ManageNotes – Technical Documentation

Comprehensive technical documentation for the ManageNotes University Grade Management System. Updated August 2025 to reflect the current backend architecture and implementation.

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System Overview

ManageNotes is a comprehensive university grade management system built with Spring Boot 3.5.3, designed to handle academic operations for administrators, teachers, and students. The system provides secure role-based access control, grade management, academic reporting, and administrative functions.

Key Features

- **Multi-role Authentication**: JWT-based authentication for Admin, Teacher, and Student roles
- **Grade Management**: Complete CRUD operations with validation and grading windows
- **Academic Structure**: Department, subject, semester, and student management
- **Grade Claims**: Student-initiated grade dispute system with approval workflow
- **Reporting**: Academic transcripts and performance reports
- **Audit Trail**: Complete tracking of changes and user actions

System Capabilities

- Real-time grade entry validation
- Time-controlled grading windows

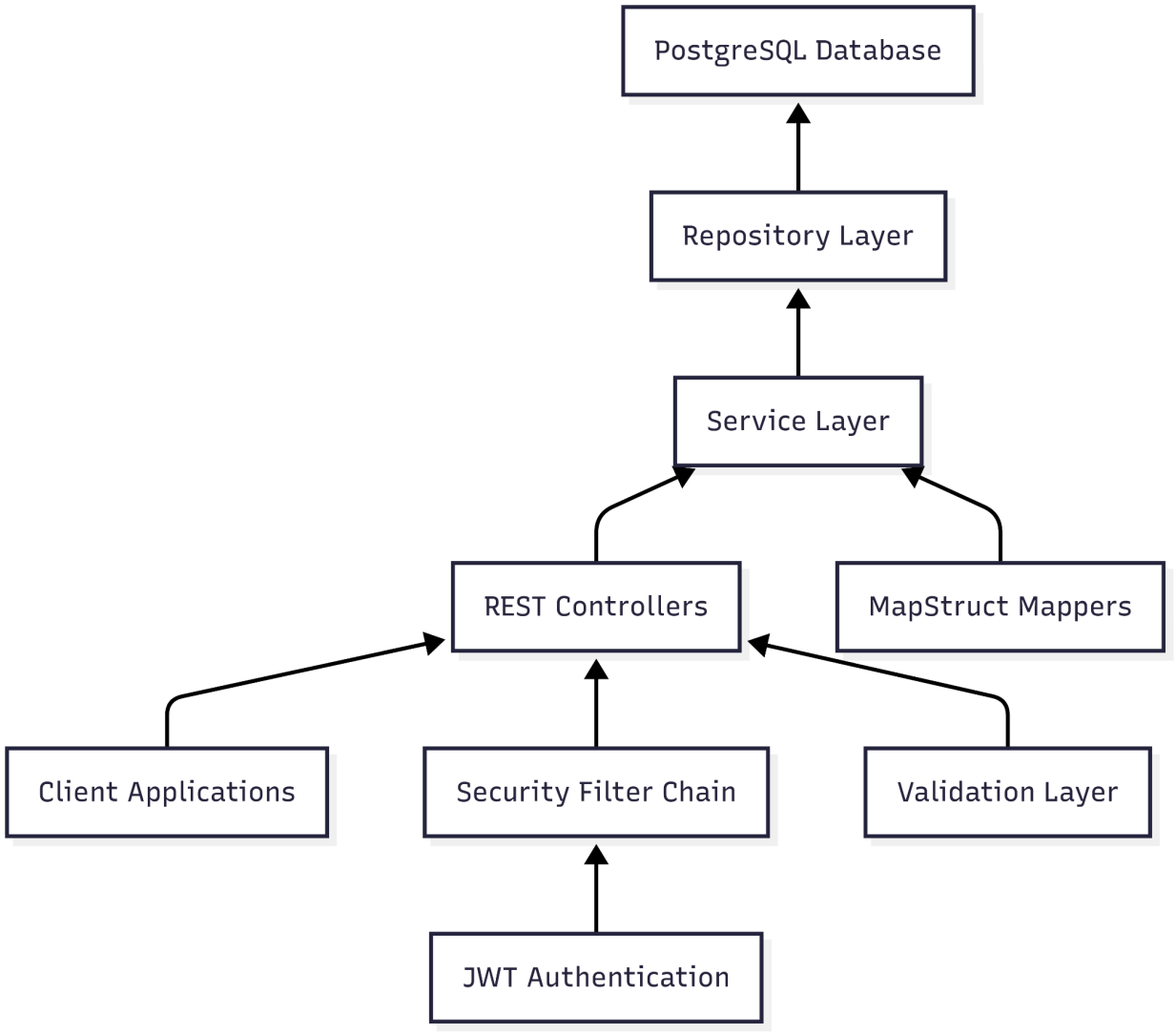
- Bulk operations for administrative tasks
- Foreign key constraint handling with cascade operations
- Comprehensive API documentation via Swagger/OpenAPI

Architecture & Technology Stack

Technology Stack

- **Java 21** - Latest LTS version with modern language features
- **Spring Boot 3.5.3** - Main application framework
- **Spring Security 6.5.1** - Authentication and authorization
- **Spring Data JPA 3.5.1** - Data persistence layer
- **PostgreSQL 17.5** - Primary database
- **JWT (JSON Web Tokens)** - Stateless authentication
- **MapStruct 1.6.0** - Entity-DTO mapping
- **Lombok** - Boilerplate code reduction
- **Swagger/OpenAPI 3** - API documentation
- **Maven 3.9+** - Build and dependency management

Architectural Patterns



Package Structure

```
com.university.ManageNotes/
├── config/                  # Configuration classes
├── controller/              # REST endpoints
├── dto/                    # Data Transfer Objects
│   ├── Request/            # Request DTOs
│   └── Response/           # Response DTOs
├── mapper/                 # MapStruct mappers
├── model/                  # JPA entities
├── repository/             # Data access layer
├── security/               # Security components
├── service/                # Business logic
└── util/                   # Utility classes
```

Layered Architecture

Layer	Responsibility	Components
Presentation	HTTP endpoints, request/response handling	Controllers, DTOs
Business	Business logic, validation, orchestration	Services
Persistence	Data access, repository pattern	Repositories, Entities
Security	Authentication, authorization, JWT	Security filters, JWT utils

