

ECE 493 Capstone Test Plan and Suite for PolyPong

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April 16, 2021

1 Test Plan

Overall, the tests for the backend code are automated, and will have over 80% line coverage, as outlined in the software requirements specification document. Because the backend is using the Deno runtime, we are using a built-in testing tool. In conjunction with this, we are also using a library called 'superoak', which is designed to help with testing oak applications. Oak is a framework we use for routing requests in the server.

The frontend code will be subject to manual testing, due to the difficulty with automating tests for a multiplayer game. We do have an automated test which clicks buttons and navigates the site to ensure that our navigation works, and certain things are displayed correctly. However, we found that manual tests were necessary to ensure that our functional requirements are satisfied and the application works as expected. The automated test which click buttons and navigates around is written using the puppeteer framework. Puppeteer is a tool written by Google, which allows one to automate actions in the Chrome browser. With the combination of this tool plus manual testing, we are confident that the lines covered far exceed 80%, however, since a coverage report is not automatically generated like in automated tests, we do not know the exact percentage of lines covered.

1.1 User Login

1.1.1 FR1

Setting up a repeatable test that covers everything for this feature would be difficult to say the least, because it would require burning email accounts. That is, once an email address is used to sign up, it cannot be re-used to

test this functional requirement. As a result, a new email would need to be created each time we would want to run the test. A compromise would be to delete the email in our database, so that the user is still new to us, even though the OAuth provider (In this case, Auth0) would still remember that the user had previously authorized our application.

An automated test will test the server side code, while a manual test will ensure that a user can in fact, log in.

1.2 User Registration

1.2.1 FR2

Setting up a test for login will also be slightly difficult. For security reasons, both GitHub and Google (the social login providers we chose) occasionally require a code to be entered which is sent by e-mail. For this reason, an manual test is required to test the frontend part of this feature.

An automated test will test the server side code, while a manual test will ensure that a user can in fact, log in.

1.3 Play Game

1.3.1 FR3 Create Game

To test this functionality, at least three users are required to test the requirement that the game can start when three or more players are present as outlined in the Software Requirements Specification. This needs to happen in three separate browser windows either on the same computer, or on different computers. This makes an automated test difficult, so a manual test should be designed instead.

1.3.2 FR4 Share Link

To test this functionality, a link needs to be copied, and then pasted into a new browser window. Even if you ignore the security implications of using a script to copy clipboard contents, this requires opening a new browser window and pasting a link. A manual test will be designed for this feature.

1.3.3 FR5 Join Game

To test this functionality, a lobby id would have to already exist, meaning that this test would depend on the create game functionality, which will be a manual test. Therefore, a manual test will also be designed for this feature.

1.3.4 FR6 Play Game

To test this functionality, one would have to actually play the game. There are a lot of things that can happen in a game, and many scenarios to think about that can happen in the game. There are virtually infinite possibilities of combinations of game states, which depend on things like:

- the number of players
- the positions of paddles
- the powerups used
- network latency

We found from preliminary playtesting that the game gets really chaotic past about 12 players. Beyond that point, the distance you can move a paddle becomes really small. So, the test will start with 12 players, each with powerups such that all of the power ups will be used multiple times throughout the game, and will run until there is one player left. Also, it will be a manual test because of the amount of players required.

1.4 Leaderboard and Statistics

1.4.1 FR7 Earn XP

Parts of this feature can be tested with automated tools. In the backend, an automated test can be made to ensure that the function which adds XP to a user updates the database correctly.

For a player to actually earn XP however, they must play the game. So, the other part of this test would be to ensure that when a game ends, the correct amount of XP is awarded. This will be a manual test case.

1.4.2 FR8 View Local Leaderboard

Parts of this feature can be tested with automated tools. In the backend, an automated test can be made to ensure that the function which returns the data that the frontend requests is in the correct format.

A manual test will be used to ensure that the correct data is shown in the frontend. Another acceptable solution would be to have a unit test in the frontend which mocks the response from the server and ensures the data is displayed correctly.

1.4.3 FR9 View Global Leaderboard

Parts of this feature can be tested with automated tools. In the backend, an automated test can be made to ensure that the function which returns the data that the frontend requests is in the correct format.

A manual test will be used to ensure that the correct data is shown in the frontend. Another acceptable solution would be to have a unit test in the frontend which mocks the response from the server and ensures the data is displayed correctly.

1.4.4 FR10 User statistics

Parts of this feature can be tested with automated tools. In the backend, an automated test can be made to ensure that the function which returns the user statistics data that the frontend requests is in the correct format.

A manual test will be used to ensure that the correct data is shown in the frontend. Another acceptable solution would be to have a unit test in the frontend which mocks the response from the server and ensures the data is displayed correctly.

