An Interactive End-To-End Machine Learning Platform

Quality Assurance

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Contents

1 Introduction

The purpose of this document is to inform the reader about the quality assurance phase of our project. Through this steps we will assure that the code written in the Implementation phase is reliable and the software is easy to use and has a high performance:

- Testing basic actions the user can take, by simulating all test scenarios mentioned in the Requirements Specification Document
- Checking what percentage of the code is test covered by line coverage, function coverage and statement coverage
- Usability testing using the Think-Aloud Method to show how users interact with the software

2 Test Scenarios

In the following section the resulting software is tested against the test scenarios from the Requirements Specification. Passed test cases of a scenario is denoted by a cross under the accepted column of the corresponding row. Starred test scenarios indicate that extending functionalities are also tested in the scenario.

2.0.1 Test Scenario 1 - First Time User

A user opens the webpage on their computer and registers to the service. After logging in, the user creates a new workspace. The user adds a new label to this workspace and initiates data collection via scanning the QR code. On their mobile device they choose a label for the action they will record. The user then starts recording using the default configuration. After the recording concludes, the user starts another recording. With the data they have collected, the user trains and deploys a machine learning model. The user then scans the deployed machine learning model's unique QR code to identify new data they record in real-time. Lastly, the user stops the classification and examines the classified actions.

FR	Designation	accepted
/T010/	Access web page.	X
/T021/	Sign up with new credentials	X
/T031/	Login with existing credentials.	X
/T040/	Create a new workspace with a name, sampling rate value and required sensors	X
/T070/	Open the labels overview.	X
/T071/	Create new label.	X
/T081/	Initiate data collection via scanning the QR code.	X
/T230/	Choose a label for the data that will be recorded.	X
/T260/	Start recording data	X
/T280/	Record another data after one recording completes	X
/T190/	Train the model.	X
/T200/	Open the models overview.	X
/T290/	Initiate data classification via scanning the QR code.	X
/T300/	Record data to classify	X

2.0.2 Test Scenario 2 - Invalid credentials

User tries to login with invalid credentials first and manages to login after a few unsuccessful attempts.

FR	Designation	accepted
/T010/	Access web page.	X
/T032/	Login with invalid credentials	X
/T032/	Login with invalid credentials	X
/T031/	Login with existing credentials.	X

2.0.3 Test Scenario 3 - Unsupported Desktop Client

User opens the website on an unsupported desktop browser and is welcomed with an error message.

FR	Designation	accepted
/T013/	Access web page via Internet Explorer 6	

2.0.4 Test Scenario 4 - Unsupported Mobile Client

User scans the QR code they received to begin recording data. It turns out their device doesn't support the Sensor API and the website notifiees the user about it.

FR	Designation	accepted
/T092/	Initiate data collection via scanning the QR code.	X

2.0.5 Test Scenario 5 - Forgotten Password*

User tries to login with an invalid username and/or password. After a few attempts user requests a new password using the "Forgot Password" functionality and successfully manages to login using their new password.

FR	Designation	accepted
/T010/	Access web page.	X
/T032/	Login with invalid credentials .	X
/T032/	Login with invalid credentials	X
/T400/	/ Select "Forgot Password".	
/T031/	/ Login with existing credentials	X

2.0.6 Test Scenario 6 - Data Deletion

User logs in and opens their previously set workspace. User finds some data samples and labels to be improper and deletes them.

FR	Designation	accepted
/T010/	Access web page	X
/T031/	Login with existing credentials.	X
/T050/	Open an already existing workspace	X
/T130//	delete the selected label.	X
/T070/	Open the labels overview.	X
/T072/	Delete Label.	X

2.0.7 Test Scenario 7 - Interruption during Recording

User uses the link that was provided previously to start collecting data. After configuring the options the user starts the recording. Whilst recording, the user receives a phone call. Recording continues during the call. The user then discards the recording and start a new recording.

FR	Designation	accepted
/T010/	Access web page	X
/T031/	Login with existing credentials.	X
/T050//	Open an already existing workspace	X
/T081/	Initiate data collection via using the link.	X
/T230/	Choose a label for the data that will be recorded.	X
/T240/	Set the countdown to start of recording.	X
/T250/	Set the recording duration	X
/T260/	Start recording data.	X
/T270/	Discard recorded data	X
/T280/	Record another data after one recording completes.	X
/T260/	Start recording data.	X

2.0.8 Test Scenario 8 - Registration with Already Existing Credentials

User opens the website on their desktop device and tries to register with an already existing username.

