



**BILKENT UNIVERSITY  
COMPUTER SCIENCE DEPARTMENT  
CS 319 OBJECT-ORIENTED SOFTWARE  
ENGINEERING  
DELIVERABLE 2 ITERATION 1  
SPRING 2025  
GROUP 2 SECTION 1  
16.03.2025**

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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) complete within **≤2 seconds** under standard load conditions (≤500 concurrent users).
- Chronological sorting, filtering, and dashboard rendering operations shall complete 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**.
- Real-time updates must be implemented via **WebSockets** or **Server-Sent Events (SSE)** to ensure timely information delivery.
- The system shall employ **lazy loading** and **pagination** for large datasets (e.g., notifications, logs).
- React frontend shall utilize **code splitting** (e.g., **React.lazy**, **Suspense**) to improve initial load times.
- Database queries shall be optimized through proper **indexing** and **query caching** where appropriate.

## 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.
- TA assignment workflows shall automatically exclude TAs with time conflicts or other course enrollment restrictions.
- 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.

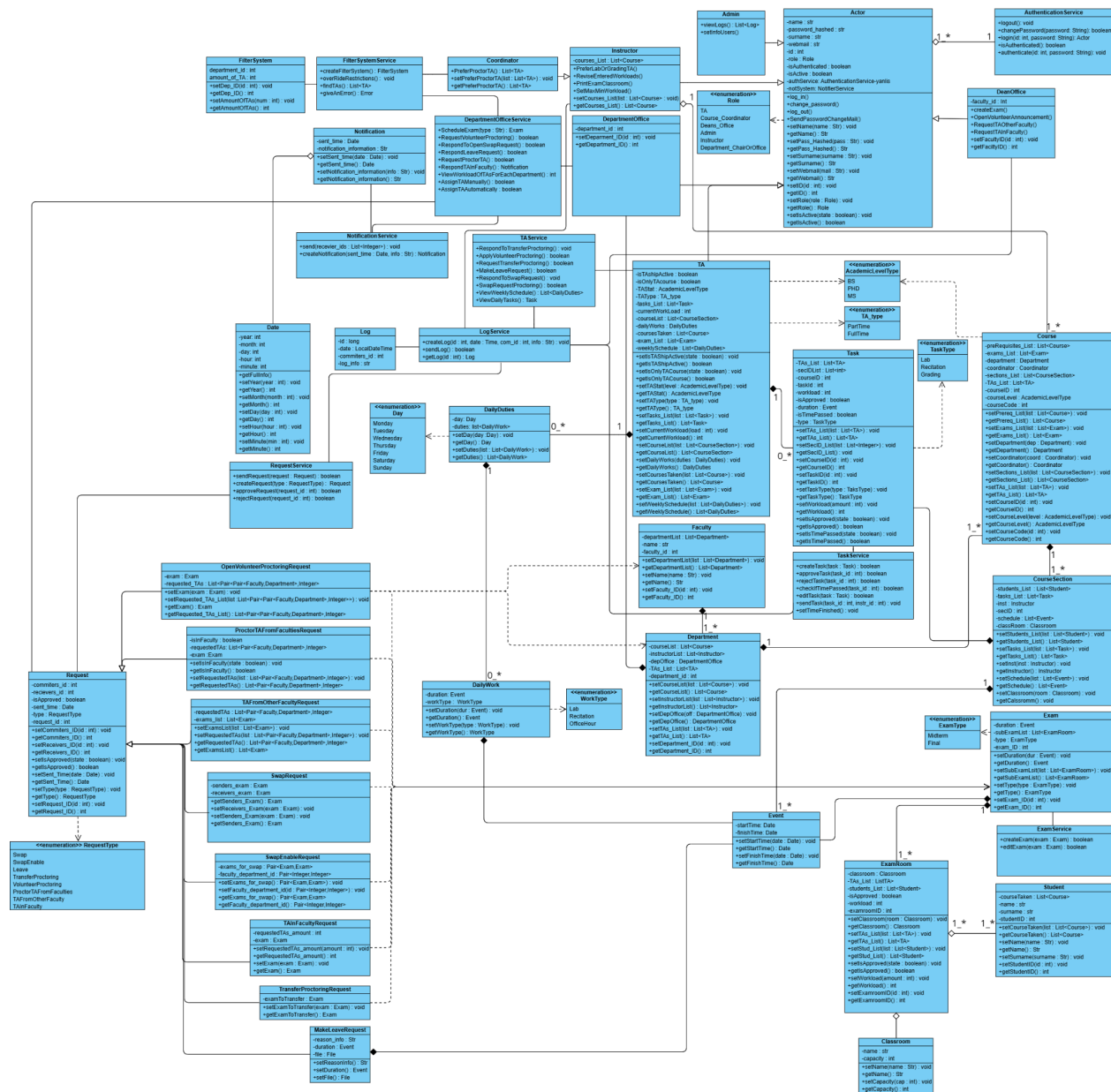
## 1.10 Proctoring and Scheduling Requirements

- 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.
- Leave approvals shall automatically restrict TA assignments during approved leave periods.
- Rejected leave requests may include justifications optionally provided by approvers.
- The TA assignment algorithm shall ensure equitable workload distribution among available TAs.
- The Dean's Office shall have real-time access to monitor and manage proctoring requests and exceptions.