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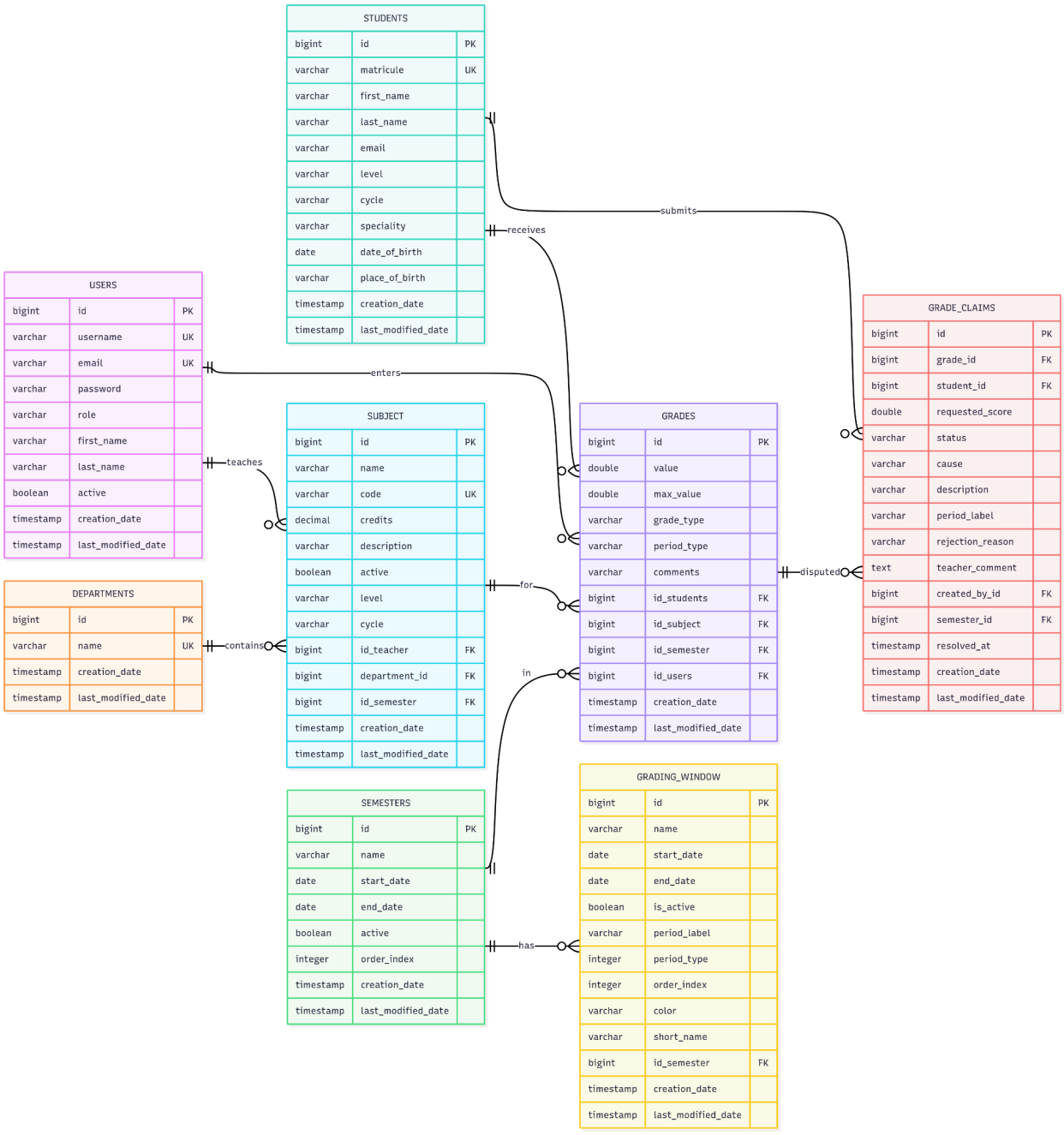
Database Schema & Domain Model

Core Entities

Entity Relationships



Users & Students

- **Users** table stores authentication and basic user information
- **Students** table stores academic-specific information
- Relationship: Users.username = Students.matricule (for student users)

Academic Structure

- **Departments** contain multiple **Subjects**
- **Subjects** are taught by **Users** (teachers) and belong to **Semesters**
- **Grades** link Students, Subjects, and Semesters with the entering User