1.5 Power Ups

1.5.1 FR11 Power Ups

There are 11 Choose 3 = 165 possible combinations of power up choices that users can make. Given more time, we could make that many test cases, however, because a game has multiple players, we could have a game with say, 12 players (because there are 11 power ups in total), and get each player to pick three power ups. This is a much more reasonable solution, and we still ensure that all of the power ups can be picked. Each power up is still has their respective tests for ensuring that the powerup itself works as expected, and this helps us to test some of the possible Combinations of powerups together.

1.5.2 FR12 Expanded Paddle

This functional requirement is a power up, and a power up is activated during a game. The actions that happen in a game cannot be automated, so testing is to be done manually.

1.5.3 FR13 Shrink Paddle

This functional requirement is a power up, and a power up is activated during a game. The actions that happen in a game cannot be automated, so testing is to be done manually.

1.5.4 FR14 Self Invisible Paddle

This functional requirement is a power up, and a power up is activated during a game. The actions that happen in a game cannot be automated, so testing is to be done manually.

1.5.5 FR15 Others Invisible Paddle

This functional requirement is a power up, and a power up is activated during a game. The actions that happen in a game cannot be automated, so testing is to be done manually.

1.5.6 FR16 Invisible Ball

This functional requirement is a power up, and a power up is activated during a game. The actions that happen in a game cannot be automated, so testing is to be done manually.

1.5.7 FR17 Self Curved Outwards Paddle

This functional requirement is a power up, and a power up is activated during a game. The actions that happen in a game cannot be automated, so testing is to be done manually.

1.5.8 FR18 Self Curved Inwards Paddle

This functional requirement is a power up, and a power up is activated during a game. The actions that happen in a game cannot be automated, so testing is to be done manually.

1.5.9 FR19 Self Bumpy Paddle

This functional requirement is a power up, and a power up is activated during a game. The actions that happen in a game cannot be automated, so testing is to be done manually.

1.5.10 FR20 Distracting Background

This functional requirement is a power up, and a power up is activated during a game. The actions that happen in a game cannot be automated, so testing is to be done manually.

1.5.11 FR21

This optional functional requirement was scrapped. Therefore, the feature does not exist, so no tests are required for a feature that does not exist.

1.5.12 FR22

This optional functional requirement was scrapped. Therefore, the feature does not exist, so no tests are required for a feature that does not exist.

1.5.13 FR23 Add Ball

This functional requirement is a power up, and a power up is activated during a game. The actions that happen in a game cannot be automated, so testing is to be done manually.

1.5.14 FR24

This optional functional requirement was scrapped. Therefore, the feature does not exist, so no tests are required for a feature that does not exist.

1.5.15 FR25

This optional functional requirement was scrapped. Therefore, the feature does not exist, so no tests are required for a feature that does not exist.

1.5.16 FR26 Path Trace

This functional requirement is a power up, and a power up is activated during a game. The actions that happen in a game cannot be automated, so testing is to be done manually.

1.6 Skins

1.6.1 FR27 Earn Skin

Parts of this feature can be tested with automated tools. In the backend, an automated test can be made to ensure the following:

- the function which returns the available skins (based on current XP) is correct
- the user can select a new skin when the XP threshold for that skin is earned

A manual test would be needed to ensure that the user can actually select a skin when the skin has been earned

1.6.2 FR28 Select skin

Parts of this feature can be tested with automated tools. In the backend, an automated test can be made to ensure the following:

- the function which returns the available skins (based on current XP) is correct
- the function that sets the user's skin works, and does not allow a user to set a skin they have not unlocked yet

A manual test would be needed to ensure that the user's currently selected skin is visible when the game starts, since testing the game is also done manually and cannot be automated.

2 Test Suite

2.1 Automated tests

To run the automated tests that we have, the instructions are as follows:

2.1.1 Frontend

For the frontend, we have an automated puppeteer test. Puppeteer is a tool developed by Google which allows for programatically controlling a Google Chrome browser. We use it to ensure that navigation and pressing buttons on our site works properly.

To run it,

```
cd e2e-test
npm i
npm test
```

Note: Due to security issues, it is very likely that GitHub will request a two-factor code to be entered which is sent by email if this test is run on a different computer for the first time. As a result, this test is likely to fail because it would get stuck waiting for a two factor code to be entered. If a two factor code is not required because the browser fingerprint is recognized, this test does in fact pass, and we can watch it browse polypong.ca

Backend For the backend, we are using Deno's built in testing functionality to make sure that the database works. We use a library called superoak which helps to test the REST endpoints we expose, like `/leaderboard` for example to get the leaderboard data.

here's how you run the tests: you need to make sure than an instance of mongodb is running and is accessible at `mongodb://localhost:27017` for it to work

```
cd server
deno test --allow-env --allow-net --coverage=coverage --unstable server.ts
```

To get the code coverage, run this:

```
deno coverage --unstable coverage --include="db.ts"
```

2.2 User Login

2.2.1 FR1

This is a manual test

1. Test steps

- (a) Go to `https://polypong.ca`
- (b) Click on the **Sign Up/Log In** buttons
 - you will be redirected to log in to either your github or google account

2. Expectations

- (a) When the login process is finished, you should be redirected to the home page. If it was successful, you will see two new buttons on the home page: **My Stats** and **Leaderboard**, and **Settings**. Also, the **Sign Up/Log In** button should no longer be visible.

