



**BILKENT UNIVERSITY  
COMPUTER SCIENCE DEPARTMENT  
CS 319 OBJECT-ORIENTED SOFTWARE  
ENGINEERING  
DELIVERABLE 2 ITERATION 2  
SPRING 2025  
GROUP 2 SECTION 1  
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# 1. Non-Functional Requirements

## 1.1 Performance Requirements

- The system shall ensure that critical operations (e.g., login, schedule viewing, data retrieval) are complete within **≤2 seconds** under standard load conditions (≤500 concurrent users).
- Chronological sorting, filtering, and dashboard rendering operations shall be completed within **≤2 seconds** for optimal usability.
- The system must scale to handle **up to 1000 concurrent users** during peak periods using **Tomcat connection pooling** and **Spring Boot microservices**.
- To ensure timely and efficient information delivery, real-time updates must be implemented using WebSockets or Server-Sent Events (SSE), enabling immediate communication between client and server. Immediate communication ensures fast, accurate, and reliable user interactions — making the system responsive, trustworthy, and resource-efficient.
- The system shall employ **lazy loading** and **pagination** for large datasets (e.g., notifications, logs). It leads to less data is transferred initially, benefiting users on:
  - faster page loads, because only subset of data is fetched initially;
  - better smooth-scrolling and on-demand loading preventing usage of large datasets;
- React frontend shall utilize **code splitting** (e.g., **React.lazy**, **Suspense**) to improve initial load times by loading only necessary components and deferring unnecessary components for future usages. This approach increases page speed, decreases time for interaction.

## 1.2 Usability and Accessibility Requirements

- The system shall feature a user-friendly **React-based UI** compatible with desktop and mobile devices.
- The user interface shall comply with **WCAG 2.1 AA accessibility standards**, including keyboard navigation support and sufficient contrast ratios.
- Session termination must securely clear all session data (e.g., cookies, local storage) to prevent unauthorized access.
- All dashboards and views shall be role-specific (e.g., TAs, instructors, admins) with consistent design principles.
- React state management (e.g., **Redux** or **Context API**) shall minimize full-page reloads, ensuring seamless user experience.

- Critical user workflows (e.g., approving overrides, submitting swap requests) shall be reachable within **≤3 clicks** from the dashboard.

## 1.3 Security Requirements

- The system shall implement **Role-Based Access Control (RBAC)** using **Spring Security** with **JWT tokens** stored in **HTTP-only cookies** to mitigate XSS vulnerabilities.
- **Two-Factor Authentication (2FA)** shall be mandatory for administrative users.
- Passwords shall comply with the organization's policy: minimum **12 characters**, with at least **1 uppercase letter**, **1 number**, and **1 special character**.
- Passwords shall be hashed using **bcrypt** with a minimum cost factor of **12**.
- All sensitive data (e.g., IBANs, schedules, exam details) shall be encrypted using **AES-256** both at rest and in transit (via **TLS 1.3**).
- CSRF protection shall be enforced on all relevant endpoints.
- Users shall be logged out after **15 minutes** of inactivity.
- API communications between frontend and backend shall be restricted to **HTTPS** and secure headers (e.g., **CORS**, **Strict-Transport-Security**).

## 1.4 Reliability and Availability Requirements

- The system shall maintain **≥99.9% uptime**, corresponding to a maximum downtime of **8.76 hours per year**.
- Backend services shall utilize **automatic failover mechanisms** (e.g., Kubernetes readiness/liveness probes).
- Daily **automated backups** shall be performed to enable rapid recovery.
- Bulk operations (e.g., TA imports, mass notifications) shall include **rollback mechanisms** to ensure data consistency and integrity.
- The frontend shall support **offline access** (where applicable) via service workers or **IndexedDB** for caching critical data.

## 1.5 Scalability and Maintainability Requirements

- The system shall be designed to support an increase from **500 to 2000 concurrent users** with minimal architectural changes.
- The backend shall implement **HikariCP connection pooling** to optimize database connections.
- Spring Boot services shall follow a **layered architecture (Controller-Service-Repository)** to facilitate maintainability and modularity.

- Frontend components (built with **TypeScript**) shall achieve **≥90% unit test coverage**.
- Backend services shall achieve **≥80% test coverage** for unit and integration tests.
- All APIs shall comply with **OpenAPI 3.0** for ease of integration and future extensibility.

## 1.6 Interoperability and Integration Requirements

- The system shall integrate with the university's **Single Sign-On (SSO)** via **OAuth2**.
- The system shall interoperate with the university's **SMTP servers** (using **STARTTLS**) for sending transactional emails (e.g., password resets, notifications).
- The backend shall expose **RESTful APIs** adhering to **OpenAPI 3.0** standards.
- External systems and future modules shall be able to communicate via these standardized APIs.

## 1.7 Data Integrity and Validation Requirements

- All user input forms shall be subject to completeness checks and validation before submission.
- IBAN fields shall be validated using standard checksum algorithms.
- The system shall validate assignment inputs against schedule conflicts in under 2 second to ensure timely processing.
- Optimistic locking techniques shall be used to prevent race conditions in TA assignment workflows.
- Data imports (e.g., bulk TA lists) shall undergo **schema validation** and reject invalid entries.

## 1.8 Logging, Auditability, and Compliance Requirements

- All critical actions (e.g., swap requests, approvals, leave submissions) shall be logged with metadata such as **timestamp**, **user ID**, and **IP address**.
- Logs shall be retained for a minimum of **7 years** to comply with audit and regulatory requirements.
- Log data shall be centralized using **Logback** or integrated with an external system (e.g., **ELK stack**).

## 1.9 Notification System Requirements

- Notifications shall be delivered in real-time or near real-time using **WebSockets** or **SSE**.
- The Dean's Office shall be notified immediately of critical events (e.g., override approvals).
- Notification lists shall support pagination and filtering.
- Swap and override request responses must generate automatic notifications to relevant TAs and instructors.