Grade Management

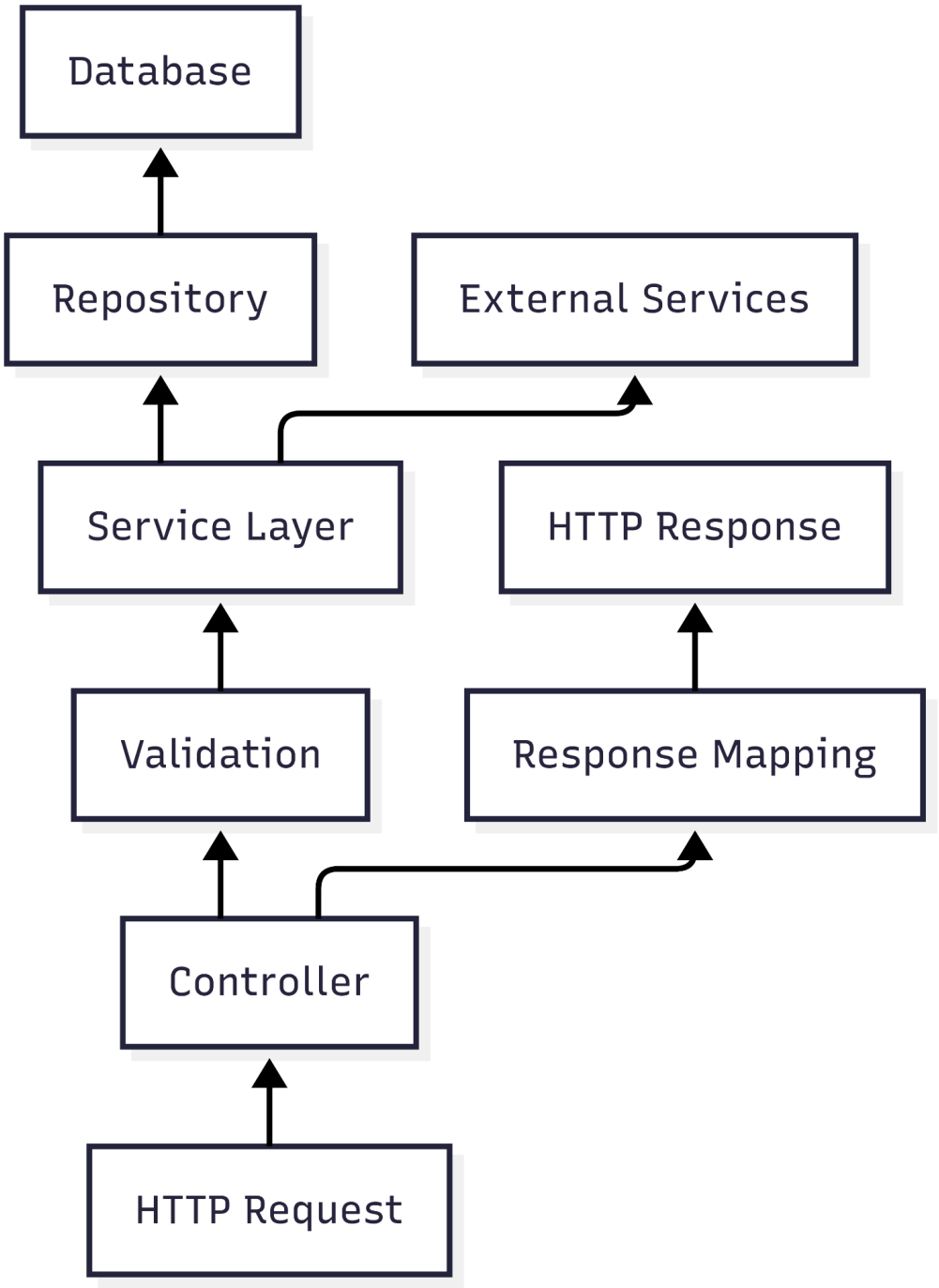
- **Grades** store individual assessment scores
- **Grade Claims** allow students to dispute grades
- **Grading Windows** control when grades can be entered

Enums and Constants

```
// Student Academic Levels
public enum StudentLevel {
    LEVEL1(1), LEVEL2(2), LEVEL3(3), LEVEL4(4), LEVEL5(5)
}

// Academic Cycles
public enum StudentCycle {
    BACHELOR, MASTER, PHD
}

// User Roles
public enum Role {
    ADMIN, TEACHER, STUDENT
}

// Grade Types
public enum GradeType {
    CC_1, CC_2, SN_1, SN_2
}

// Period Types
public enum PeriodType {
    CC_1, CC_2, SN_1, SN_2
}

// Request Status
public enum RequestStatus {
    PENDING, APPROVED, REJECTED
}
```

API Layer Architecture

Controller Design Pattern



Base Controller Structure

```
@RestController
@RequestMapping("/api")
@SecurityRequirement(name = "Bearer Authentication")
@Tag(name = "Controller Name", description = "Description")
```

```java
public class ExampleController {

    private final ExampleService service;

    @GetMapping
    @PreAuthorize("hasRole('ROLE')")
    @Operation(summary = "Description")
    public ResponseEntity<List<ResponseDTO>> getAll() {
        return ResponseEntity.ok(service.getAll());
    }
}
```

Controller Hierarchy

Core Controllers

- **AuthController** (`/api/auth`) - Authentication and user management
- **UserController** (`/api`) - User operations and profile management
- **AdminController** (`/api/admin`) - Administrative operations

Academic Controllers

- **DepartmentController** (`/api/departments`) - Department management
- **SubjectController** (`/api/subjects`) - Subject management
- **SemesterController** (`/api/semesters`) - Semester management

Grade Management Controllers

- **GradeController** (`/api/grades`) - Grade CRUD operations
- **GradeClaimController** (`/api/grade-claims`) - Grade dispute system
- **GradingWindowController** (`/api/grading-windows`) - Grading period management

Request/Response Flow

1. **Request Validation** - Bean validation on DTOs
2. **Security Check** - JWT token validation and role authorization
3. **Service Delegation** - Business logic execution
4. **Data Mapping** - Entity to DTO conversion
5. **Response Formation** - HTTP response with appropriate status codes

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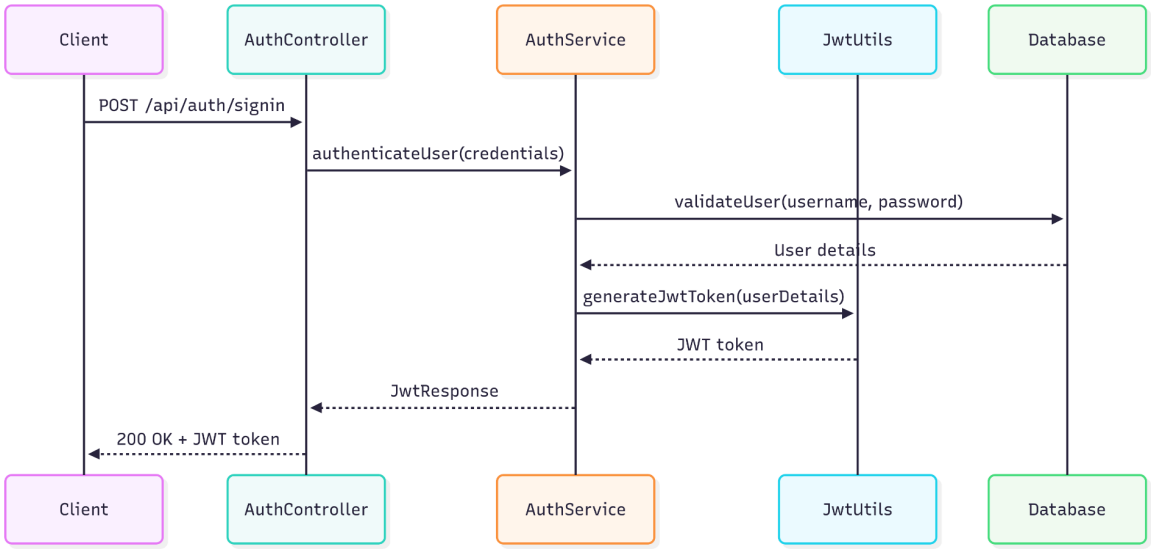
Security Implementation

