Lab 1. RESTful API Specification & Implementation

I chose topic at number 7: ***Хмарна інформаційна система для обліку спожитих калорій.***

GitHub link: https://github.com/SE240-API-Design-25/lab1-rest-MarharytaFilipovych

Goal*

Develop a comprehensive RESTful API specification and implementation for a cloud-based calorie tracking system that enables users to monitor their daily caloric intake, manage food databases, and track nutritional goals through standardized HTTP endpoints.

Project Tasks*

- Perform system decomposition and identify core modules
- Perform event storming
- Create a Ubiquitous Language for domain entities
- Design a RESTful API specification with proper endpoints and data models
- Implement API with validation, pagination, and error handling
- Develop a presentation layer with CRUD operations
- Add filtering and search capabilities for food items and meal tracking
- Create your own API documentation with YAML

Results

Entities

Product: represents any edible item that you may find and buy in any super(mini)markets, from raw ingredients to ready-to-eat products. Note: complex plates from the culinary department don’t count → only those things that were brought from a factory warehouse, village, market, or somewhere they are usually brought from (I do not have a clue).

- `id` UUID → this is a primary key
- `name` string
- `barcode` string value, if this product comes from a factory, I suppose it has to have this thing.
- `proteins` decimal, per 100
- `fats` decimal, per 100
- `carbohydrates` decimal, per 100
- `water` decimal, 0-100%
- `salt` decimal, per 100
- `sugar` decimal, per 100
- `fiber` decimal, per 100
- `alcohol` decimal, per 100
- `description` something that needs to be told about this particular product
- `measurement_unit` I believe this can be represented as an enum value → GRAMS, MILLILITERS, PIECES
- `calories` decimal, per 100 grams
- `created_at` timestamp. This field should not be shown to our end customer, but I think it needs to be included for our developer purposes.
- `brand_id` reference to a product's brand. This field is optional because not all products have a brand. For instance, a plain dirty carrot does not have one.
- `updated_at` timestamp. This field should not be shown to our end customer, but I think it needs to be included for our developer purposes.

Brand: represents a product's brand:

- `id` UUID → this is a primary key
- `name` string value
- `description`

Category: represents a product classification system (such things as dairy, fast food, sweets, chocolate, etc). It is allowed for a product to be included in multiple categories**:**

- `id` UUID → this is a primary key

- `name` string value
- `description` explanation for those who do not know what dairy, sweets, and vegetables are : (((
- `parent_category_id` foreign key, for subcategories. *(cloud ai generated)*
- `created_at` timestamp, explained the purpose above

User: my app users. I believe that almost every app needs a user, and mine is not an exception. However, my users have some additional info defined with them since I have a calorie app here.

- `id` UUID → this is a primary key
- `email` string value, I think it has to be unique. This is because in my system this field is one of those things that define the personality.
- `first_name` string value
- `last_name` string value
- `telephone` string value. This is optional because this is not a primary user identifier. By the way, this does not have to be unique.
- `birth_date` date
- `gender` enum → MALE, FEMALE. I will not have UNDEFINED, sorry.
- `weight` decimal in kg
- `height` decimal in cm
- `activity_level` enum → SEDENTARY, LOW, MODERATE, HIGH, VERY_HIGH *(cloud ai generated)*
- `goal` enum → LOSE, MAINTAIN, GAIN)
- `target_weight` decimal, in kg. This is the optional field → maybe my user does not want to loose or gain weight, just support.
- `registered_at` timestamp
- `updated_at` timestamp. This field should not be shown to our end customer, but I think it needs to be included for our developer purposes.

