Project Plan Version 1.0

Team: May1639

A Web-based Q&A Platform for Collecting and Indexing Publicly Available Information About Common Java Libraries

CprE/SE 491
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1 Project Statement

In the world of software development, specifications inform both humans and computers alike how software is intended to behave, and are highly important to the verification process. Checkable, understandable, useful formal specifications can significantly help minimize the cost of developing software which is secure, assured, and reliable. However, such specifications are not widely available.

Interest in formal specifications, or more precisely behavioral interface specifications, lies primarily in their capability to verify the functionality of software in addition to guaranteeing the behavior of an API. Outside of academia, concern often falls on the observable functionality of code over the explicit guarantees offered by formal specifications. There is little motivation for developers to take the time to write formal specifications for their code, due to the time and difficulty involved. As a result, within an academic setting or any environment that requires strict verification of software, there is a noticeable lack of such specifications for commonly available libraries, and available specifications are not necessarily easily accessible.

A solution offered by Rajan et al. proposes the use of data mining to retrieve formal specifications from sites such as StackOverflow and consolidate them on a web platform. These specifications may then be approved or modified by users of the platform, and missing specifications may be added manually. This project involves the development of a web platform in Question and Answer (Q&A) discussion format to host and to answer questions regarding formal specifications for commonly used Java libraries.

2 Deliverables

The primary deliverable for team May1639 is a Q&A web platform dedicated to hosting and answering questions regarding formal specifications that fulfills the functional requirements outlined below. As the project is still in its early stages, additional deliverables may be added as needed in future iterations.

3 System Requirements

3.1 Requirements

Dr. Rajan has indicated that he will define more requirements for the second semester of development. The requirements already specified, including those to receive primary developmental focus during the first semester, are listed below.

Functional Requirements

- The system will display and traverse a library/class/method hierarchy for supported libraries.
- The system will allow for upvoting/favoriting of specifications that are considered correct.
- The system will facilitate creating/editing specifications with manual input.
- The system will allow users to create and contribute to discussions.
- The system will display relevant discussions for currently selected libraries/classes/methods.
- The system will display source code for currently selected classes and methods.
- The system will support additional features as needed to mimic desirable functionality of a StackExchange site, with emphasis on StackOverflow.

Non-Functional Requirements

- The system shall implement the StackExchange API, allowing for back-end programming such as that under development by team May1620 to access information.
- The system shall be extensible, allowing for the addition of new features both during and after development.
- The system shall be maintainable, allowing the project to be appropriately managed in the event control is transferred to other parties.

3.2 Possible Solutions

Our group discussed three possible means of constructing our web-based Q&A discussion platform.

- Create a Q&A platform using an existing internet forums framework
    - There are a variety of available frameworks for the purpose of creating internet forums, including Q&A discussion sites.
    - Notable options include NodeBB and MyBB.
- Construct a new platform from scratch

    - Using a language/framework such as ASP.NET to create our own platform with our necessary functionalily.
- Construct a StackExchange site dedicated to formal specifications
    - With permission, it is possible to create a StackExchange site dedicated to the discussion of topics distinct enough to separate from already existing StackExchange sites.

Our group has settled on the first option of using an as of yet undecided internet forums framework to create our web-based Q&A discussion platform.

3.3 Solution Assessment

There are several reasons that make the first solution the best option. While the second option was brought up, it was immediately considered too involved. It would be too time consuming to learn a framework and build a web-platform to meet the project requirements from scratch. The third option is one that was seriously considered. However, using the StackExchange framework may not give the freedom to completely customize our web platform as we may like. So, using a forums framework was determined to be the best option.

3.4 Validation & Acceptance Testing

Proposed requirements tests (working list, high-level abstractions of types of tests):

- Make several calls to the web platform utilizing the StackExchange API.
- Traverse the library-->class-->method hierarchy to locate a specific method by finding a specific class by searching for a particular library.
- Create, then upvote and/or favorite a question to the web platform.
- Create a set of specifications for some code, then edit it, then delete it.
- Create a new discussion, then contribute to it.
- Form a discussion that is relevant for a currently existing specification, and check to see if the discussion is listed as ‘related’.
- Select a class/method in a commonly used API and confirm that the source code is correctly displayed.