JWT Authentication Flow



Security Configuration

```
@Configuration
@EnableWebSecurity
@EnableMethodSecurity(prePostEnabled = true)
public class WebSecurityConfig {

    @Bean
        public SecurityFilterChain filterChain(HttpSecurity http) throws
Exception {
        http.cors().and().csrf().disable()

.sessionManagement().sessionCreationPolicy(SessionCreationPolicy.STATELESS)
            .authorizeHttpRequests(authz -> authz
                .requestMatchers("/api/auth/**").permitAll()
                                        .requestMatchers("/swagger-ui/**",
"/v3/api-docs/**").permitAll()
                                          .requestMatchers(HttpMethod.GET,
"/api/students").hasAnyRole("TEACHER", "ADMIN")
                .requestMatchers("/api/admin/**").hasRole("ADMIN")
                .anyRequest().authenticated()
            );

                                    http.addFilterBefore(authTokenFilter(),
UsernamePasswordAuthenticationFilter.class);
        return http.build();
    }
}
```

Role-Based Access Control

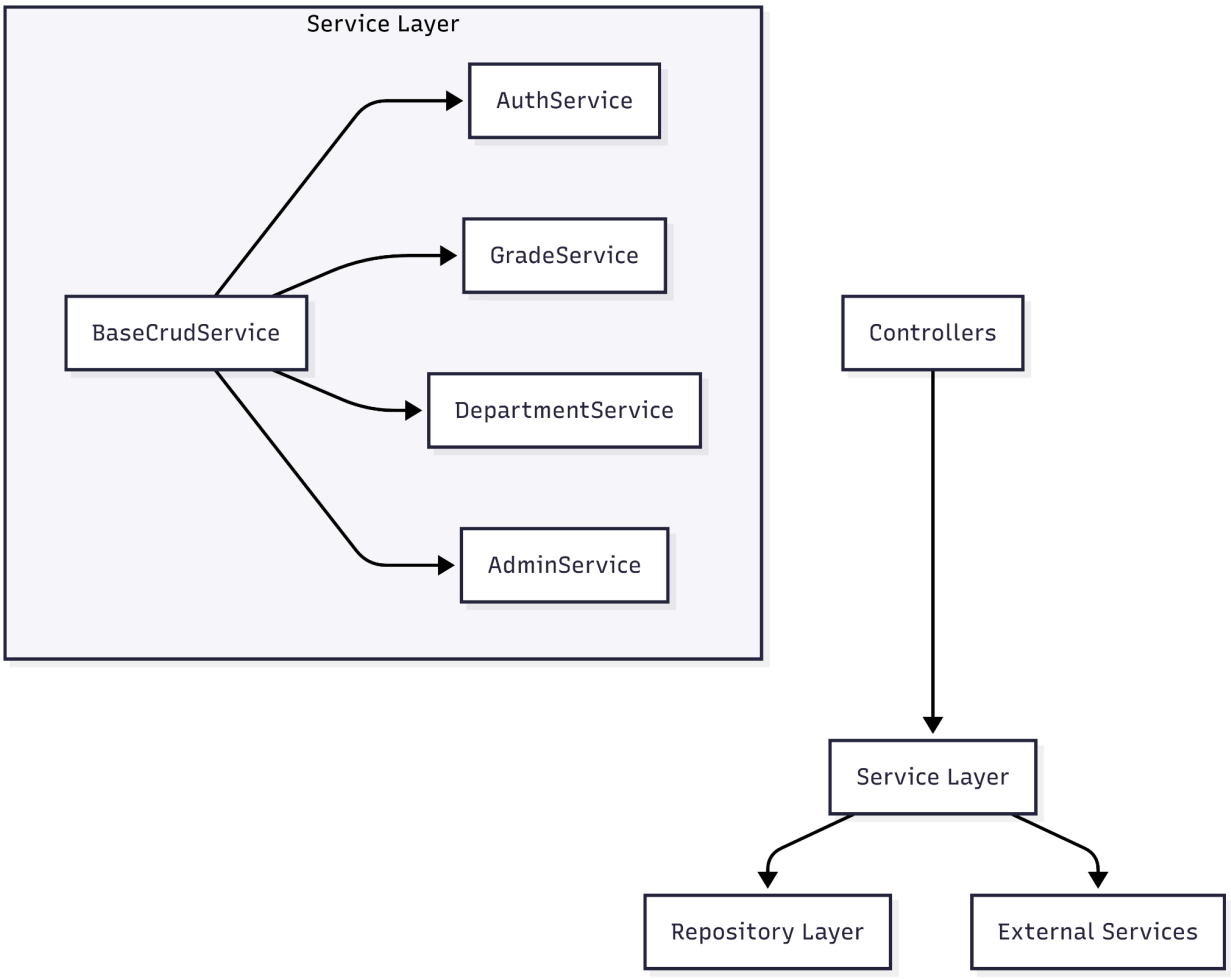
Endpoint Pattern	Required Role	Description
`/api/auth/**`	Public	Authentication endpoints
`/api/admin/**`	ADMIN	Administrative functions
`/api/students` (GET)	TEACHER, ADMIN	View students
`/api/grades` (POST/PUT)	TEACHER, ADMIN	Grade management
`/api/grade-claims` (POST)	STUDENT	Submit grade claims
`/api/departments`	ADMIN	Department management

JWT Token Structure

```
{
  "sub": "username",
  "iat": 1693123456,
  "exp": 1693209856,
  "roles": ["ROLE_STUDENT"]
}
```

Business Logic & Services

Service Layer Architecture



Core Services

AuthService

```
@Service
@Transactional
public class AuthService {

    public JwtResponse authenticateUser(LoginRequest request) {
        // Authenticate user credentials
        // Generate JWT tokens
        // Return authentication response
    }

    public MessageResponse registerUser(SignupRequest request) {
        // Validate user data
        // Create user account
        // Send confirmation email
    }
}
```

GradeService

```
@Service
@Transactional
public class GradeService {

    public GradeResponse createGrade(GradeRequest request) {
        // Validate grading window
        // Convert user ID to student ID
        // Create grade record
        // Return grade response
    }

    public StudentGradesResponse getStudentGrades(Long userId, Long
semesterId) {
        // Convert user ID to student record
        // Fetch grades for student
        // Calculate GPA
        // Return aggregated response
    }
}
```

