

Sample Response to Design Project

The 6.033 staff is looking to replace its content management system, MUGS, with a more flexible and better performing option. The system spec offers a number of requirements and desired use cases from the spec description that will be analyzed below.

The new MIT Unified Submission and Grading System (MUGS) is requested to address concerns about the flexibility and reliability of function in the current system. In particular, the system needs to better account for proper functionality across a number of user roles (particularly instructors), allow for reliable submissions of individual and team assignments, and potentially be able to store video content for oral presentations (P. 13). The system must also interact with a number of MIT external modules, including Gradescope, MIT File Service, MIT Sync Service, MIT ID Service, and MIT Lock System.

Responding Context

The previous system served a class of 400 students and a number of instructors with various roles. It lacked key functionality around students' team assignments, lacked fault tolerance for submission failures, and also lacks a number of desirable ease of use and usability features. However, it was reliable in providing correct grades to students securely and had desirable modularity and integration with external Gradescope system; the design must maintain these desired behaviors and properties.

Key Requirements and Evaluation of Properties

The system has a number of required modules, including Gradescope, MIDS, MFS, MLS, and a central server for the MUGS backend storage and processing. Beyond the required modules, MUGS will be evaluated based on the following key properties: correctness, flexibility, and performance (pp. 12-13). Correctness primarily entails that students can reliably and correctly submit assignments as individuals and team members, can access individual and team grades and feedback, but cannot access grades and assignment feedbacks of other students and teams. The system asks for several performance goals related to mass submissions (90% of students submitting at once), fast access to grades by instructors, reasonable kill commands for file uploads, and reliable sync parameters with Gradescope. Resources must also be "efficiently used" (p. 11).

Flexibility appears to be more of a stretch goal, where the system might later be applied to all 5,000 students at MIT and additional rich media for audio and visual feedback could be added down the road.

Specific Use Cases

The project description for MUGS outlines a number of use cases regarding grading, class set up, and student management (pp. 14-15). This includes initial creation of accounts for all 400 students, simultaneous submission of assignment by all 400 students, notification of grades, regrade requests, presentation of grades, and student drop requests. Below I walk through simultaneous submissions as a use case to better express my understanding of the system. I believe this to be the most important use cases based upon the framing of key requirements and desire properties.

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In 400 simultaneous submissions, we can review concerns about all three properties, though I will focus on performance. Notably, the demands for 400 PDF submissions is less severe than 400 video uploads. While both must be addressed, performance will be sacrificed in video uploads in order to allow the functionality. Video uploads are more likely to be killed and less likely to upload in under a minute when facing simultaneous uploads.

The exact nature of these tradeoffs will be based upon expected demands. The spec states that 90% will need to be processed in the final two minutes (p. 13). Additionally 50% of assignments two or more times in the final 5 minutes. In addition to performance, these multiple submissions will require proper use of MIT lock service (p. 9) and MIT sync service (p. 8) to ensure correctness of final submission. The constraints of the server (pp. 4-5) with 16GB of main memory, 10 cores, and 11MB of cache have also been noted.

Key Questions¹

I pose the following questions in regards to the design:

- Are we able to require submissions be under a certain file size for MUGS? The DP says "As described, there are no constraints on the storage or computation that can be used by an individual or team." Are we allowed to impose one, though?
- Where is the MIT File System stored? Is it a physical server that's local, or is it only abstracted out to a service? In other words, should we treat it as a protocol to interface with the hardware we've been given?
- What does the Gradescope grades csv data structure look like? i.e. is it indexed by user (MIDS)? Is it a table that has users along rows, assignments on columns, and grades in the cells?

¹ Key Questions sampled from actual student MUGS questions asked on Piazza in 2019.