Abstract

Arbiter is an online solution designed to efficiently run and judge programming competitions. The user interaction is provided via a clean, concise interface where users are capable of executing all of the actions provided by current judging solutions (creating new problems, setting up new contests, competing in existing contests, and viewing the results of concluded contests). The remarkable improvement that Arbiter can claim over its competition is that it is entirely cloud based. This allows for a user to connect to a competition from anywhere without having to install bulky, difficult to use software; only a web browser is needed for full functionality. Further, the cloud basis grants Arbiter the ability to save all previous problems, contests, and results. This allows the user quick and easy access to thousands of problems and information about any contest that the user participated in. Arbiter has a clear advantage over existing solutions with expanded functionality, eased use, and vastly improved scalability; all offered by the cloud.

Architecture

The basic architecture of the database structure depicted below. The database structure consists of these main components:

- Users
- Contests
- Problems
- Submissions

The core application is divided into three parts:

- The front end user interface
- A web api to communicate information
- Workers to run submissions

Additionally, the application relies on cloud services such as Amazon Web Services.

For security reasons, each worker executes a submission within a file system jail. Since each worker compiles unknown and possibly unverified code, this extra precaution ensures that the workers continue serving multiple requests with neither interruption nor attack.

Results

This is the login page for Project Arbiter. Here users create accounts which then take them to the contest portal. From there they have the opportunity to join other contests, start practice problems, or create contests (for admin users).

Implementation

The final implementation of the application used the following technologies:

- Workers – Java running in Ubuntu (Linux) with chroot jails for security
- Web API – C# for easy integration with browser interface
- Front End – C# to JavaScript for easy and fast loading
- Amazon Web Services (AWS) – Maintain job queues as well as provide cloud hosting services

Impact

The Arbiter Contest Application is aimed at providing a cleaner and simpler way to start and maintain programming contests. The advantages it provides over other similar applications are:

- Fully web based implementation with no extra needed software; only a web browser is required
- Quick, painless set up of new and practice competitions
- User account system for both admins and participants to maintain records of previous contests
- Fast cloud based computing and grading with high security, reliability, and scalability
- Flexible grading options for different contests rules
- Live scoring and monitoring of contest with added contest analytics

Summary

Arbiter is a reliable, scalable, cloud based contest application aimed at allowing users to create and participate in contests and maintain a history of these contests. The application is aimed at providing a cleaner and faster user interface for both administrators and participants that does not currently exist.