- (b) In the developer tools for your browser, you should see a cookie set by auth0:
 - Name: auth0.isauthenticated
 - Value: true

2.3 User Registration

2.3.1 FR2

On the server side, there is an automated test. Use the provided test.sh script in the server/ folder to run it, along with other tests

A manual test is used to test the functionality from the user's perspective, and also to test portions of code that are not covered by automated tests.

1. Test steps

- (a) Pick a Google or GitHub account with an email that does not already exist in the database
 - if the user already exists, either delete the entry in the database, or create a new GitHub/Google account.
- (b) Go to <https://polypong.ca>
- (c) Click on the **Sign Up/Log In** buttons
 - you will be redirected to log in to either your github or google account
- (d) When login in to Google or GitHub is done, you should be redirected to a sign up page where you are asked to choose a username for your new account
- (e) Type a username that already exists in the database. (If one is not known already, you can look at the leaderboard to see some already existing usernames)
- (f) Hit **Create Account**
- (g) Change the username requested to something unique
- (h) Hit **Create Account**

2. Expectations

- (a) When the sign up process is finished, you should be redirected to the home page. If it was successful, you will see two new buttons on the home page: **My Stats and Leaderboard**, and **Settings**. Also, the **Sign Up/Log In** button should no longer be visible.

- (b) In the developer tools for your browser, you should see a cookie set by auth0:
 - Name: auth0.isauthenticated
 - Value: true
- (c) On step 6, when a user attempts to sign up with an already existing username, an error should notify the user that the requested username is taken.
- (d) Also on step 6, on the network tab of your browser's developer tools, a request to `https://polyserver.polypong.ca/signup` should be made, with the response status code being 409 `Conflict` indicating that the username is already taken
- (e) After step 8, you should be redirected to the home page for polypong.ca. If it was successful, you will see two new buttons on the home page: **My Stats and Leaderboard**, and **Settings**. Also, the **Sign Up/Log In** button should no longer be visible.
- (f) In the developer tools for your browser, you should see a cookie set by auth0:
 - Name: auth0.isauthenticated
 - Value: true

2.4 Play Game

2.4.1 FR3 Create Game

This is a manual test

1. Test steps
 - (a) Go to `https://polypong.ca`
 - (b) Click on **Create Private Game**
2. Expectations
 - (a) You should see that you are put into a new lobby, and that you are waiting for users to join the lobby.
 - (b) You should also see a lobby id

2.4.2 FR4 Share Link

This is a manual test

1. Test steps
 - (a) Go to <https://polypong.ca>
 - (b) Click on **Create Private Game**
 - (c) Click on **Copy Link to Clipboard to Invite Friends**
2. Expectations
 - (a) You should see that you are put into a new lobby, and that you are waiting for users to join the lobby.
 - (b) You should also see a lobby id
 - (c) When step 3 above is completed, a link should be copied to your system clipboard

2.4.3 FR5 Join Game

This is a manual test

1. Test steps
 - (a) Go to <https://polypong.ca>
 - (b) Click on **Create Private Game**
 - (c) Click on **Copy Link to Clipboard to Invite Friends**
 - (d) Open a new browser window, paste the link, and hit enter
2. Expectations
 - (a) You should see that you are put into a new lobby, and that you are waiting for users to join the lobby.
 - (b) You should also see a lobby id
 - (c) When step 3 above is completed, a link should be copied to your system clipboard
 - (d) When step 4 is completed, there should now be two players in the lobby

2.4.4 FR6 Play Game

This is a manual test

1. Test steps

- (a) Go to <https://polypong.ca>
- (b) Click on **Create Private Game**
- (c) Click on **Copy Link to Clipboard to Invite Friends**
- (d) Open a new browser window, paste the link, and hit enter
- (e) Repeat step 4, so that a third person joins the lobby
- (f) Have all users in the lobby click on the **Let's Play** button at the bottom of the page

2. Expectations

- (a) You should see that you are put into a new lobby, and that you are waiting for users to join the lobby.
- (b) You should also see a lobby id
- (c) When step 3 above is completed, a link should be copied to your system clipboard
- (d) When step 4 is completed, there should now be two players in the lobby
- (e) When step 5 is completed, there should now be three players in the lobby
- (f) When step 6 is completed, the game should start and users can start playing.

2.5 Leaderboard and Statistics

2.5.1 FR7 Earn XP

This is a manual test

1. Test steps

- (a) Go to <https://polypong.ca>
- (b) Click on **Create Private Game**
- (c) Click on **Copy Link to Clipboard to Invite Friends**

- (d) Open a new browser window, and log in as a different user, or get a friend to log in with their account and paste the link and hit enter
- (e) Repeat step 4, so that a third person joins the lobby
- (f) Have all users in the lobby click on the **Let's Play** button at the bottom of the page
- (g) Play the game until each player either wins or gets eliminated.