You may wonder, how can we understand how many calories a user can consume in a day? This is the tempting question, I know. The thing is that this field (`daily_calorie_target`) can be calculated from the existing data: goal, gender, weight, age, activity, and height. Therefore, it should not be stored in the table according to the third normal form. Here is the formula* my app uses:

~~~
## Daily Calorie Target Formula

**Step 1: BMR (Basal Metabolic Rate)**
- **Men:** `BMR = (10 × weight) + (6.25 × height) - (5 × age) + 5`
- **Women:** `BMR = (10 × weight) + (6.25 × height) - (5 × age) - 161`

**Step 2: Activity Adjustment**
```
TDEE = BMR × Activity_Factor
```
- Sedentary: 1.2
- Low: 1.375
- Moderate: 1.55
- High: 1.725
- Very High: 1.9

**Step 3: Goal Adjustment**
- **Lose Weight:** `TDEE - 500`
- **Maintain:** `TDEE`
- **Gain Weight:** `TDEE + 500`

**Complete Formula:**
daily_calories = (BMR × activity_factor) ± goal_adjustment

**Safety limits:** Minimum 1200 (women) / 1500 (men) calories per day.
~~~

Plate: represents a combination of products representing a meal or recipe. So, in order to create a plate, one needs to define its name and add a collection of different products with their appropriate measurement to this plate.

- `id` UUID → this is a primary key
- `name` string value
- `description` optional description of what this plate represents. Perhaps a user is lazy and does not wish to provide any description, and this is totally okay
- `user_id` reference to the user who created this plate

- `is_public` boolean. This is false by default, but if the user has a premium account, they can make their plate public and available for usage by others.
- `created_at` timestamp

`total_calories, total_proteins, total_fats, total_carbohydrates, total_quantity` -> these info is calculated when needed.

Record this is about which plate or product a user consumed and recorded, like 50 grams of a self-made chocolate cake or 70 grams of a cucumber on the 30th of May, for lunch.

- `id` UUID → this is a primary key
- `user_id` reference to the hungry user
- `meal_type` enum → BREAKFAST, LUNCH, DINNER, FIRST_SNACK, SECOND_SNACK, THIRD_SNACK
- `consumed_at` timestamp
- `updated_at` timestamp. This field should not be shown to our end customer, but I think it needs to be included for our developer purposes.

The `calories_consumed, total_proteins, total_fats, total_carbohydrates,` and total_quantity fields are calculated based on the product record's values per 100. These fields are shown in response only (not stored).

Weight_History* tracks user weight changes over time.

- `id` UUID → this is a primary key
- `user_id` reference to the user
- `weight` decimal in kg
- `recorded_at` timestamp

Junction entities

Product_Category represents a many-to-many relationship between products and categories.

- `product_id` reference to a product
- `category_id` reference to a category
- `quantity` decimal in grams

The primary key is a composite of these 2 IDs.

Plate_Product represents a many-to-many relationship defining which products are in each plate.

Attributes:

- `plate_id` reference to a plate
- `product_id` reference to a product
- `quantity` decimal in grams

The primary key is a composite of these 2 IDs.

Product_record: this is about which product a user consumed and recorded, like 50 grams of a green apple on the 30th of May, lunch.

- `record_id` reference to a record
- `product_id` reference to the consumed (or to-be consumed) product
- `created_at` timestamp
- `quantity` how much of this product was consumed

The primary key is a composite of these 2 IDs.

Plate_Record this is about which plate a user consumed and recorded, like 50 grams of a self-made chocolate cake on the 30th of May, lunch.

Attributes:

- `record_id` reference to a record
- `plate_id` reference to a plate
- `created_at` timestamp
- `quantity` how much of this plate was consumed

The primary key is a composite of these 2 IDs.

Key Relationships*

- **A user can create many plates: u**sers build their own recipe collections over time
- **A user can log many consumption records:** each time someone eats, they create a new record (this is how I live)
- **A user can have multiple weight entries: w**eight is tracked over time to show progress
- **A user belongs to one account: e**ach person has their own profile with personal goals
- **A brand can have many products:** Coca-Cola makes Coke, Sprite, Fanta, etc.

