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Unit Testing

Unit testing was performed by the dev team as they were creating the features. For a new feature to be merged into the code base there had to be unit testing in place, or it would not be merged.

Unit tests were run on all PR's and could also be run locally by using the command npm run test in the root of the project.

Vite Test Unit Testing

Here is the progress of unit tests being run over the course of ID5.

Date	Results

April 2, 2024	`Test Files 13 passed (13)`
	`Tests 104 passed (104)`
	`Start at 16:40:19`
	`Duration 6.58s (transform 599ms, setup 750ms, collect 5.53s, tests 2.34s, environment 6.56s, prepare 1.32s)`
	
	Test Results (GitHib)

April 1, 2024	`Test Files 13 passed (13)`
	`Tests 105 passed (105)`
	`Start at 01:10:01`
	`Duration 6.03s (transform 540ms, setup 702ms, collect 5.12s, tests 2.30s, environment 5.69s, prepare 1.26s)`
	`Test Results (GitHub)`

March 30, 2024	`Test Files 12 passed (12)`
	`Tests 103 passed (103)`
	`Start at 14:16:35`
	`Duration 5.66s (transform 497ms, setup 629ms, collect 4.56s, tests 2.07s, environment 5.45s, prepare 1.20s)`
	`Test Results (GitHub)`

March 28, 2024	`Test Files 9 passed (9)`
	`Tests 95 passed (95)`
	`Start at 15:29:47`
	`Duration 4.45s (transform 590ms, setup 546ms, collect 3.62s, tests 1.32s, environment 4.64s, prepare 1.01s)`
	`Test Results (GitHub)`

March 26, 2024	`Test Files 9 passed (9)`
	`Tests 98 passed (98)`
	`Start at 06:08:07`
	`Duration 3.75s (transform 430ms, setup 424ms, collect 2.69s, tests 1.14s, environment 4.12s, prepare 891ms)`

	Test Results (GitHub)

For all other results consult the build history in the GitHub actions here
All Test Results

Integration Testing

Our integration testing is cross referenced with smoke tests in both the simulator and the Meta Quest to verify the reliability of a new feature. This along with the verification of our gherkin allowed for a high reliability in our testing and new feature releases.

Smoke Testing in Simulator

These are the human in the loop tests done on the simulator. All tests were done at the same times as their counter part on the actual meta quest below

Human in the loop Smoke Test Results over time in simulator

Date Tested	March 27th
Test Result	Triggered CSV buttonTriggered no file selectedTriggered CSV buttonTriggered no file selectedLoad CSV from URL visible : Url is empty or not a csv file : Load CSV from file system visible : No file selected : Load CSV from URL visible : URL CSV has been successfully loaded : URL visible : URL CSV has been successfully loaded : URL visible : URL CSV has been successfully loaded :
Smoke Tests Ran	CSV Loading
Passed	5/5
Problems	Failed on files > 5mb

Date Tested	March 29th
Test Result	
Smoke Tests Ran	CSV Loading
Passed	5/5
Problems	Failed on files > 5mb

Date Tested	March 31th
Test Result	Generated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated ZAxisGenerated X-AxisGenerated Y-AxisGenerated Z-Axis
Smoke Tests Ran	CSV Loading Axis Display
Passed	2/7
Problems	Merge removed smoke tests for csv and url loading.

Date Tested	April 1st
Test Result	Generated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated ZAxisGenerated X-AxisGenerated Y-AxisGenerated Z-Axis
Smoke Tests Ran	CSV Loading Axis Display
Passed	2/11
Problems	Fix in pr to address failing smoke tests.