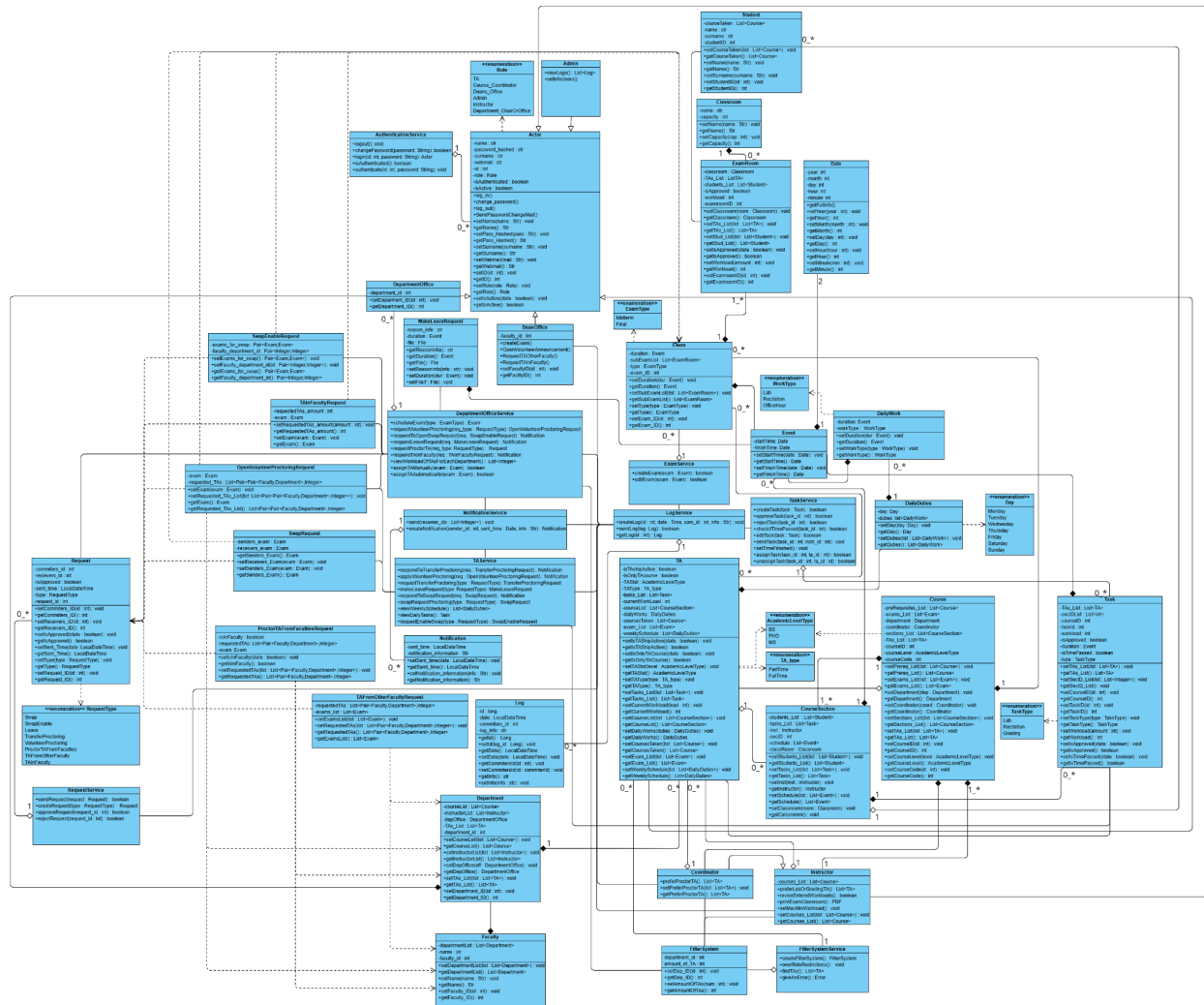
## 1.10 Proctoring and Scheduling Requirements

- Proctoring, swap, and override requests must be submitted no later than **6 hours** before the exam.
- The system shall enforce non-overlapping exam times and locations at both application and database levels.
- The system shall maintain consistency between leave data and assignment records, ensuring synchronization within 5 seconds of an update.
- The system shall provide real-time dashboard access with data refresh intervals not exceeding 3 seconds.

## 1.11 Data Import and Export Requirements

- The system shall complete bulk import operations of up to 10,000 records within 10 seconds.
- Data imports must validate schema compliance and reject invalid or incomplete entries.
- Rollback functionality shall be available for bulk operations affecting critical datasets.

Link for the [Class Diagram](#)