2. Expectations

- (a) You should see that you are put into a new lobby, and that you are waiting for users to join the lobby.
- (b) You should also see a lobby id
- (c) When step 3 above is completed, a link should be copied to your system clipboard
- (d) When step 4 is completed, there should now be two players in the lobby
- (e) When step 5 is completed, there should now be three players in the lobby
- (f) When step 6 is completed, the game should start and users can start playing.
- (g) When step 7 is completed, there should be a notification at the end of the game indicating the amount of XP earned for playing the game.
 - i. The first player to get eliminated should have earned 1 XP
 - ii. The second player should have earned 2 XP
 - iii. The player that won the game should have earned 3 XP

2.5.2 FR8 View Local Leaderboard

On the server side, there is an automated test. Use the provided test.sh script in the server/ folder to run it, along with other tests

A manual test is used to test the functionality from the user's perspective, and also to test portions of code that are not covered by automated tests.

1. Test Steps

- (a) Go to <https://polypong.ca>

- (b) Log in if not already logged in yet.
- (c) If you have 0 XP, play the game to earn some XP
- (d) On the home page, click on the **My Stats and Leaderboard** button

2. Expectations

- (a) You should see a list of usernames and their corresponding XP. The users that appear directly next to your name should be the ones that have the closest amount of XP to you

2.5.3 FR9 View Global Leaderboard

On the server side, there is an automated test. Use the provided test.sh script in the server/ folder to run it, along with other tests

A manual test is used to test the functionality from the user's perspective, and also to test portions of code that are not covered by automated tests.

1. Test Steps

- (a) Go to <https://polypong.ca>
- (b) Log in if not already logged in yet.
- (c) If you have 0 XP, play the game to earn some XP
- (d) On the home page, click on the **My Stats and Leaderboard** button
- (e) Click on the **Top in the World** button

2. Expectations

- (a) You should see a top 10 list of usernames and their corresponding XP. These users are the 10 players in descending order with the highest XP.

2.5.4 FR10 User statistics

On the server side, there is an automated test. Use the provided test.sh script in the server/ folder to run it, along with other tests

A manual test is used to test the functionality from the user's perspective, and also to test portions of code that are not covered by automated tests.

1. Test Steps

- (a) Go to <https://polypong.ca>
- (b) Log in if not already logged in yet.
- (c) If you have 0 XP, play the game to earn some XP
- (d) On the home page, click on the **My Stats and Leaderboard** button

2. Expectations

- (a) You should see three statistics which should match with your past play history
 - i. Games Played
 - ii. Games Won
 - iii. XP Level

2.6 Power Ups

2.6.1 FR11 Power Ups

This is a manual test

1. Test steps

- (a) Go to <https://polypong.ca>
- (b) Click on **Create Private Game**
- (c) Click on **Copy Link to Clipboard to Invite Friends**
- (d) Open a new browser window, paste the link, and hit enter
- (e) Repeat step 4 ten more times, so that twelve people join the lobby
- (f) Have every player select three random powerups, ensuring each powerup has been selected at least once.
- (g) Once each player has selected three random powerups, have them hit the **Let's Play** button at the bottom of the page.
- (h) Over the course of a regular 12-player game, have each player use their powerups by pressing 1, 2 and 3. Make sure each player knows which powerup they are using by having them view the inventory before they press 1, 2 or 3.
- (i) When the player uses the powerup, ensure the specified powerup's behaviour is consistent with the expectations for the powerup set out below.

2.6.2 FR12 Expanded Paddle

This is a manual test

1. Test steps

- (a) Go to <https://polypong.ca>
- (b) Click on **Create Private Game**
- (c) Click on **Copy Link to Clipboard to Invite Friends**
- (d) Open a new browser window, paste the link, and hit enter
- (e) Repeat step 4, so that a third person joins the lobby
- (f) In the power selection part of the lobby, double click on the “Bigger Paddle” button, ensuring that it is highlighted in white (to indicate it has been selected). Make sure this is the only powerup you have selected.
- (g) Once you have selected this powerup, click on the **Let’s Play** button at the bottom of the page.
- (h) Have all the other users in the lobby also click on the **Let’s Play** button at the bottom of the page.
- (i) Once the countdown (3-2-1) is over and you see the game board as well as other players’ paddles, press 1 to use the powerup.

2. Expectations

- (a) You should see that you are put into a new lobby, and that you are waiting for users to join the lobby.
- (b) You should also see a lobby id.
- (c) When step 3 above is completed, a link should be copied to your system clipboard.
- (d) When step 4 is completed, there should now be two players in the lobby.
- (e) When step 5 is completed, there should now be three players in the lobby.
- (f) When step 6 is completed, only the current powerup should be highlighted in white (to indicate it has been selected).
- (g) When step 8 is completed, the game should start and users can start playing. Gameplay should be normal.