- **A product may or may not have a brand: b**randed items vs. generic produce like "potatoes"
- **A product can belong to multiple categories: a Greek** yogurt is both "dairy" and "protein-rich."
- **A category can have subcategories**: "Dairy" contains "Milk", "Cheese", "Yogurt"
- **A record can contain multiple products:** breakfast might include bread, butter, and jam
- **A record can contain multiple plates:** lunch could be salad + soup (two different recipes)
- **A product appears in many consumption records: p**eople eat the same apple brand repeatedly
- **A plate appears in many consumption records: u**sers repeat their favorite recipes
- **A plate contains multiple products as ingredients:** Caesar salad needs lettuce, croutons, dressing, and parmesan
- **A product can be used in multiple dishes: e**ggs go in pancakes, omelets, cakes, etc.
- **A plate belongs to one creator**: each recipe has an owner who designed it
- **A plate can be shared publicly: p**remium users can make their recipes available to others

Explicit explanation of relationships:*

- **User (1) → Plate (N) -** One user creates many plates
- **User (1) → Record (N) -** One user logs many consumption events
- **User (1) → Weight_History (N) -** One user has many weight measurements over time
- **Brand (1) → Product (N) -** One brand manufactures many products
- **Category (1) → Category (N) -** One category contains many subcategories
- **Record (1) → Product_Record (N) -** One meal record contains many individual products
- **Record (1) → Plate_Record (N) -** One meal record contains many plates/recipes
- **Product (1) → Product_Record (N) -** One product appears in many consumption events
- **Plate (1) → Plate_Record (N) -** One recipe is consumed many times by users
- **Product (M) ↔ Category (N)** via Product_Category junction. Many products belong to many categories

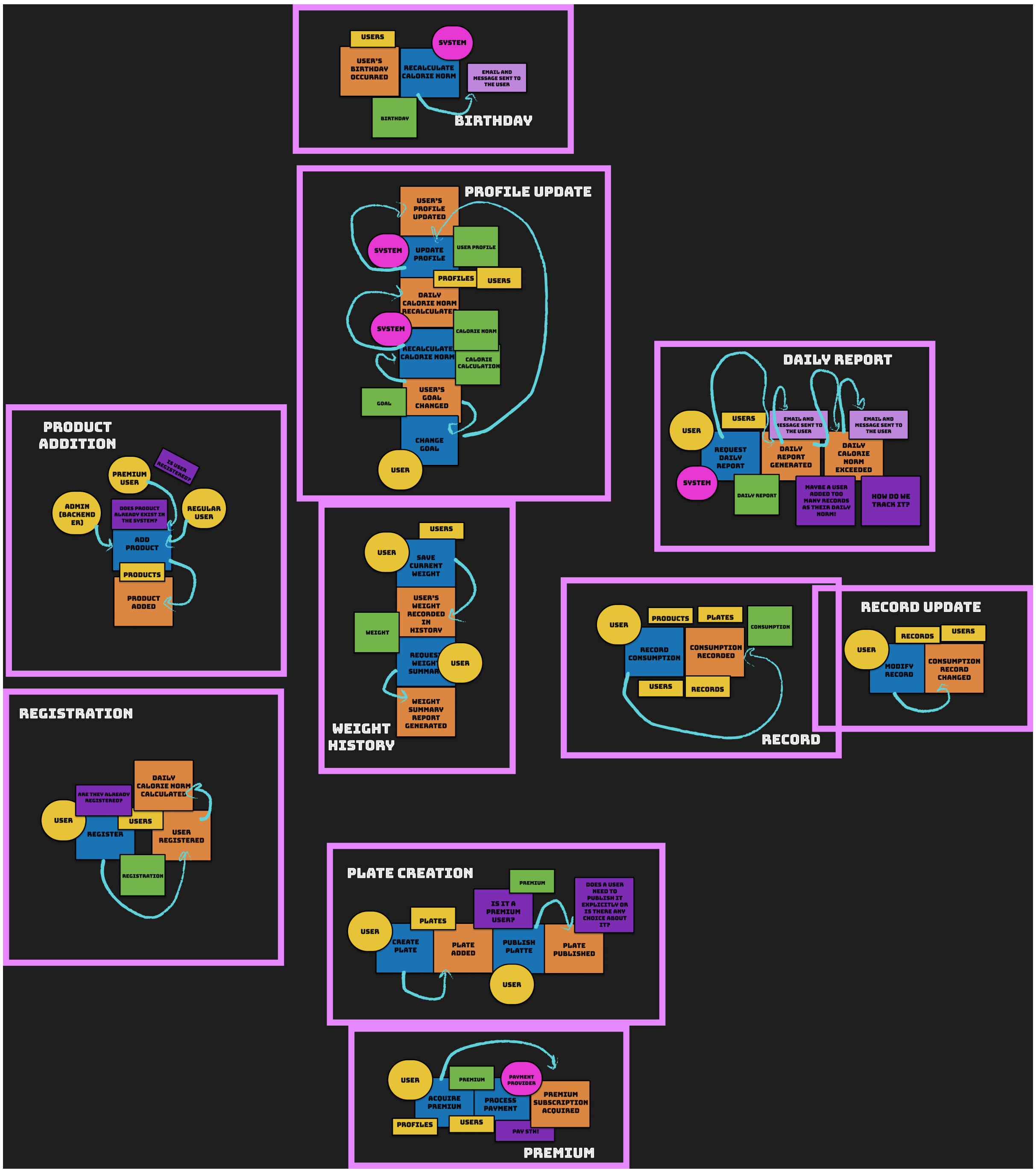
- **Product (M) ↔ Plate (N)** via Plate_Product junction. Many products are ingredients in many recipes. Many recipes contain many products
- **Brand (0:1) → Product (N)** - Products may or may not have a brand (carrots don't, Coca-Cola does)

