema (MySQL)

Restaurant Table

```
CREATE TABLE restaurant (
  id BIGINT NOT NULL AUTO_INCREMENT,
  name VARCHAR(255) NOT NULL,
  address VARCHAR(255),
  city VARCHAR(255),
  pincode VARCHAR(20),
  PRIMARY KEY (id)
);

CREATE INDEX idx_restaurant_city ON restaurant (city);
```

MenuItem Table

```
CREATE TABLE menu (
  id BIGINT NOT NULL AUTO_INCREMENT,
  availability BIT(1) NOT NULL,
  created_on DATETIME(6) DEFAULT NULL,
  dish_name VARCHAR(255) NOT NULL,
  price DOUBLE NOT NULL,
  type ENUM('NON_VEG','VEG') NOT NULL,
  updated_on DATETIME(6) DEFAULT NULL,
  restaurant_id BIGINT DEFAULT NULL,
  PRIMARY KEY (id),
  KEY FK_menu_restaurant (restaurant_id),
  CONSTRAINT FK_menu_restaurant FOREIGN KEY (restaurant_id) REFERENCES restaurant (id)
);


CREATE INDEX idx_menu_dish_name ON menu (dish_name);

CREATE INDEX idx_menu_restaurant_type ON menu (restaurant_id, type);
```

API Data Models

MenuItemRequest

```
{
  "dishName": "Margherita Pizza",
  "price": 299.99,
  "availability": true,
  "type": "VEG"
}
```

CreateRestaurantRequest

```
{
  "name": "Pizza Haven",
  "address": "123 Food Street, Koramangala",
  "city": "Bangalore",
  "pincode": "560034",
  "menuItems": [
    {
      "dishName": "Margherita Pizza",
      "price": 299.99,
      "availability": true,
      "type": "VEG"
    },
    {
      "dishName": "Chicken Tikka Pizza",
      "price": 399.99,
      "availability": false,
      "type": "NON_VEG"
    }
  ]
}
```

PaginatedMenuItemResponse (Paginated)

```
{
  "restaurantId": 1,
  "restaurantName": "Pizza Haven",
  "menuItems": [
    {
```

```
      "id": 1,
      "dishName": "Margherita Pizza",
      "price": 299.99,
      "availability": true,
      "type": "VEG"
    },
    {
      "id": 2,
      "dishName": "Chicken Tikka Pizza",
      "price": 399.99,
      "availability": false,
      "type": "NON_VEG"
    }
  ],
  "currentPage": 0,
  "totalPages": 1,
  "totalElements": 2
}
```


RestaurantMenuResponse


```
{
  "id": 1,
  "name": "Pizza Haven",
  "menuItems": [
    {
      "id": 1,
      "dishName": "Margherita Pizza",
      "price": 299.99,
      "availability": true,
      "type": "VEG"
    },
    {
      "id": 2,
      "dishName": "Chicken Tikka Pizza",
      "price": 399.99,
      "availability": false,
      "type": "NON_VEG"
    }
  ]
}
```


RestaurantResponse


```
{
  "id": 1,
  "name": "Pizza Haven",
  "address": "123 Food Street, Koramangala",
  "city": "Bangalore",
  "pincode": "560034"
```

```
}
```

MenuItemBasicResponse

```
{
  "id": 1,
  "dishName": "Margherita Pizza",
  "price": 299.99,
  "availability": true,
  "type": "VEG"
}
```

RestaurantMenuResponse

```
{
  "dishName": "Margherita Pizza",
  "price": 299.99,
  "availability": true,
  "type": "VEG"
}
```

Caching Strategy

- **L2 Cache (Redis)**: Caches frequently accessed data with configurable TTL. Invalidates on data updates/deletes.
- **L1 Cache (Caffeine, planned)**: For high-frequency data to reduce latency.
- **Cache-Aside Pattern**: Check cache first; on miss, query database, cache result.
- **Invalidation**: Clears cache on data modifications for consistency.

Rate Limiting, Pagination & Versioning

- Rate Limiting: (TO-DO) Redis-based, per-client/IP, configurable limits ensure fair resource usage and prevent abuse.

- Pagination: Supported in menu fetch APIs (page, size params) for efficient data retrieval.
- API Versioning: URL-based (`/api/v1/restaurant/...`) for backward compatibility and smooth updates.

Assumptions and Trade-offs

Assumptions

- Menu changes are infrequent compared to reads.
- Each restaurant has at least one menu.
- Restaurant data changes less frequently than menu items.
- Eventual consistency is acceptable for menu reads.

Trade-offs

- Cache vs. Consistency: Prioritise read performance and accept eventual consistency.
- Performance vs Resource Usage: Caching increases memory usage but improves latency.

Monitoring & Observability

- Spring Boot Actuator: Exposes endpoints (health, metrics, info, caches, loggers) for real-time application monitoring and management.
- Logging: Structured logs, correlation IDs, and error stack traces.
- Metrics: Tracks response times, error rates, cache hit/miss ratios, and DB/Redis health for performance insights.
- Future: Integrate Prometheus for metrics collection, Grafana for visualization, ELK for log analysis, and distributed tracing for request flow tracking.

Resilience: Circuit Breaker & Fallback Strategy

- Circuit Breaker: Planned using Resilience4j or Spring Cloud Circuit Breaker to handle transient faults in downstream systems (e.g., database, Redis).
- Fallback Mechanism: In case of service unavailability or timeout, fallback responses will ensure graceful degradation. Example: returning cached stale data or a custom error message.