- (h) When step 9 is completed, your paddle should be twice as big as normal on your screen and your friends' screens.
- (i) Thirty seconds after step 9 is completed, your paddle should return to regular size on your screen and your friends' screens.

2.6.3 FR13 Shrink Paddle

This is a manual test

1. Test steps

- (a) Go to <https://polypong.ca>
- (b) Click on **Create Private Game**
- (c) Click on **Copy Link to Clipboard to Invite Friends**
- (d) Open a new browser window, paste the link, and hit enter
- (e) Repeat step 4, so that a third person joins the lobby
- (f) In the power selection part of the lobby, double click on the "Smaller Paddle" button, ensuring that it is highlighted in white (to indicate it has been selected). Make sure this is the only powerup you have selected.
- (g) Once you have selected this powerup, click on the **Let's Play** button at the bottom of the page.
- (h) Have all the other users in the lobby also click on the **Let's Play** button at the bottom of the page.
- (i) Once the countdown (3-2-1) is over and you see the game board as well as other players' paddles, press 1 to use the powerup.

2. Expectations

- (a) You should see that you are put into a new lobby, and that you are waiting for users to join the lobby.
- (b) You should also see a lobby id.
- (c) When step 3 above is completed, a link should be copied to your system clipboard.
- (d) When step 4 is completed, there should now be two players in the lobby.
- (e) When step 5 is completed, there should now be three players in the lobby.

- (f) When step 6 is completed, only the current powerup should be highlighted in white (to indicate it has been selected).
- (g) When step 8 is completed, the game should start and users can start playing. Gameplay should be normal.
- (h) When step 9 is completed, your paddle should be half as big as normal on your screen and your friends' screens.
- (i) Thirty seconds after step 9 is completed, your paddle should return to regular size on your screen and your friends' screens.

2.6.4 FR14 Self Invisible Paddle

This is a manual test

1. Test steps

- (a) Go to <https://polypong.ca>
- (b) Click on **Create Private Game**
- (c) Click on **Copy Link to Clipboard to Invite Friends**
- (d) Open a new browser window, paste the link, and hit enter
- (e) Repeat step 4, so that a third person joins the lobby
- (f) In the power selection part of the lobby, double click on the “Invisible Paddle, Self” button, ensuring that it is highlighted in white (to indicate it has been selected). Make sure this is the only powerup you have selected.
- (g) Once you have selected this powerup, click on the **Let's Play** button at the bottom of the page.
- (h) Have all the other users in the lobby also click on the **Let's Play** button at the bottom of the page.
- (i) Once the countdown (3-2-1) is over and you see the game board as well as other players' paddles, press 1 to use the powerup.

2. Expectations

- (a) You should see that you are put into a new lobby, and that you are waiting for users to join the lobby.
- (b) You should also see a lobby id.
- (c) When step 3 above is completed, a link should be copied to your system clipboard.

- (d) When step 4 is completed, there should now be two players in the lobby.
- (e) When step 5 is completed, there should now be three players in the lobby.
- (f) When step 6 is completed, only the current powerup should be highlighted in white (to indicate it has been selected).
- (g) When step 8 is completed, the game should start and users can start playing. Gameplay should be normal.
- (h) When step 9 is completed, your paddle should be invisible on your screen and your friends' screens.
- (i) One minute after step 9 is completed, your paddle should return to being visible on your screen and your friends' screens.

2.6.5 FR15 Others Invisible Paddle

This is a manual test

1. Test steps

- (a) Go to <https://polypong.ca>
- (b) Click on **Create Private Game**
- (c) Click on **Copy Link to Clipboard to Invite Friends**
- (d) Open a new browser window, paste the link, and hit enter
- (e) Repeat step 4, so that a third person joins the lobby
- (f) In the power selection part of the lobby, double click on the “Invisible Paddle, Others” button, ensuring that it is highlighted in white (to indicate it has been selected). Make sure this is the only powerup you have selected.
- (g) Once you have selected this powerup, click on the **Let's Play** button at the bottom of the page.
- (h) Have all the other users in the lobby also click on the **Let's Play** button at the bottom of the page.
- (i) Once the countdown (3-2-1) is over and you see the game board as well as other players' paddles, press 1 to use the powerup.

2. Expectations

- (a) You should see that you are put into a new lobby, and that you are waiting for users to join the lobby.
- (b) You should also see a lobby id.
- (c) When step 3 above is completed, a link should be copied to your system clipboard.
- (d) When step 4 is completed, there should now be two players in the lobby.
- (e) When step 5 is completed, there should now be three players in the lobby.
- (f) When step 6 is completed, only the current powerup should be highlighted in white (to indicate it has been selected).
- (g) When step 8 is completed, the game should start and users can start playing. Gameplay should be normal.
- (h) When step 9 is completed, your friends' paddles should be invisible on your screen and your friends' screens.
- (i) Fifteen seconds after step 9 is completed, your friends' paddles should return to being visible on your screen and your friends' screens.