### 3. State Machine Diagrams

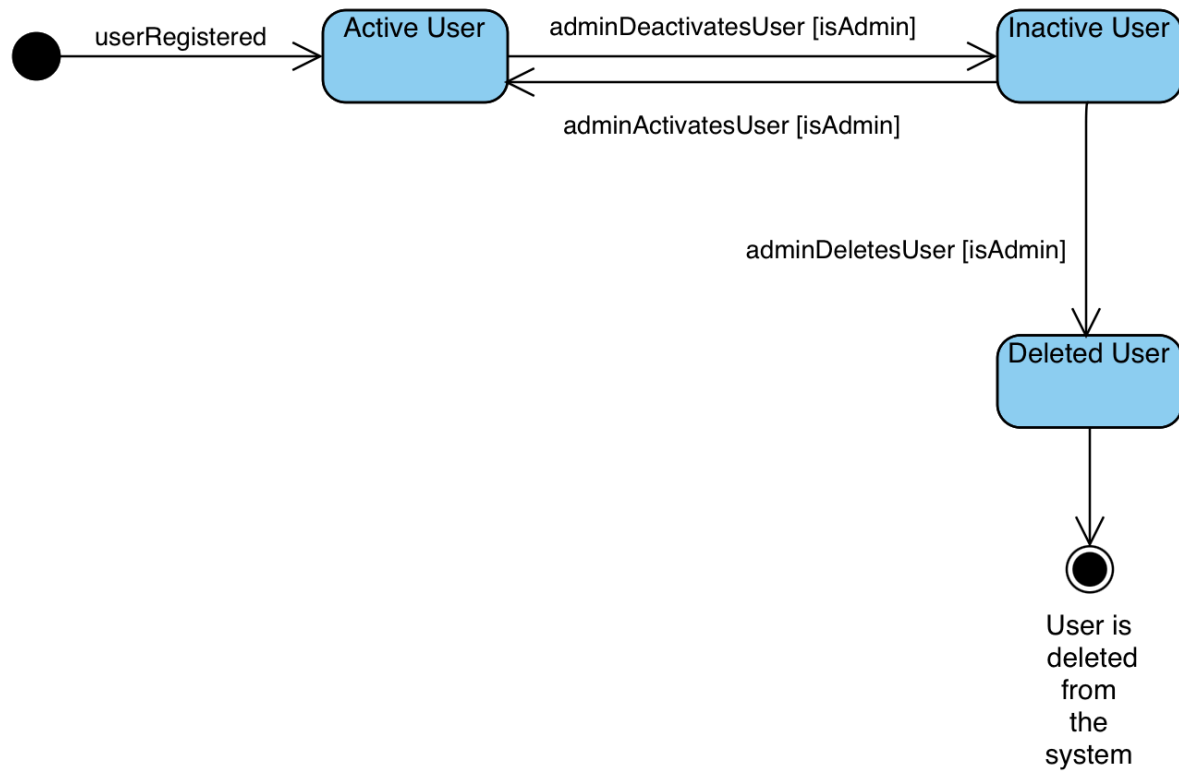


Diagram 1: State Machine Diagram of a User



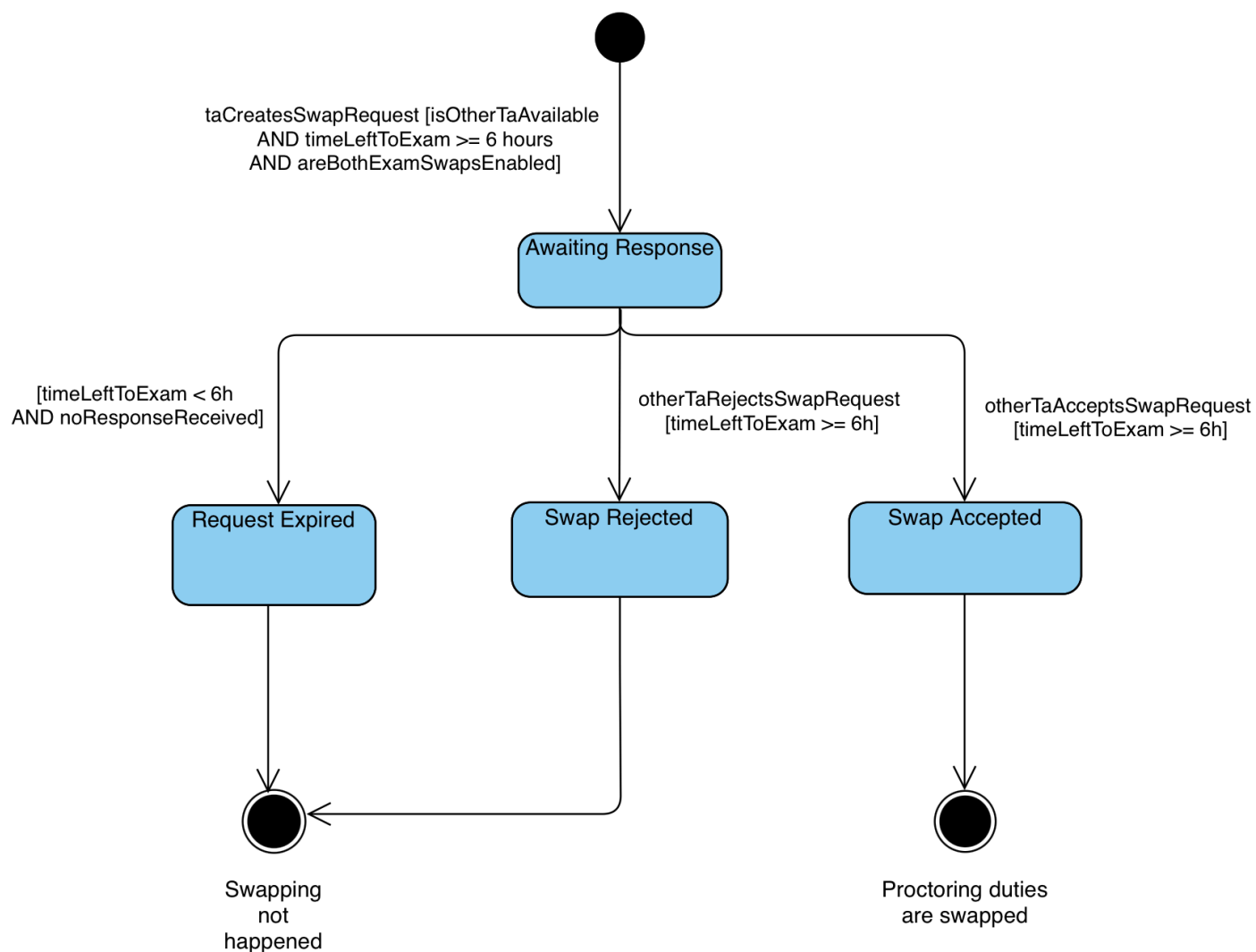


Diagram 2: State Machine Diagram of a Proctoring Swap Request between Teaching Assistants

Link for all of the state machine diagrams: [State Diagrams](#)

