CMSC 447

Software Test Description (STD)

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# Scope

## Identification

This project is a web application which when implemented allows the user to input preferences into a questionnaire and top locations will then be outputted onto a map. When first accessing the webpage, the user will begin with the “login page.” From the login page, a user can access a “create an account page” or after authentication access their “homepage.” The homepage will allow the user to modify their account information from a “modify account page,” as well as allow the user to see the “map” and access the “questionnaire,” which are defined below.

The “questionnaire” refers to the portion of the project where the user inputs these preferences. This will be accessed from the homepage into a “questionnaire page.” The “ratings” will refer to the numerical input from a user in which they determine which statistics have a higher preference. The “statistics” refer to the set of data that our project will be accessing. The “map” refers to the portion of the project which is the visualization of data. The map is initially displayed from the homepage, but will initially be empty, and be modified as the user takes the questionnaire. After the user completes the questionnaire the map is referenced to be an “updated map” with the continuing definitions being components of the map. The map may also have markers which will be referred to as “pins.” The pins will allow the user to see an image of the location referred to as the “pin image.” In some cases where an image is not available, or if there is additional implementation, a pin may allow the user to see descriptive information on the location which will be referred to as the “pin information.”

The system has been developed with the goal of system reliability in mind. As a result, the system ought to maintain the different tests throughout the entirety of the development process. The system should have test functions and procedures within each testable directory. These should be found within both the frontend and backend subdirectories found within the main Code directory. Testing is meant to verify the visualization of data is occurring properly as well as verify the information being sent throughout the system.

This system will contain both unit, integration, and system tests. These will be further broken into visual and automation tests. Unit tests are generally associated with the individual components of the application. Integration tests refer to the different parts of a CSCI component. System tests will refer to those which contain multiple CSCI components. Visual tests will refer to those tests, generally relating to the frontend portions, which will be verified by looking at the output on the screen. The automation tests, generally relating to the backend portions, will be verified with a simple pass/fail output. These tests are intended to ease in the verifiability of the system. These will then be used to say what progress has been made within the system, and which components need further development.

## System overview

The goal of this project is to create a web application which will allow a user to create an account, and from such account be able to evaluate different statistical values such that a list of locations within the United States will be outputted to the user which correlate to the user input. With the list, a map should be presented with pins that correlate to the location and can then be further expanded to output a location image or description.

We expect to use a database for maintaining username and password data. Along with this we expect to be using third party software for our output. This would include the use of GoogleMaps for our map output, and GooglePlaces for our image outputs, and Wikipedia for a description output. Further third-party software will be expanded in this section as seems fit throughout the project. All project development will be done through GitHub and then developer preference for development environments, debuggers, etc. The web portion of the application will be run using an Angular Framework on a localhost.

The system is one that has been developed within a web application. As a result, a majority of the corresponding tests are to be done within the web environment. These tests have not been automated and are normally verifications of the data visualization procedures. These tests correspond specifically with the frontend portions of the system. The backend portion is expected to follow normal automated testing procedures unless further documented within the code.

## Document overview

The purpose of this document is to describe the testing procedure that is to be implemented for the system previously described. This will include the procedures for setting up a test environment, the testing cases, and descriptions of the actual tests. Each test will be testing a different unique feature within the system. These will be broken into unit, integration, system, and acceptance tests. Unit tests will be testing the individual functions within the system. These will be written by the developer of the function.

Automated tests should also be included within a test driver unique to each programming language. This will be done to allow for ease of regression testing. Integration testing will be done after completion of each CSCI component. Automation of the integration testing should have a unique driver for each CSCI component. Similarly, after completion of each CSCI component, a regression test should be done for the previously developed CSCI components. Finally, the system test should be done after completion of the last CSCI component is developed, tested, and completion of all regression testing. Automated system tests should have a unique test driver. Finally, after completion of the system test then acceptance tests should be done with the project client.