Ubiquitous language:

- **per 100** - means that a particular attribute represents a quantity per 100 of a particular measurement (like 100 g or 100 ml)
- **product** - anything that you may get in the market, but not sth that was prepared
- **plate** - a combination of such products
- **daily report** - a report about the quantity of all nutrients, products (or plates), and calories eaten during a particular day
- **admin (backender)** - people who manage this system and add products. Products can be added either by a user or by an admin. If a product is added by a user, it becomes visible and usable to all other users without a premium.
- **update profile** - in the current context, it means changing body details (height, weight, birthday, etc.), which impacts daily calorie norm
- **weight summary** and **weight history** represent the same thing
- **premium** - premium account

Event storming

```
https://www.figma.com/design/kYlvz2Dwpqq8ePjTY6ciGJ/Event-storming?node-id=
0-1
```



Context Mapping and Module Decomposition*

User Management Context handles user lifecycle operations including registration, profile management, and authentication. This context owns the User aggregate and manages personal information, physical characteristics, and fitness goals. Key events include User Registered, Profile Updated, and Daily Calorie Norm Calculated, with the system automatically recalculating calorie targets when user parameters change.

Product Catalog Context manages the food database including products, brands, and categories. This context supports both admin-managed and user-contributed products, with validation ensuring data quality. Core events include Product Added, Product Updated, and Product Archived, enabling a comprehensive food database that serves the entire application.

Consumption Tracking Context represents the core domain functionality, handling meal logging and nutritional calculations. This context orchestrates consumption records, integrating products and plates into daily meal tracking. Primary events include Consumption Recorded, Record Updated, and Daily Report Generated, with complex business logic for calculating nutritional totals and validating consumption data.

Recipe Management Context manages user-created plates and recipes, supporting both private and public sharing for premium users. Events include Plate Created, Plate Published, and Recipe Shared, enabling users to build reusable meal combinations and share successful recipes with the community.

Analytics Context provides reporting and progress tracking functionality, generating daily summaries and weight history analysis. Key events include Daily Report Generated, Weight History Updated, and Progress Calculated, delivering insights into user consumption patterns and goal achievement.

Premium Context handles subscription management and premium feature access, controlling which users can publish public plates and access advanced analytics. Events include Premium Activated, Subscription Renewed, and Premium Features Unlocked ensure proper feature gating and billing integration.