2.6.6 FR16 Invisible Ball

This is a manual test

1. Test steps

- (a) Go to <https://polypong.ca>
- (b) Click on **Create Private Game**
- (c) Click on **Copy Link to Clipboard to Invite Friends**
- (d) Open a new browser window, paste the link, and hit enter
- (e) Repeat step 4, so that a third person joins the lobby
- (f) In the power selection part of the lobby, double click on the "Invisible Ball" button, ensuring that it is highlighted in white (to indicate it has been selected). Make sure this is the only powerup you have selected.
- (g) Once you have selected this powerup, click on the **Let's Play** button at the bottom of the page.

- (h) Have all the other users in the lobby also click on the **Let's Play** button at the bottom of the page.
- (i) Once the countdown (3-2-1) is over and you see the game board as well as other players' paddles, press 1 to use the powerup.

2. Expectations

- (a) You should see that you are put into a new lobby, and that you are waiting for users to join the lobby.
- (b) You should also see a lobby id.
- (c) When step 3 above is completed, a link should be copied to your system clipboard.
- (d) When step 4 is completed, there should now be two players in the lobby.
- (e) When step 5 is completed, there should now be three players in the lobby.
- (f) When step 6 is completed, only the current powerup should be highlighted in white (to indicate it has been selected).
- (g) When step 8 is completed, the game should start and users can start playing. Gameplay should be normal.
- (h) When step 9 is completed, the ball should be invisible on your screen and your friends' screens.
- (i) Fifteen seconds after step 9 is completed, the ball should return to being visible on your screen and your friends' screens.

2.6.7 FR17 Self Curved Outwards Paddle

This is a manual test

1. Test steps

- (a) Go to <https://polypong.ca>
- (b) Click on **Create Private Game**
- (c) Click on **Copy Link to Clipboard to Invite Friends**
- (d) Open a new browser window, paste the link, and hit enter
- (e) Repeat step 4, so that a third person joins the lobby

- (f) In the power selection part of the lobby, double click on the “Curved Outwards” button, ensuring that it is highlighted in white (to indicate it has been selected). Make sure this is the only powerup you have selected.
- (g) Once you have selected this powerup, click on the **Let’s Play** button at the bottom of the page.
- (h) Have all the other users in the lobby also click on the **Let’s Play** button at the bottom of the page.
- (i) Once the countdown (3-2-1) is over and you see the game board as well as other players’ paddles, press 1 to use the powerup.

2. Expectations

- (a) You should see that you are put into a new lobby, and that you are waiting for users to join the lobby.
- (b) You should also see a lobby id.
- (c) When step 3 above is completed, a link should be copied to your system clipboard.
- (d) When step 4 is completed, there should now be two players in the lobby.
- (e) When step 5 is completed, there should now be three players in the lobby.
- (f) When step 6 is completed, only the current powerup should be highlighted in white (to indicate it has been selected).
- (g) When step 8 is completed, the game should start and users can start playing. Gameplay should be normal.
- (h) When step 9 is completed, your paddle should be curved outwards on your screen and your friends’ screens.
- (i) When a ball collides with your paddle, the collision return angle should range from 60 degrees to the left on the left side of the paddle to 60 degrees to the right on the right side of the paddle (continuous 120 degree range).
- (j) Your paddle should remain curved outwards until you are eliminated or you win the game.

2.6.8 FR18 Self Curved Inwards Paddle

This is a manual test

1. Test steps

- (a) Go to <https://polypong.ca>
- (b) Click on **Create Private Game**
- (c) Click on **Copy Link to Clipboard to Invite Friends**
- (d) Open a new browser window, paste the link, and hit enter
- (e) Repeat step 4, so that a third person joins the lobby
- (f) In the power selection part of the lobby, double click on the “Curved Inwards” button, ensuring that it is highlighted in white (to indicate it has been selected). Make sure this is the only powerup you have selected.
- (g) Once you have selected this powerup, click on the **Let’s Play** button at the bottom of the page.
- (h) Have all the other users in the lobby also click on the **Let’s Play** button at the bottom of the page.
- (i) Once the countdown (3-2-1) is over and you see the game board as well as other players’ paddles, press 1 to use the powerup.

2. Expectations

- (a) You should see that you are put into a new lobby, and that you are waiting for users to join the lobby.
- (b) You should also see a lobby id.
- (c) When step 3 above is completed, a link should be copied to your system clipboard.
- (d) When step 4 is completed, there should now be two players in the lobby.
- (e) When step 5 is completed, there should now be three players in the lobby.
- (f) When step 6 is completed, only the current powerup should be highlighted in white (to indicate it has been selected).
- (g) When step 8 is completed, the game should start and users can start playing. Gameplay should be normal.