Date Tested	April 2nd
Test Result	Generated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated: undefined : undefined : undefined : undefined : undefined : undefined |No more DataPoint info to display; previously null:Generated X-AxisGenerated Y-AxisGenerated Z-AxisLoad CSV from URL button visible : URL not a CSV : Generated X-AxisGenerated Y-AxisGenerated Z-Axis| undefined : undefined : undefined : undefined : undefined : undefined : undefined |Generated X-AxisGenerated Y-

	AxisGenerated Z-Axis| null:Generated X-AxisGenerated Y-: undefined : undefined : undefined : undefined : undefined |Load CSV from URL visibleGenerated X-AxisNo more DataPoint info to display; previously 11Now showing info for DataPoint 11; previously 10Now showing info for DataPoint 10; previously null-5,0,5Datapoint is selectedDatapoint is hoveredDatapoint is selectedDatapoint is selectedDatapoint is selectedDatapoint is selected-5,0,5-5,0,5-5,0,5-5,0,5yellowcirclecirclecirclecircle131313Loaded CSV with 3 rowsLoaded CSV with 31 rows
Smoke Tests Ran	Axis Display Data exclusion DisplayDataIn3DSpace DisplayPoints ImportFromCSV UIInteractino
Passed	22/22
Problems	

Smoke Testing in Meta Quest

Human in the loop Smoke Test Results over time on the Meta Quest. These Tests were run once the first smoke tests were integrated with human in the loop testing. These tests must be run specifically by the developer for them to manually verify the results before they could merge, the smoke tests how to instructions are below in their own section.

Date Tested	March 27th
Test Result	Triggered CSV buttonTriggered no file selectedTriggered CSV buttonTriggered no file selectedTriggered CSV buttonTriggered no file selectedTriggered CSV buttonTriggered no file selectedLoad CSV from URL visible : Url is empty or not a csv file : Load CSV from file system visible : No file selected : Load CSV from URL visible : URL CSV has been successfully loaded :
Smoke Tests Ran	CSV Loading
Passed	5/5
Problems	Failed on files > 5mb

Date Tested	March 29th
Test Result	Triggered CSV buttonTriggered no file selectedTriggered CSV buttonTriggered no file

	selectedTriggered CSV buttonTriggered no file selectedLoad CSV from URL visible : Url is empty or not a csv file : Load CSV from file system visible : No file selected : Load CSV from URL visible : URL CSV has been successfully loaded : Load CSV from file system visible : No file selected : Load CSV from file system visible : File system CSV has been successfully loaded : Load CSV from URL visible : URL CSV has been successfully loaded : Load CSV from URL visible : Load CSV from URL visible : Load CSV from URL visible : URL CSV has been successfully loaded : Load CSV from URL visible : Url is empty or not a csv file : Load CSV from file system visible : File system CSV has been successfully loaded :
Smoke Tests Ran	CSV Loading
Passed	5/5
Problems	Failed on files > 5mb

Date Tested	March 31th
Test Result	Generated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated Z-Axis
Smoke Tests Ran	CSV Loading Axis Display
Passed	2/7
Problems	Failed on files > 5mb

	Merge removed smoke tests for csv and url loading.

Date Tested	April 1st
Test Result	Generated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-
Smoke Tests Ran	CSV Loading Axis Display
Passed	2/11
Problems	Failed on files > 5mb Fix in pr to address failing smoke tests.

Date Tested	April 2nd
Test Result	Generated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X-AxisGenerated Y-AxisGenerated Z-AxisGenerated X- AxisGenerated X-AxisGenerated Y-AxisGenerated Z-Axis| undefined : undefined : undefined : undefined : undefined : undefined : undefined |Generated X-AxisGenerated Y-AxisGenerated Z-Axis| undefined : undefined : undefined : undefined : undefined : undefined : undefined |Generated X-AxisGenerated Y-AxisGenerated Z-Axis| undefined : undefined : undefined : undefined : undefined : undefined : undefined |No more DataPoint info to display; 5,0,5yellowcirclecirclecirclecircle131313Loaded CSV with 3 rowsLoaded CSV with 31 rows
Smoke Tests Ran	Axis Display Data exclusion DisplayDataIn3DSpace DisplayPoints ImportFromCSV UIInteractino
Passed	22/22
Problems	

System Testing

The system testing that was completed was primarily done through that of manual testing on the Meta Quest, in combination with a bug party, which as reported below found 6 distinct bugs through the use of a bug party, as well as 6 things that could be future improvements to the system