Description of API specification

I defined my specification in the **api_documentation.yaml file. Here it is:**

api_documentation.yaml

Short overview*

This is a cloud-based RESTful API designed for comprehensive caloric intake and nutritional tracking. The system revolves around three core entities: Products containing detailed nutritional information including calories and nine different nutritional components, Users with complete profiles encompassing physical statistics and dietary goals, and Records that log consumption events linking users to specific products with quantities and meal categorization.

The API provides full CRUD operations for both products and users, while consumption tracking allows users to log meals, update existing records, and view their consumption history. A notable feature is the automatic daily calorie target calculation based on individual user profiles including weight, height, activity level, and goals. The system supports comprehensive search and filtering capabilities, enabling product searches by name and date-based filtering for consumption records.

Following RESTful principles, the API uses standard HTTP methods and status codes with a hierarchical design where records are nested under users. All list endpoints implement consistent pagination using limit and offset parameters. The system employs UUID identifiers for all entities and uses JSON for all request and response formats. Input validation is comprehensive with detailed error responses, and the API supports flexible meal categorization across six different meal types including breakfast, lunch, dinner, and three snack categories.

Products Management

- `GET /products` - List products with filtering by name and pagination
- `POST /products` - Create new product
- `GET /products/{id}` - Get specific product details
- `PUT /products/{id}` - Update existing product
- `DELETE /products/{id}` - Remove product

User Management

- `GET /users` - List all registered users (paginated)
- `POST /users` - Register new user
- `GET /users/{id}` - Get user profile
- `PUT /users/{id}` - Update user profile
- `DELETE /users/{id}` - Remove user
- `GET /users/email/{email}` - Find user by email

Calorie Calculation

- `GET /users/{id}/daily-target` - Calculate daily calorie target for user

Consumption Records

- `GET /users/{userId}/records` - Get user's consumption history (filterable by date)
- `POST /users/{userId}/records` - Log new meal consumption

- `PUT /users/{userId}/records/{id}` - Update consumption record
- `DELETE /users/{userId}/records/{id}` - Delete consumption record

Key Features

- **Hierarchical API**: Records are nested under users (`/users/{userId}/records`)
- **Comprehensive Product Data**: Detailed nutritional information (proteins, fats, carbs, water, salt, sugar, fiber, alcohol)
- **Flexible Meal Types**: 6 meal categories (breakfast, lunch, dinner, 3 snack types)
- **User Profiles**: Complete user data including physical stats, activity level, and weight goals
- **Pagination**: Consistent limit/offset pagination across list endpoints
- **Filtering**: Product search by name, record filtering by date

App code description*

For the code implementation, four core entities were selected: **User**, **Product**, **Record**, and **ProductRecord** (serving as a junction entity linking products to consumption records with quantities). These entities form the essential foundation for user management, food database, and consumption tracking functionality, representing the minimum viable product for a calorie-tracking application. Other entities were omitted for simplicity.

Presentation layer

The presentation layer serves as the interface boundary of this Spring Boot calorie tracking application, handling HTTP requests, data validation, response formatting, and implementing comprehensive RESTful API controllers.

The layer defines five core enums that represent the application's domain concepts: ActivityLevel (from sedentary to very high), Gender (male/female), Goal (lose/maintain/gain weight), MealType (breakfast through dinner plus three snack options), and MeasurementUnit (grams, milliliters, pieces). These enums provide type safety and constrain valid values throughout the application.

A sophisticated validation system is built around three custom annotations. The @CorrectEnum annotation validates enum values using the EnumValidator class, ensuring only valid enum instances are accepted. The @CorrectName annotation employs NameValidator to enforce name formatting rules, requiring 2-150 character names containing only letters, spaces, hyphens, apostrophes, and periods, with optional fields supported. The

@Nutrient annotation uses NutrientValidator to validate nutritional values, ensuring they fall between 0-100 with customizable nutrient names and measurement units in error messages.

