Department of Information Engineering and Computer Science

Master's Degree in Information Engineering

Project Course

ShiftManager:

Application for staff shift management, substitution requests, and automatic compensation calculation

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Febbraio 2025

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1. INTRODUCTION

ShiftManager is a full-stack web application designed to streamline staff shift management within sports organizations, particularly swimming pools. The system supports three user profiles with role-specific functionalities:

- Administrators create template-based schedules and publish shifts for various roles (lifeguards, instructors, receptionists);
- Collaborators view their assignments and can request replacements from colleagues for their shifts;
- Accountants access automated payroll tools to calculate monthly compensation based on customizable rates.

Technology stack:

- Backend: Django 5.2.8 + Django REST Framework 3.16.1
- Frontend: React 19.1.1 + Vite 7.1.7
- Database: SQLite (development) → PostgreSQL (production)
- Authentication: JWT (djangorestframework-simplejwt)
- UI: FullCalendar 6.1.19 + Tailwind CSS 4.1.17

2. SYSTEM ARCHITECTURE

2.1 Backend Structure (Django)

The backend is organized into 3 Django apps that handle specific domains:

- **users**: User management, JWT authentication, multi-category roles, accounting tracking
- **shifts**: Weekly shifts, weekly shift templates, substitution requests
- **courses**: Course types, base and user-/course-specific compensation

2.2 Frontend Structure (React)

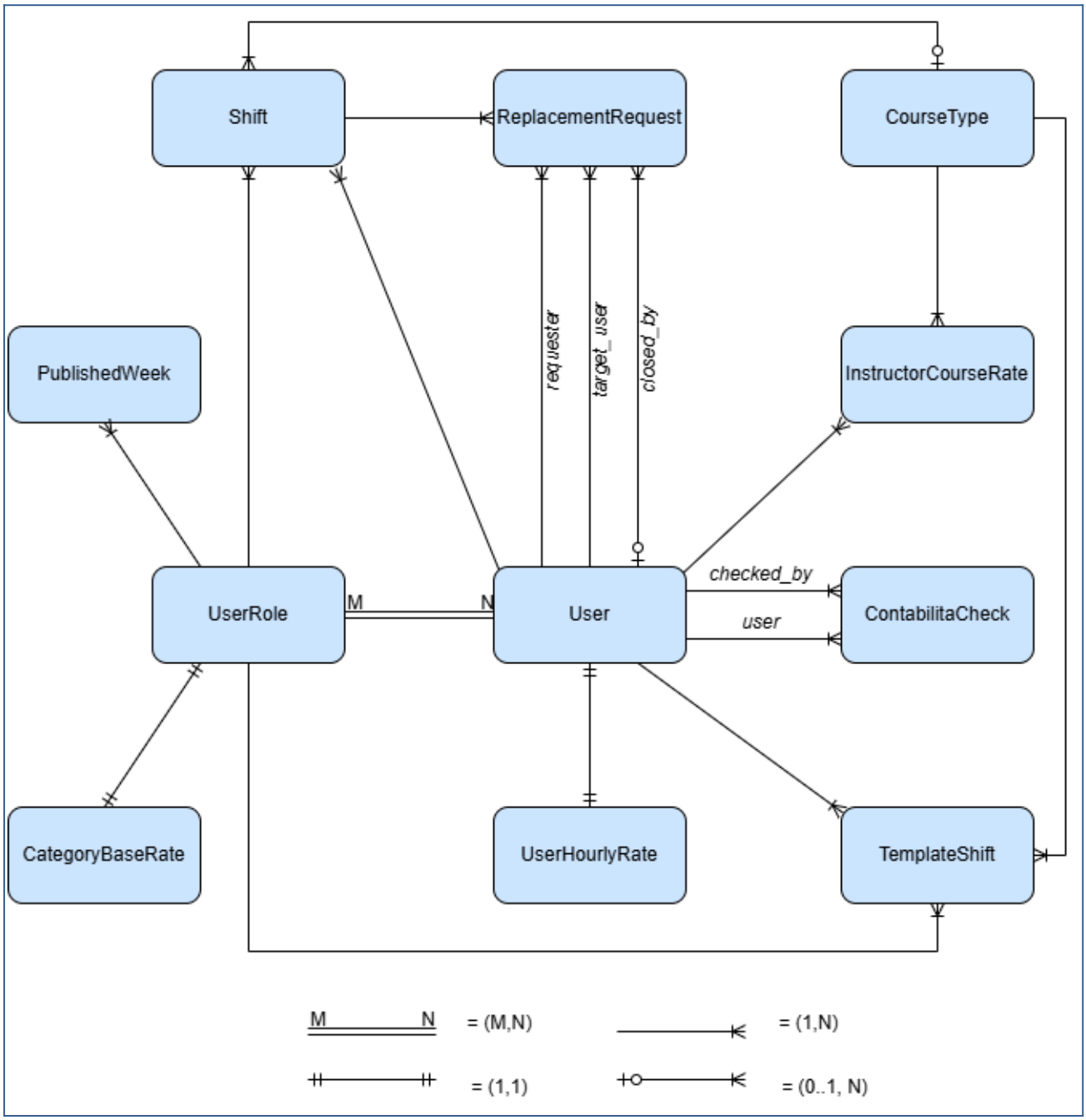
The frontend is a Single Page Application (SPA) with protected routing and Context API for authentication:

- **App.jsx** and **RealCalendar.jsx**: administrator dashboard with 2 sections: template and real shifts. A template week is created in the template calendar and then it can be published to the real shift calendar
- **MyShifts.jsx**: collaborator dashboard for viewing personal shifts and managing substitutions
- **ContabilitaPage.jsx**: Administrator/accountant dashboard with a list of collaborators and tracking checks
- **ContabilitaDettaglio.jsx**: Detailed monthly report per user with automatic salary calculation

3. DATA MODEL

3.1 Conceptual Schema (Entity–Relationship Diagram)

The database is structured around 11 main models. The conceptual schema is as follows:



3.2 Logical Schema

For the sake of simplicity and conciseness, only the primary key, foreign keys, and the most significant fields have been specified, while all other fields have been omitted.

Legend:

- PK = Primary Key
- FK = Foreign Key

3.2.1 App: User

UserRole: Available roles in the system

Field	Type	Constraints / Notes
id	INTEGER	PK — Auto-increment
code	VARCHAR(50)	UNIQUE, NOT NULL
label	VARCHAR(100)	NOT NULL

User: System user (extends Django AbstractUser)

Field	Type	Constraints / Notes
id	INTEGER	PK — Auto-increment
username	VARCHAR(150)	UNIQUE, NOT NULL
password	VARCHAR(128)	NOT NULL (Django hash)
first_name	VARCHAR(150)	Optional
last_name	VARCHAR(150)	Optional
email	VARCHAR(254)	Optional
date_of_birth	DATE	Optional
is_staff	BOOLEAN	DEFAULT False
is_superuser	BOOLEAN	DEFAULT False

User_UserRole: M:N junction table — a user can have multiple roles

Field	Type	Constraints / Notes
user_id	INTEGER	PK (composite) FK → User(id) ON DELETE CASCADE
userrole_id	INTEGER	PK (composite) FK → UserRole(id) ON DELETE CASCADE

ContabilitaCheck: Marks collaborators whose payroll has already been verified by the accountant

Field	Type	Constraints / Notes
id	INTEGER	PK — Auto-increment
checked_by_id	INTEGER	FK → User(id) ON DELETE CASCADE — who performed the check
user_id	INTEGER	FK → User(id) ON DELETE CASCADE — the collaborator being checked
checked_at	DATETIME	AUTO — timestamp of when the check was performed

3.2.2 App: Shifts

Shift: *Published real shift assigned to a collaborator*

Field	Type	Constraints / Notes
id	INTEGER	PK — Auto-increment
user_id	INTEGER	FK → User(id) ON DELETE CASCADE
role_id	INTEGER	FK → UserRole(id) ON DELETE PROTECT
date	DATE	NOT NULL
start_time	TIME	NOT NULL
end_time	TIME	NOT NULL
course_type_id	INTEGER	[optional] FK → CourseType(id) ON DELETE SET NULL — instructors only