## 1.11 Data Import and Export Requirements

- The system shall support **bulk data import** of TA lists, schedules, and assignments via **Excel (.xlsx)** files.
- Data imports must validate schema compliance and reject invalid or incomplete entries.
- Exports shall be available in **PDF** and **Excel** formats, optionally including relevant metadata (e.g., export data, filters applied).
- Rollback functionality shall be available for bulk operations affecting critical datasets.

## 2. Class Diagram

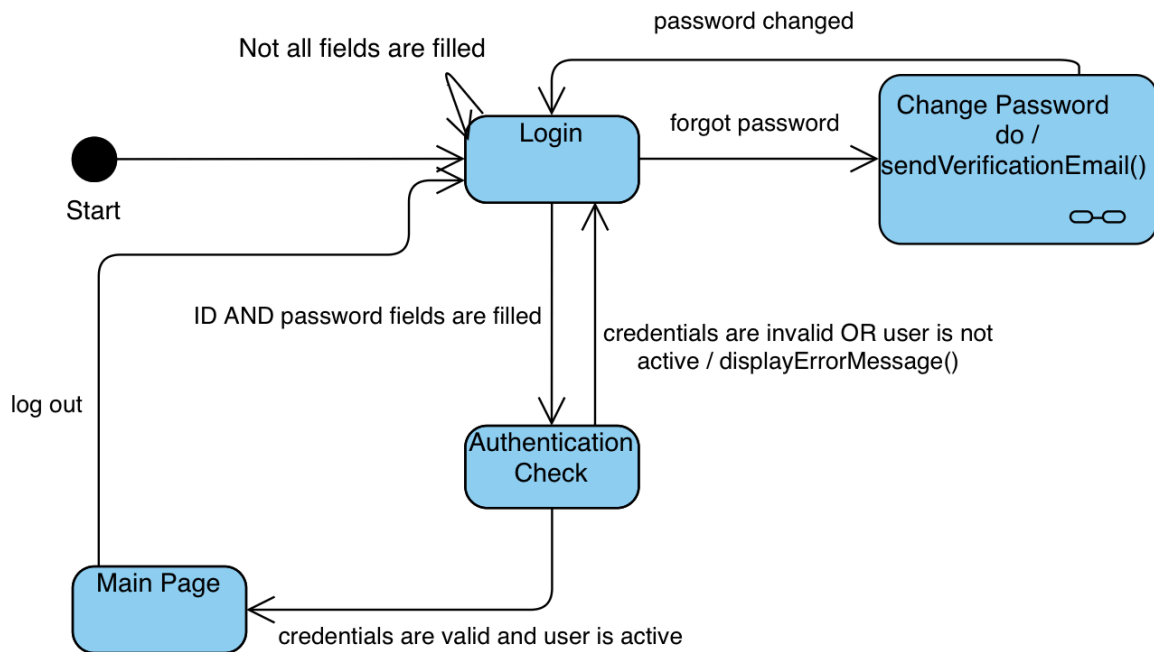


Link for the [Class Diagram](#)