DepartmentService

```
@Service
@Transactional
public class DepartmentService extends BaseCrudService<Department, Long,
DepartmentRequest, DepartmentResponse> {

    public DepartmentResponse createDepartmentWithSubjects(DepartmentRequest
request) {
        // Create department
        // Assign subjects if provided
        // Return department details
    }

    @Override
    public MessageResponse delete(Long id) {
        // Remove department references from subjects
        // Delete department safely
        // Return success message
    }
}
```

Business Rules Implementation

Grade Entry Validation

1. **Grading Window Check** - Verify current time is within active grading window
2. **Teacher Authorization** - Ensure teacher is assigned to the subject
3. **Student Enrollment** - Verify student is enrolled in the subject
4. **Grade Range** - Validate grade value is within acceptable range (0-20)

Teacher Assignment Rules

- **One Subject Per Level**: A teacher can only be assigned to one subject per academic level
- **Level Constraint**: Database enforces unique constraint on (teacher_id, level)
- **Assignment Validation**: System validates teacher-level assignments during subject creation/update

ID Consistency Rules

- **Student Operations**: Always use User ID in API, convert to Student record ID internally
- **Teacher Operations**: Use User ID throughout
- **Admin Operations**: Use User ID for user management, entity IDs for other operations

Cascade Delete Handling

- **Department Deletion**: Remove department references from subjects before deletion
- **Teacher Deletion**: Unassign subjects and grades, preserve data for reassignment
- **Student Deletion**: Remove all associated grades and records

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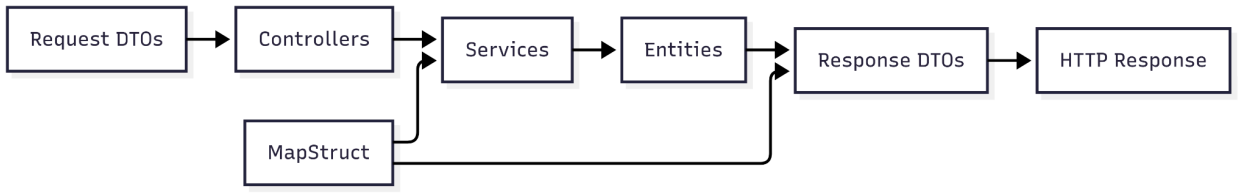
Data Transfer Objects (DTOs)

DTO Architecture



Request DTOs

Authentication DTOs

```
@Data
public class LoginRequest {
    @NotBlank
    private String username;

    @NotBlank
    private String password;
}

@Data
public class SignupRequest {
```

```
    @NotBlank
    @Size(min = 3, max = 20)
    private String username;

    @NotBlank
    @Email
    private String email;

    @NotBlank
    @Size(min = 6, max = 40)
    private String password;

    private String firstName;
    private String lastName;
    private Role role = Role.STUDENT;
}
```

Grade Management DTOs

```
@Data
public class GradeRequest {
    @NotNull
    private Long studentId;  // User ID (converted internally)

    @NotNull
    private Long subjectId;

    @NotNull
    private Long semesterId;

    @NotNull
    @DecimalMin("0.0")
    @DecimalMax("20.0")
    private Double value;

    private Double maxValue = 20.0;

    @NotNull
    private GradeType type;

    @NotNull
    private PeriodType periodType;

    private String comments;

    @NotNull
    private Long enteredBy;
}

@Data
public class GradeClaimRequest {
```

```
    @NotNull
    private Long gradeId;

    @NotNull
    private Double requestedScore;

    @NotBlank
    private String cause;

    @NotNull
    private PeriodType period;

    @NotBlank
    private String description;
}
```

Response DTOs

User Profile Response

```
@Data
@Builder
@NoArgsConstructor
@AllArgsConstructor
public class UserProfileResponse {
    private Long id;
    private String username;
    private String firstName;
    private String lastName;
    private String email;
    private Role role;
    private StudentLevel level;        // For students
    private List<String> levels;       // For teachers
    private List<SubjectResponse> subjects;
}
```

Grade Response

```
@Data
public class GradeResponse {
    private Long id;
    private Long studentId;           // User ID for API consistency
    private String studentName;
    private Long subjectId;
    private String subjectName;
    private String subjectCode;
    private Long semesterId;
    private String semesterName;
    private Double value;
    private GradeType type;
    private String periodLabel;
    private String comments;
```

```
    private Long enteredBy;
    private String enteredByName;
    private Boolean passed;
    private BigDecimal creditsEarned;
    private Instant createdDate;
    private Instant lastModifiedDate;
}
```

DTO Validation Rules

Validation	Purpose	Example
`@NotNull`	Required fields	`@NotNull private Long studentId`
`@NotBlank`	Non-empty strings	`@NotBlank private String username`
`@Email`	Email format	`@Email private String email`
`@Size`	String length	`@Size(min = 3, max = 20)`
`@DecimalMin/Max`	Numeric range	`@DecimalMax("20.0")`
`@Pattern`	Regex validation	`@Pattern(regexp = "^[A-Z]{2}[0-9]{3}$")`

API Endpoints Reference

Authentication Endpoints (`/api/auth`)

Method	Endpoint	Request	Response	Description
POST	`/signin`	`LoginRequest`	`JwtResponse`	User authentication
POST	`/signup`	`SignupRequest`	`MessageResponse`	User registration
POST	`/refresh`	`TokenRefreshRequest`	`JwtResponse`	Token refresh

User Management (`/api`)

Method	Endpoint	Request	Response	Roles	Description
GET	`/me`	-	`UserProfileResponse`	Any	Current user profile
GET	`/students`	-	`List<UserProfileResponse>`	TEACHER, ADMIN	List students

Method	Endpoint	Request	Response	Roles	Description
GET	`/teachers`	-	`List<UserProfileResponse>`	ADMIN	List teachers
PUT	`/students/{id}`	`StudentUpdateRequest`	`UserProfileResponse`	ADMIN	Update student
DELETE	`/users/{id}`	-	`MessageResponse`	ADMIN	Delete user

Academic Management

Departments (/api/departments)

Method	Endpoint	Request	Response	Roles	Description
GET	/	-	`List<DepartmentResponse>`	ADMIN	List departments (newest first)
POST	/	`DepartmentRequest`	`MessageResponse`	ADMIN	Create department
DELETE	`/{id}`	-	`MessageResponse`	ADMIN	Delete department

