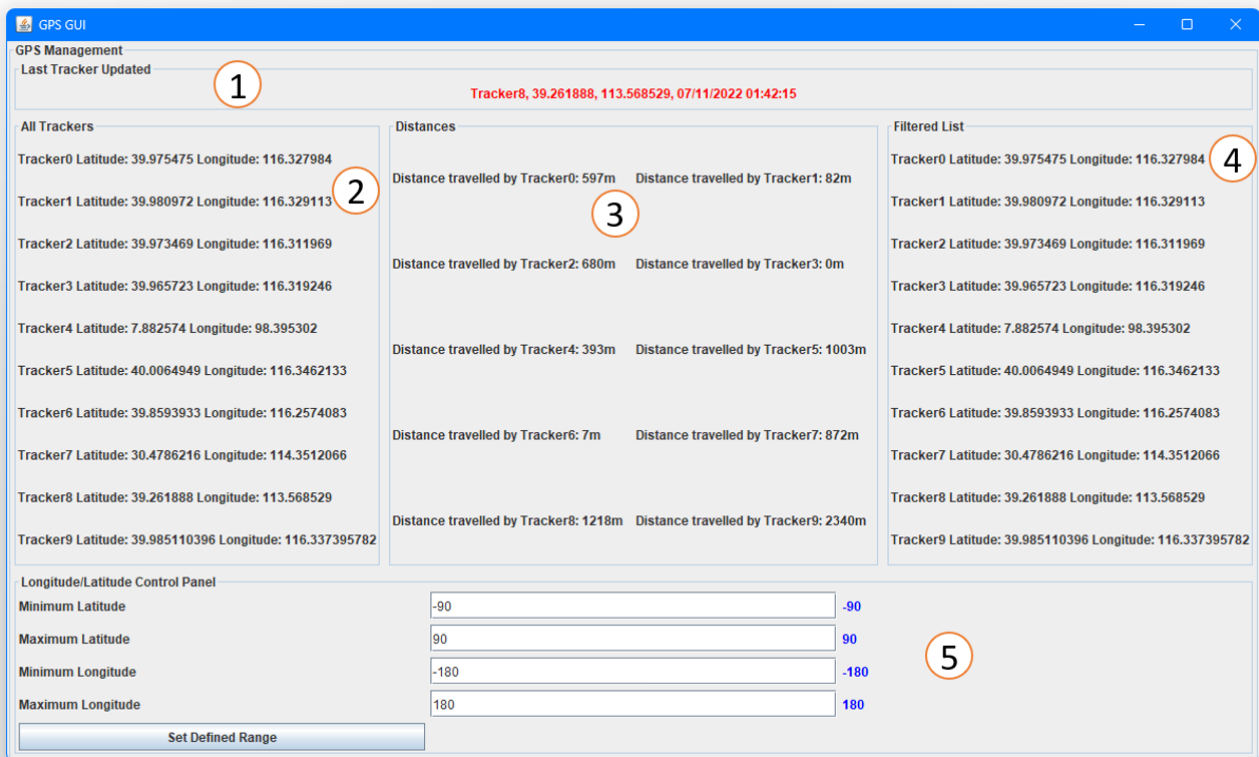


Testing Report for EDC Assignment 3:

How to start:

1. Run the command to compile
 - a. `javac -cp ".;lib/sodium.jar;lib/swidgets.jar" GpsGUI.java GpsService.java GpsEvent.java`
2. Run the command to run the application
 - a. `java -cp ".;lib/sodium.jar;lib/swidgets.jar" GpsGUI`

Testing Report:



The user interface of the GPS GUI is divided into 5 distinct sections. According to the Expected GUI Display/ Output Format, the following are the points and the corresponding sections:

1. **SECTION 2** Ten tracker simplified displays. Simplified tracking data has its altitude data removed and this should be carried out with Sodium FRP operations. From this stream, display, in separate cells:
 - Tracker number
 - latitude