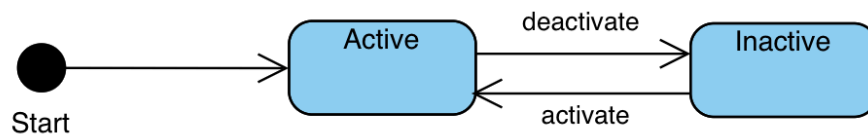
### 3. State Machine Diagrams

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

### 3.1 State Machine Diagram for the Login System

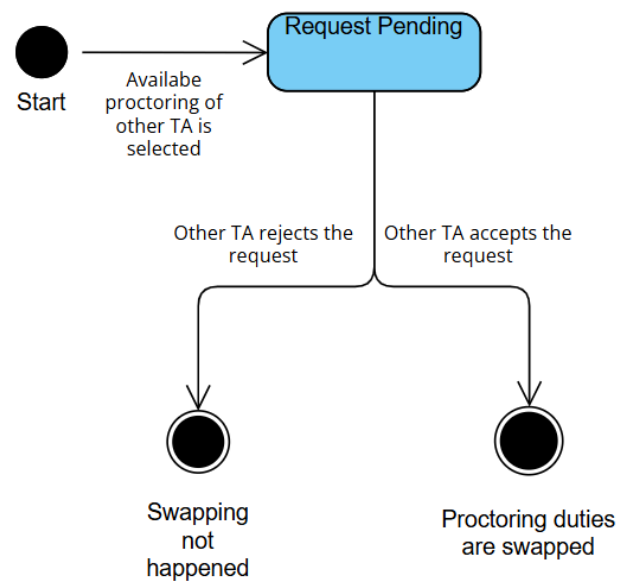


### 3.2 State Machine Diagram of an Online Status For User Saved in The System





### 3.3 State Machine Diagram of a Swap Request



## 4. Activity Diagrams

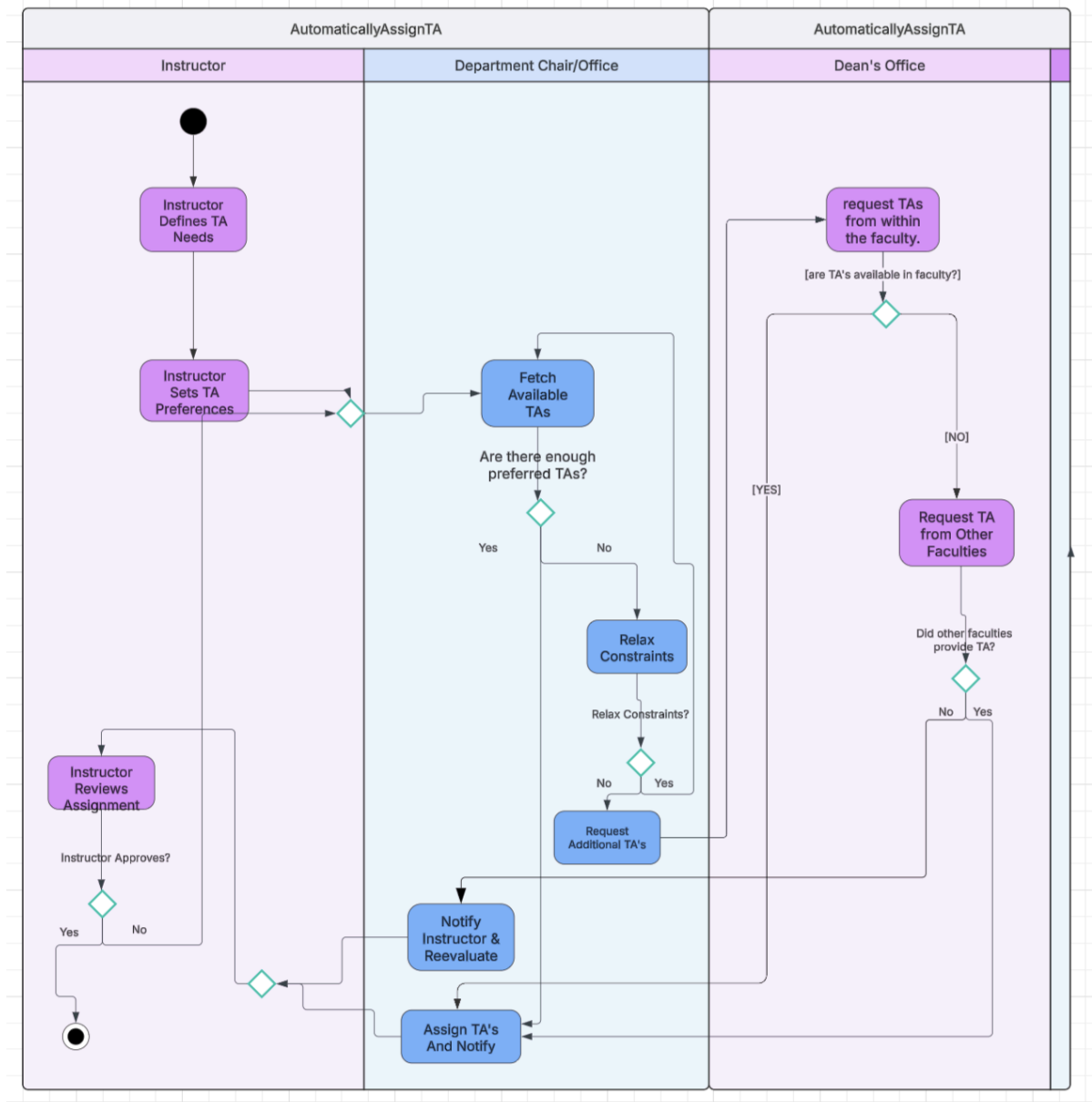


Diagram 1: The activity diagram for automatically assigning the TA process

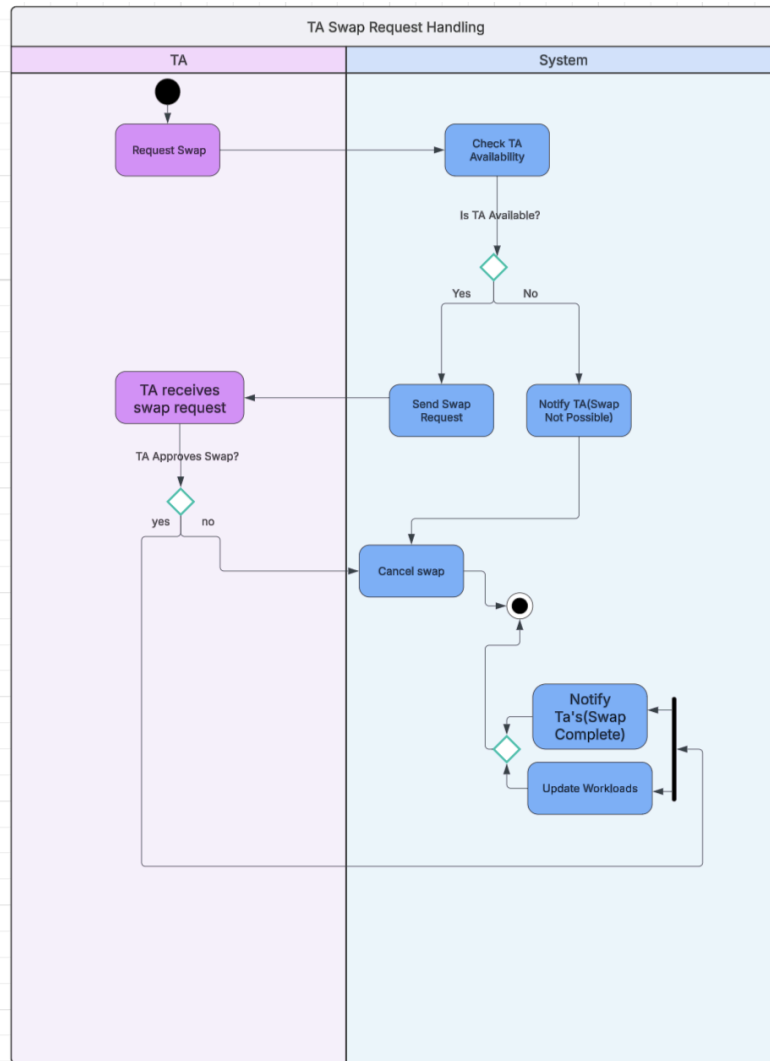


Diagram 2: The activity diagram of TA swap request handling process