Subjects (/api/subjects)

Method	Endpoint	Request	Response	Roles	Description
GET	/	-	`List<SubjectResponse>`	Any	List subjects (newest first)
POST	/	`SubjectRequest`	`MessageResponse`	ADMIN	Create subject
PUT	`/{id}`	`SubjectRequest`	`MessageResponse`	ADMIN	Update subject
DELETE	`/{id}`	-	`MessageResponse`	ADMIN	Delete subject

Semesters (/api/semesters)

Method	Endpoint	Request	Response	Roles	Description
GET	/	-	`List<SemesterResponse>`	ADMIN	List semesters
POST	/	`SemesterRequest`	`MessageResponse`	ADMIN	Create semester
PUT	/	`List<SemesterRequest>`	`MessageResponse`	ADMIN	Bulk update semesters
PUT	`/{id}`	`SemesterRequest`	`MessageResponse`	ADMIN	Update semester
DELETE	`/{id}`	-	`MessageResponse`	ADMIN	Delete semester

Grade Management

Grades (/api/grades)

Method	Endpoint	Request	Response	Roles	Description
POST	/	`GradeRequest`	`GradeResponse`	TEACHER, ADMIN	Create grade
GET	`/student/{id}`	-	`StudentGradesResponse`	STUDENT (self), TEACHER, ADMIN	Get student grades
PUT	`/{id}`	`GradeUpdateRequest`	`GradeResponse`	TEACHER, ADMIN	Update grade
DELETE	`/{id}`	-	`MessageResponse`	TEACHER, ADMIN	Delete grade

Grade Claims (/api/grade-claims)

Method	Endpoint	Request	Response	Roles	Description
POST	/	`GradeClaimRequest`	`MessageResponse`	STUDENT	Submit grade claim
GET	/	-	`List<GradeClaimResponse>`	TEACHER, ADMIN	List grade claims

Method	Endpoint	Request	Response	Roles	Description
PUT	`/{id}/decision`	`GradeClaimDecisionRequest`	`MessageResponse`	TEACHER, ADMIN	Approve/reject claim

Administrative Endpoints (`/api/admin`)

Method	Endpoint	Request	Response	Description
PUT	`/students/{id}`	`StudentUpdateRequest`	`MessageResponse`	Update student (admin)
PUT	`/subjects/{id}`	`SubjectRequest`	`MessageResponse`	Update subject (admin)

Authentication & Authorization

JWT Token Management

Token Generation

```
public String generateJwtToken(UserPrincipal userPrincipal) {
    return Jwts.builder()
        .setSubject(userPrincipal.getUsername())
        .setIssuedAt(new Date())
                    .setExpiration(new   Date(System.currentTimeMillis()   +
jwtExpirationMs))
        .signWith(SignatureAlgorithm.HS512, jwtSecret)
        .compact();
}
```

Token Validation

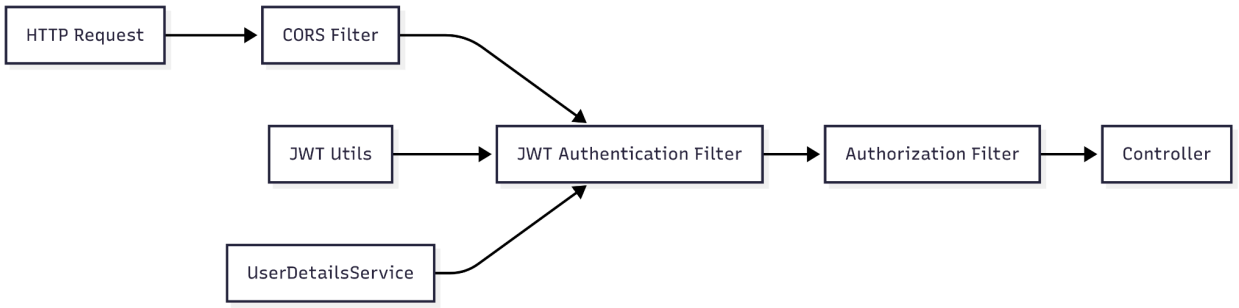
```
public boolean validateJwtToken(String authToken) {
    try {
        Jwts.parser().setSigningKey(jwtSecret).parseClaimsJws(authToken);
        return true;
    } catch (SignatureException | MalformedJwtException | ExpiredJwtException
|
             UnsupportedJwtException | IllegalArgumentException e) {
        logger.error("Invalid JWT token: {}", e.getMessage());
        return false;
    }
}
```

Role-Based Method Security

```
@PreAuthorize("hasRole('ADMIN')")
public MessageResponse deleteUser(Long id) { ... }
```