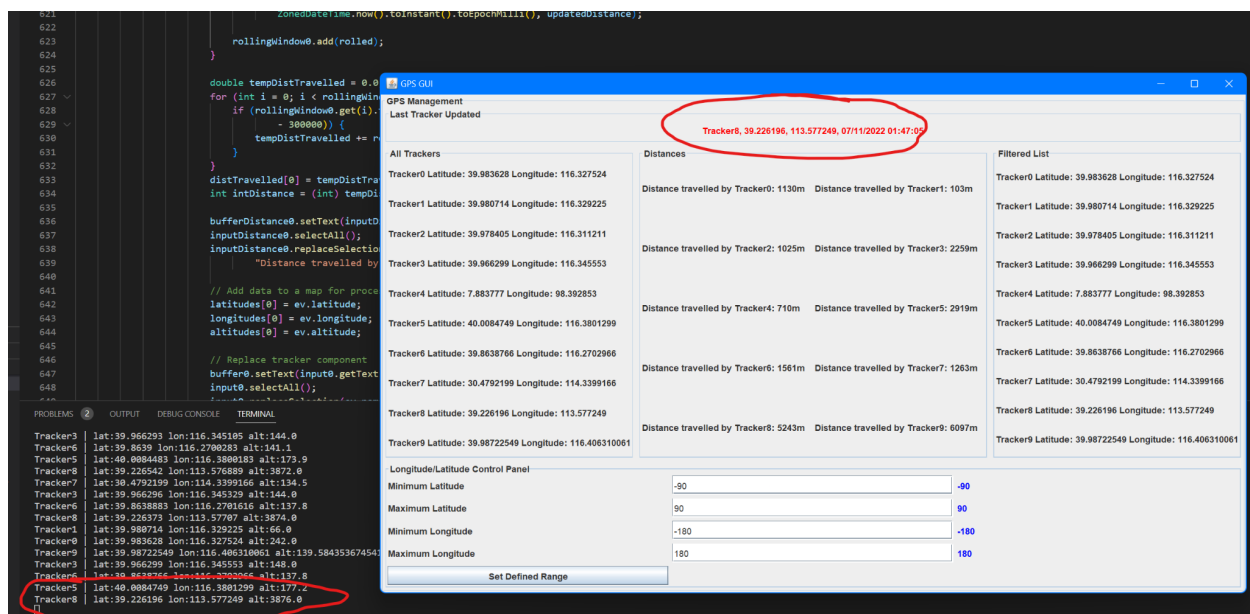
- longitude
- 2. **[SECTION 1]** A display field shows each event as it is passed to the GUI, at the time it occurs.
 - This is presented as a comma-delimited string of 4 items
 - Only a single entry is presented at a time, and cleared after 3 seconds if not overwritten.
- 3. **[SECTION 4 & 5]** A single (1) display that combines all input streams, and only outputs GPS events in the defined range of Latitude and Longitude.
 - The defined range is controlled by a control panel consisting of a latitude input field, a longitude input field, and a button to set the restriction.
 - The latitude and longitude restriction will probably require the use of the **snapshot** primitive.
 - Labels show the current setting of the restriction.
 - The GUI element displays the data in an identical form to the display field in (2), as long as the data is in the range.
- 4. **[SECTION 3 & 5]** A distance field for each tracker that outputs the total distance travelled over the last 5 minutes for each tracker.
 - Your GUI should display a label for each tracker, with the current distance travelled next to it.
 - This only includes events that are within the currently set Lat/Long range.
 - The value should be a distance in meters, rounded up to the nearest integer meter.
 - **Important: The tracker altitude data is in feet. You should use `map` to transform this data.**
 - Distance calculations may be calculated without considering the curvature of the Earth but must take the altitude into account.
(See Latitude and Longitude section below)
 - **Hint:** You might want to look at the FRP primitive `snapshot`.
 - **Hint:** A sliding window of 5 minutes, however you implement it, will make this calculation easier. You only calculate distances between known positions, i.e. two distinct events

Your GUI should use framing and clear structure to group similar elements and make it easy to understand what is going on.

Section 1 Last Tracker Updated (Point 2)

This section shows a display field of each event that happens as a comma-delimited string of 4 items that is cleared after 3 seconds if not overwritten.

Testing this section was just corresponding to the last events that were printed in the terminal with the tracker that was showing as the 'last event'. This test shows that it works:

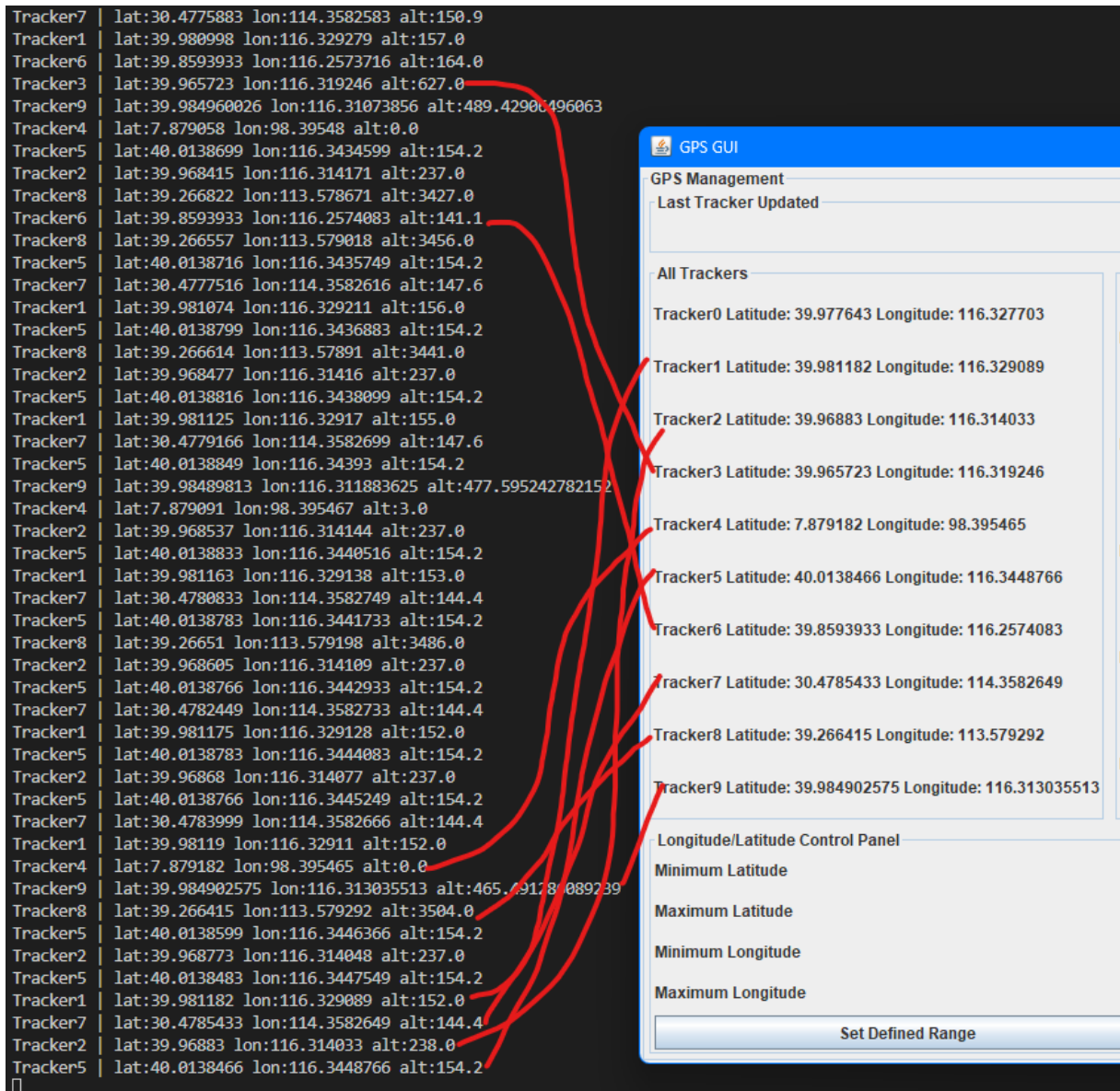


We can inspect that every 3 seconds if not updated it will clear itself by placing a print statement and modifying the code in the loop to stop events from happening. From this it has been verified that the timer every 3 seconds works.

Section 2 All Trackers (Point 1)

This section shows ten simplified tracker displays. The altitude of this data has been removed with Sodium FRP operations.

Testing this section was just corresponding to the events that were printed in the terminal with the tracker that was showing as the 'last event'. This test shows that it works:



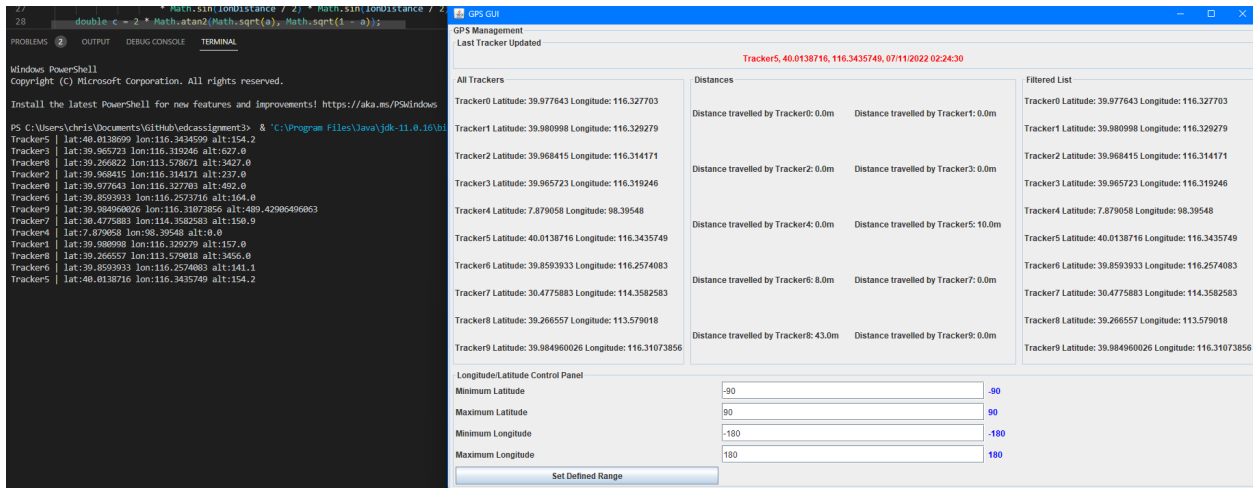
Section 3 Distances (Point 4)

This section shows ten tracker labels with their corresponding distance traveled.

It only includes events that are within the Lat/Long range from Section 5.

The value should be in meters (rounded up).

To test this section, I first just looked at the values of the distances traveled in correspondence to what was displayed on the output of the GPS Service.

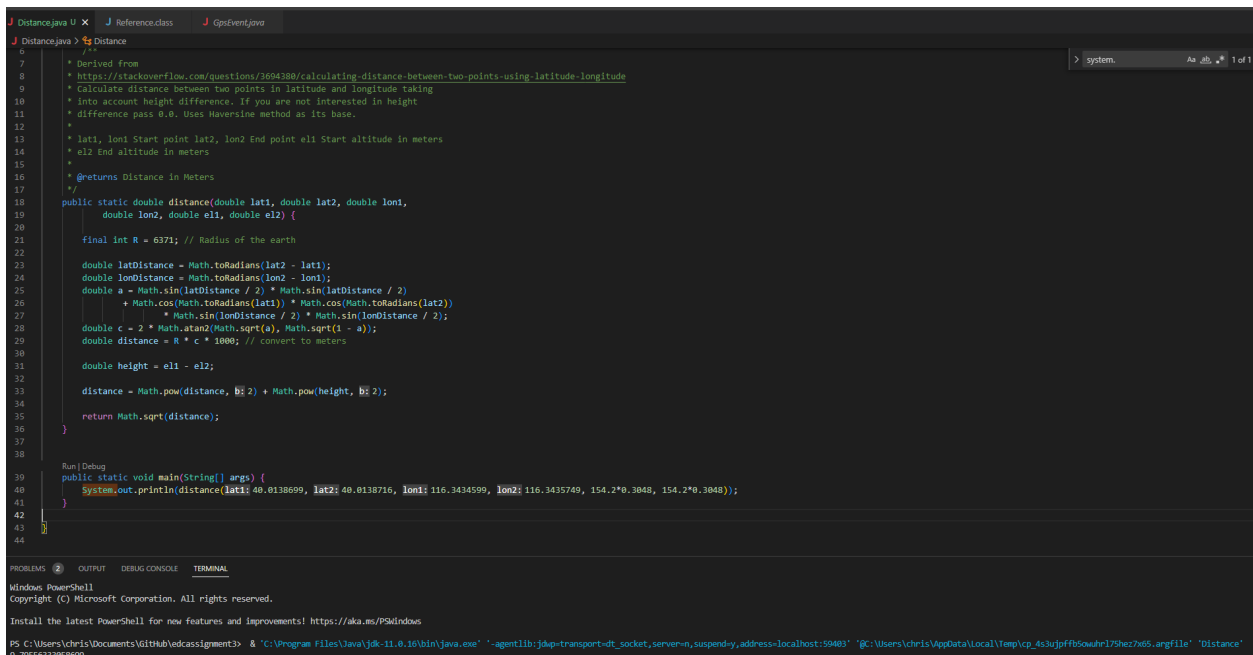


I then looked at the two strings that were shown highlighted at the beginning:

Tracker5 | lat:40.0138699 lon:116.3434599 alt:154.2

Tracker5 | lat:40.0138716 lon:116.3435749 alt:154.2

With the altitude multiplied by 0.3048 to convert to meters



Which gives us 9.79556333058699 ~ 10 m

Therefore the rounding and distance calculation is correct. I repeated this for a few other strings.

Note this uses the distance formula from

<https://stackoverflow.com/questions/3694380/calculating-distance-between-two-points-using-latitude-longitude>

Now to test that it only registers events that are within the range we set.

We quickly set the minimum latitude to 40 so that only tracker 5 meets the requirements

The screenshot shows a Java application window titled 'GPS GUI' with a 'GPS Management' tab. The 'Last Tracker Updated' section displays 'Tracker5, 40.0138766, 116.3445249, 07/11/2022 02:29:05'. The 'All Trackers' section lists 10 trackers with their coordinates and altitudes. The 'Distances' section shows the distance travelled by each tracker. The 'Filtered List' section shows the filtered list of trackers. The 'Longitude/Latitude Control Panel' section has input fields for Minimum Latitude (40), Maximum Latitude (90), Minimum Longitude (-180), and Maximum Longitude (180), with a 'Set Defined Range' button.

After a few seconds we find that everything else has remained the same except for tracker 5, which has gone from 91 m to 168m. Therefore we know that the filter is working and it only updates if the tracker is in range. We can also see from the terminal all the other events that are happening which do update on the All Trackers part of the program but does not register on the distance - which is a clear separation of both modules.

The screenshot shows a Java application window titled 'GPS GUI' with a 'GPS Management' tab. The 'Last Tracker Updated' section displays 'Tracker5, 40.0138233, 116.3454216, 07/11/2022 02:29:13'. The 'All Trackers' section lists 10 trackers with their coordinates and altitudes. The 'Distances' section shows the distance travelled by each tracker. The 'Filtered List' section shows the filtered list of trackers. The 'Longitude/Latitude Control Panel' section has input fields for Minimum Latitude (40), Maximum Latitude (90), Minimum Longitude (-180), and Maximum Longitude (180), with a 'Set Defined Range' button.

Section 4 + 5 Filtered List and Control Panel (Point 3)

Section 4 and 5 correspond to point 3 where the requirements for testing were that the defined range is controlled by a control panel consisting of a latitude input field and a longitude input field and a button to set this restriction.

As we can see there are the input fields of the minimum and maximum latitude and longitudes. The labels show the current setting of the restriction.

The screenshot displays the 'GPS GUI' application window. The title bar reads 'GPS GUI'. The main content area is divided into several sections:

- GPS Management**: A status bar at the top showing 'Last Tracker Updated'.
- Tracker8, 39.265255, 113.574234, 07/11/2022 02:33:19**: A red text label indicating the current selected tracker.
- All Trackers**: A list of 10 trackers with their coordinates:
 - Tracker0 Latitude: 39.97541 Longitude: 116.329522
 - Tracker1 Latitude: 39.98099 Longitude: 116.329158
 - Tracker2 Latitude: 39.969906 Longitude: 116.313603
 - Tracker3 Latitude: 39.965723 Longitude: 116.319246
 - Tracker4 Latitude: 7.881982 Longitude: 98.395303
 - Tracker5 Latitude: 40.0090199 Longitude: 116.3461016
 - Tracker6 Latitude: 39.8593933 Longitude: 116.2574083
 - Tracker7 Latitude: 30.4786783 Longitude: 114.3551716
 - Tracker8 Latitude: 39.265255 Longitude: 113.574234
 - Tracker9 Latitude: 39.984522857 Longitude: 116.323522032
- Distances**: A section showing the distance travelled by each tracker:
 - Distance travelled by Tracker0: 456.0m Distance travelled by Tracker1: 72.0m
 - Distance travelled by Tracker2: 245.0m Distance travelled by Tracker3: 0.0m
 - Distance travelled by Tracker4: 328.0m Distance travelled by Tracker5: 722.0m
 - Distance travelled by Tracker6: 8.0m Distance travelled by Tracker7: 490.0m
 - Distance travelled by Tracker8: 581.0m Distance travelled by Tracker9: 1157....
- Filtered List**: A list of 10 trackers, identical to the 'All Trackers' list, showing the result of the current filter settings.
- Longitude/Latitude Control Panel**: A section with four input fields and a button:
 - Minimum Latitude: -90
 - Maximum Latitude: 90
 - Minimum Longitude: -180
 - Maximum Longitude: 180
 - Button: Set Defined Range

To test the normal use of this application, we can choose a tracker to filter out. For example, choosing to filter by latitude to show tracker4 as it is around 7 compared which is different from the others:

GPS GUI

GPS Management
Last Tracker Updated

Tracker5, 40.0084366, 116.36931, 07/11/2022 02:37:36

All Trackers	Distances	Filtered List
Tracker0 Latitude: 39.981118 Longitude: 116.327676	Distance travelled by Tracker0: 964.0m Distance travelled by Tracker1: 108.0m	
Tracker1 Latitude: 39.980954 Longitude: 116.329165		
Tracker2 Latitude: 39.977755 Longitude: 116.310714	Distance travelled by Tracker2: 1046.0m Distance travelled by Tracker3: 0.0m	
Tracker3 Latitude: 39.966233 Longitude: 116.325571		
Tracker4 Latitude: 7.883777 Longitude: 98.392853	Distance travelled by Tracker4: 394.0m Distance travelled by Tracker5: 2718.0m	Tracker4 Latitude: 7.882574 Longitude: 98.395302
Tracker5 Latitude: 40.0084366 Longitude: 116.36931		
Tracker6 Latitude: 39.86359 Longitude: 116.25997	Distance travelled by Tracker6: 143.0m Distance travelled by Tracker7: 1451.0m	
Tracker7 Latitude: 30.4783849 Longitude: 114.3443683		
Tracker8 Latitude: 39.23975 Longitude: 113.56449	Distance travelled by Tracker8: 2749.0m Distance travelled by Tracker9: 4539.0m	
Tracker9 Latitude: 39.986524521 Longitude: 116.384629129		

Longitude/Latitude Control Panel

Minimum Latitude	6	6
Maximum Latitude	8	8
Minimum Longitude	-180	-180
Maximum Longitude	180	180

We can see the other trackers disappear as they are not in the range of the control panel.

If we want to filter based on longitude, we can choose the trackers that fit in the 116 range.

GPS GUI

GPS Management
Last Tracker Updated

Tracker6, 39.8640149, 116.2675833, 07/11/2022 02:38:42

All Trackers	Distances	Filtered List
Tracker0 Latitude: 39.983062 Longitude: 116.327696	Distance travelled by Tracker0: 964.0m Distance travelled by Tracker1: 74.0m	Tracker0 Latitude: 39.983062 Longitude: 116.327696
Tracker1 Latitude: 39.980699 Longitude: 116.329225		Tracker1 Latitude: 39.980699 Longitude: 116.329225
Tracker2 Latitude: 39.978389 Longitude: 116.311217	Distance travelled by Tracker2: 1017.0m Distance travelled by Tracker3: 1894.0m	Tracker2 Latitude: 39.978389 Longitude: 116.311217
Tracker3 Latitude: 39.96629 Longitude: 116.341363		Tracker3 Latitude: 39.96629 Longitude: 116.341363
Tracker4 Latitude: 7.883777 Longitude: 98.392853	Distance travelled by Tracker4: 394.0m Distance travelled by Tracker5: 2950.0m	
Tracker5 Latitude: 40.0084399 Longitude: 116.3798883		Tracker5 Latitude: 40.0084399 Longitude: 116.3798883
Tracker6 Latitude: 39.8640149 Longitude: 116.2675833	Distance travelled by Tracker6: 1185.0m Distance travelled by Tracker7: 1319.0m	Tracker6 Latitude: 39.8640149 Longitude: 116.2675833
Tracker7 Latitude: 30.4790833 Longitude: 114.3403016		
Tracker8 Latitude: 39.229432 Longitude: 113.573953	Distance travelled by Tracker8: 4810.0m Distance travelled by Tracker9: 6097.0m	
Tracker9 Latitude: 39.987052903 Longitude: 116.400773349		Tracker9 Latitude: 39.987052903 Longitude: 116.400773349

Longitude/Latitude Control Panel

Minimum Latitude	-90	-90
Maximum Latitude	90	90
Minimum Longitude	115	115
Maximum Longitude	117	117

As can be seen, this example test shows that the control panel works.

Edge Case / Error Handling:

To test that the values do not go over the minimum and maximum values of -90, 90 and -180, 180 for latitude and longitude respectively, we try setting the defined range over.

GPS GUI

GPS Management

Last Tracker Updated

Tracker2, 39.973312, 116.312039, 07/11/2022 02:34:09

All Trackers

Tracker0 Latitude: 39.975442 Longitude: 116.328011

Tracker1 Latitude: 39.980975 Longitude: 116.329108

Tracker2 Latitude: 39.973312 Longitude: 116.312039

Tracker3 Latitude: 39.965723 Longitude: 116.319246

Tracker4 Latitude: 7.882574 Longitude: 98.395302

Tracker5 Latitude: 40.0064949 Longitude: 116.3462133

Tracker6 Latitude: 39.8593933 Longitude: 116.2574083

Tracker7 Latitude: 30.4786266 Longitude: 114.3513233

Tracker8 Latitude: 39.262215 Longitude: 113.568993

Tracker9 Latitude: 39.985068614 Longitude: 116.336193258

Distances

Distance travelled by Tracker0: 553.0m Distance travelled by Tracker1: 80.0m

Distance travelled by Tracker2: 470.0m Distance travelled by Tracker3: 0.0m

Distance travelled by Tracker4: 394.0m Distance travelled by Tracker5: 992.0m

Distance travelled by Tracker6: 8.0m Distance travelled by Tracker7: 767.0m

Distance travelled by Tracker8: 976.0m Distance travelled by Tracker9: 1996....

Filtered List

Longitude/Latitude Control Panel

Minimum Latitude -9012389 -90

Maximum Latitude 2948924 90

Minimum Longitude -394084 -180

Maximum Longitude 893434 180

Set Defined Range

We can see that it doesn't register anything because it goes over the limit. Only registering the -90, 90, -180, and 180.

We can also test that the minimum can't go over the maximum and will be limited.