## 5. Sequence Diagrams

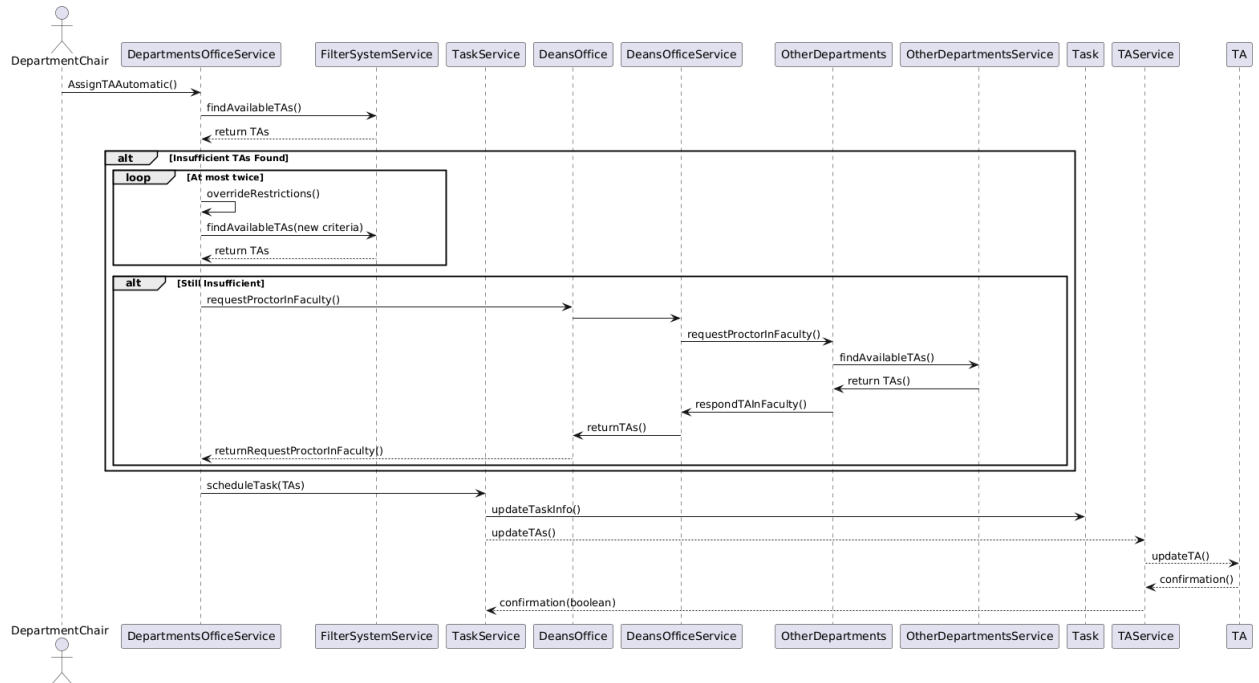


Diagram 1 : Sequence diagram of AssignTAAutomatic

[https://www.planttext.com?text=fLNDRcM3Bxp53wsXxu0XwdHfaezRMfvWJl4DLf8MEaQwjiilHfG21OggIFma\\_lpP\\_cB2rYDt64gTS87MmOUiuhok1j\\_FNBc4PageYXlisFndKIWXZz9TugC7sYcDqXrl7cKvPi-u\\_xcl3zYvQNYdriVuFI4iNIUpMMCRE1dK2PctoV9IODwhRvCn5j2MFBAlriaKcfX6D4YXK2Pd5wuqFscPCHyvHd2mcSt4IGpEG7IFDN2Di3S-44H9qfPvsDbWyWJYqDPMm11Awn7mldL3C-QldmkbBz8vbSk3zEYKG6KDLR64T9aYHbv1E1MHYZzu\\_wKI4SX6aFf6eXrHQtsJRg4oRITIZDyGTVXobhwRITbn4JJUUdggqy87tdJE5CN0duh1\\_buGT-epnp3Nb5C-BjEwAlyZakKvozfKrUSPUg3Yz5Hly7tlcfRSI2\\_heC2ivDHTTimT2vz1BmOkpp4EKEowkOjRh6E-erC8LSwn1krDOLS35C5OlbWQmNQvGRqjDR6eQkmfb2EJZLhdhsxUVUG9sjrr74TZw5jB3\\_-GFu0](https://www.planttext.com?text=fLNDRcM3Bxp53wsXxu0XwdHfaezRMfvWJl4DLf8MEaQwjiilHfG21OggIFma_lpP_cB2rYDt64gTS87MmOUiuhok1j_FNBc4PageYXlisFndKIWXZz9TugC7sYcDqXrl7cKvPi-u_xcl3zYvQNYdriVuFI4iNIUpMMCRE1dK2PctoV9IODwhRvCn5j2MFBAlriaKcfX6D4YXK2Pd5wuqFscPCHyvHd2mcSt4IGpEG7IFDN2Di3S-44H9qfPvsDbWyWJYqDPMm11Awn7mldL3C-QldmkbBz8vbSk3zEYKG6KDLR64T9aYHbv1E1MHYZzu_wKI4SX6aFf6eXrHQtsJRg4oRITIZDyGTVXobhwRITbn4JJUUdggqy87tdJE5CN0duh1_buGT-epnp3Nb5C-BjEwAlyZakKvozfKrUSPUg3Yz5Hly7tlcfRSI2_heC2ivDHTTimT2vz1BmOkpp4EKEowkOjRh6E-erC8LSwn1krDOLS35C5OlbWQmNQvGRqjDR6eQkmfb2EJZLhdhsxUVUG9sjrr74TZw5jB3_-GFu0)