## 4. Activity Diagrams

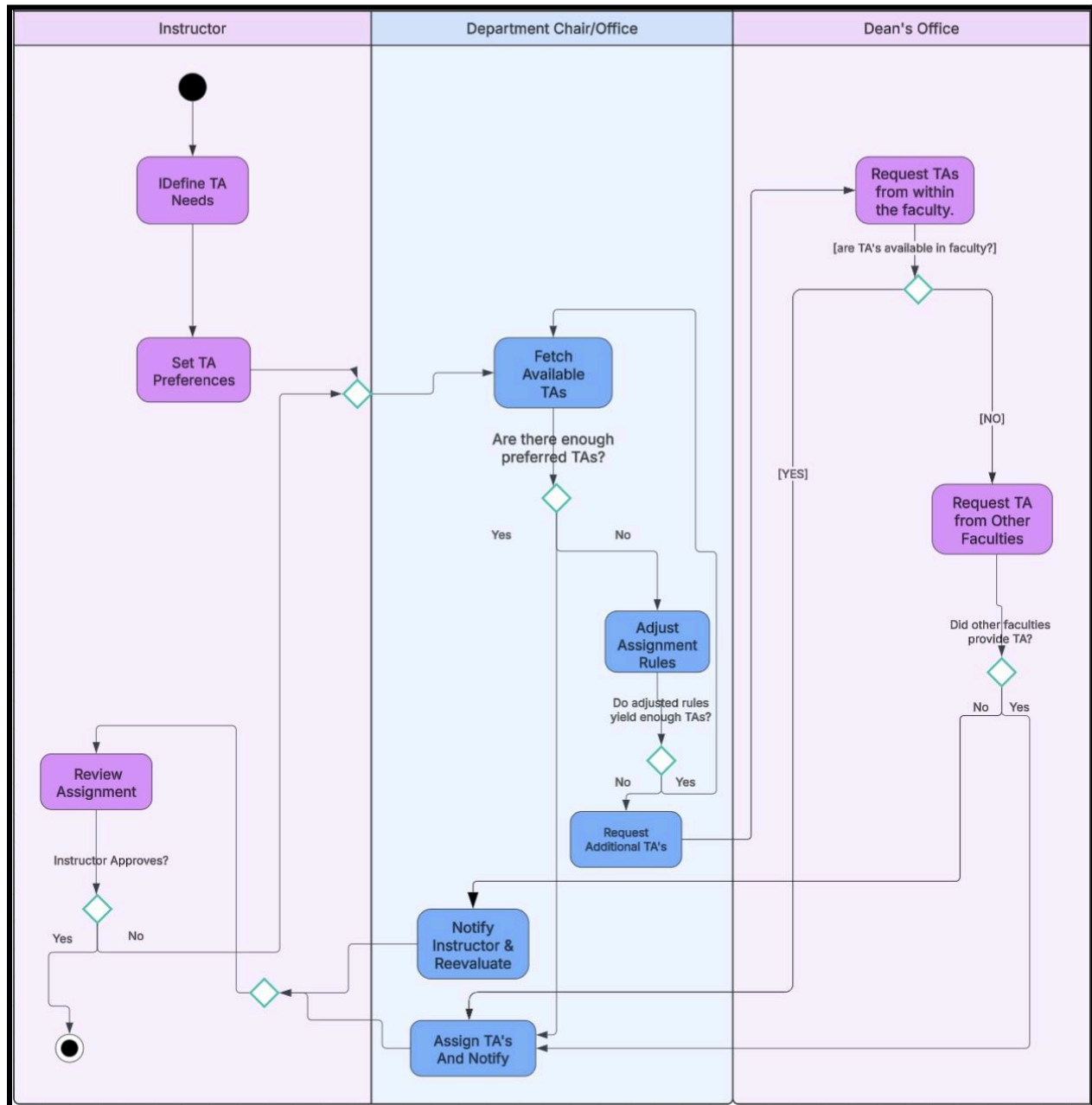


Diagram 1: The activity diagram for automatically assigning the TA process

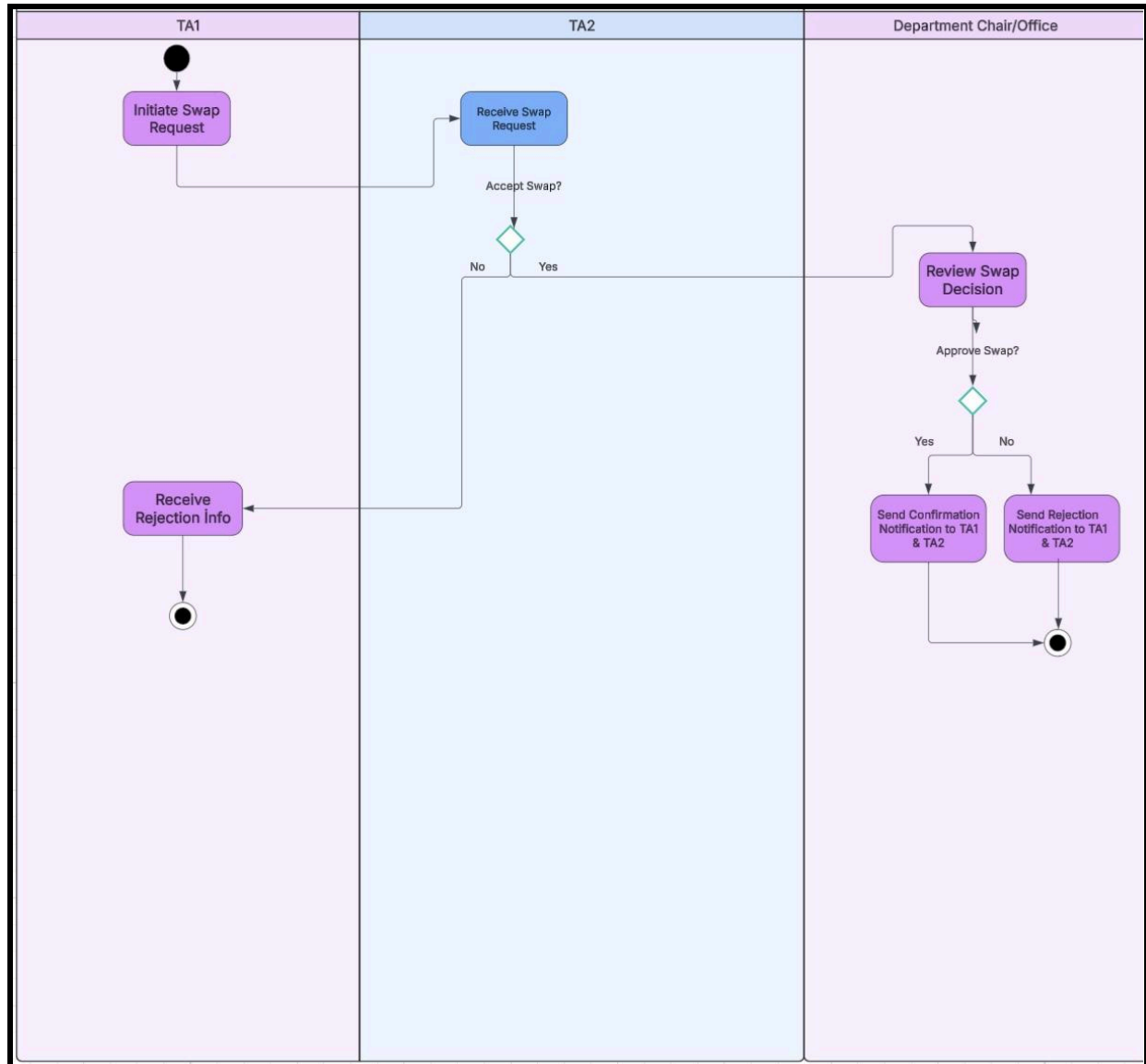


Diagram 2: Activity Diagram for TA-to-TA Swap Request with Department Chair Approval

Link for Activity Diagrams : [Activity Diagrams](#)

