Exam Management System

Application Requirements Document (ARD)

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Chapter 1 – Introduction

The Problem Domain

With the increase in the size of the student body, it has become difficult to manage grading within the given time constraints. This has led many courses to adopt a multiple-choice format, which is faster to grade, and easier to analyse. And still, the creation of challenging multiple-choice tests in the sciences is a non-trivial task and creation of one-time-use questions is costly and unsustainable.

While trying to come up with a system of his own, Dr. Goldberg found that maintenance of a large and growing pool of questions is proving to be difficult. Division of labor between TAs and test examiners is done by hand and is hard to track and the possibility of tracking quality of questions & answers is crucially needed.

Context

The system is designed to manage work inside of an academic course between the lecturer(s) and the TAs.
Through the system will the course administration develop, test and create multiple-choice questions and generate exams.
The system will be installed remotely on university's servers and be accessed through web applications, while the data will be stored on databases.

Vision

- Workflow Management System:
  - Support various roles (for TAs, graders, instructors, etc).
  - Manual+Algorithmical generation of tasks based on priority and needs.
  - Manual+Algorithmical spread of tasks throughout configured workforce.
  - Tracking over work velocity and output (= blame feature).
- UI:
  - Web-based system.
  - Dashboard based on Role.
- Content creation:
  - Manage content by subjects/keywords/classes.
  - Creation and management of stems, meta-questions, questions, appendices.
  - Creation and management of possible solutions/distractors per question.
- Output creation:
  - Flexible LaTeX-based creation of exams/keys/solutions.
- System:
  - Have both WMS and content handled in DB.
  - Version control of questions, handled in DB.
  - Easy install, migration, backup and cloning of the system.

Stakeholders

Client: Dr. Mayer Goldberg – Supervisor Lecturer for "Compiler Construction" course.
Users: "Compiler Construction" course administration – lecturers, TAs, assignment checkers.
Additional people of interest: Other courses' supervisors are interested in the system when it comes to existence.

Software Context

Access
Access to the system will be through browsers and only while connected to the university's network.

Regular Use (Course downtime)
Users will access the system to maintain question stock based through various tasks completion based on their respective roles.
High roles will be able to track work velocity and quality of lower-level roles.

Pre-Exam
High roles will be able to produce exams/keys/solutions through the system and by choosing subjects distribution.

Post-Exam
Inputting students' answers will be used to further analyze questions/answers/distractors quality.

Chapter 2– Usage Scenarios

User Profiles — The Actors

Certainly! Let's describe the main user categories or profiles (actors) for the Exam Management System:

1. System Administrator:
   - Characteristics:
     - Manages the overall WMS at the department/university level.
     - Handles tasks like migration, installation, updates, and system management.
     - Manages courses within the WMS.
   - Data Exchange:
     - Migrates, installs, and updates the WMS system.
     - Manages courses, including creating, backing up, and removing course entries.

2. Course Administrator:
   - Characteristics:
     - Responsible for managing courses, defining course staff, and overseeing exams.
     - Assigns roles to course staff and defines exam parameters.
   - Data Exchange:
     - Defines course staff and assigns roles.
     - Defines exam parameters, including type, length, date, direction and stylistic elements.
     - Generate exam documents.

3. Course Staff (Instructors, TAs, Graders):
   - Characteristics:
     - Involved in the creation and validation of questions, stems, keys, distractors, and solutions.
     - Performs various activities based on assigned roles.
   - Data Exchange:
     - Works on existing questions, validates, edits, and adds new content.

Use cases :

1. **Manage Courses:**
   - Actor: System Administrator and Course Administrator
   - Description: Managing course, this includes tasks such as creating new courses, updating course information, and removing courses when necessary.

2. **Manage Exams:**
   - Actor: Course Administrator
   - Description: Define and manage exams. This involves specifying exam type, length, direction, date etc.

3. **Manage Course Staff:**
   - Actor: Course Administrator
   - Description: Define the course staff roles, including instructors, TAs, and graders. They assign roles to individuals, track their activities, and manage any changes in the course staff.

4. **Edit and Validate Questions:**
   - Actor: Course Staff (Course administrator, Instructors, TAs, Graders)
   - Description: Course staff members edit, validate, and manage questions within the system. They can add, delete, or modify question elements, such as stems, keys, distractors, and solutions.

5. **Generate Exam Documents:**
   - Actor: Course Administrator
   - Description: Generate exam documents based on the defined parameters. This includes creating different versions of exams.

6. **Inspect Changes by Course Staff:**
   - Actor: Course Administrator
   - Description: Course administrators review and inspect changes made by course staff members. They can accept, reject, modify, or conditionally validate these changes based on the quality and relevance of the modifications.

7. **Search and Edit Questions:**
   - Actor: Course Staff (Course Administrator, Instructors, TAs, Graders)
   - Description: Course staff members can search for specific meta-questions and edit them. The system allows users to locate questions based on keywords and strings, facilitating efficient editing and validation processes.