NFR tests are still under consideration; currently, the noted NFRs do not have any measurable goals to be met, such as “must be down for no more than 5 minutes” or “must be able to support at least 25 users in an hour”. In addition, more NFRs will be added following additional discussion with Dr. Rajan concerning his goals with this project.

4 Interface / System Description

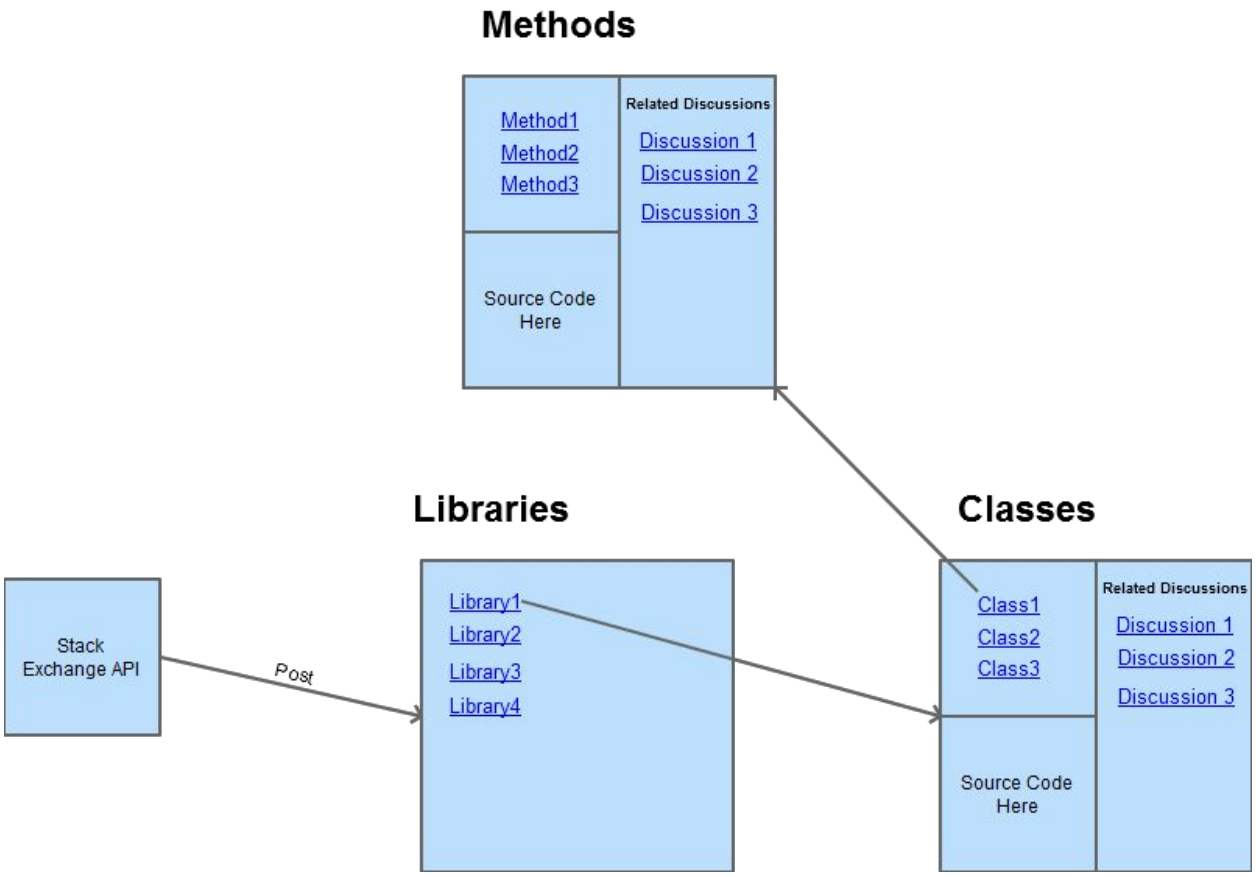

Figure 1: A high-level abstract diagram of the eventual structure of the web platform interface system.