TemplateShift: *Template shift (weekly schedule) used to generate real shifts*

Field	Type	Constraints / Notes
id	INTEGER	PK — Auto-increment
category_id	INTEGER	FK → UserRole(id) ON DELETE PROTECT — role of the shift
weekday	INTEGER	NOT NULL — 0=Mon, 1=Tue, ..., 6=Sun
start_time	TIME	NOT NULL
end_time	TIME	NOT NULL
user_id	INTEGER	[optional] FK → User(id) ON DELETE SET NULL — shift not yet assigned
course_type_id	INTEGER	[optional] FK → CourseType(id) ON DELETE SET NULL

PublishedWeek: *Tracks which weeks have been published for each role/category*

Field	Type	Constraints / Notes
id	INTEGER	PK — Auto-increment
role_id	INTEGER	FK → UserRole(id) ON DELETE CASCADE
start_date	DATE	NOT NULL — Monday of the published week

ReplacementRequest: *Shift replacement request between collaborators*

Field	Type	Constraints / Notes
id	INTEGER	PK — Auto-increment
shift_id	INTEGER	FK → Shift(id) ON DELETE CASCADE
requester_id	INTEGER	FK → User(id) ON DELETE CASCADE — who requests the replacement
target_user_id	INTEGER	FK → User(id) ON DELETE CASCADE — who is asked to cover
partial	BOOLEAN	DEFAULT False — True if only part of the shift is being replaced
partial_start	TIME	[optional] — start time for partial replacement
partial_end	TIME	[optional] — end time for partial replacement
original_start_time	TIME	[optional] — original shift start time
original_end_time	TIME	[optional] — original shift end time
status	VARCHAR(20)	DEFAULT 'pending' — values: pending | accepted | rejected | cancelled
closed_by_id	INTEGER	[optional] FK → User(id) ON DELETE SET NULL — who closed the request
created_at	DATETIME	AUTO — request creation timestamp
updated_at	DATETIME	AUTO — last update timestamp

3.3.3 App: Courses

CourseType: *Type of course (e.g. Swimming School, Fitness, Competitive)*

Field	Type	Constraints / Notes
id	INTEGER	PK — Auto-increment
name	VARCHAR(100)	UNIQUE, NOT NULL
base_rate	DECIMAL(6,2)	NOT NULL — base rate for this course type (€/session or €/h)

CategoryBaseRate: *Base hourly rate for each role/category*

Field	Type	Constraints / Notes
id	INTEGER	PK — Auto-increment
role_id	INTEGER	FK → UserRole(id) ON DELETE CASCADE UNIQUE — 1:1 relationship
base_rate	DECIMAL(6,2)	NOT NULL — base rate (€/hour)

UserHourlyRate: *Custom hourly rate for a single collaborator (overrides the base rate)*

Field	Type	Constraints / Notes
id	INTEGER	PK — Auto-increment
user_id	INTEGER	FK → User(id) ON DELETE CASCADE UNIQUE — 1:1 relationship
rate	DECIMAL(6,2)	NOT NULL — custom rate (€/hour)

InstructorCourseRate: *Custom rate for an instructor for a specific course type*

Field	Type	Constraints / Notes
id	INTEGER	PK — Auto-increment
instructor_id	INTEGER	FK → User(id) ON DELETE CASCADE
course_type_id	INTEGER	FK → CourseType(id) ON DELETE CASCADE
rate	DECIMAL(6,2)	NOT NULL — custom rate (€/session)

3.3.4 Relationship Summary

Relationship	Type	Description
User — UserRole	**M:N**	A user can have multiple roles; a role can be assigned to multiple users (User_UserRole table)
Shift — User	**N:1**	Every real shift is assigned to one user
Shift — UserRole	**N:1**	Every shift has an associated role (e.g. lifeguard, instructor)
Shift — CourseType	**N:1 (opt)**	Instructor shifts are linked to a course type
TemplateShift — UserRole	**N:1**	Every template shift belongs to a role/category
TemplateShift — User	**N:1 (opt)**	A template shift may not yet have an assigned user
TemplateShift — CourseType	**N:1 (opt)**	Instructor templates only
PublishedWeek — UserRole	**N:1**	Tracks which week has been published for which role
ReplacementRequest — Shift	**N:1**	Multiple requests can refer to the same shift
ReplacementRequest — User (requester)	**N:1**	The collaborator requesting the replacement
ReplacementRequest — User (target)	**N:1**	The collaborator asked to cover the shift
ReplacementRequest — User (closed_by)	**N:1 (opt)**	Who managed/closed the request (null if still open)
CategoryBaseRate — UserRole	**1:1**	Each role has exactly one base hourly rate
UserHourlyRate — User	**1:1**	Each user may have at most one custom hourly rate (override)
InstructorCourseRate — User	**N:1**	An instructor can have custom rates for multiple course types
InstructorCourseRate — CourseType	**N:1**	Multiple instructors can have different rates for the same course
ContabilitaCheck — User (checked_by)	**N:1**	The accountant who performed the verification
ContabilitaCheck — User (user)	**N:1**	The collaborator whose compensation has been verified