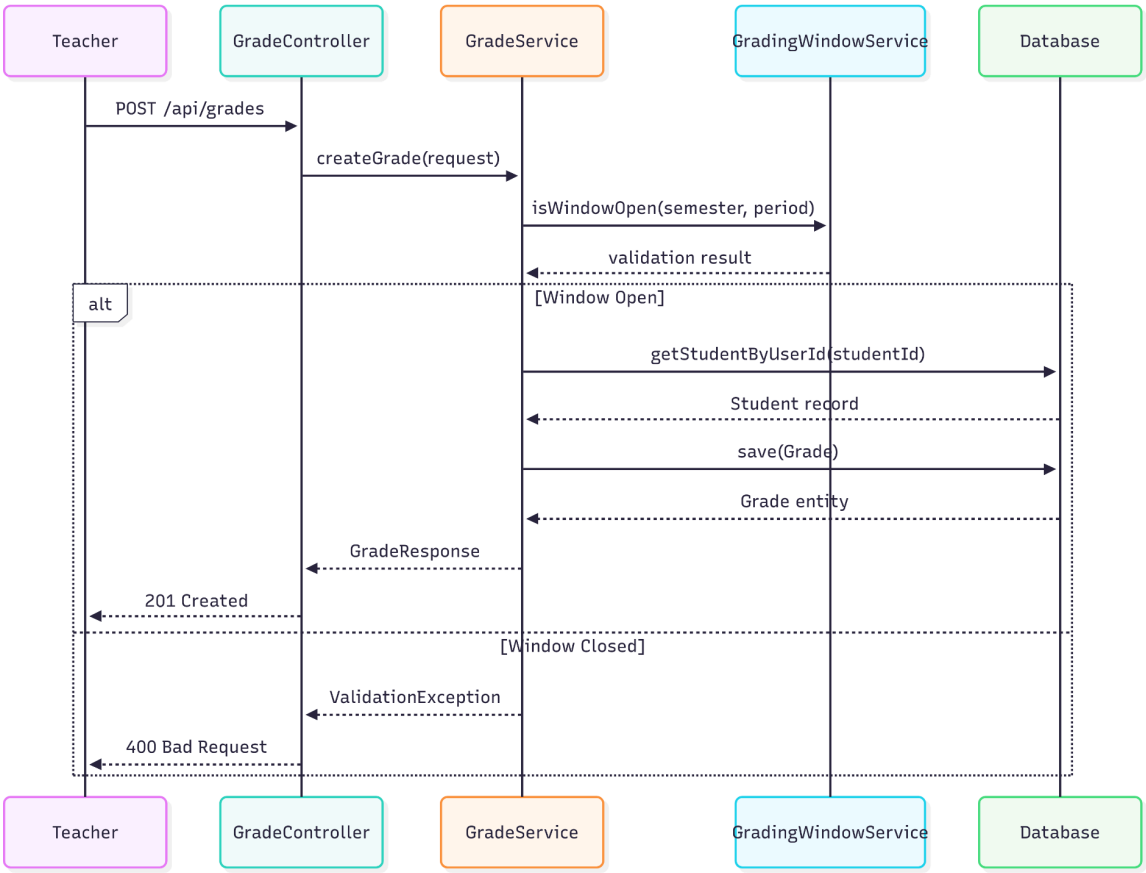
```java
@PreAuthorize("hasAnyRole('TEACHER', 'ADMIN')")
public List<UserProfileResponse> getStudents() { ... }

@PreAuthorize("hasRole('STUDENT') and #userId == authentication.principal.id")
public StudentGradesResponse getMyGrades(Long userId) { ... }
```

Security Filter Chain



Grade Management System

Grade Entry Workflow



Grade Calculation Logic

Individual Grade Processing

```
public GradeResponse createGrade(GradeRequest request) {
    // 1. Validate grading window
            if   (!gradingWindowService.isWindowOpen(request.getSemesterId(),
request.getPeriodType())) {
        throw new ValidationException("Grading window is closed");
    }

    // 2. Convert user ID to student record
    Students student = getStudentByUserId(request.getStudentId());

    // 3. Create and save grade
    Grades grade = new Grades();
    grade.setStudent(student);
    grade.setValue(request.getValue());
    // ... set other properties

    Grades saved = gradeRepository.save(grade);
    return convertToResponse(saved);
}
```

GPA Calculation

```
public double calculateGPA(List<Grades> grades) {
    return grades.stream()
        .mapToDouble(Grades::getValue)
        .average()
        .orElse(0.0);
}
```

Grading Windows

Window Configuration

- **CC_1**: September 15, 2025 - October 15, 2025
- **SN_1**: January 15, 2026 - February 15, 2026
- **CC_2**: March 22, 2026 - April 22, 2026
- **SN_2**: May 15, 2026 - June 1, 2026

Window Validation Logic

```
public boolean isWindowOpen(Long semesterId, PeriodType periodType) {
    Optional<GradingWindow> window = gradingWindowRepository
        .findBySemesterIdAndPeriodType(semesterId, periodType);

    if (window.isEmpty()) return false;

    LocalDate now = LocalDate.now();
    GradingWindow gw = window.get();
```

```
        return !now.isBefore(gw.getStartDate()) &&
               !now.isAfter(gw.getEndDate()) &&
               gw.getIsActive();
    }
```

Academic Structure

Student Level System

Academic Periods

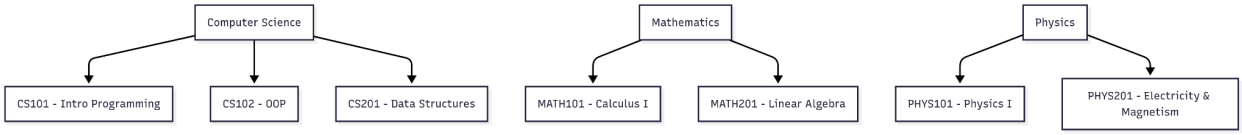
Semester Structure

- **Semester 1**: September 8, 2025 - February 23, 2026
- **Semester 2**: March 15, 2026 - June 2, 2026

Assessment Periods

- **CC_1/CC_2**: Continuous Assessment (Contrôle Continu)
- **SN_1/SN_2**: Normal Session (Session Normale)

Department-Subject Relationship



Error Handling & Validation

Error Response Structure

```
@Data
public class ErrorResponse {
    private String message;
    private String status;
    private int code;
    private String timestamp;
    private String path;

    public static class FieldError {
        private String field;
        private String message;
    }
}
```

Global Exception Handler

```
@RestControllerAdvice
public class GlobalExceptionHandler {

    @ExceptionHandler(ValidationException.class)
     public ResponseEntity<ErrorResponse> handleValidation(ValidationException
ex) {
        ErrorResponse error = new ErrorResponse();
        error.setMessage(ex.getMessage());
        error.setStatus("VALIDATION_ERROR");
        error.setCode(400);
        return ResponseEntity.badRequest().body(error);
    }

    @ExceptionHandler(MethodArgumentNotValidException.class)
                          public      ResponseEntity<ValidationErrorResponse>
handleMethodArgumentNotValid(
            MethodArgumentNotValidException ex) {

        ValidationErrorResponse error = new ValidationErrorResponse();
        error.setMessage("Validation failed");
        error.setStatus("error");

        List<FieldError> fieldErrors = ex.getBindingResult()
            .getFieldErrors()
            .stream()
            .map(fe -> new FieldError(fe.getField(), fe.getDefaultMessage()))
            .collect(Collectors.toList());

        error.setErrors(fieldErrors);
        return ResponseEntity.badRequest().body(error);
    }
}
```

HTTP Status Code Mapping

Status Code	Scenario	Response Type
200	Success	Data response
201	Created	Success message
400	Validation error	Error details
401	Unauthorized	Error message
403	Forbidden	Error message
404	Not found	Error message
409	Conflict	Error message
500	Server error	Error message