We are intending to use the same REST API as Stack Exchange, in order to facilitate a more streamlined integration process. The user would be presented with a number of libraries of code to choose from, or as the results of a search for a library. Selecting a library would then present the user with a number of classes from that library, along with related discussions about the selected library. (It may also be possible to reach this class-listing screen by searching for a specific class.) selecting a class will lead the user to a screen listing the methods contained within that class, as well as the source code and related discussions regarding the selected class. (Again, it may also be possible to reach this method-listing screen by searching for a specific method.)

5 Work Breakdown Structure

5.1 Project Schedule

- Completed for CprE/SE 491 by December, 2015
    - Display and traverse a library/class/method hierarchy for supported libraries.
    - Display relevant source code and discussions for currently selected libraries/classes/methods.
    - Implement full support for the StackExchange API to facilitate later connections to a another module in development by team May1620.
    - Complete any other requirements necessary for the implementation of the interface outlined in Section 4.
- Completed for CprE/SE 492 by May, 2016
    - Implement any listed requirements not completed for December, 2015.
    - Implement any additional requirements requested by Dr. Rajan for the second semester.
    - Allow for integration with a back-end in development by team May1620.

5.2 Risk & Feasibility Assessment

Many aspects of this project have already been proven feasible by work others have done. Creating a Q&A website should not be too difficult, as these types of websites are common, and there are many existing frameworks dedicated to their development. Some aspects that may prove challenging will be extracting class and method source code and implementing a way to add, remove and update specifications through our website. Our team has some learning to do, but overall, this project seems very feasible.

5.3 Cost Estimate

There are no expected costs for this project at the moment. As a predominantly software-based project, there are no costs due to hardware. Currently, the plan is to select a freely available forum software as a development platform. We wish to avoid purchasing any development software for this project. There will be no costs due to labor. Overall, the project is presently expected to cost: $0.00.

5.4 Previous/Existing Work

There have been similar efforts to increase the availability of formal behavioral specifications, most of which worked through predominantly technical solutions. One focused on analyzing

programs by running significantly large numbers of test cases and processing the results to detect patterns and invariants. This approach, however, can only provide, at best, an estimate at how a program behaves, since, in order to learn of how the program behaves universally through this method, we would need test cases for every conceivable possibility in which the program can be called. Such a number of test cases is regrettably infeasible to run, if not impossible to completely generate. Another approach that's been attempted was a program that analyzes another program's code statically. The fruit of such efforts, however, are specifications that apply to that program - and that program alone. These kinds of specifications aren't open enough to easily allow for maintenance or evolution. Still other efforts have focused on tracking the analysis of the APIs of the program they're specifying. By understanding what methods are called, when they are called, and in what order, patterns can arise that can be useful in the generation of specifications. Regrettably, such attempts do not utilize detailed analysis of the program itself enough to directly create specifications.

6. Conclusion

The direct result of our project will be a web platform to host formal specifications for commonly used Java libraries. In addition, the platform will be of a Q&A format allowing human users to validate and edit existing or computer generated specifications as well as propose and manually create new specifications. The platform is planned for use past the departure of the developing senior design students, and development will proceed with the intention of passing the work on to the community for future upkeep and extension.

Currently, there are no such services that meet the needs outlined above, so in addition to providing a working platform with the described functionality, it will also serve as a proof of concept that such platforms are feasible, ideally prompting further development in the area of formal specifications.

7 Figures, Tables, and References

7.1 Figures

1. A high-level abstract diagram of the eventual structure of the web platform interface system.

7.2 References

1. Rajan, Hridesh, Tien N. Nguyen, Gary T. Leavens, and Robert Dyer. "Inferring Behavioral Specifications from Large-scale Repositories by Leveraging Collective Intelligence." “37th International Conference on Software Engineering: NIER Track” May 2015, ICSE’15, Florence, Italy.