4. MAIN FRONTEND FEATURES

4.1 Admin Dashboard: Shift Management

The administrator accesses the reserved area via login credentials.
From the dashboard, they can create a “typical week” for each role using an interactive FullCalendar interface. Shifts are saved as TemplateShift models. The administrator can then publish real shifts for one or more weeks based on the selected template.

Workflow:

1. Select category (lifeguard, instructor, reception, cleaning).
2. Create shifts in the template calendar via drag-and-drop or quick-insert buttons.
    2.1 Assign employee and course (if it’s an instructor shift)
3. Publish: select one or more weeks to publish the template shifts. A control system prevents publishing already-published weeks to avoid overwrites and duplicates
4. It’s possible to modify (time, employee, etc.) or delete template and/or real shifts

4.2 Employee Dashboard: Shift Viewing and Substitution Management

Each employee accesses their reserved area via the login page (with registration available if no account exists). The employee dashboard manages personal shifts: it displays weekly shifts in a calendar view with assigned role and working hours, and allows management of each shift. A profile section enables users to update personal information (e.g., password) and log out. Clicking on a shift opens a popup to request a substitution. The substitution can be total (entire shift) or partial (part of the shift). The user can select colleagues with the same role from a dedicated list to send the request.

A secondary page allows users to view:

- Sent requests (status: pending, accepted, rejected)
- Received requests (with “Accept” and “Reject” buttons, or “already accepted by <username>”)
- Each new sent or received request, and each status change of sent or received requests, triggers notifications to sender and recipients with a red badge
- A filter enables viewing request history by selecting a specific month and year.

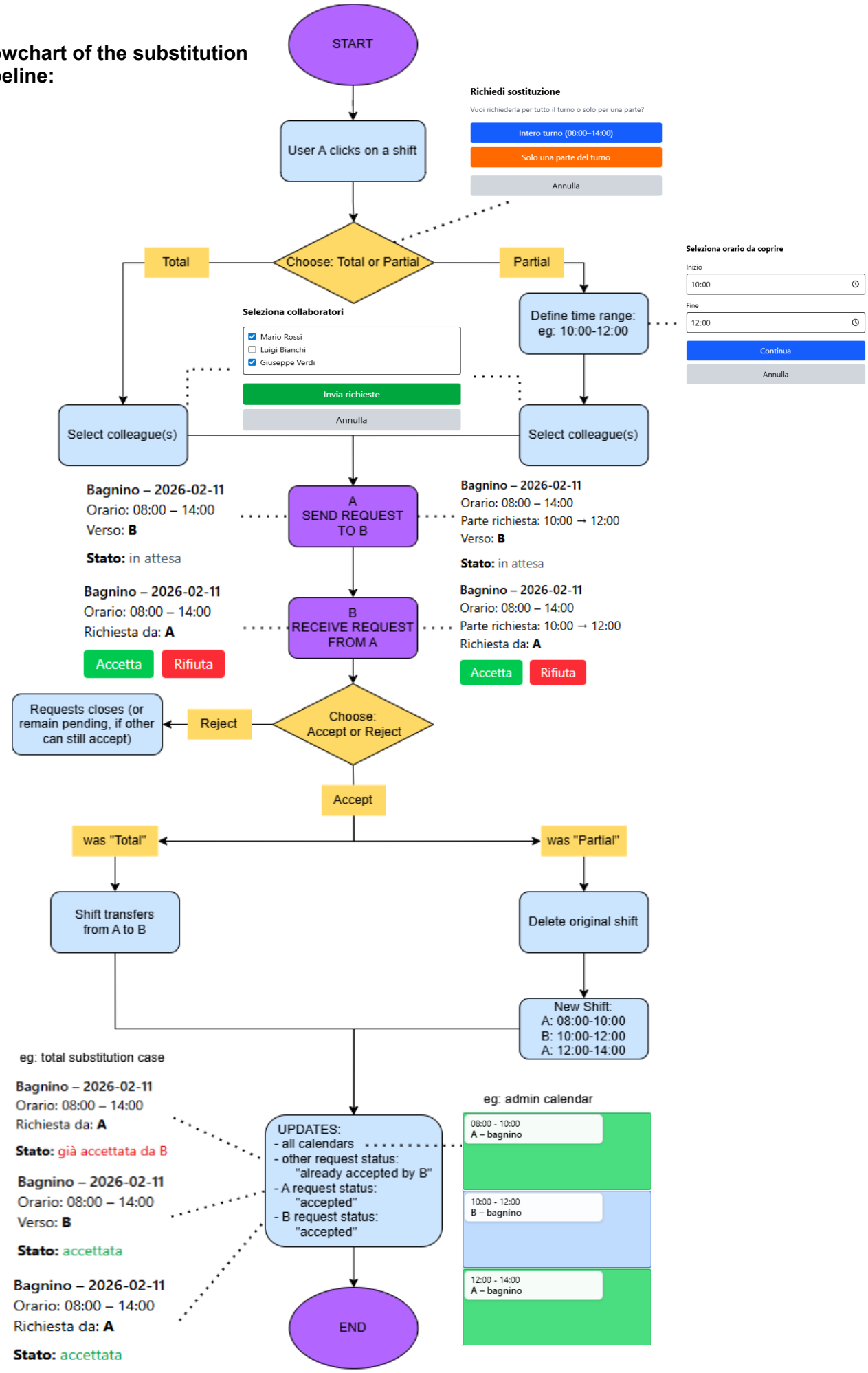
When user A’s substitution request is accepted by user B:

- The shift is automatically transferred to B and removed from A, ensuring consistency in monthly compensation calculations.
- The administrator’s calendar updates accordingly: the shift changes color, and clicking on it shows substitution details (requested by, accepted by, timestamp, and whether the substitution was partial or total).

Example Flow for Total (or Partial) Substitution:

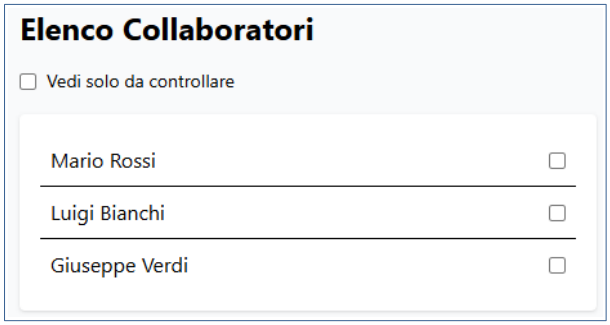
1. Employee A requests substitution for 08:00-14:00 shift (or for a part of the shift if “Partial” substitution)
2. Selects recipients among colleagues with same role
3. A sees their request as "pending" in sent requests while each recipient receives a request in their "Received requests" section with "Accept" and "Reject" buttons
4. Employee B accepts: A sees the request with status "accepted", all other recipients see the request with status "already accepted by B"
5. The original shift (or the requested part if “Partial” substitution) transfers from A to B; calendars update accordingly, including the administrator's calendar

Flowchart of the substitution pipeline:



4.3 Accounting Dashboard

Through a dedicated menu, the administrator can switch from the shift management dashboard to the accounting dashboard. A specific accountant role is also available, providing direct access to this section.



The dashboard displays a list of all collaborators. Each name has an associated checkbox to mark the collaborator; a filter allows hiding the marked entries.

By selecting a collaborator, a detailed monthly report is shown, listing the activities performed day by day. The system automatically calculates the monthly salary based on the shifts actually worked and on rates defined per user, role, or course. A base rate is set for each role, with support for customized rates per individual user.