**1.3.1 Version Modifications**

For transparency, the following section will include any updates made to this document:

Version 1.0: This is the completion of the original document.

Version 1.1: Updated spelling and grammar throughout the document. Also updated test to include test for the avatar requirement which was updated as of our 4/23 meeting with the client. This also included an update to the setup which now includes installation information for Python, Visual C++, and MYSQL.

Version 1.2 Updated Requirements Traceability to reflect the test numbers.

Version 1.3 Removed Skeletal Template and updated table of contents.

Version 2.3 Updated the numbering system to match those of the other documents. Updated sections 1.1-1.3.

# Referenced documents

The following documents may be referenced throughout this document:

SDP- Software Development Plan

SRS- Software Requirements Specification

SDD- Software Design Description

# Test preparations

## (Project-unique identifier of a test)

### Hardware preparation

This system is purely a software system. As a result, there is no hardware preparation outside of a required internet connection setup.

### Software preparation

The following items will need to be installed and setup for this system: Python3, Visual C++, and MYSQL. Additionally, there will be a description for how to start the web application. Each will then have a further description on how to install below.

To run the backend code Python 3 will need to be installed. This will just require running the python-3.6.5-amd64.exe. This can be found in the Programs directory. In the first stage of the installation, you will need to choose the “Add to Path” checkbox option. Further instructions for the Python Installation can be found within the SETUP README file found in the home directory.

Most machines already have an installation of Microsoft Visual C++. To verify if your machine has Microsoft Visual C++ installed simply search for the application in your application search bar. If Microsoft Visual C++ is not installed on the machine simply run the vc\_redist.x64.exe found in the Programs directory. Further instruction for the Microsoft Visual C++ Installation can be found within the SETUP README file found in the home directory.

MYSQL will be required to run the login database in the frontend, as well as the Census Bureau database in the backend. This install file is called mysql-installer-web-community-8.0.11.0.exe which can be found in the Programs directory. This will require a custom install of MYSQL. The following will need to be installed during the process.

1. MySQL Server

2. MySQL Workbench

3. MySQL Shell

4. MySQL Router

5. Connector/Python (3.6) 8.0.11

For help finding the hidden installation requirements directions are below:

1. MySQL Server is under the MySQL Servers folder

2. MySQL Workbench, Shell, Router are under the Applications folder

3. Python connector is in the MySQL Connectors folder. Make sure to get the Python 3.6 x64 connector

From here leave all settings except the root password should be the default setting. Set the password to be "password" (without the quotation marks.) When asked for the Authentication Method, check the Legacy Authentication Method. Finally, open the program MySQL Workbench and double click on "Local instance MySQL Router and do the following:

1) When asked for the root password, enter "password" and click connect

2) Click on the button in the toolbar that looks like two cylinders stacked on top of each other (If you hover over it should say create new schema) and call the new schema "project”. Further instructions for the MYSQL installation can be found within the SETUP README file.

Next is how to configure the backend environment. This will first require changing the PowerShell execution policy. To change the PowerShell execution policy. This can be done by opening. PowerShell as Administrator and run the command:

"Set-ExecutionPolicy RemoteSigned"

Next to set up the virtual environment to run python code. This can be done with the following steps:

1) In PowerShell run "pip install virtualenv"

2) Then in the Group2Project folder, run "virtualenv venv/"

3) Then run "venv/Scripts/activate"

4) then run "pip install -r Code/requirements/base.txt"

5) then run "python Code/manage.py migrate"

Python code can now be executed using the command:

"python Code/manage.py runserver". Further instructions can be found in the SETUP README file.

This setup is for a Windows environment. First, in a browser go to: https://nodejs.org/dist/v8.11.1/node-v8.11.1-x64.msi

Next, install node js 8.1.1 with the default options. From the root directory, enter the frontend directory. Open a Windows PowerShell by holding shift and right clicking. From the list of options, click the “open PowerShell window here.” From here run the following commands:

npm install

npm run

This first command will install the dependencies for the system. The second command will open the site. Afterwards the website may be reached from localhost:4200. Further instructions on the setup process can be found within the SETUP README.