The LogAspect class provides comprehensive logging through aspect-oriented programming. It intercepts all controller methods to log HTTP requests, parameters, execution times, and response status codes. Additionally, it captures and logs exceptions from both service and repository layers, providing complete visibility into application behavior and error tracking.

The presentation layer includes utility classes for consistent API responses. The ErrorResponse record provides standardized error messaging, while the Meta class encapsulates pagination metadata extracted from Spring Data Page objects, including page numbers, total counts, and navigation flags. The Pagination class defines request parameters for paginated endpoints with validation constraints limiting page sizes between 1-100 items.

The controllers implement a comprehensive RESTful API structure handling all aspects of the calorie tracking application through three primary controller classes.

The UserController serves as the primary interface for user lifecycle management, implementing a complete set of RESTful endpoints for user operations. The controller would be annotated with @RestController and @RequestMapping("/api/users") to establish the base path for all user-related operations. A GET endpoint at the root path would handle user listing with pagination support, accepting Pagination objects as @ModelAttribute parameters to enable query parameters like ?page=1&limit=20. The method would delegate to UserService.getAllUsers() and return a ResponseEntity containing a Page<UserDto> wrapped in a standardized response format with embedded Meta pagination information.

User registration would be handled through a POST endpoint at the root path, accepting a @Valid @RequestBody UserDto parameter to trigger comprehensive validation including email format validation, name validation through @CorrectName, enum validation for gender, activity level, and goals, plus range validation for physical measurements. The controller would catch validation exceptions and return structured error responses using the ErrorResponse record. Upon successful validation, it would call UserService.createUser() and return a 201 Created status with the newly created user's UUID in the Location header.

Individual user operations would include GET "/{id}" for user profile retrieval using @PathVariable UUID id, with the controller handling EntityNotFoundException from the service layer and converting it to a 404 Not Found response. User profile updates would use a PUT endpoint at "/{id}" accepting both path variable and request body, implementing complete resource replacement semantics through UserService.updateUser(). A DELETE endpoint at "/{id}" would handle user removal by calling UserService.deleteUser().

A specialized GET endpoint at "/{id}/daily-target" would expose the calculated daily calorie target through UserService.getDailyTarget(), demonstrating how controllers can expose computed business logic through clean REST interfaces. An additional GET endpoint at "/email/{email}" would support user lookup by email address using UserService.getUserByEmail(), providing an alternative access pattern for user identification.

The ProductController manages the extensive food product database through a sophisticated set of endpoints designed for both administrative product management and user product discovery. The controller would be mapped to "/api/products" and implement comprehensive CRUD operations with advanced querying capabilities.

The primary GET endpoint would support optional query parameters including name-based search, with the controller method signature accepting @RequestParam(required = false) String name alongside pagination parameters extracted from a Pagination object. This demonstrates Spring's flexible parameter binding where missing query parameters result in null values passed to the service layer. The search functionality would integrate with ProductService.getAll() to enable efficient product discovery through database-level filtering rather than application-level filtering.

Product creation through POST would implement sophisticated validation combining standard Bean Validation annotations with custom validators. The @Valid @RequestBody ProductDto would trigger validation of nutritional values through the @Nutrient annotation, barcode format validation with @Size constraints, and measurement unit enum validation through @CorrectEnum. The controller would handle the business logic exception for duplicate barcodes by catching IllegalArgumentException and returning a 409 Conflict status with descriptive error messages derived from the service layer's validation logic.

Individual product operations would include GET "/{id}" for product retrieval through ProductService.getById() with automatic EntityNotFoundException to 404 Not Found conversion, PUT "/{id}" for complete product updates with validation through ProductService.updateProduct(), and DELETE "/{id}" implementing intelligent deletion logic. The delete operation would demonstrate complex business rules where the controller delegates to ProductService.delete(), which implements either hard deletion for unused products or soft deletion (archiving) for products referenced in consumption records through the ProductRecordRepository.existsByProduct_Id() check.