FR	Designation	accepted
/T010/	Access web page	X
/T022/	Sign up with existing credentials.	X

2.0.9 Test Scenario 9 - Multi-language Support

User opens the website and changes the language option to German.

FR	Designation	accepted
/T010/	Access web page	X
/T380/	Change the language of the desktop web client.	

2.0.10 Test Scenario 10 - Extensive Use of Main Functionalities

FR	Designation	accepted
/T010/	Access web page	X
/T021/	Sign up with new credentials.	X
/T032/	Login with invalid credentials.	X
/T031/	Login with existing credentials.	X
/T040/	Create a new workspace with a name, sampling rate value and required sensors.	X
/T060/	Rename the workspace	X
/T070/	Open the labels overview	X
/T071/	Create new label	X
/T072/	Rename label.	X
/T071/	Create new label	X
/T073/	Delete label.	X
/T080/	Initiate data collection via scanning the QR code.	X
/T230/	Choose a label for the data that will be recorded.	X
/T240/	Set the countdown to start of recording.	X
/T250/	Set the recording duration	X
/T260/	Start recording data	X
/T270/	Discard recorded data.	X
/T280/	Record another data after one recording completes.	X
/T230/	Choose a label for the data that will be recorded.	X
/T240/	Set the countdown to start of recording.	X
/T250/	Set the recording duration	X
/T260/	Start recording data	X
/T090/	Open the sample overview	X
/T100/	Choose another graph type to visualize data.	X
/T120/	Relabel the selected sample.	X
/T110/	Set the relevant time frame of the selected data sample on the graph.	X
/T130/	delete the selected label.	X
/T140/	Select the desired data imputation options.	X
/T150/	Select the desired feature extraction options.	X
/T160/	Select the normalization options.	X
/T170/	Select the desired machine learning model.	X
/T180/	Set the hyperparameters of the model.	X
/T190/	Train the model	X
/T200/	Open the models overview.	X
/T210/	Open the overview of a specific model	X
/T082/	Initiate data via scanning the QR code.	X
/T290/	Record data to classify	X
/T300/	Stop the classification.	X
/T310/	Restart the classification.	X
/T300/	Stop the classification.	X

2.0.11 Test Scenario 11 - Brute-force Attempt

User with malicious intents tries to hack an account through brute-forcing. After 5 unsuccessful login attempts, they are presented with a CAPTCHA to solve.

FR	Designation	accepted
/T010/	Access web page	X
/T032/	Login with invalid credentials	X
/T032/	Login with invalid credentials	X
/T032/	Login with invalid credentials	X
/T032/	Login with invalid credentials	X
/T032/	Login with invalid credentials	X
/T330/	Solve CAPTCHA	

2.0.12 Test Scenario 12 - Multiple/Simultaneous Data Collection and Classification

Two mobile clients (A and B) collect data for one workspace simultaneously. Client A uses the link to initiate data collection, while client B scans the QR code. They both choose a label for their recording. Client A sets the recording countdown and duration, whereas client B start recording directly using the default configuration. While client A is recording their first data, client B starts another recording. After their recordings conclude, client A uses the link to initiate classification, while client B scans the QR link. They concurrently classify the data they record.

FR	Designation	accepted
/T081/	Initiate data collection via using the link. (A)	X
/T082/	Initiate data collection via scanning the QR code. (B)	X
/T230/	Choose a label for the data that will be recorded. (A)	X
/T230/	Choose a label for the data that will be recorded. (B)	X
/T240/	Set the countdown to start of recording. (A)	X
/T260/	Start recording data.(B)	X
/T250/	Set the recording duration (A)	X
/T280/	Record another data after one recording completes.(B)	X
/T221/	Initiate data classification via using the link. (A)	X
/T222/	/ I Initiate data classification via scanning the QR code. (B)	X
/T290/	Record data to classify. (A)	X
/T290/	Record data to classify. (B)	X

3 Coverage-Tests

3.0.1 Client

Framework: jest
Library:react-hooks-testing-library

Number of Tests	Number of test files	Number of code lines
68	28	1537

Lines Coverage	statements Coverage	functions Coverage
33.25%	31 %	15 %

3.0.2 Workspace-Management

Libraries:Supertest, Mocha, Chai

Number of Tests	Number of test files	Number of code lines
19	1	1980

Lines Coverage	statements Coverage	functions Coverage
98.75%	98.5 %	95.9 %

3.0.3 Model-Management

Framework:Pytest

Number of Tests	Number of test files	Number of code lines
41	10	1495

Lines Coverage	statements Coverage	functions Coverage
71%	64 %	32 %

4 Missing test-cases and Errors

4.0.1 Missing test-cases Requirements

/T013/	Access web page via Internet Explorer 6
/T092/	Initiate date collection via scanning the QR code.
/T400/	/ Select "Forgot Password".
/T380/	Change the language of the desktop web client.
/T330/	Solve CAPTCHA

4.0.2 Errors

- 1.Error: Login information is only persisted for 15 minutes.
  Solution: make use of refreshToken and persist refreshed credentials into localStorage.