### Other pre-test preparations

This project will require the use of a MYSQL database. The database name should be known as ‘TEAM2.’ This database will store a single table with the name of ‘USERINFO.’ This table will have fields ‘username’, ‘password’, and ‘about me.’ The username and password will be stored as VARCHAR(255) data type. The about me will be stored as a TEXT data type.

The Census Bureau table is being stored as an Excel document which is loaded during runtime. This could be changed into a database to improve runtime; however, the setup costs currently outweigh the runtime expense. This table is found within the Census\_Bureau\_Data directory.

# Test descriptions

## (Project-unique identifier of a test)

### (Project-unique identifier of a test case)

The following are the tests that need to be done for the defined completion of this project as described within the system description. These tests will address those of the CSCI components and the overall system and will not go into the individual unit tests. For information on the unit test, description will be given upon their development within the automated testing code. The test described here will be done to verify that the designs described within the SDD are completed as described. Test 1-4 are tests corresponding to the individual CSCI components within the system. Test 5 will verify that the CSCI components integrate into the system.

Test 1 will refer to verification of the login and create account pages portion of the system. Test 1.a will verify that the user cannot enter a NULL value for the username field. Test 1.b will verify that the user cannot enter a NULL value for the password field. Test 1.c will verify that the username entered is unique within the database. Test 1.d will verify that when the user enters ‘good’ input, which is input that passes tests 1.a-1.c, then the data is submitted into the login database. Test 1.e will verify that in the case of bad input from 1.a-c then the user receives an error message. Test 1.f will verify that the user can choose and avatar from the create account page. These tests all assume an initial state within the login page portion of the system. Verification that this page can be reached will be done in a later test. Test 1 will be viewed as a ‘pass’ if Tests 1.a-1.f are passed.

Test 1.a will be verified by an automated NULL entering the javascript for the username of the webpage. Test 1.b will be verified by an automated NULL entering the javascript for the password of the webpage. Test 1.c will be verified by entering an automated new username entry, as well as an automated copy of that username entry. The first automation should pass, and the second test should not allow the creation of the new account. Test 1.d will be a visual verification by performing a “SELECT \* FROM login” query on the login database verifying the account from Test 1.c was created. Test 1.e will be a visual verification that the second account from Test 1.d was not created. Test 1.f will be a visual verification that the avatar choice is presented during the login procedure.

Test 2 will refer to the modify account page portion of the system. These tests should mirror those of the create account portion of the project. Test 2.a will verify that the newly entered username is not NULL. Test 2.b will verify that a newly entered password is not NULL. Test 2.c will verify that a newly entered username is unique from previously entered usernames within the login database. Test 2.d will verify that when the user enters ‘good’ input, which is input that passes tests 2.a-2.c, then the login database is updated with the new user information. Test 2.e will verify that if tests 2.a-c fail that the user receives an error message. Test 2.f will verify that the user may modify their avatar. These test all assume an initial state within the modify account portion of the system. Verification that this page can be reached will be done in a later test. Test 2 will be viewed as a ‘pass’ if Tests 2.a-2.e are passed.

Test 2.a will be verified by automated submitting of the modify account page without a username entry. Test 2.b will be verified by automated submitting of the modify account page without a password entry. Test 2.c will be verified by an automated username modification to a known account username. Test 2.d will be verified by an automated submission of the modify account page with a new username, password, and avatar. This will then be visually verified by a “SELECT \* FROM login” query on the login database. Test 2.e will be verified by an automated resubmission of the 2.d page does not allow the new account modification. Test 2.f will be a visual verification that the avatar portion of the user account has been modified in Test 2.d.