Bug Party

Bug Party: Apr 2, 2024

Duration: 1.5 hrs
Notes assembled and triaged performed by Matthew and Mitchell

Team A:

- Mitchel
- Quinn
- Zander

Issues (A.x):

1. Loading Null Column (all zeros) — Everything freezes and then Invalid Array Length Error using the /box.csv null column
2. When loading columns if selecting more then 1 of the same column header it breaks
3. Letters with large data set seem to shift off of the billboard 2000.csv as the points are too large so it shifts values off of the billboard boarder.
4. When loading data sets with column starting with a negative header it goes black and does not recover. — or something is happening might not be negative could be Null value 2000.csv
5. Tilting backboard is uncomfortable
6. When placed out of bounds there is no way to navigate the graph

Team B:

- Tony
- Trang
- Aesha
- Matthew

Issues (B.x):

1. Number headers breaks the plot

2. When using the data set 5by5.csv, selecting the columns Pc1, y, pc3 for the x, y, and z axes crashes the app. This is perhaps due to bugs in the PCA, whic shouldn't be running at this point.
3. Slider not smoothly slide
4. Billboard turn side opposite try to be orthogonal to the eye sight
5. One decimal point under ticks labels. This should be two decimal points.
6. Y axis is the vertical one
7. Billboard text go off the borders
8. Point cover the billboard
9. Freeze on random occasions?

Issue Triage:

Net List (N.x):

1. **Loading Null Column (all zeros) — Everything freezes and then Invalid Array Length Error using the /box.csv null column (A.1)**
2. **When loading columns if selecting more then 1 of the same column header it breaks (A.2)**
3. Letters with large data set seem to shift off of the billboard 2000.csv as the points are too large so it shifts values off of the billboard border. (A.3, B.4)
4. **When loading data sets with columns starting with a negative header it goes black and does not recover. — or something is happening might not be negative could be Null value 2000.csv (A.4, B.1)**
5. Tilting backboard is uncomfortable (A.5, B.4)
6. When placed out of bounds there is no way to navigate the graph (A.6)
7. **When using the data set 5by5.csv, selecting the columns Pc1, y, pc3 for the x, y, and z axes crashes the app. This is perhaps due to bugs in the PCA, which shouldn't be running at this point. (B.2)**
8. The slide for the scaling is not smooth on the oculus (B.3)
9. **One decimal point under ticks labels. This should be two decimal points. (B.5)**
10. Y axis is the vertical one (B.6)
11. Point cover the billboard (B.8)
12. **Freeze on random occasions? (B.9)**
    a. **Tends to happen when removing the headset while running the vr context and putting it back on**

Feature Request	Minor Bug	Major Bug
N.3 N.5 N.6 N.8 N.10 N.11	N.1 N.9 N.12 (may be hardware related)	N.2 (need graceful handling) N.4 N.7

Manual Testing

A large part of verifying how the system worked involved the use of manual verification of the system. For manual verification this involved running the program in the web emulator, but ultimately would require the QA team to walk through the application in the Meta Quest to verify that the application was working as intended.

Note
For manual testing this ID we verified that the system worked not only on the Meta Quest 2 but also the newer Meta Quest 3, confirming that the application is not platform specific but supported on all devices that can use WebXR.

Date	Bugs	Status
March 23, 2024	Cannot load any data. Cannot load large files	App is still not together, can load data points together but mostly unable to verify any new findings until the different sections are brought together.
March 25, 2024		Loading large files has been fixed but the app is still unable to load any new data points
March 27, 2024		No noticeable change yet to the application compared to prior
March 30, 2024	When using certain headers the app fails – reason currently unknown Graph will sometimes move out of the displayed field and Is hard to use App is extremely slow but can load larger data sets, anything more then 2000 is very laggy aprox 5-20fps, app could load upto 500k but it would likely be mostly impossible to use	App has been brought together but team is working to fix as there are large amounts of bugs produced when different sections of the data are used.
March 31, 2024		Some changes were made to the apps points so that it would be more efficient to use, improvement was noticed with the head set on

April 1, 2024	When clicking the complete selection button before any selections are made exceptions are thrown and not properly handled	

For April 2, a bug party was created to compare and bring the team in together to find more problems.