- (h) When step 9 is completed, your paddle should be curved inwards on your screen and your friends' screens.
- (i) When a ball collides with your paddle, the collision return angle should range from 60 degrees to the right on the left side of the paddle to 60 degrees to the left on the right side of the paddle (continuous 120 degree range).
- (j) Your paddle should remain curved inwards until you are eliminated or you win the game.

2.6.9 FR19 Self Bumpy Paddle

This is a manual test

1. Test steps

- (a) Go to <https://polypong.ca>
- (b) Click on **Create Private Game**
- (c) Click on **Copy Link to Clipboard to Invite Friends**
- (d) Open a new browser window, paste the link, and hit enter
- (e) Repeat step 4, so that a third person joins the lobby
- (f) In the power selection part of the lobby, double click on the "Bumpy Paddle" button, ensuring that it is highlighted in white (to indicate it has been selected). Make sure this is the only powerup you have selected.
- (g) Once you have selected this powerup, click on the **Let's Play** button at the bottom of the page.
- (h) Have all the other users in the lobby also click on the **Let's Play** button at the bottom of the page.
- (i) Once the countdown (3-2-1) is over and you see the game board as well as other players' paddles, press 1 to use the powerup.

2. Expectations

- (a) You should see that you are put into a new lobby, and that you are waiting for users to join the lobby.
- (b) You should also see a lobby id.
- (c) When step 3 above is completed, a link should be copied to your system clipboard.

- (d) When step 4 is completed, there should now be two players in the lobby.
- (e) When step 5 is completed, there should now be three players in the lobby.
- (f) When step 6 is completed, only the current powerup should be highlighted in white (to indicate it has been selected).
- (g) When step 8 is completed, the game should start and users can start playing. Gameplay should be normal.
- (h) When step 9 is completed, your paddle should be bumpy on your screen and your friends' screens.
- (i) When a ball collides with your paddle, the collision return angle should be random, ranging from 60 degrees to the left to 60 degrees to the right (continuous 120 degree range).
- (j) Your paddle should remain bumpy until you are eliminated or you win the game.

2.6.10 FR20 Distracting Background

This is a manual test

1. Test steps

- (a) Go to <https://polypong.ca>
- (b) Click on **Create Private Game**
- (c) Click on **Copy Link to Clipboard to Invite Friends**
- (d) Open a new browser window, paste the link, and hit enter
- (e) Repeat step 4, so that a third person joins the lobby
- (f) In the power selection part of the lobby, double click on the “Distracting Background” button, ensuring that it is highlighted in white (to indicate it has been selected). Make sure this is the only powerup you have selected.
- (g) Once you have selected this powerup, click on the **Let's Play** button at the bottom of the page.
- (h) Have all the other users in the lobby also click on the **Let's Play** button at the bottom of the page.
- (i) Once the countdown (3-2-1) is over and you see the game board as well as other players' paddles, press 1 to use the powerup.

2. Expectations

- (a) You should see that you are put into a new lobby, and that you are waiting for users to join the lobby.
- (b) You should also see a lobby id.
- (c) When step 3 above is completed, a link should be copied to your system clipboard.
- (d) When step 4 is completed, there should now be two players in the lobby.
- (e) When step 5 is completed, there should now be three players in the lobby.
- (f) When step 6 is completed, only the current powerup should be highlighted in white (to indicate it has been selected).
- (g) When step 8 is completed, the game should start and users can start playing. Gameplay should be normal.
- (h) When step 9 is completed, the background should have changed colour on your screen and your friends' screens.
- (i) Every 5 seconds going forward, the background colour should randomly change on your screen and your friends' screens.

2.6.11 FR21

This optional functional requirement was scrapped. Therefore, the feature does not exist, so no tests are required for a feature that does not exist.

2.6.12 FR22

This optional functional requirement was scrapped. Therefore, the feature does not exist, so no tests are required for a feature that does not exist.

2.6.13 FR23 Add Ball

This is a manual test

1. Test steps

- (a) Go to <https://polypong.ca>
- (b) Click on **Create Private Game**
- (c) Click on **Copy Link to Clipboard to Invite Friends**

- (d) Open a new browser window, paste the link, and hit enter
- (e) Repeat step 4, so that a third person joins the lobby
- (f) In the power selection part of the lobby, double click on the “Add Ball” button, ensuring that it is highlighted in white (to indicate it has been selected). Make sure this is the only powerup you have selected.
- (g) Once you have selected this powerup, click on the **Let’s Play** button at the bottom of the page.
- (h) Have all the other users in the lobby also click on the **Let’s Play** button at the bottom of the page.
- (i) Once the countdown (3-2-1) is over and you see the game board as well as other players’ paddles, press 1 to use the powerup.