For example, in this case:

GPS GUI

GPS Management

Last Tracker Updated

Tracker1, 39.980906, 116.329071, 07/11/2022 02:35:54

All Trackers

Tracker0 Latitude: 39.977563 Longitude: 116.327712
Tracker1 Latitude: 39.980906 Longitude: 116.329071
Tracker2 Latitude: 39.976139 Longitude: 116.310998
Tracker3 Latitude: 39.965723 Longitude: 116.319246
Tracker4 Latitude: 7.883777 Longitude: 98.392853
Tracker5 Latitude: 40.0081066 Longitude: 116.3621966
Tracker6 Latitude: 39.8594983 Longitude: 116.2581566
Tracker7 Latitude: 30.4783099 Longitude: 114.3456299
Tracker8 Latitude: 39.254969 Longitude: 113.556287
Tracker9 Latitude: 39.985836004 Longitude: 116.359494582

Distances

Distance travelled by Tracker0: 821.0m Distance travelled by Tracker1: 101.0m

Distance travelled by Tracker2: 1026.... Distance travelled by Tracker3: 0.0m

Distance travelled by Tracker4: 394.0m Distance travelled by Tracker5: 2373....

Distance travelled by Tracker6: 77.0m Distance travelled by Tracker7: 1420....

Distance travelled by Tracker8: 2567.... Distance travelled by Tracker9: 4225....

Filtered List

Tracker0 Latitude: 39.977563 Longitude: 116.327712
Tracker1 Latitude: 39.980906 Longitude: 116.329071
Tracker2 Latitude: 39.976139 Longitude: 116.310998
Tracker3 Latitude: 39.965723 Longitude: 116.319246
Tracker4 Latitude: 7.882574 Longitude: 98.395302
Tracker5 Latitude: 40.0081066 Longitude: 116.3621966
Tracker6 Latitude: 39.8594983 Longitude: 116.2581566
Tracker7 Latitude: 30.4783099 Longitude: 114.3456299
Tracker8 Latitude: 39.254969 Longitude: 113.556287
Tracker9 Latitude: 39.985836004 Longitude: 116.359494582

Longitude/Latitude Control Panel

Minimum Latitude

-90

-90

Maximum Latitude

50

50

Minimum Longitude

-180

-180

Maximum Longitude

180

180

Set Defined Range

If we try and set minimum latitude to be larger than 51, we are capped at 50 instead.

GPS GUI

GPS Management

Last Tracker Updated

Tracker7, 30.4785266, 114.3454616, 07/11/2022 02:36:11

All Trackers

Tracker0 Latitude: 39.978636 Longitude: 116.327796
Tracker1 Latitude: 39.980958 Longitude: 116.329098
Tracker2 Latitude: 39.976287 Longitude: 116.310974
Tracker3 Latitude: 39.965723 Longitude: 116.319246
Tracker4 Latitude: 7.883777 Longitude: 98.392853
Tracker5 Latitude: 40.0082549 Longitude: 116.3664616
Tracker6 Latitude: 39.8596299 Longitude: 116.2589083
Tracker7 Latitude: 30.4785266 Longitude: 114.3454616
Tracker8 Latitude: 39.253431 Longitude: 113.5573
Tracker9 Latitude: 39.98600197 Longitude: 116.364494719

Distances

Distance travelled by Tracker0: 964.0m Distance travelled by Tracker1: 108.0m

Distance travelled by Tracker2: 1046.0m Distance travelled by Tracker3: 0.0m

Distance travelled by Tracker4: 394.0m Distance travelled by Tracker5: 2718.0m

Distance travelled by Tracker6: 143.0m Distance travelled by Tracker7: 1451.0m

Distance travelled by Tracker8: 2749.0m Distance travelled by Tracker9: 4539.0m

Filtered List

Longitude/Latitude Control Panel

Minimum Latitude

51

50

Maximum Latitude

50

50

Minimum Longitude

-180

-180

Maximum Longitude

180

180

Set Defined Range

With the filter list not updating due to the invalid format.

Testing the 5 minute Window: Quick Test

A quick test can be performed to see if there is indeed a window by seeing if there is a fluctuation both upwards and downwards of the distances after 5 minutes.

GPS GUI

GPS Management
Last Tracker Updated

Tracker3, 39.967101, 116.388015, 07/11/2022 02:43:34

All Trackers

Tracker0 Latitude: 39.991152 Longitude: 116.327038
Tracker1 Latitude: 39.980802 Longitude: 116.329071
Tracker2 Latitude: 39.989014 Longitude: 116.309623
Tracker3 Latitude: 39.967101 Longitude: 116.388015
Tracker4 Latitude: 7.908411 Longitude: 98.391283
Tracker5 Latitude: 40.0204799 Longitude: 116.4259133
Tracker6 Latitude: 39.82927 Longitude: 116.2873149
Tracker7 Latitude: 30.4935549 Longitude: 114.3342333
Tracker8 Latitude: 39.188761 Longitude: 113.616594
Tracker9 Latitude: 39.980934418 Longitude: 116.446302328

Distances

Distance travelled by Tracker0: 1109.0m Distance travelled by Tracker1: 96.0m
Distance travelled by Tracker2: 1319.0m Distance travelled by Tracker3: 4148.0m
Distance travelled by Tracker4: 394.0m Distance travelled by Tracker5: 5838.0m
Distance travelled by Tracker6: 5021.0m Distance travelled by Tracker7: 1319.0m
Distance travelled by Tracker8: 6141.0m Distance travelled by Tracker9: 4328.0m