Acceptance Testing

Requirement Verification

Requirement	Meets Requirements
Can load a CSV through file system or a URL	Success The application successfully can load the application through both a URL and the file system with a .csv file.
Can display and is always displaying the graph in 3D space using a VR system	Success The graphing for this project was completed using WebXR and successfully can represent a graph and its features in 3D space
For continuous and ordinal data: (e.g., integer [e.g., “1”, “23”, “323”] or real-valued data [e.g., 21.52] * data should be displayed aligning with a labeled continuous line. * Regular “ticks” should be present to denote values in that line.	Success The graph has a proper access with self-adjusting increments on a continuous line, the ticks appear in a regular fashion and the scale can be adjusted.
Walk around in the space (when viewed in particular orientation), allowing the user to view the space from different angles.	Success The user when in VR mode can walk around the graph, allowing them to see it from any angle that they desire.
Change of displayed fields: * each axis should have a drop-down menu supporting choosing of a field, as well as incremental search for a field (as each successive element of the name is typed). * Selection of a new field shall lead to the update of the visualized space.	Success The menu allows the user to choose which axis is represented in which direction, and the drop down updates live when opened concurrently with the VR mode enabled.

Reports

Test Coverage

Due to us no longer using Jest for our unit testing, we had to make the change from using the jest –coverage tool to using v8 which allows us to get a very similar code test coverage report.

File	% Stmts	% Branch	% Funcs	% Lines	Uncovered Line #s
All files	71.8	76.5	66.66	71.8	
smoketests	9.6	25	20	9.6	
TestHookWrite.tsx	80.95	50	100	80.95	17-18,20-21
TestHooksWorktest.tsx	0	0	0	0	13-Jan
TestingOptions.tsx	0	0	0	0	1-86
TextInFileSearch.tsx	0	0	0	0	1-38
TextInFileSearchtest.tsx	0	0	0	0	19-Jan
src	0	0	0	0	
App.tsx	0	0	0	0	1-82
main.tsx	0	0	0	0	12-Jan
src/components	62.94	78.04	52	62.94	
Box.tsx	0	0	0	0	1-44
Button.tsx	0	0	0	0	1-52
CreateGraphingDataPoints.tsx	98.01	100	100	98.01	66-67
CreatePointPositions.tsx	100	33.33	100	100	49
CsvReader.tsx	0	0	0	0	1-184
Floor.tsx	0	0	0	0	15-Jan
GenerateTick.tsx	100	100	100	100	

GenerateXYZ.tsx	98.24	100	100	98.24	58-59
GraphingDataPoint.tsx	80.35	75	20	80.35	44-53,60-71
GraphingDataPointMenu.tsx	0	0	0	0	1-77
ScaleSlider.tsx	100	100	100	100	
SelectAxesMenu.tsx	81.45	85.71	50	81.45	34-38,77-79,95-107,117-118
SingleAxis.tsx	100	100	100	100	
src/contexts	87.56	85.71	50	87.56	
AxesSelectionContext.tsx	84.03	75	40	84.03	62-66,69-73,76-80,114-117
PointSelectionContext.tsx	92.68	100	66.66	92.68	48-53
src/data	97.04	89.79	83.33	97.04	
DataAbstractor.tsx	100	100	100	100	
DataLayer.tsx	96.89	89.58	82.35	96.89	115-117,225-226,237-238,331-332,420-422,461-463
src/repository	90.78	81.96	95	90.78	
Column.tsx	100	100	100	100	
DataPoint.tsx	100	100	100	100	
DbRepository.tsx	94.87	81.81	100	94.87	37-38,81,103-104,115-116,121-122,125,152-153,155-156,158,164-165,198,254-255,266-267
Repository.tsx	0	0	0	0	27-Jan
src/types	0	0	0	0	