2. Expectations

- (a) You should see that you are put into a new lobby, and that you are waiting for users to join the lobby.
- (b) You should also see a lobby id.
- (c) When step 3 above is completed, a link should be copied to your system clipboard.
- (d) When step 4 is completed, there should now be two players in the lobby.
- (e) When step 5 is completed, there should now be three players in the lobby.
- (f) When step 6 is completed, only the current powerup should be highlighted in white (to indicate it has been selected).
- (g) When step 8 is completed, the game should start and users can start playing. Gameplay should be normal.
- (h) When step 9 is completed, there should be an additional ball in play on your screen and your friends’ screens.
- (i) The additional ball should behave exactly like a regular ball. When one player is eliminated, the next round should only have one ball.

2.6.14 FR24

This optional functional requirement was scrapped. Therefore, the feature does not exist, so no tests are required for a feature that does not exist.

2.6.15 FR25

This optional functional requirement was scrapped. Therefore, the feature does not exist, so no tests are required for a feature that does not exist.

2.6.16 FR26 Path Trace

This is a manual test

1. Test steps

- (a) Go to <https://polypong.ca>
- (b) Click on **Create Private Game**
- (c) Click on **Copy Link to Clipboard to Invite Friends**
- (d) Open a new browser window, paste the link, and hit enter
- (e) Repeat step 4, so that a third person joins the lobby
- (f) In the power selection part of the lobby, double click on the “Trace Ball Path” button, ensuring that it is highlighted in white (to indicate it has been selected). Make sure this is the only powerup you have selected.
- (g) Once you have selected this powerup, click on the **Let’s Play** button at the bottom of the page.
- (h) Have all the other users in the lobby also click on the **Let’s Play** button at the bottom of the page.
- (i) Once the countdown (3-2-1) is over and you see the game board as well as other players’ paddles, press 1 to use the powerup.

2. Expectations

- (a) You should see that you are put into a new lobby, and that you are waiting for users to join the lobby.
- (b) You should also see a lobby id.
- (c) When step 3 above is completed, a link should be copied to your system clipboard.
- (d) When step 4 is completed, there should now be two players in the lobby.
- (e) When step 5 is completed, there should now be three players in the lobby.

- (f) When step 6 is completed, only the current powerup should be highlighted in white (to indicate it has been selected).
- (g) When step 8 is completed, the game should start and users can start playing. Gameplay should be normal.
- (h) When step 9 is completed, there should be an arrow indicating the direction of the ball's path on your screen.
- (i) One minute after step 9 is completed, the arrow indicating the direction of the ball's path on your screen should disappear.

2.7 Skins

2.7.1 FR27 Earn Skin

On the server side, there is an automated test. Use the provided test.sh script in the server/ folder to run it, along with other tests

A manual test is used to test the functionality from the user's perspective, and also to test portions of code that are not covered by automated tests.

1. Test Steps

- (a) Go to <https://polypong.ca>
- (b) Log in if not already logged in yet.
- (c) Make note of your current XP level. This can be checked on the leaderboard page by clicking on the **My Stats and Leaderboard** button on the home page
- (d) Make note of the current skins you have unlocked. This can be checked on the settings page by clicking on the **Settings** button on the home page.
- (e) Play enough games to earn enough XP to unlock a new skin: Skins are unlocked at the following thresholds

```
{
  [Color.White]: 0,
  [Color.BlueGrey]: 7,
  [Color.Grey]: 11,
  [Color.Brown]: 18,
  [Color.DeepOrange]: 29,
  [Color.Orange]: 47,
  [Color.Amber]: 76,
```

```

[Color.Yellow]: 123,
[Color.Lime]: 199,
[Color.LightGreen]: 322,
[Color.Green]: 521,
[Color.Teal]: 843,
[Color.Cyan]: 1364,
[Color.LightBlue]: 2207,
[Color.Blue]: 3571,
[Color.Indigo]: 5778,
[Color.DeepPurple]: 9349,
[Color.Purple]: 15127,
[Color.Pink]: 24476,
[Color.Red]: 39603,
[Color.Black]: 64079,
[Color.BackgroundColor]: 103682
}

```

- (f) When enough experience points are earned to unlock a new skin, go to the home page and click on the **Settings** button

2. Expectations

- (a) You should now see a new skin available to choose from

2.7.2 FR28 Select skin

On the server side, there is an automated test. Use the provided test.sh script in the server/ folder to run it, along with other tests

A manual test is used to test the functionality from the user's perspective, and also to test portions of code that are not covered by automated tests.

1. Test Steps

- (a) Go to <https://polypong.ca>
- (b) Log in if not already logged in yet.
- (c) Go to the settings page by clicking on the **Settings** button
- (d) Select a different skin from the one you currently have equipped
- (e) Play a game to see the new skin in action

2. Expectations

- (a) You should see a selection of skins that you can choose
- (b) After step 3, in the network tab of the developer console of your browser, a network request should be seen made to `https://polyserver.polypong.ca/getavailableskins` The response code should be 200
- (c) After step 4, in the network tab of the developer console of your browser, a network request should be seen made to `https://polyserver.polypong.ca/setskin` The response code should be 204
- (d) During step 5, you should see the new skin that was selected active in the game. Your opponents should also be able to see the skin colour you chose.