Test 3 will refer to the questionnaire page portion of the system. Test 3.a will verify that there are at least 5 statistics that a user can rate. Test 3.b will verify that the user has entered a rating for each of the statistics. Test 3.c will verify that a list will output with 10 different locations. This shall be verified with a list output. Test 3.c will assume tests 3.a-b have been passed. Test 3.d will verify that the different statistical input will present different outputs to the user. Test 3.d will assume tests 3.a-3.c have been passed. Test 3.e should verify that data is being accessed from the correct inputs of the Census Bureau dataset. Test 3 will assume that the user can reach the questionnaire page of the system. Verification that this page can be reached will be done in a later test. Tests 3 will be viewed as a ‘pass’ if Tests 3.a-3.e are passed.

Test 3.a will be verified by a visual verification of the questionnaire page for the five different questions. Test 3.b will be verified by a visual verification that the user may enter integer ratings on the questionnaire page. Test 3.c will be verified by an automated submission of the questionnaire page and confirming that the length of the returned list is of size 10. Test 3.d will be verified by a visual verification through multiple entries of the questionnaire. Test 3.e will be verified by an automated verification through a set questionnaire entry returns a particular set list of locations.

Test 4 will refer to the map output and homepage portions of the system. Test 4.a will verify that the user is presented with a list of their personal top choices. Test 4.b will verify that the list presented in 4.a has 10 unique locations. Test 4.c will verify that the user is presented with a map of the United States. Test 4.d will verify that the map has pins corresponding to the list in 4.a. Test 4.e will verify that the pins in 4.d may be clicked. Test 4.f will verify that the pins in 4.d, when clicked will output an image of the location. Test 4.g will verify that the pins in 4.d, when clicked will output a description of the location. Test 4.h will verify that the user’s avatar is presented on the homepage. Test 4.i will test the administrative permissions of the accounts. This will be broken into two separate tests. Test 4.i.1 will test if a user can look up another specific user by their username. Test 4.i.2 will test if an administrator account can look up all users. Test 4 will assume that the user can reach the homepage. Test 4 will also assume that the list of locations was created by the questionnaire. Within testing, this list may be hardcoded with locations in the same format that they would be outputted from Test 3. This output is assumed to be verified through the tests checked in Test 3.a-c. Testing that the homepage will be done in a later test. Test 4 will be viewed as a ‘pass’ if Tests 4.a-g are passed.

Test 4.a will be a visual verification that the user list is presented on the homepage. Test 4.b will be an automated verification that the elements in the list are unique. Test 4.c will be a visual verification that the map is shown on the homepage. Test 4.d will be a visual verification that the map locations match an automated list. Test 4.e will be a manual verification that the map’s pins produce a popup when clicked. Test 4.f will be a visual verification that the Test 4.e pins displays the location image. Test 4.g will be a visual verification that the Test 4.e pins displays the location description. Test 4.h will be a visual verification that the user avatar is displayed at the top of the homepage. Test 4.i will be an automated verification that the administrator accounts can be created. Test 4.i.1 will be an automated verification query using an administrative account’s permissions. Test 4.i.2 will be an automated verification query using a user account’s permissions.

Test 5 will test the integration of the CSCI components tested within Test 1-4. Test 5.a will verify that the user may reach the login page. Test 5.b will verify that the user may reach the create account page. Test 5.c will verify that the user may reach the homepage. Test 5.d will verify that the user may reach the modify account page. Test 5.d will verify the user may reach the questionnaire page. Test 5.e will verify that completion of the questionnaire page redirects the user to the homepage. Test 5.f will verify the output of the questionnaire is a list type. Test 5.g will verify that the map is originally presented on the homepage. Test 5 will be viewed as a pass if Tests 5.a-g are passed.