DataPointTypes.tsx	0	0	0	0	18-Jan
src/utils	80.39	61.29	71.42	80.39	
Assert.tsx	100	100	100	100	
CsvUtils.tsx	54.63	42.85	40	54.63	35-40,47-51,55-84,90-92
LoggingUtils.tsx	87.2	36.36	100	87.2	13-14,16-23,76
PcaCovariance.tsx	91.59	100	80	91.59	88-97
StandardizeDataset.tsx	88.57	83.33	100	88.57	25-28

Test Matrix

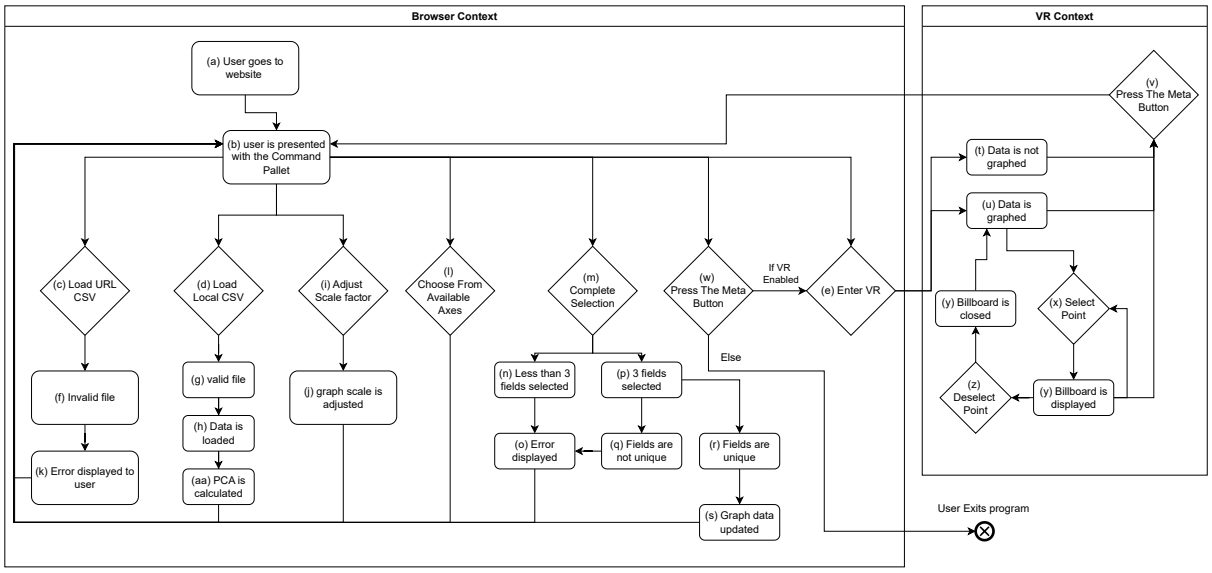
Finalized test matric that covers all of the required sections from the stake holder

Tests\Features	Loading CSV Documents	Creating Data Points For 3D Graph	Create Axis for 3D graph	UI Interaction for	Integrate showin	Data processing backend of the PCA a	Exclude incomplete data from a CSV
Test #1							
Test #2							
Test #3							
Test #4							
Test #5							
Test #6							
Test #7							
Test #8							
Test #9	X						
Test #10	X						
Test #11	X						
Test #12	X						
Test #13	X						
Test #14	X						
Test #15	X						
Test #16		X					
Test #17		X					
Test #18		X					
Test #19		X					
Test #20		X					
Test #21		X					
Test #22		X					
Test #23			X				
Test #24			X				
Test #25			X				
Test #26			X				
Test #27			X				
Test #28			X				
Test #29				X			
Test #30				X			
Test #31				X			
Test #32				X			
Test #33							
Test #34							
Test #35					X		
Test #36					X		
Test #37					X		
Test #38						X	
Test #39						X	
Test #40	X						
Test #41							X
Test #42							X