The ConsumptionController implements the most complex controller logic, managing meal logging and consumption tracking with sophisticated data aggregation and filtering capabilities. Mapped to "/api/users/{userId}/records", this controller would handle the core functionality of the calorie tracking application with user-scoped operations.

The primary consumption recording endpoint would be a POST at the root path accepting @PathVariable UUID userId and @Valid @RequestBody RecordRequestDto. The RecordRequestDto contains nested validation through the @Valid annotation on the

Set<ProductRecordInRequestDto> products field, which itself validates product IDs and quantities with @DecimalMin constraints. This demonstrates Spring's deep validation capabilities where validation cascades through object graphs. The controller would call UserService.createRecord() with the user ID and validated request data, returning the newly created record's UUID with a 201 Created status.

Record retrieval would be implemented through a sophisticated GET endpoint supporting multiple query parameters for filtering. The method signature would include @PathVariable UUID userId, @RequestParam(required = false) LocalDate date for date-based filtering, and pagination parameters through a Pagination object. This endpoint would showcase Spring's automatic type conversion where string date parameters are converted to LocalDate objects through registered converters. The controller would call UserService.getRecords() with all parameters, returning a paginated list of RecordResponseDto objects with calculated nutritional totals.

Individual record operations would include GET "/{userId}/records/{id}" for detailed consumption viewing through UserService.getConsumption(), which triggers the complex calculateRecordTotals() business logic to compute total calories, proteins, fats, carbohydrates, and total quantity consumed. The response would include the complete record with embedded product information and all calculated nutritional summaries. PUT "/{userId}/records/{id}" would handle meal modifications through UserService.updateRecord(), accepting a RecordRequestDto and implementing complete record replacement including product list updates. DELETE "/{userId}/records/{id}" would remove consumption records through UserService.deleteRecord() with proper user ownership validation.

All controllers implement consistent error handling through a global @ControllerAdvice class that would catch common exceptions and convert them to appropriate HTTP responses. EntityNotFoundException would map to 404 Not Found responses, IllegalArgumentException would map to 400 Bad Request for business rule violations (like duplicate emails or barcodes), and MethodArgumentNotValidException would produce 422 Unprocessable Entity responses with detailed field-level error information extracted from BindingResult.

The controllers would leverage Spring's automatic content negotiation to support JSON request/response handling through Jackson serialization. The DTOs already include @JsonProperty annotations for field naming control (like "first_name" vs "firstName") and @JsonInclude annotations for conditional field inclusion. Jackson would automatically serialize enum values and handle LocalDateTime formatting for timestamps.

Response formatting would be standardized across all endpoints, with successful responses containing data payloads and pagination metadata through the Meta class where applicable, while error responses would consistently use the ErrorResponse record. HTTP status codes would be precisely implemented following REST conventions: 200 for successful retrieval, 201 for creation with Location headers containing resource URLs, 204 for successful deletion, 400 for validation errors, 404 for missing resources, and 409 for business rule conflicts.

The controllers would implement proper resource identification patterns, with user-scoped records accessed through "/api/users/{userId}/records" to clearly establish the hierarchical relationship between users and their consumption data. This RESTful design makes resource ownership explicit in the URL structure while enabling efficient data access patterns through the service layer's optimized query methods like RecordRepository.findIdsByUserIdAndDateTime() for date-filtered retrieval.

Pagination integration would be seamless, with controllers accepting Pagination objects that automatically bind query parameters and pass them to service methods. The service layer's use of PageRequest.of(offset - 1, limit) demonstrates the conversion between user-friendly 1-based page numbers and Spring Data's 0-based internal representation, with controllers handling this abstraction transparently.

This presentation layer seamlessly integrates with the business layer through DTOs and the data layer through JPA entities. The validation annotations work in conjunction with Spring's validation framework to provide declarative input validation, while the aspect-oriented logging provides non-intrusive monitoring capabilities. The enum mappings between presentation and data layers ensure clean separation of concerns while maintaining type safety across architectural boundaries. The controller layer effectively serves as the entry point for all external interactions, transforming HTTP requests into business operations while ensuring proper validation, logging, and response formatting throughout the request lifecycle.