## 5. Sequence Diagram

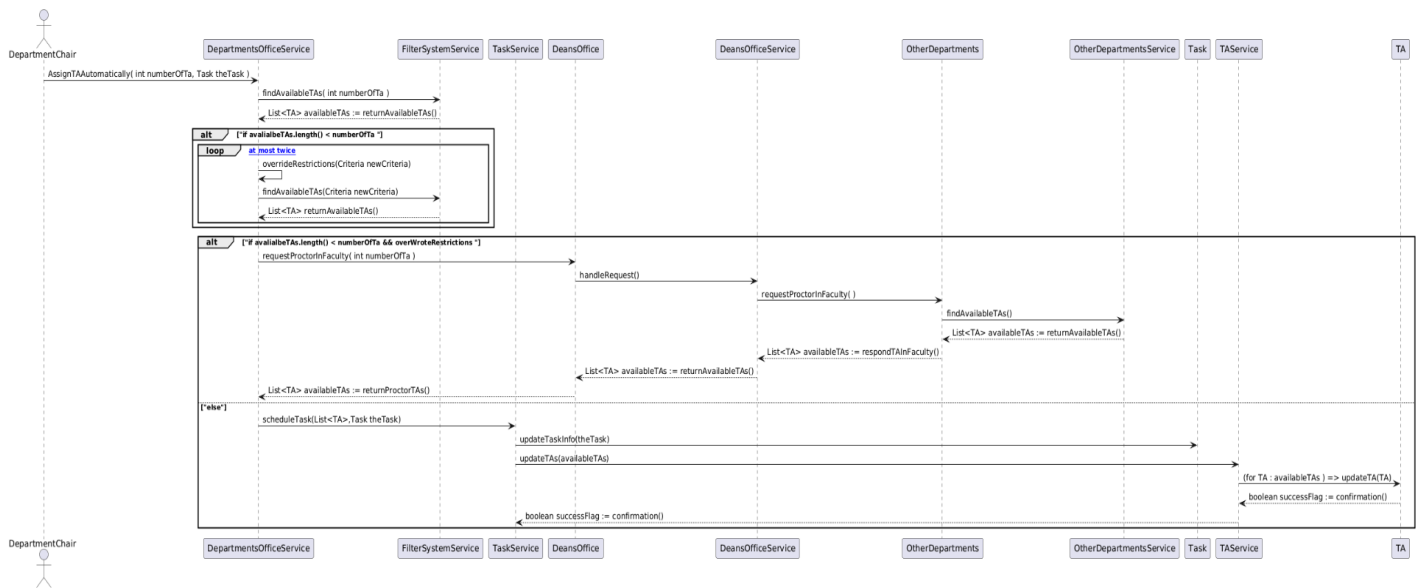


Diagram 1 : Sequence diagram of AssignTAAutomatically  
 Link for Sequence Diagram: [Sequence Diagram](#)

## 6. Mockups

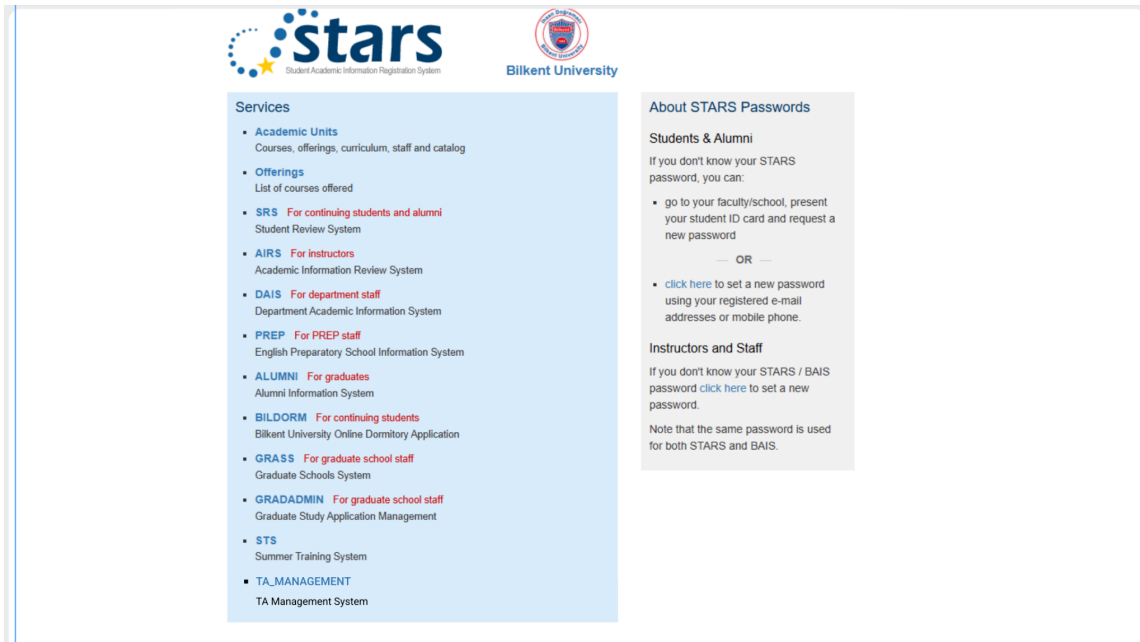



Figure 1: First Screen

Bilkent University Online Services

TürkçeReset passwordLogin



Bilkent University

Secure Login Gateway

Login : TA Management System

Bilkent ID

Bilkent ID cannot be blank.

Personnel ID or Student ID number

Password

Login

If you are having problems logging in, please check the time zone setting on your computer.

Turkey no longer uses daylight saving time (DST). Your computer time zone setting should be set as UTC+3.

Bilkent Computer Center uses this common login gateway page for user authentication. Most Bilkent University online services are accessed through this Secure Login Gateway.

If you don't know your STARS or BAIS password, please click here.

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Figure 2: Login Page of the TA Management System


Stars Logo

TA Management

Home

Make Leave RequestNotificationsLogout

Academic Status



Yahya Elnoubly

CS

Logout

Mobile Phone:

Contact E-Mail Address:

Send E-mail to Registrar's Office

Useful Links

Links

Your Bookmarks

WebMail

Bilkent University Page

Dorm-Net

Bilkent University Library

Bus Schedules

Academic Calendar

Academic Regulations

Exchange Programs

Last Login: 14.03.2025 14:31 from 5.46.44.46

Request Zoom LicenseMoodle

Current SemesterCurriculum of Computer Engineering

View Daily TasksView Monthly Schedule

Load Prior Semester

Hours	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
08:30 - 09:30	ECON-107 A-127 Recitation	Office Hour EA-517	CS-590 EE-214 Course				
09:30 - 10:30	ECON-107 A-127 Recitation	Office Hour EA-517	CS-590 EE-214 Course				
10:30 - 11:30							
11:30 - 12:30							
12:30 - 13:30							
13:30 - 14:30			CS-224 EA-101 Lab				
14:30 - 15:30			CS-224 EA-101 Lab				
15:30 - 16:30			CS-224 EA-101 Lab				
16:30 - 17:30			CS-224 EA-101 Lab				
17:30 - 18:30							
18:30 - 19:30							
19:30 - 20:30							
20:30 - 21:30							
21:30 - 22:30							

Online/hybrid Lecture

Face-to-face Lecture

Recitation

Figure 3: TA Main Page

Stars Logo

TA Management

Home

Make Leave Request

Notifications

Logout

< January 2025 >

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

Start Time: 15:40

< January 2025 >

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

Finish Time: 16:30

Enter message here...