## 6.Mockups

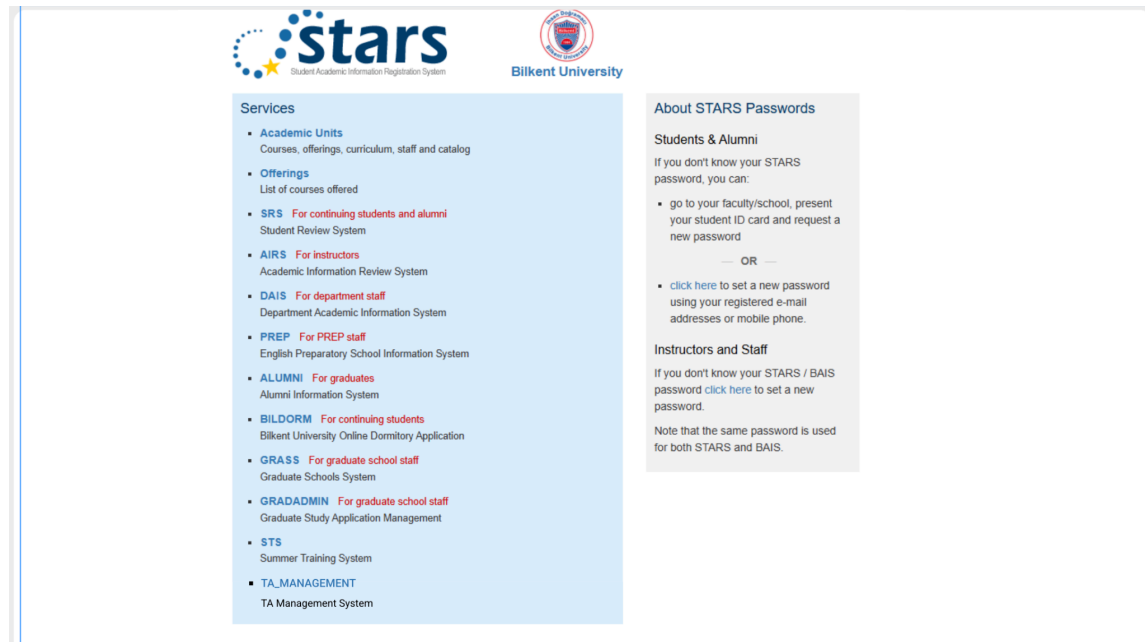


Figure 1: First Screen

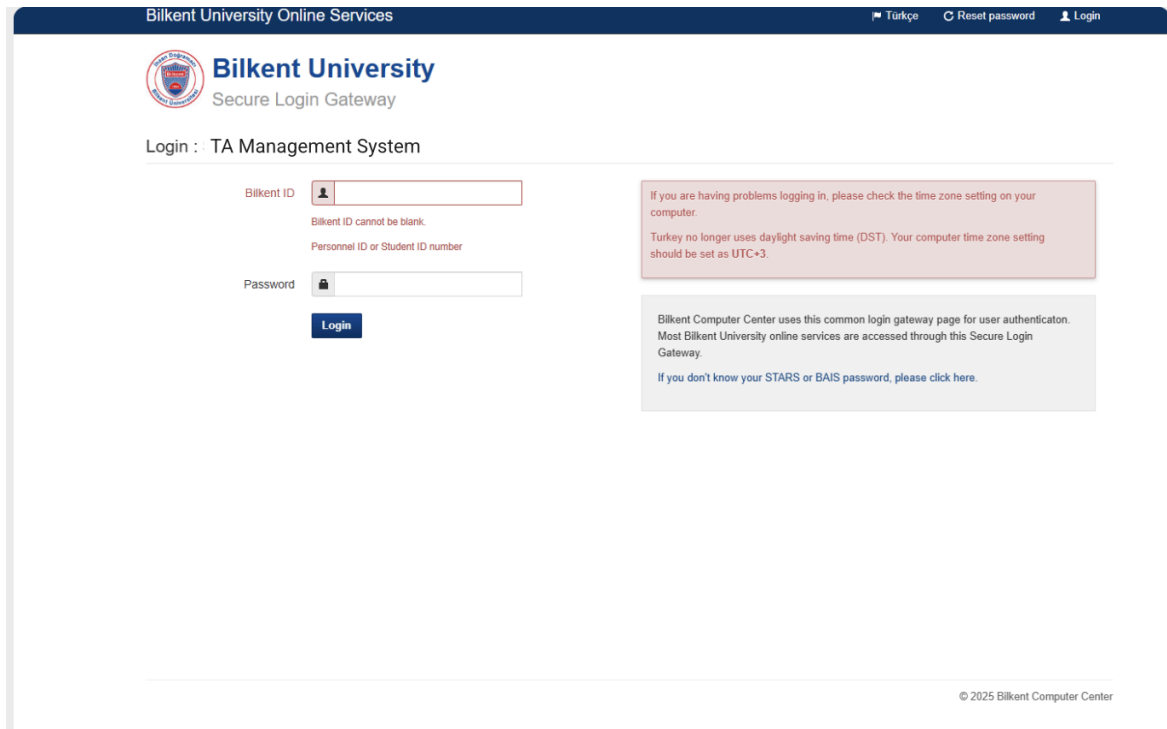


Figure 2: Login Page of the TA Management System

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TA Management System

Make Leave Request

Notification 10

Logout

Student Information

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

SRS :: Student Review System

Last Login: 14.03.2025 14:31 from 5.46.44.46

Request Zoom License

Moodle

Current Semester

Curriculum of Computer Engineering

Load Prior Semester

View Daily Tasks

View Monthly Schedule

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

Online/hybrid Lecture

Face-to-face Lecture

Recitation

Figure 3: TA Main Page

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TA Management

Make Leave Request

Notification 10

Logout

Make Leave Request

January 2025

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Start Time

January 2025

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Finish Time

Attach File

Enter message here....