Data Layer

The data layer implements the persistence architecture using JPA entities and Spring Data repositories. Four main entities define the domain model: the User entity stores personal information and fitness goals with enum fields for gender, activity level, and goal type; the Product entity represents food items with comprehensive nutritional information including macronutrients, micronutrients, calories, and measurement units; the Record entity captures meal consumption events linked to users with meal type and timestamp; and the ProductRecord entity serves as a join entity connecting products to records with quantity information. The entities use UUID primary keys, JPA auditing for timestamps, and bidirectional relationships with proper cascade configurations.

Repository interfaces extend JpaRepository providing standard CRUD operations plus custom query methods. UserRepository handles user management with email-based lookups and existence checks. ProductRepository provides product search capabilities with name filtering and archived status management through methods like findProductByNameContainingIgnoreCaseAndArchivedIsFalse(). RecordRepository implements complex querying with date-based filtering and user-scoped operations using @Query annotations for optimized data retrieval like findIdsByUserIdAndDateTime(). ProductRecordRepository manages the join table operations with methods for checking product usage in consumption records.

Business Layer

The business layer contains the service classes that orchestrate business logic and coordinate between the presentation and data layers. UserService handles user management including registration, profile updates, daily calorie target calculations using Harris-Benedict equations, and complex record operations with nutritional aggregations through methods like createRecord(), getRecords(), and calculateRecordTotals(). ProductService manages the food database with search capabilities, validation for duplicate barcodes, and intelligent deletion logic implementing soft deletion for referenced products through methods like create(), getById(), updateProduct(), and delete().

The layer uses MapStruct mappers for seamless conversion between entities and DTOs. ProductMapper handles entity-DTO conversion with automatic calorie calculation using the calculateCalories() method and enum mapping between presentation and data layer enums. UserMapper provides bidirectional conversion between User entities and UserDto objects with proper enum mappings for gender, activity level, and goals. RecordMapper converts Record entities to RecordResponseDto objects, integrating with ProductMapper to populate nested product information and enabling the complex nutritional calculations performed by the service layer.

Services implement transactional operations and business rule validation, throwing appropriate exceptions like EntityNotFoundException for missing resources and IllegalArgumentException for business rule violations that are handled by the presentation layer's error management system.

Conclusion*

This laboratory work successfully implemented a RESTful API for a calorie tracking application using Spring Boot with a well-structured three-layer architecture. The presentation layer provides comprehensive request handling through custom validation annotations, sophisticated error management, and complete CRUD operations via UserController, ProductController, and ConsumptionController. The business layer orchestrates domain logic through service classes that handle complex operations like calorie calculations and nutritional aggregations, while MapStruct mappers ensure clean entity-DTO conversions. The data layer demonstrates proper JPA design with optimized repositories and custom query methods.

The application adheres to REST principles with appropriate HTTP status codes, resource-oriented URLs, and standardized JSON responses. Key achievements include advanced validation cascading, aspect-oriented logging, intelligent soft deletion, and hierarchical resource relationships. The implementation successfully balances functionality with maintainability through consistent architectural patterns and clean separation of concerns.

AI usage:

- all headers highlighted in pink color with * indicate sections generated by Cloud AI. Hence, almost all description (conclusion, goal, task objectives/ code description) were generated.
- For the code implementation, I used AI only to find sth new for myself and for the error (bug) handling (obviously), since I started learning the Spring Framework recently. Whenever AI generated sth for me, I did not copy and paste it without thinking. Unfortunately, it is difficult for me to point out what was purely generated (except for standard error messages), because there was no situation when I asked him to purely generate a code section for me. If you ask me about a specific part of my code, I will tell you what I was helped wit if needed. :))
- used it for bug handling (in api doc as well)