Attach File

Make Leave Request

Figure 4: Leave Request Form Page of TA

Stars Logo

TA Management

Home

Make Leave Request

Notifications

Logout

< January 2025 >

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2 ✓	3	4 ✓
5	6	7	8	9 ✓	10	11
12	13 ✓	14	15	16	17	18
19	20	21	22 ✓	23	24	25
26	27	28 ✓	29	30	31	

Start Time: 15:40

Time Table

Time	Task	Lessons	Actions	
08:00 - 10:00	Proctoring	CS-101	Swap	Transfer
10:30 - 12:00	Proctoring	CS-102	Swap	Transfer

Figure 5: Monthly Schedule of TA

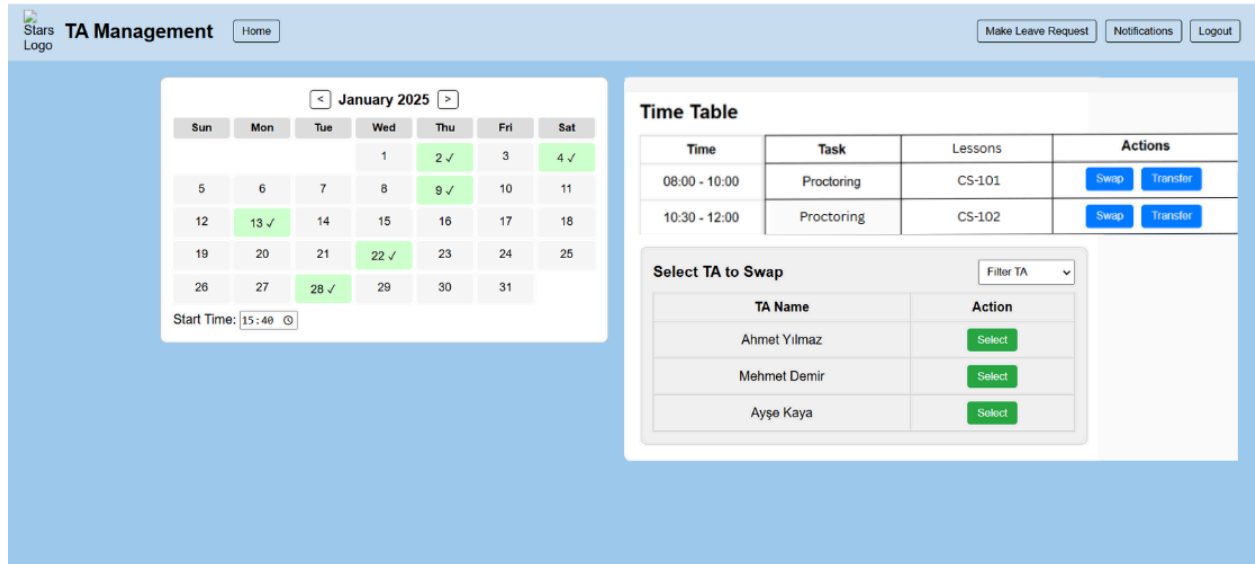


Figure 6: Monthly Schedule of TA

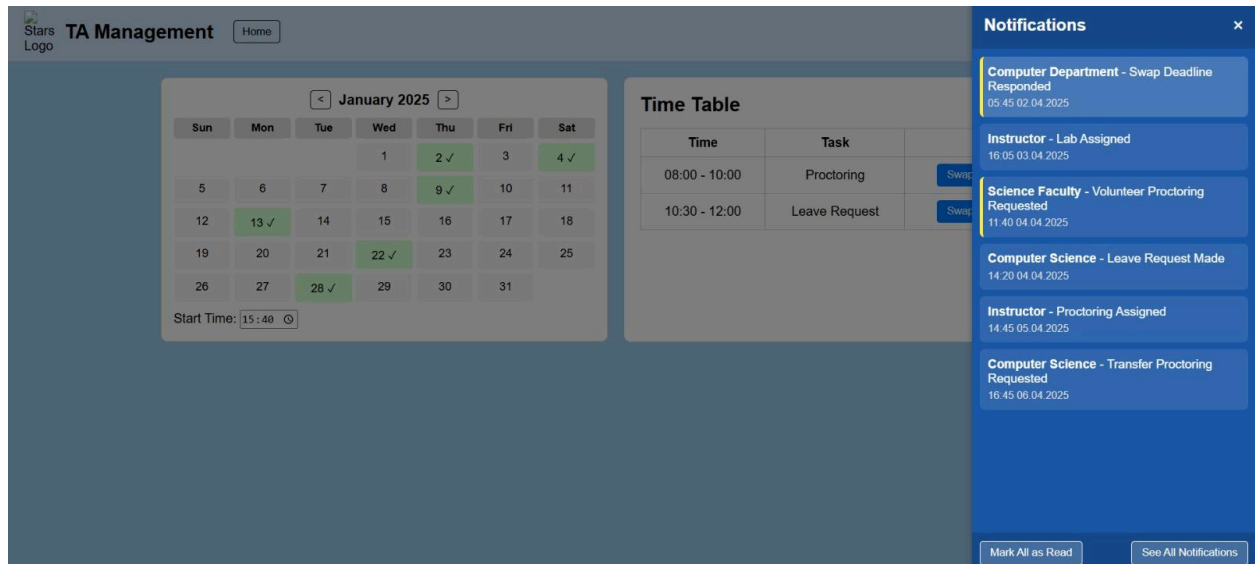


Figure 7: TA Notification Box



Stars Logo

TA Management

Home

Make Leave Request

Notifications

Logout

Volunteer Proctoring

Mark as Read/Unread

Course	TA Needed	Closes At	Assign
CS-224	TA Needed: 3	02.03.2025	Unassigned
CS-101	TA Needed: 2	06.03.2025	Assigned
ENG-101	TA Needed: 1	08.03.2025	Unassigned
MATH-103	TA Needed: 4	10.03.2025	Unassigned
CS-102	TA Needed: 2	15.03.2025	Assigned
BIO-110	TA Needed: 3	18.03.2025	Unassigned
CHEM-101	TA Needed: 2	20.03.2025	Assigned

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Figure 8: Volunteer Proctoring Announcements List for TA