Figure 4: Leave Request Form Page of TA

The screenshot shows the '2025 JUNE PLANNER' interface. On the left is a calendar for June 2025. The days of the week are listed at the top: MON, TUE, WED, THU, FRI, SAT, SUN. The calendar shows dates from 1 to 30. Some dates have green checkmarks (6, 19, 29) and some have red numbers (1, 8, 15, 22, 29). On the right, there is a sidebar with a 'Make Leave Request' button, a 'Notification' badge with the number 10, and a 'Logout' button. Below these, there is a section titled 'Available TA List' with a 'TA Filter' dropdown. The list contains five entries: TA1, TA2, TA3, TA4, and TA5, each with a vertical ellipsis icon. In the center, there is a table with time slots and course information. The table has two columns: 'Time Slot' and 'Course'. The time slots are listed on the left, and the course information is on the right. The courses listed are CS-315 Exam Proctoring EE-412 and CS-3159 Exam Proctoring V-01. Between the time slots and course information, there are 'Swap' and 'Transfer' buttons.

Time Slot	Course	Swap	Transfer
08:30 - 09:20			
09:30 - 10:20	CS-315 Exam Proctoring EE-412	Swap	Transfer
10:30 - 11:20			
11:30 - 12:20			
12:30 - 13:20	CS-3159 Exam Proctoring V-01	Swap	Transfer
13:30 - 14:20			
14:30 - 15:20			
15:30 - 16:20			
16:30 - 17:20			
17:30 - 18:20			
18:30 - 19:20			
19:30 - 20:20			
20:30 - 21:20			
21:30 - 22:20			

Figure 5: Monthly Schedule of TA

The screenshot shows the 'Volunteer Proctoring' interface. It features a list of courses with their respective TA needs and closing dates. The courses are listed in a table with columns for course ID, TA Needed, and Closes at. The courses listed are CS-224, CS-101, CS-201, ENG-101, ECON-107, PHYSC-102, MATH-101, and CS-102. The TA Needed values are 3, 5, 8, 2, 1, 4, 7, and 3 respectively. The closing dates are 02.03.2025, 06.03.2025, 09.03.2025, 02.03.2025, 11.03.2025, 02.03.2025, 13.03.2025, and 02.04.2025. The interface also includes a 'Make Leave Request' button, a 'Notification' badge with the number 10, and a 'Logout' button.

Course	TA Needed	Closes at
CS-224	3	02.03.2025 11:30
CS-101	5	06.03.2025 11:30
CS-201	8	09.03.2025 11:30
ENG-101	2	02.03.2025 11:30
ECON-107	1	11.03.2025 11:30
PHYSC-102	4	02.03.2025 11:30
MATH-101	7	13.03.2025 11:30
CS-102	3	02.04.2025 11:30

Figure 6: Volunteer Proctoring Announcements List for TA

Inbox			
☆	Computer Department	Swap Enable Respond	At : 05:45 04.02.2025
☆	Instructor	Lab Assigned	At : 16:45 01.03.2025
★	Instructor	Rectitation Assigned	At : 16:00 05.07.2025
☆	Science Faculty	Volunteer Proctoring Respond	At : 16:45 04.09.2025
☆	Computer Science	Make Leave Respond	At : 13:45 04.11.2025
☆	Instructor	Lab Assigned	At : 16:45 04.03.2025
☆	Computer Science	Proctoring Assigned	At : 14:45 04.06.2025
★	TA	Swap Respond	At : 13:45 05.08.2025
★	TA	Transfer Proctoring Respond	At : 16:45 06.03.2025

Figure 7: TA Notification Box

stars TA Management							Notification 10	Logout
Proctor Assignment								
IsPreferTA	☆	CS-224	RequestTAInFaculty	RequestTAFromOtherFaculty	Manually Assign	Left TA: 1	Automatically Assign	
IsPreferTA	☆	TUR-101	RequestTAInFaculty	RequestTAFromOtherFaculty	Manually Assign	Left TA: 6	Automatically Assign	
IsPreferTA	★	TUR-102	RequestTAInFaculty	RequestTAFromOtherFaculty	Manually Assign	Left TA: 2	Automatically Assign	
IsPreferTA	☆	ENG-101	RequestTAInFaculty	RequestTAFromOtherFaculty	Manually Assign	Left TA: 3	Automatically Assign	
IsPreferTA	☆	ENG-102	RequestTAInFaculty	RequestTAFromOtherFaculty	Manually Assign	Left TA: 7	Automatically Assign	
IsPreferTA	☆	CS-319	RequestTAInFaculty	RequestTAFromOtherFaculty	Manually Assign	Left TA: 4	Automatically Assign	
IsPreferTA	☆	CS-315	RequestTAInFaculty	RequestTAFromOtherFaculty	Manually Assign	Left TA: 9	Automatically Assign	