Test List

TestID	IssueID	FeatureName	Intent	Pass / Fail	Ideration #	Notes
1	#61	WebXR spike	Loading WebXR through Quest Browser	Pass	1	
2	#61	WebXR spike	Launch Quest Through Firebase Host	Pass	1	
3	#61	WebXR spike	Meta Quest Controls interact with spike	Pass	2	ID1, Found some Converns with controlls notr releasing as Expected
4	#61	WebXR spike	Spike Responsitivity	Pass	1	
5	#61	WebXR spike	Quest Can Enter VR Mode	Pass	1	
6	#100	FixedJest		N/A	2	
7	#100	FixedJest		N/A	2	
8	#100	FixedJest		N/A	2	
9	#10	Importing From a CSV	CSV buttons become visible to the user	Pass	2	
10	#10	Importing From a CSV	Loading CSV from URL	Pass	2	
11	#10	Importing From a CSV	Loading CSV from local files system	Pass	2	
12	#10	Importing From a CSV	Correct data is loaded from CSV	Pass	2	
13	#10	Importing From a CSV	Pressing import button without CSV	Pass	2	Throws exeption, handle it or disable button until input provided
14	#10	Importing From a CSV	Importing empty CSV	Pass	2	Does not break, but indicate to user that selected CSV file is empty
15	#10	Importing From a CSV	Selecting a new CSV after already selecting one	Pass	2	
16	#79	Creating Data Points For 3D Graph	View Data Points in 3D Space	Pass	2	
17	#79	Creating Data Points For 3D Graph	View Data Points in 3D Space while walking	Pass	2	
18	#79	Creating Data Points For 3D Graph	Interact with Data Points in 3D Space	Pass	2	
19	#79	Creating Data Points For 3D Graph	Touch a Data Point in 3D Space with left controll	Pass	2	
20	#79	Creating Data Points For 3D Graph	Touch with Data Points in 3D Space with right co	Pass	2	
21	#79	Creating Data Points For 3D Graph	Choose Data Point in 3D Space with left controll	Pass	2	no data point's information is shown yet as we haven't use CSV data to draw those points
22	#79	Creating Data Points For 3D Graph	Choose Data Point in 3D Space with right contro	Pass	2	no data points's information is shown yet as we haven't use CSV data to draw those points
23	#78	Create Axis for 3D graph	View the Axises in 3D Space	Pass	2	
24	#78	Create Axis for 3D graph	Axises visibility when moving along x-axis	Pass	2	
25	#78	Create Axis for 3D graph	Axises visibility when moving along y-axis	Pass	2	
26	#78	Create Axis for 3D graph	Axises visibility when moving along z-axis	Pass	2	
27	#78	Create Axis for 3D graph	Checking the stability of the 3D axes, no lag	Pass	2	
28	#78	Create Axis for 3D graph	Scaling the 3D axes based on loaded data points	Pass		No data points to render and have no method on the user side to check the scaling
29	#26	UI Interaction for Point Details	Details show when a data point is clicked	Pass	3	
30	#26	UI Interaction for Point Details	Details show for second clicked data point and p	Pass	3	
31	#26	UI Interaction for Point Details	Details of a data point disappear when clicking o	Pass	3	
32	#26	UI Interaction for Point Details	Details of data point stay where they are when u	Pass	3	
33	-- No Issue	App Builds	Verify that the app builds without failure	Pass	3	
34	-- No Issue	Original Spike Removed		Pass	3	
35	#13	Integrate showing the data in 3D	Multiple Access Data is visible	Pass	3	
36	#13	Integrate showing the data in 3D	No data to be show	Pass	3	
37	#13	Integrate showing the data in 3D	Loading data for floats	Pass	3	
38	#120	Data processing backend of the PC	Passing the right amount of data to be processe	Pass	3	
39	#120	Data processing backend of the PC	Handling incorrect amount of data passed in for	Pass	3	
40	#10	Importing From a CSV	Importing 500, 000 data points	Pass	4	This is a new test case that was missed. We will need to use some type of streaming to get all
41	#22	Exclude incomplete data from a CS	Complete CSV import (all data should be importe	Pass	5	
42	#22	Exclude incomplete data from a CS	Incomplete CSV import (only complete rows sho	Pass	5	

Path Coverage



To cover all possible paths, we relied on the gherkin-based smoke tests/ manual tests, and for individual nodes/ blocks each contained individual unit testing to prove accuracy.