Filtered List

Tracker0 Latitude: 39.991152 Longitude: 116.327038
Tracker1 Latitude: 39.980802 Longitude: 116.329071
Tracker2 Latitude: 39.989014 Longitude: 116.309623
Tracker3 Latitude: 39.967101 Longitude: 116.388015
Tracker4 Latitude: 7.882574 Longitude: 98.395302
Tracker5 Latitude: 40.0204799 Longitude: 116.4259133
Tracker6 Latitude: 39.82927 Longitude: 116.2873149
Tracker7 Latitude: 30.4789433 Longitude: 114.3413466
Tracker8 Latitude: 39.188761 Longitude: 113.616594
Tracker9 Latitude: 39.980934418 Longitude: 116.446302328

Longitude/Latitude Control Panel

Minimum Latitude
Maximum Latitude
Minimum Longitude
Maximum Longitude

-90
90
-180
180

-90
90
-180
180

Set Defined Range

GPS GUI

GPS Management
Last Tracker Updated

Tracker3, 39.967156, 116.389785, 07/11/2022 02:43:43

All Trackers

Tracker0 Latitude: 39.991236 Longitude: 116.327038
Tracker1 Latitude: 39.980792 Longitude: 116.329067
Tracker2 Latitude: 39.989218 Longitude: 116.309724
Tracker3 Latitude: 39.967156 Longitude: 116.389785
Tracker4 Latitude: 7.908411 Longitude: 98.391283
Tracker5 Latitude: 40.0204099 Longitude: 116.4284666
Tracker6 Latitude: 39.829245 Longitude: 116.2892683
Tracker7 Latitude: 30.4941733 Longitude: 114.3343833
Tracker8 Latitude: 39.186807 Longitude: 113.617516
Tracker9 Latitude: 39.980774646 Longitude: 116.446556576

Distances

Distance travelled by Tracker0: 1097.0m Distance travelled by Tracker1: 95.0m
Distance travelled by Tracker2: 1344.0m Distance travelled by Tracker3: 4116.0m
Distance travelled by Tracker4: 394.0m Distance travelled by Tracker5: 6029.0m
Distance travelled by Tracker6: 5067.0m Distance travelled by Tracker7: 1830.0m
Distance travelled by Tracker8: 6372.0m Distance travelled by Tracker9: 4133.0m

Filtered List

Tracker0 Latitude: 39.991236 Longitude: 116.327038
Tracker1 Latitude: 39.980792 Longitude: 116.329067
Tracker2 Latitude: 39.989218 Longitude: 116.309724
Tracker3 Latitude: 39.967156 Longitude: 116.389785
Tracker4 Latitude: 7.882574 Longitude: 98.395302
Tracker5 Latitude: 40.0204099 Longitude: 116.4284666
Tracker6 Latitude: 39.829245 Longitude: 116.2892683
Tracker7 Latitude: 30.4941733 Longitude: 114.3343833
Tracker8 Latitude: 39.186807 Longitude: 113.617516
Tracker9 Latitude: 39.980774646 Longitude: 116.446556576

Longitude/Latitude Control Panel

Minimum Latitude
Maximum Latitude
Minimum Longitude
Maximum Longitude

-90
90
-180
180

-90
90
-180
180

Set Defined Range

Which can be observed as so, with multiple trackers going down and some going up.

Complex Test

A more complex test would be to create a modification to the application as follows:

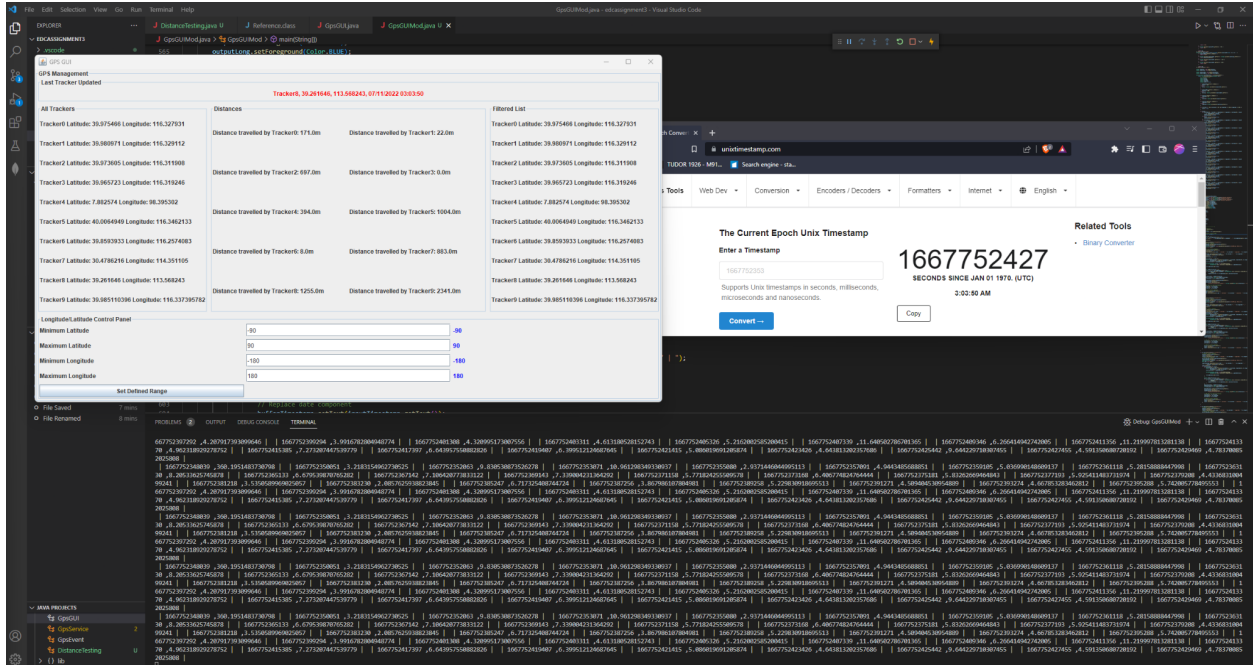
```
double tempDistTravelled = 0.0;
for (int i = 0; i < rollingWindow0.size(); i++) {
    if (rollingWindow0.get(i).timeAdded > ((ZonedDateTime.now().toInstant().toEpochMilli()
        - 60000)) {
        tempDistTravelled += rollingWindow0.get(i).distanceTravelled;
    }
}
```