- 2.Error: models and labels on workspace page not updated in realtime.
  Solution: Promise invalidator for:models and labels

- 3.Error: sending empty mails in signups doesn't raise an error.
  Solution:Currently it fails silently with an 200 OK status code.

5 Think-Aloud Tests

5.1 Think-Aloud Test 1

5.1.1 Participant

Age: 25
Profession: Electrical Engineering Student
Machine Learning Experience: None

5.1.2 Participant Transcript

"I am trying to connect with non-existant [sic] credentials which didn't work. So we need to sign up first. Signing up is very smooth, few personal data required. Username, password and email, which was very quick. After creating a new account, I am able to connect. The design is very simple and right away you can see what you should do next. Clicking on create new workspace displays a window where you can choose a name for the workspace and the corresponding sensors and sample [sic] rates. I choose as sensor Gyroscope and Accelerometer both with a sample [sic] rate of 50. And then click create. Now I can select it with the chosen name in the workspace page. When clicking on it, you can edit its name, add new labels, edit models and delete the workspace. I created a vertical label, horizontal and one for the shaking. I need to enter the name of the label each time and click on create. Labels are ordered from 1 to 3 and you can delete the labels you want. We have 0 samples, so we should collect some date [sic]. Then when clicking on collect data a QR-code shows up. I think that for someone new to machine learning the message should ask to copy the link in a device having the chosen sensors. I don't have QR scanner in my phone, So copying the link to my phone browser takes some time. After copying the link I opened it and I am asked to choose one of the labels I created. I will start with the vertical label. I can edit the parameters of the record: countdown and duration and put them to 10 each. And I clicked record. I put my device in a vertical position. And I can see in the chart the collected data with 6 inputs 3 for each sensor. By choosing a point on the chart, you can see values of the inputs in the chosen point of time. If I'm not happy with the recorded sample, I can restart the recording with the same configuration or choose another configuration. For the time I will accept the sample so I click on send sample. When going back to the computer browser I can't see the sample but loading is written. After reconnecting and going back to the workspace the sample is there. And it shows that the label vertical has 1 sample but the others none. Now I will create a sample for the horizontal label. I choose the same configuration and run the recording. We can see the countdown and

directly after it starts collecting data for 10 sec. We can see the difference between the vertical chart and the horizontal one. I send this sample again. It shows an error saying that the label does not exist. I tried to delete it and create the label again. This time I am able to send data. I collect data one more time for vertical and one for shaking. Now all samples are on my workspace with 2 samples for vertical one for shaking and one for horizontal. Now I create a new model. I can see for the accelerometer and gyroscope in all 3 x,y,z axes: imputations, features and normalizer. I don't have a big idea about these characteristics so I choose randomly. On the right side i can choose a name for my model, its classifier and its hyperparameters including the window size, sliding step .. I will fill them randomly too. Now i can press train model. The Steps of the training shows up and become green one by one. When going back to my workspace, I can see my model. i can delete it or go to a QR link for identification. Which i think should be classify since identification is not that clear.i again copy the link and opened it in my mobile browser. i can see a chart similar to the recording chart. and above we can see the program is trying to predict the action that the smartphone is performing. For the most of the time the real-time prediction is right.But sometimes when a lot of labels occur at the same time it can lead to a delay. All in all I think the goal of the experience is reached but there are some bugs especially when collecting a sample."

5.1.3 Participant SUS

	1	2	3	4	5
I think i would like to use this system frequently			x		
I found the system unecessarily complex	X				
I thought the system was easy to use					X
I think that i would need the support of a technical person to be able to use this system		X			
I found the various functions in this system were well integrated				X	
I thought there was too much inconsistency in this system		X			
I would imagine that most people would learn to use this system very quickly					X
I found the system very cumbersome to use		X			
I felt very confident using this system			X		
I need to learn a lot of things before i could get going with this system			X		

5.1.4 Feedback

- For someone with no experience in Machine learning imputations, features ,normalizer, hyperparameters, sliding window should be more explained.

- In rare cases a loading problem occurs when sending a sample in the desktop client and the user needs to reconnect to his account.

- In rare cases when trying to send a sample an error saying that the label does not exist occurs. Recreating the label fixes the problem.