Test 5.a will be a visual verification that the login page is initially presented. Test 5.b will be a visual verification that the created account page button allows access to the create account page from the login page. Test 5.c will be an automated submission of the login page verifying that the homepage is accessed with correct user account credentials. Test 5.d will be a visual verification that the questionnaire button allows access to the questionnaire page from the homepage. Test 5.e will be an automated verification which confirms when the survey is submitted with integer input for all questions the system redirects to the homepage. Test 5.f will be an automated verification which confirms the list returned in Test 5.e is of type list.

#### Requirements addressed

This section will serve to map the requirements described in the SRS table to the test numbers described above. This will be done through a table mapping requirement number to test number.

|  |  |  |
| --- | --- | --- |
| Number | Requirement Summary | Test Number |
| 3.1 | State Requirements | 1-5 |
| 3.1.a | Login page | 1,5 |
| 3.1.a.1 | Access account creation | 5a,5b |
| 3.1.a.2 | Username input | 1.a |
| 3.1.a.3 | Password input | 1.b |
| 3.1.a.4 | Authentication | 1.d |
| 3.1.a.5 | Admin Permissions | 4.i.1-2 |
| 3.1.b | CAP | 5.b |
| 3.1.b.1 | Create username | 1.a |
| 3.1.b.2 | Unique username | 1.c |
| 3.1.b.3 | Create Password | 1.b |
| 3.1.b.4 | About me | 1.d |
| 3.1.b.5 | Avatar | 1.f |
| 3.1.c | Homepage | 5.c |
| 3.1.c.1 | Original Map | 5.g |
| 3.1.c.2 | Access modify account page | 5.b |
| 3.1.c.3 | Access questionnaire | 5.d |
| 3.1.c.4 | Updated Map | 4.c-f |
| 3.1.c.5 | Avatar Display | 4.h |
| 3.1.d | Modify Account Page | 2.a-e |
| 3.1.d.1 | Change username | 2.a |
| 3.1.d.2 | Change password | 2.b |
| 3.1.d.3 | Change about me | 2.d |
| 3.1.d.4 | Change Avatar | 2.f |
| 3.1.e | Questionnaire | 3.a-e |
| 3.1.e.1 | Display Statistics | 3.a |
| 3.1.e.2 | Rate statistics | 3.b |
| 3.1.e.3 | Updated Map Algorithm | 3.d,4,5 |
| 3.1.e.3.a | List top 10 | 3.a |
| 3.1.e.3.b | Pin Information | 4.f,4.g |
| 3.1.e.3.c | Multiple Questionnaires | 5.e |
| 3.2 | Capability Requirements | 1-5 |
| 3.2.a | Login Page | 1 |
| 3.2.a.1 | Successful login | 1.b |
| 3.2.a.2 | Unsuccessful login | 1.e |
| 3.2.b | Create Account | 1.d |
| 3.2.b.1 | Unique username | 1.c |
| 3.2.b.2 | Non-unique username | 1.c |
| 3.2.b.3 | Empty Username | 1.a |
| 3.2.b.4 | Empty Password | 1.b |
| 3.2.c | Homepage | 5.c |
| 3.2.c.1 | Empty Map | 5.g |
| 3.2.c.2 | Top 10 | 4.a |
| 3.2.c.3 | Pin Info | 4.f,4.g |
| 3.2.d | Modify Account | 2.a-e |
| 3.2.d.1 | Empty Username | 2.a |
| 3.2.d.2 | Unique Username | 2.c |
| 3.2.d.3 | Empty Password | 2.b |
| 3.2.e | Questionnaire | 3.a-e |
| 3.2.e.1 | Display Statistics | 3.a |
| 3.2.e.2 | Empirical Statistics | 3.a |
| 3.2.e.3 | Statistical Priority | 3.b |
| 3.2.e.4 | Varied Output | 3.d |
| 3.2.e.5 | Updated Map | 4.d |
| 3.5 | Database Requirements | 1 |
| 3.5.a | Database usernames | 1.d |
| 3.5.b | Database passwords | 1.d |
| 3.5.c | Database Avatar | 1.d, f |