8. **View Dashboard:**
   - Actor: All Users
   - Description: Users view a personalized dashboard based on their roles in the current/given course. The dashboard provides an overview of relevant information and tasks for the user.

9. **Generate Solved Exam:**
   - Actor: Course Administrator
   - Description: Course administrators generate solved exams for distribution to students after an exam is completed. This document includes correct answers and explanations.

Special Usage considerations:

The system should be tangible and attractive, due to the high need of user cooperation for the system to be beneficial.

Chapter 3– Functional Requirements

Workflow Management System

No.	Description	Priority	Risk
1.1	The system shall support multiple user roles, including but not limited to TAs, graders, and instructors	MH	Low
1.2	Each user role shall have specific permissions to access and perform actions within the system	MH	Low
2.1	Users with appropriate permissions shall be able to manually input tasks, providing details such as description, priority, and due date	MH	Low
2.2	The system shall have an algorithmic task generation feature that considers priority and educational needs	NTH	Medium
3.1	The system shall automatically distribute tasks among configured workforce based on workload and expertise	NTH	Medium
3.2	Users with sufficient permissions shall be able to manually assign tasks to specific roles or individuals	MH	Low
4.1	The system shall be accessible through a web-based interface	MH	Low
4.2	Role-based dashboards shall be provided, displaying relevant information for each user role	MH	Low
5.1	The system shall include a notification system to inform users of task assignments, updates, and relevant events	NTH	High
6.1	System Admins shall be available for system maintenance and updates	MH	Low
7.1	The system shall include features for users to provide feedback on tasks and overall system usability	NTH	Medium
8.1	The system shall implement secure authentication and authorization mechanisms	NTH	Low

Content Management

No.	Description	Priority	Risk
9.1	Content shall be organized by subjects, keywords, and classes	MH	Low
10.1	Users shall be able to create, edit, and manage stems, meta-questions, questions, and appendices	MH	Low
10.2	The system shall allow users to create and manage possible solutions and distractors per question	MH	Low
11.1	Users shall be able to create exams, keys, and solutions using a flexible LaTeX-based system	MH	Low
12.1	The system shall store both WMS and content in a centralized database	MH	Low
12.2	Version control shall be implemented for questions and other relevant content	NTH	High

Chapter 4 – Non-functional requirements

Implementation constraints

1. Performance (Speed, Capacity, Throughput, etc.)
    1. The system should be able to support multiple users (of the same or different types) using the system at the same time.
2. Reliability & Stability
    1. the questions diverters and answers as well as past exams will be persisted in a database and will support data recovery.
    2. In case of errors in internet connection, crash or hardware failure, the system will roll back all related updates until reaching the last stable version.
3. Safety & Security
    1. The system will save any sensitive data such as password only encrypted.
    2. The system will not allow any access to its sensitive data to users without permission.
4. Portability
    1. The system is web based and can be accessed only while connected to the university's network.
    2. The system should be accessible from different browsers.
    3. The current requirement is to support Hebrew language only.
5. Usability
    1. The system's users do not have any special expertise in computers or programming; therefore, the system's interface should be as simple and clear as possible.
6. Availability
    1. Unless the system is undergoing updates, the system should be available 24/7

Platform constraints

SE Project constraints

1. The system will be an interactive system, the inputs come naturally from the end users.
2. The system will need access to student exam answers to analyze questions/answers/distractors quality.
3. The system shall use samples of actual data in case of simulation.

Special restrictions & limitations

1. The system will be installed remotely on the university's servers.
2. The system will rely on the cooperation of end users, without it no data will flow in the system.

Chapter 5 – Risk assessment & Plan for the proof of concept

Risk assessment

- Resistance from users to adapt to the new system.
- Vulnerability to unauthorized access and leaking of sensitive information.
- None of the members had work as a web developer.

Plan for the proof of concept

Research:

- **Examination of Web-Based Workflow Tools:**

    - Investigate popular web-based workflow management tools.

    - Assess their capabilities for role-based dashboards and task distribution.

- **Algorithmic Task Distribution:**

    - Research and develop a preliminary algorithm for task distribution.

Preliminary:

- **Selection of Web-Based Framework:**

    - Based on research, choose a web-based framework suitable for developing the workflow management system.

- **Basic UI Development:**

    - Implement basic UI features, such as role-based dashboards and content organization.

    - Integrate a simple manual task assignment mechanism.

Proof of Concept:

- **System Implementation:**

    - Develop a basic version of the system with the following components:

        1. **Task Distribution:**

            - Implement a simplified version of the algorithm for task distribution.

        2. **LaTeX-Based Exam Creation:**

            - Develop a module for flexible LaTeX-based exam, key, and solution creation.

        3. **Database Integration:**

            - Establish basic database integration for handling workflow and content data.

Appendices