Validation Rules

Grade Validation

- Value must be between 0.0 and 20.0
- Student must exist and be active
- Subject must exist and be active
- Grading window must be open
- Teacher must be authorized for the subject

User Validation

- Username must be unique and 3-20 characters
- Email must be valid format and unique
- Password must be 6-40 characters
- Role must be valid enum value

Configuration & Deployment

Application Configuration

Database Configuration

```
# Database
spring.datasource.url=jdbc:postgresql://localhost:5432/managerNotes
spring.datasource.username=postgres
spring.datasource.password=nathan
spring.datasource.driver-class-name=org.postgresql.Driver

# JPA/Hibernate
spring.jpa.hibernate.ddl-auto=update
spring.jpa.show-sql=false
spring.jpa.properties.hibernate.format_sql=true
```

Security Configuration

```
# JWT Configuration
app.jwtSecret=R2RThdHu3OKhHvJ3QgUnkQsVv8Af+Jsw9A9+1oSx6nE=
app.jwtExpirationMs=86400000

# Security
spring.security.enabled=true
```

Server Configuration

```
# Server
server.port=3030

# File Upload
spring.servlet.multipart.max-file-size=10MB
spring.servlet.multipart.max-request-size=10MB
```

Environment Variables

Variable	Default	Description
`DB_PASSWORD`	`nathan`	Database password
`DB_URL`	`jdbc:postgresql://localhost:5432/managerNotes`	Database URL
`JWT_SECRET`	Generated	JWT signing secret
`JWT_EXPIRATION`	`86400000`	Token expiration (24h)
`EMAIL_USERNAME`	-	SMTP username
`EMAIL_PASSWORD`	-	SMTP password

Database Setup

PostgreSQL Installation

```
# Ubuntu/Debian
sudo apt update && sudo apt install postgresql postgresql-contrib

# Create database
sudo -u postgres createdb managerNotes
sudo -u postgres psql -c "ALTER USER postgres PASSWORD 'nathan';"
```

Schema Initialization

```
-- Import initial schema
psql -h localhost -U postgres -d managerNotes -f src/main/resources/managerNotes.sql

-- Fix sequence issues (if needed)
ALTER TABLE departments ALTER COLUMN id SET DEFAULT nextval('departments_seq');
ALTER TABLE grade_claims ALTER COLUMN id SET DEFAULT nextval('grade_claims_seq');
```

Production Deployment

Docker Configuration

```
FROM openjdk:21-jdk-slim
COPY target/ManageNotes-0.0.1-SNAPSHOT.jar app.jar
EXPOSE 3030
ENTRYPOINT ["java", "-jar", "/app.jar"]
```

Production Properties

```
# Production Database
spring.datasource.url=${DB_URL}
spring.datasource.username=${DB_USERNAME}
spring.datasource.password=${DB_PASSWORD}

# Security
```

```
spring.jpa.hibernate.ddl-auto=validate
spring.jpa.show-sql=false
logging.level.org.hibernate.SQL=WARN

# Performance
spring.jpa.properties.hibernate.jdbc.batch_size=20
spring.jpa.properties.hibernate.order_inserts=true
spring.jpa.properties.hibernate.order_updates=true
```

Development Guidelines

Code Organization Principles

Package Structure Rules

- **Controllers**: Handle HTTP requests/responses only
- **Services**: Contain business logic and orchestration
- **Repositories**: Data access layer with custom queries
- **DTOs**: Data transfer between layers
- **Entities**: JPA entities with minimal business logic

Naming Conventions

- **Classes**: PascalCase (e.g., `UserController`, `GradeService`)
- **Methods**: camelCase (e.g., `createGrade`, `validateUser`)
- **Constants**: UPPER_SNAKE_CASE (e.g., `MAX_GRADE_VALUE`)
- **Database**: snake_case (e.g., `student_id`, `creation_date`)

Best Practices

Service Layer

```java
@Service
@Transactional
@RequiredArgsConstructor
public class ExampleService {

    private final ExampleRepository repository;
    private final ExampleMapper mapper;

    public ExampleResponse create(ExampleRequest request) {
        // 1. Validate input
        validateRequest(request);

        // 2. Convert to entity
        Example entity = mapper.toEntity(request);

        // 3. Business logic
        processBusinessRules(entity);
```

```
        // 4. Save and return
        Example saved = repository.save(entity);
        return mapper.toResponse(saved);
    }
}
```

Error Handling

```
// Use specific exceptions
throw new ValidationException("Grade value must be between 0 and 20");

// Use Optional for null safety
return repository.findById(id)
    .map(mapper::toResponse)
    .orElseThrow(() -> new EntityNotFoundException("User not found"));
```

Testing Guidelines

```
@SpringBootTest
@Transactional
class GradeServiceTest {

    @Autowired
    private GradeService gradeService;

    @Test
    void shouldCreateGradeSuccessfully() {
        // Given
        GradeRequest request = createValidGradeRequest();

        // When
        GradeResponse response = gradeService.createGrade(request);

        // Then
        assertThat(response.getValue()).isEqualTo(request.getValue());

assertThat(response.getStudentId()).isEqualTo(request.getStudentId());
    }
}
```

API Design Standards

RESTful Conventions

- Use HTTP methods appropriately (GET, POST, PUT, DELETE)
- Use plural nouns for resource names (`/students`, `/grades`)
- Use HTTP status codes correctly
- Include proper error messages and validation feedback

Response Consistency

```
// Success responses
return ResponseEntity.ok(data);
return
ResponseEntity.status(HttpStatus.CREATED).body(MessageResponse.success("Creat
ed"));

// Error responses
return     ResponseEntity.badRequest().body(ErrorResponse.validation("Invalid
input"));
return
ResponseEntity.status(HttpStatus.FORBIDDEN).body(ErrorResponse.forbidden("Acc
ess denied"));
```

Security Guidelines

Input Validation

- Always validate DTOs with Bean Validation annotations
- Sanitize user input to prevent injection attacks
- Use parameterized queries in custom repository methods

Authentication & Authorization

- Always use `@PreAuthorize` for method-level security
- Validate JWT tokens on every protected endpoint
- Implement proper role-based access control

Data Protection

- Never log sensitive information (passwords, tokens)
- Use HTTPS in production
- Implement proper CORS configuration

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This technical documentation reflects the current state of the ManageNotes system and should be updated as the system evolves.