#### Prerequisite conditions

Prerequisite testing should be completed with Test 5 and with the SETUP README instructions. However, these will be described more explicitly here. The entire system will be running on a localhost:4200 after the setup is done. For an abnormal IP setup, the 4200 portion may be required to be modified based on the setup of the local machine. This modification will be stated after the npm run command. The following are the page dependencies for navigating the system. The create account page is dependent on access from the login page. The homepage is dependent on access from the login page. This homepage will have an empty map output. The questionnaire page is dependent on access from the homepage. The questionnaire upon completion should redirect the user to the homepage with the updated map output. The map pin image and descriptions depend on user completion of the questionnaire.

#### Test inputs

The following will describe the inputs for the tests. Any test which is testing NULL input should test an empty string, as well as no input. Validation testing of user input should also test values larger than the buffer described within the database. For example, the username has a varchar of size 255. A username of 256 should then be tested. To test modification to a database, automation testing should use a SQL SELECT query and validate the value within the database. An entire profile should be verified by placing the user information into a list and validating the list of user information. Verification of the database information should use correctly formatted data whose format has been verified through the previous tests. Testing uniqueness of a value within a database should also be done through a SQL SELECT query and validating that the new value is unique within the established data. This will require having sample data within the database for testing purposes. Any data visualization testing is assumed to not be automated. The testing of data visualization should be done through access to the web environment following the procedures described in the software environment setup.

#### Expected test results

Automated testing should simply output a pass or fail to the developers. This is assumed to be done through the system’s standard output. Failed outputs should print a failure message as well as information pertaining to the test. This should include the function being tested, as well as a corresponding test number. Passing outputs should simply output a pass and the test being done. If a component is tested using multiple automated tests, Boolean values should be used with each test, which will then be compared to validate the component. If a single test fails, then the component is to be viewed as failing.

Data visualization testing should be described within a test.txt file. These tests should be simple yes/no or true/false test which will be written out corresponding to the test described in section 3 of this document. The test.txt file should just be a description of the testing procedure for what a developer is looking to confirm is valid output. These test results should contain a global Boolean value within the automated testing, so that after visualization testing is concluded, automated testing can output a pass/fail value for system components.

#### Criteria for evaluating results

Within this system all tests will be outputting a simple pass or fail result. The individual tests will be determining the procedure for what constitutes a pass or fail within the context of that test. The only test which will have ambiguity will be the tests which verify requirement 3.2.e.4: The questionnaire page shall yield different outputs for different user inputs. This test will be required to test at minimum a test for maximizing each statistical input. This would be 5 separate inputs. Each of these outputs shall be unique implying that none of the 5-outputted list should be equivalent. This can be tested by using a simple if(lista == listb == …) statement using all 5 lists. If at any point a test causes a website error, i.e. 404, then the entire test is to be determined to be an error. These errors should be determined to be noted as ‘severe.’ An error which is computational in nature should be determined to be ‘moderate.’ Severe errors should not be permitted at all. Moderate errors should be reviewed for the implication of allowing such an error to persist. If the error causes only an unnoticeable slowing of website performance, it will be determined to be ‘allowable.’ If the error causes noticeable slowing of the website performance, it should be determined to be ‘moderate.’ If the error causes non-usability of the website the error should be determined to be ‘severe.’

#### Test procedure

This will describe the testing procedure for a developer. The tester should begin by setting up the test environment following the procedure in the SETUP README file. The developer should then begin with any data visualization testing. This will be done to set the global Booleans within the automated test. All data visualization test should be initialized to ‘False’ unless a developer manually modifies the test to be passed, where they may then be set to ‘True.’ After completion of the data visualization testing, the developer may proceed to run the automated tests. This should be done via a single automated test which calls other automated tests. The final print statements of any automation test should include a description of the testing results. This should include a pass or fail for each of the CSCI components and the overall system.

#### Assumptions and constraints

All assumptions for the test environment have been described within the test procedures above.