Figure 8: Proctoring Assignments List Page for the Department's Office



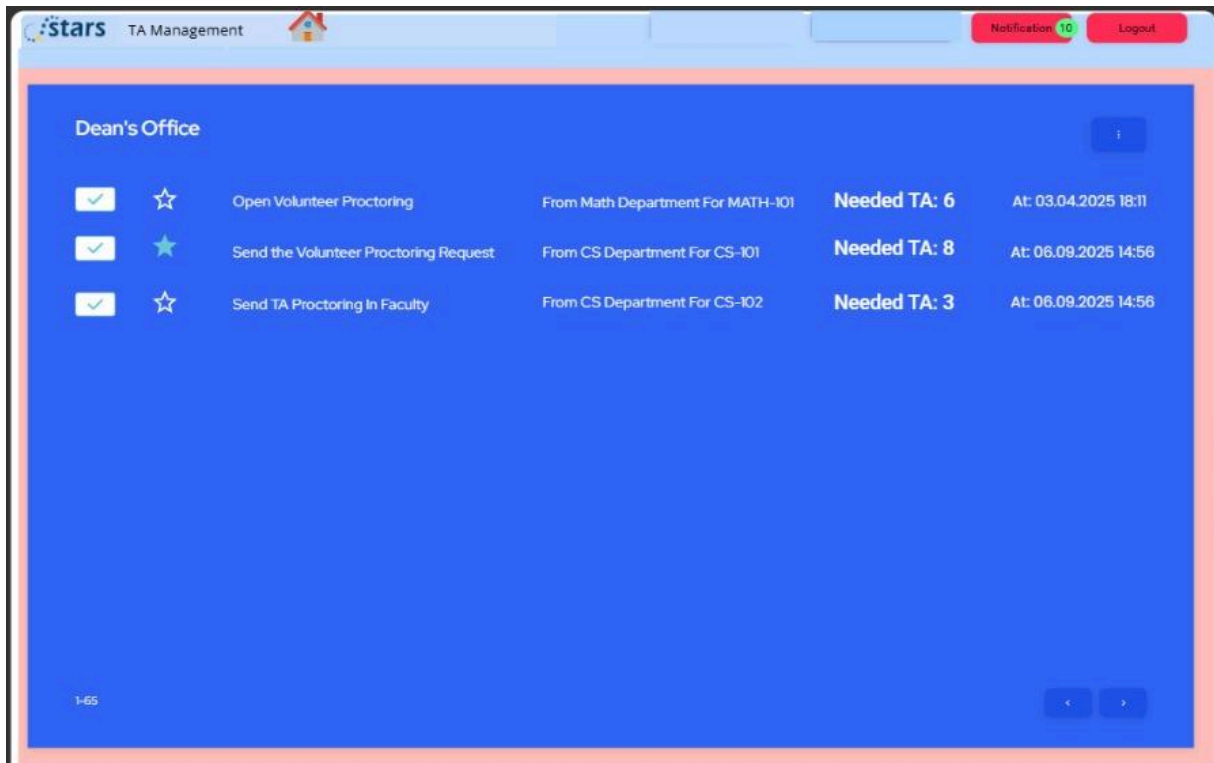


Figure 9: TA Proctoring Requests List Page

**Define TA Needs**

Select course: CS-315

Select Number of Tas needed: 6

TA Role Selection: Grading TA

Select Number of Tas needed: 2

Preferred Tas: Ahmet, Mehmet, Ayşe, None

Non-Preferred Tas:

Save and Send

Figure 10: Prefer TA for Course Coordinator

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TA Management

Notification 10

Logout

Manually Assign Ta

CS-315 PROCTORING Number of TAs required: 3

Select Preferred UnPreferred

<input type="checkbox"/>	☆	☆	AHMET TAŞ	Subject line...
<input checked="" type="checkbox"/>	★	☆	AYŞE İLGEN	Subject line...
<input type="checkbox"/>	☆	★	KAYRA UYGUR	Subject line...
<input type="checkbox"/>	☆	☆	PERHAT KESKİN	Subject line...
<input checked="" type="checkbox"/>	★	☆	ANIL KAYA	Subject line...
<input checked="" type="checkbox"/>	☆	☆	MELİKE KARA	Subject line...
<input type="checkbox"/>	☆	☆	SİMAY UYGUR	Subject line...

SAVE

Figure 11: Manual TA Assignment Page for the Department's Office

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TA Management

Notification 10

Logout

Automatically Proctoring Assignment

Filter TA

Remaining TA number: 3

Automatically Assign

Figure 12: Automatic TA Assignment page of Department's Office