Rate System:

- Lifeguard / Front Desk / Cleaning: hourly rate
- Instructors: per-shift or hourly rate depending on the course
- If a customized rate exists for the user, it is used; otherwise, the base rate is applied

5. REST API ARCHITECTURE

The backend exposes RESTful APIs organized by domain. All endpoints (except login and register) require JWT authentication via the *Authorization: Bearer <token> header.*

Users

Method	Endpoint	Description
GET	`/api/users/`	List all users
GET	`/api/users/?only_collaborators=true`	List collaborators only
GET	`/api/users/{id}/`	User detail
GET	`/api/users/roles/`	List roles

Authentication

Method	Endpoint	Description
POST	/api/auth/login/	User login
POST	/api/auth/register/	User registration
POST	/api/auth/refresh/	Refresh token
GET	/api/auth/me/	Current user profile
PUT	/api/auth/me/	Update profile
POST	/api/auth/change-password/	Change password

Template Shifts

Method	Endpoint	Description
GET	/api/templates/	List template shifts
GET	/api/templates/?category={category}	Filter by category
POST	/api/templates/	Create template
GET	/api/templates/{id}/	Template detail
PUT	/api/templates/{id}/	Update template
PATCH	/api/templates/{id}/	Partial update
DELETE	/api/templates/{id}/	Delete template

Real Shifts

Method	Endpoint	Description
GET	/api/shifts/	List shifts
GET	/api/shifts/?user={id}&month={m}&year={y}	Filter shifts
POST	/api/shifts/	Create shift
GET	/api/shifts/{id}/	Shift detail
PUT	/api/shifts/{id}/	Update shift
PATCH	/api/shifts/{id}/	Partial update
DELETE	/api/shifts/{id}/	Delete shift
POST	/api/shifts/publish/	Publish templates
GET	/api/shifts/published_weeks/?year={y}&month={m}	Published weeks
POST	/api/shifts/generate_month/	Generate monthly shifts
GET	/api/shifts/get_week_shifts/?start_date={date}	Week shifts
GET	/api/shifts/get_month_shifts/?year={y}&month={m}	Month shifts

Replacements

Method	Endpoint	Description
GET	/api/shifts/{id}/available_collaborators/	Available collaborators
POST	/api/shifts/{id}/ask_replacement/	Request replacement
GET	/api/shifts/replacements_sent/?user_id={id}	Sent requests
GET	/api/shifts/replacements_received/?user_id={id}	Received requests
POST	/api/shifts/respond_replacement/	Accept/reject eplacement

Accounting

Method	Endpoint	Description
GET	/api/contabilita/checks/	My checks
POST	/api/contabilita/checks/{user_id}/	Toggle check

Courses & Rates

Method	Endpoint	Description
GET	/api/courses/types/	Course types
GET	/api/courses/types/{id}/	Course type detail
GET	/api/courses/base-rates/	Base rates
GET	/api/courses/base-rates/{id}/	Base rate detail
GET	/api/courses/user-hourly-rates/	User hourly rates
GET	/api/courses/user-hourly-rates/{id}/	Custom user rate
GET	/api/courses/instructor-course-rates/	Instructor course rates
GET	/api/courses/instructor-course-rates/{id}/	Custom course rate

6. SECURITY AND AUTHENTICATION

JWT Authentication:

The system uses stateless JWT-based authentication with automatically expiring access tokens to ensure security and scalability. To provide a seamless user experience, refresh tokens are implemented to renew sessions without requiring a new login. On the frontend, an Axios interceptor automatically attaches the JWT token to every outgoing request, ensuring consistent authentication handling across the application.

Frontend Route Protection:

Access to frontend routes is protected through dedicated guard components. RequireAuth verifies the presence of a valid token before allowing access to protected pages. RequireStaff restricts access to administrative features to users with admin privileges (is_staff = true). RequireContabilita further limits access to the accounting dashboard, allowing only users with the accounting role or administrators.

Backend Permissions:

On the backend, all protected endpoints require authentication via the IsAuthenticated permission. Additional custom authorization checks are implemented directly in the views to enforce fine-grained access control based on roles and context.

7. CONCLUSION

PiscinaManager is a comprehensive and modern solution for staff management in sports organizations. Its REST-based architecture, with a clear separation between frontend and backend, ensures scalability and long-term maintainability.

Key features include an innovative peer-to-peer substitution system, automated accounting with customizable rates, and progressive shift publication. The platform effectively manages complex workflows such as Total and Partial substitutions, multi-role tracking through dedicated interfaces, a clear separation between Template Shifts and Real Shifts to ensure data integrity, and dedicated calendars for each role to enable independent planning and management.