# Requirements traceability

|  |  |  |  |
| --- | --- | --- | --- |
| Number | Requirement Summary | Test Number | Pass/Fail Denoted with a check or ‘X’ |
| 3.1 | State Requirements | 1-5 |  |
| 3.1.a | Login page | 1,5 |  |
| 3.1.a.1 | Access account creation | 5a,5b |  |
| 3.1.a.2 | Username input | 1.a |  |
| 3.1.a.3 | Password input | 1.b |  |
| 3.1.a.4 | Authentication | 1.d |  |
| 3.1.a.5 | Admin Permissions | 4.i.1-2 |  |
| 3.1.b | CAP | 5.b |  |
| 3.1.b.1 | Create username | 1.a |  |
| 3.1.b.2 | Unique username | 1.c |  |
| 3.1.b.3 | Create Password | 1.b |  |
| 3.1.b.4 | About me | 1.d |  |
| 3.1.b.5 | Avatar | 1.f |  |
| 3.1.c | Homepage | 5.c |  |
| 3.1.c.1 | Original Map | 5.g |  |
| 3.1.c.2 | Access modify account page | 5.b |  |
| 3.1.c.3 | Access questionnaire | 5.d |  |
| 3.1.c.4 | Updated Map | 4.c-f |  |
| 3.1.c.5 | Avatar Display | 4.h |  |
| 3.1.d | Modify Account Page | 2.a-e |  |
| 3.1.d.1 | Change username | 2.a |  |
| 3.1.d.2 | Change password | 2.b |  |
| 3.1.d.3 | Change about me | 2.d |  |
| 3.1.d.4 | Change Avatar | 2.f |  |
| 3.1.e | Questionnaire | 3.a-e |  |
| 3.1.e.1 | Display Statistics | 3.a |  |
| 3.1.e.2 | Rate statistics | 3.b |  |
| 3.1.e.3 | Updated Map Algorithm | 3.d,4,5 |  |
| 3.1.e.3.a | List top 10 | 3.a |  |
| 3.1.e.3.b | Pin Information | 4.f,4.g |  |
| 3.1.e.3.c | Multiple Questionnaires | 5.e |  |
| 3.2 | Capability Requirements | 1-5 |  |
| 3.2.a | Login Page | 1 |  |
| 3.2.a.1 | Successful login | 1.b |  |
| 3.2.a.2 | Unsuccessful login | 1.e |  |
| 3.2.b | Create Account | 1.d |  |
| 3.2.b.1 | Unique username | 1.c |  |
| 3.2.b.2 | Non-unique username | 1.c |  |
| 3.2.b.3 | Empty Username | 1.a |  |
| 3.2.b.4 | Empty Password | 1.b |  |
| 3.2.c | Homepage | 5.c |  |
| 3.2.c.1 | Empty Map | 5.g |  |
| 3.2.c.2 | Top 10 | 4.a |  |
| 3.2.c.3 | Pin Info | 4.f,4.g |  |
| 3.2.d | Modify Account | 2.a-e |  |
| 3.2.d.1 | Empty Username | 2.a |  |
| 3.2.d.2 | Unique Username | 2.c |  |
| 3.2.d.3 | Empty Password | 2.b |  |
| 3.2.e | Questionnaire | 3.a-e |  |
| 3.2.e.1 | Display Statistics | 3.a |  |
| 3.2.e.2 | Empirical Statistics | 3.a |  |
| 3.2.e.3 | Statistical Priority | 3.b |  |
| 3.2.e.4 | Varied Output | 3.d |  |
| 3.2.e.5 | Updated Map | 4.d |  |
| 3.5 | Database Requirements | 1 |  |
| 3.5.a | Database usernames | 1.d |  |
| 3.5.b | Database passwords | 1.d |  |
| 3.5.c | Database Avatar | 1.d, f |  |

# Signatures

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Client Signature

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Group Representative Signature