For the different paths, each node/ block has been given a letter to identify, as shown in the diagram above.

Gherkin / SmokeTest	Tests	Pathway(s) taken
Importing from csv	Importing from URL	a → b → c → g → h → aa → I
	Importing from file system	a → b → d → g → h → aa → I
	Importing invalid URL	a → b → c → f → k → b
	Importing invalid file	a → b → d → f → k → b
Selection Smoke Test	Selecting < 3 fields	b → m → n → o → b
	Selecting 3 different fields	b → m → p → r → s → b
	Selecting same fields	b → m → p → q → o → b
UI Interaction	Selecting a point	e → u → x → y →
	Selecting/ deselect point	e → u → x → y → z → y → u
	Returning to menu	e → u → v → b
	Selecting a second point	e → u → x → y → x → y
	Loading empty csv	e → t → v → b

With our testing we successfully covered 100% (28/28 nodes/blocks) of edge cases, meaning that we accomplished transition / edge testing pathways.

Documents

Undiagnosed Bugs

Estimation of Remaining Defects

Estimation derived using the Capture-Recapture method from:

1. S. Biffl, . "Evaluating defect estimation models with major defects".Journal of Systems and Software 65, no.1 (2003): 13-29.
2. Otis, David L., Kenneth P. Burnham, Gary C. White, and David R. Anderson. “Statistical Inference from Capture Data on Closed Animal Populations.” *Wildlife Monographs*, no. 62 (1978): 3–135. http://www.jstor.org/stable/3830650.

Let the total population of bugs be defined as N, the number of bugs found by teams A and B be n_A and n_B, respectively, and let the number of bugs found by both teams be m. Then, from Otis et al, our total population of bugs would be:

$$N = \frac{n_A n_B}{m} = \frac{3 \times 4}{1} = 12$$

Therefore given the tested scope, we likely have 6 undiagnosed bugs. However, because our PCA calculations are not connected to the UI, they were not included in this testing. The PCA specific sections of the code are approximately 5% of our source code. Therefore, the adjusted number of bugs as of yet undiagnosed is:

$$N_{total} = \frac{12}{0.95} = 12.63 \approx 13$$

$$N_{undiagnosed} = N_{total} - N_{found} = 13 - 6 = 7$$

We estimate that there are 7 undiagnosed major and minor bugs remaining in the system.

How To Smoke Test

How to run smoke tests on local simulation

1. Create a .env.local file in the root of the project
2. Add a variable for testing to true VITE_IS_TESTING=true
3. Run a local host of the development branch that you are on using npm run dev.
4. To verify that you are in the testing mode there should be options at the top of the display that look like this.

5. The begin test clears any prior results from the cache and the download button allows you to download and view the results of the smoke test to then verify that they have operated as expected.
6. To then verify the results, you can take the text file obtained from the testing download and run npm run smoketest in the terminal. This will allow the confirmation and automatic running of all smoke test complete with human in the loop testing.

To run on the meta quest

1. When starting the local host use the –- --host to allow other devices to connect to the test.
2. Connect to the URL on the meta quest.
3. Once connected run and download the tests.
4. Connect the Meta quest to computer.
5. Take results off the meta quest and run the smoke test again.

Continued Testing

The continued testing of this project if it were to continue would be to have a continued testing investment placed into creating a custom test harness. This would remove the human in the loop aspect, which while important is an extremely expensive task. Having someone manually verify everything on the Meta Quest when the team is in total 8 people. With a proper testing harness there would be less of a requirement for the developers to verify all old processes in the code work allowing for more focus on the new testing required.