Stars Logo

TA Management — Department Office

Home

Notifications

Logout

Proctor Assignments

Preferred?	Course	Left TAs	Actions
★	CS-274	Left TA: 5	<div>Request TA (Own Faculty)</div> <div>Request TA (Other Faculty)</div> <div>Manually Assign</div> <div>Automatically Assign</div>
—	CS-101	Left TA: 2	<div>Request TA (Own Faculty)</div> <div>Request TA (Other Faculty)</div> <div>Manually Assign</div> <div>Automatically Assign</div>
★	ENG-210	Left TA: 4	<div>Request TA (Own Faculty)</div> <div>Request TA (Other Faculty)</div> <div>Manually Assign</div> <div>Automatically Assign</div>

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Figure 9: Proctoring Assignments List Page for the Department's Office

Stars

TA Management — Dean's Office

Home

Notifications

Logout

Time of Request	Requesting Dept.	Requested Dept./Faculty	Course	Needed TAs	Actions
10:30 - 04.04.2025	Computer Engineering	Electrical Engineering	CS-101	3	<div>Accept</div> <div>Reject</div>
11:00 - 05.04.2025	Computer Science	Mechanical Eng.	SCI-210	2	<div>Accept</div> <div>Reject</div>
11:15 - 05.04.2025	Mathematics	Art Faculty	MATH-205	1	<div>Accept</div> <div>Reject</div>

Figure 10: All TA Proctoring Requests by Departments' Offices (TA from Other Faculty and TA from Own Faculty) List Page for the Dean's Office

Stars

TA Management — Instructor

Home

Notifications

Logout

Define TA Needs

Select Course:

Search course...

Number of TAs Required:

1

TA Role Selection:

☒ Grading
 ☒ Proctoring
 ☐ Lab TA

Preferred TA(s):

Search preferred TA...

Non-Preferred TA(s):

Search non-preferred TA...

Save and Send

Figure 11: Prefer TA Form for Course Coordinator

Stars **TA Management — Instructor** [Home](#) [Notifications](#) [Logout](#)

### Define TA Needs

**Select Course:**

**Number of TAs Required:**

**TA Role Selection:**  
☒ Grading ☐ Proctoring ☐ Lab TA

[Save and Send](#)

Figure 12: Prefer TA Form for Course Coordinator Search Bar of Preferred TA(s) When Clicked

Stars **TA Management — Department Office** [Home](#) [Notifications](#) [Logout](#)

### Manual TA Assignment

[All TAs](#) [Preferred](#) [Non-Preferred](#) [In-Faculty](#) [Out-Faculty](#)

	TA Name	Preferred?	Department	Current Status
<input checked="" type="checkbox"/>	Mehmet Demir	★	Computer Engineering	Available
<input checked="" type="checkbox"/>	Ayşe Kaya	—	Electrical Engineering	Proctoring Another Exam
<input checked="" type="checkbox"/>	Ahmet Yılmaz	★	Mathematics	Available

[Save Assignment](#)

Figure 13: Manual TA Assignment Page for the Department's Office

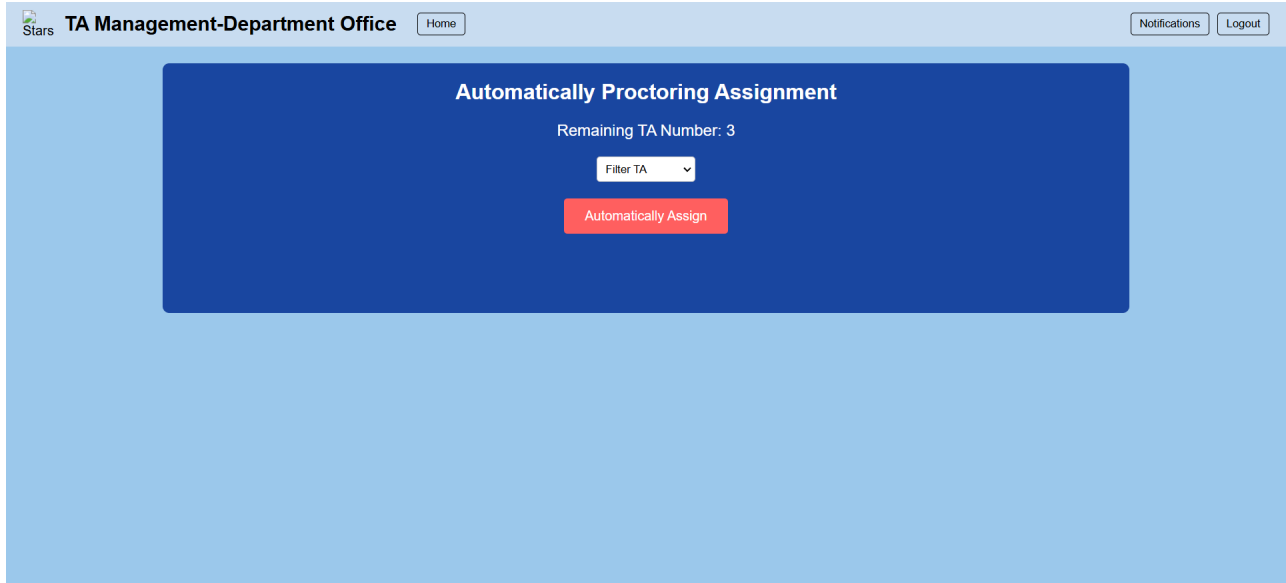


Figure 14: TA Proctoring Automatic Assignment Page for the Department's Office

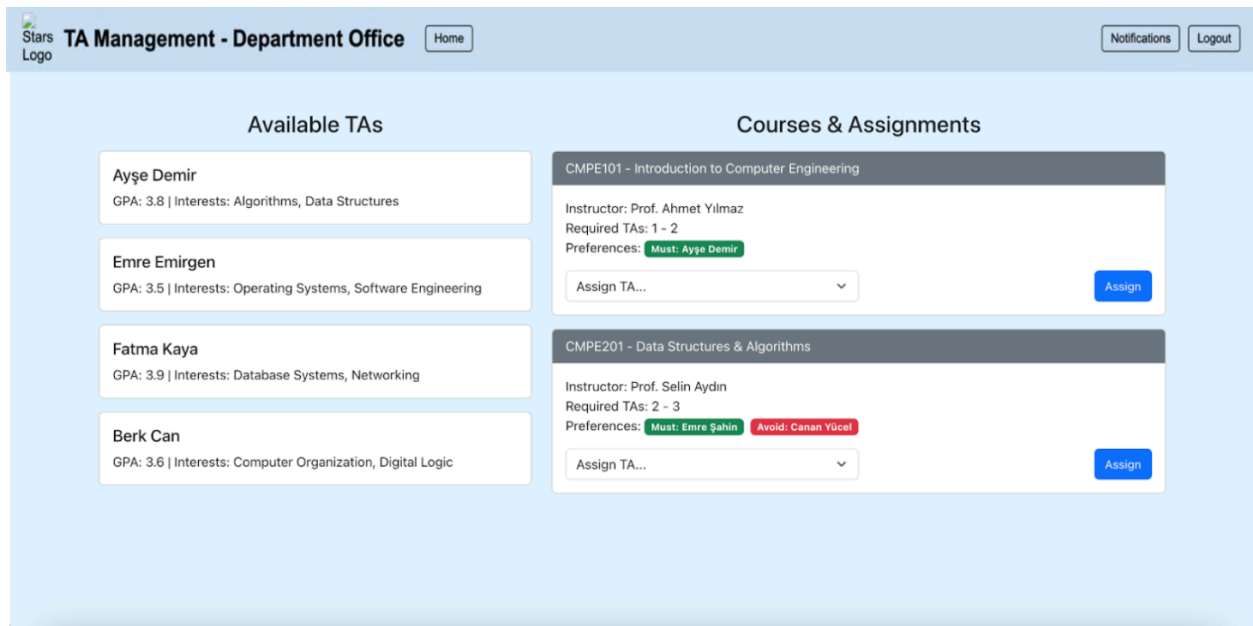


Figure 15: TA assignments to the courses by Department Office/Chair member

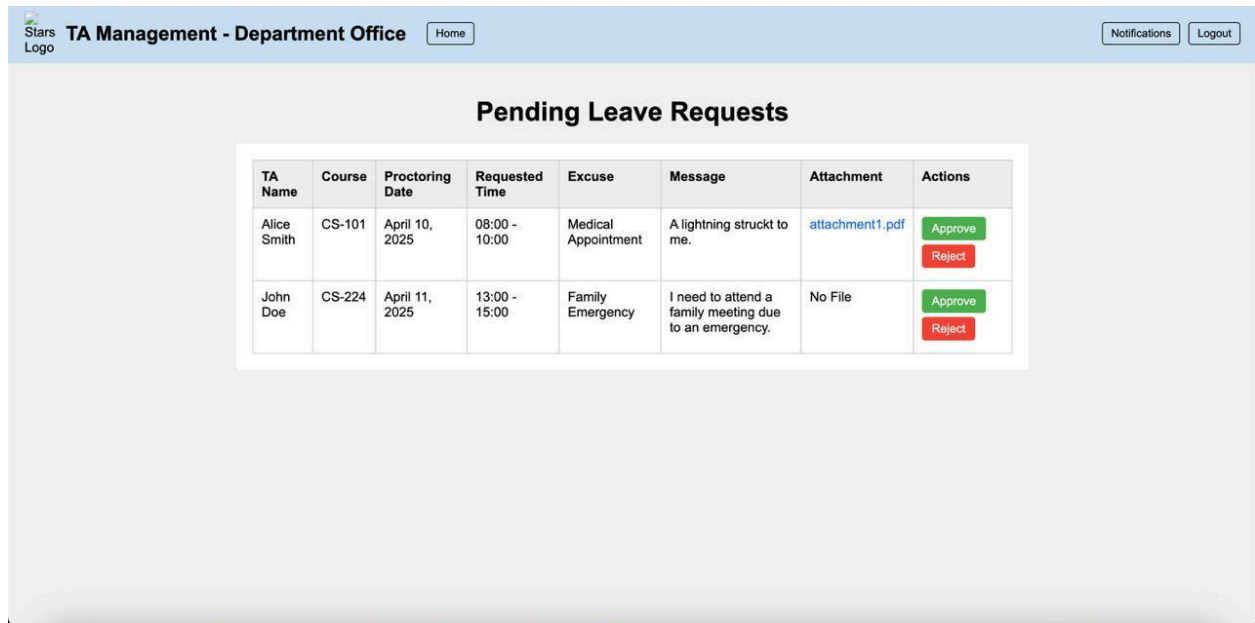


Figure 16: Awaiting Leave Requests Interface for Department Office Member

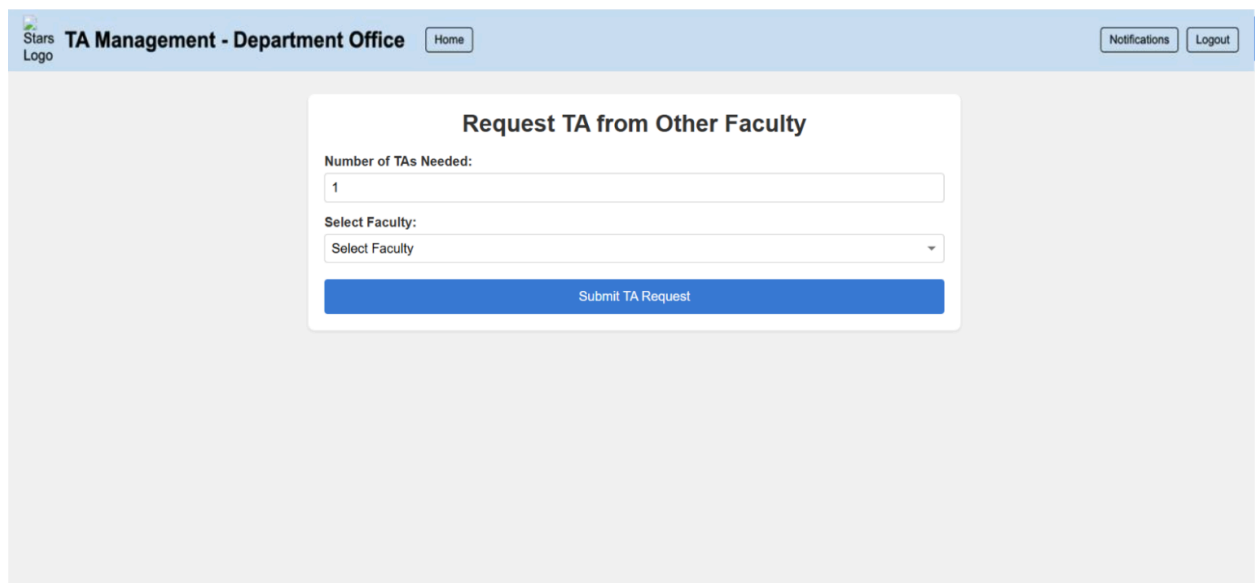


Figure 17: Request TA from Other Faculties for Department Office Member

Stars  
Logo

TA Management - Department Office

Home

Notifications

Logout

### Request TA from In Faculty

Number of TAs Needed:

Select Department:

Select Department

Submit TA Request

Figure 18: Request TA from Own Faculties for Department Office Member