Time window only 1 minute

```
s.listen((GpsEvent ev) -> {
    for (int i=0; i < rollingWindow0.size(); i++) {
        System.out.print(i + " + rollingWindow0.get(i).timeAdded+ " , " + rollingWindow0.get(i).distanceTravelled + " | ");
    }
    System.out.println();
}
```

And a different output for tracker 0

The screenshot displays a Java application window titled "GPS Manager" with a "Last Tracker Update" button. The main area shows a table of trackers with columns for Latitude, Longitude, and Distance travelled. The table lists several trackers, including Tracker0, Tracker1, Tracker2, Tracker3, Tracker4, Tracker5, Tracker6, Tracker7, and Tracker8, with their respective coordinates and distances. Below the table is a "Longitude/Latitude Control Panel" with input fields for Minimum and Maximum Latitude and Longitude, and a "Set Defined Range" button. To the right of the application window, a web browser window shows the "The Current Epoch Unix Timestamp" page, displaying the timestamp 1667752416 (SECONDS SINCE JAN 01 1970, UTC) and the time 2:02:39 AM. The browser also shows a "Related Tools" section with a "Binary Converter" link.



We see tracker0's value go from 177 to 171 from unix timestamp 1667752416 to 1667752427.
 $1667752427 - 60 = 1667752367$.

If we look closely at the output of the timestamp to distance:

```
1667752348039,360.1951483730798 | 1667752350051,3.2183154962730525 | 1667752352063,9.830530873526278 | 1667752353071,10.961298349330937 | 1667752355080,2.9371446044995113 | 1667752356709,4.9443485688851 | 1667752359105,5.036990148609137 | 1667752361118,5.28158888447998 | 1667752363130,8.20533625745878 | 1667752365133,6.679530870765282 | 1667752367142,7.106420773833122 | 1667752369143,7.339004231364292 | 1667752371158,5.77182455509578 | 1667752373168,6.406774824764444 | 1667752375181,5.83262669464843 | 1667752377193,5.925411483731974 | 1667752379208,4.433683100499241 | 1667752381218,3.5350589969025057 | 1667752383230,2.0857625938823845 | 1667752385247,6.717325408744724 | 1667752387256,3.867986107804981 | 1667752389258,5.229830918695513 | 1667752391271,4.509404530954889 | 1667752393274,4.667853283462812 | 1667752395288,5.742005778495553 | 1667752397292,4.207917393099646 | 1667752399294,3.9916782804948774 | 1667752401308,4.320995173007556 | 1667752403311,4.613180528152743 | 1667752405326,5.2162002585200415 | 1667752407339,11.640502786701365 | 1667752409346,6.266414942742005 |
```

And we add up the corresponding amount that is higher than 1667752367:

```
1667752348039,360.1951483730798 | 1667752350051,3.2183154962730525 | 1667752352063,9.830530873526278 | 1667752353071,10.961298349330937 | 1667752355080,2.9371446044995113 | 1667752356709,4.9443485688851 | 1667752359105,5.036990148609137 | 1667752361118,5.28158888447998 | 1667752363130,8.20533625745878 | 1667752365133,6.679530870765282 | 1667752367142,7.106420773833122 | 1667752369143,7.339004231364292 | 1667752371158,5.77182455509578 | 1667752373168,6.406774824764444 | 1667752375181,5.83262669464843 | 1667752377193,5.925411483731974 | 1667752379208,4.433683100499241 | 1667752381218,3.5350589969025057 | 1667752383230,2.0857625938823845 | 1667752385247,6.717325408744724 | 1667752387256,3.867986107804981 | 1667752389258,5.229830918695513 | 1667752391271,4.509404530954889 | 1667752393274,4.667853283462812 | 1667752395288,5.742005778495553 | 1667752397292,4.207917393099646 | 1667752399294,3.9916782804948774 | 1667752401308,4.320995173007556 | 1667752403311,4.613180528152743 | 1667752405326,5.2162002585200415 | 1667752407339,11.640502786701365 | 1667752409346,6.266414942742005 |
```

+1667752348039,360.1951483730798 | +1667752350051,3.2183154962730525 | +1667752352063,9.830530873526278 | +1667752353071,10.961298349330937 | +1667752355080,2.9371446044995113 | +1667752356709,4.9443485688851 | +1667752359105,5.036990148609137 | +1667752361118,5.28158888447998 | +1667752363130,8.20533625745878 | +1667752365133,6.679530870765282 | +1667752367142,7.106420773833122 | +1667752369143,7.339004231364292 | +1667752371158,5.77182455509578 | +1667752373168,6.406774824764444 | +1667752375181,5.83262669464843 | +1667752377193,5.925411483731974 | +1667752379208,4.433683100499241 | +1667752381218,3.5350589969025057 | +1667752383230,2.0857625938823845 | +1667752385247,6.717325408744724 | +1667752387256,3.867986107804981 | +1667752389258,5.229830918695513 | +1667752391271,4.509404530954889 | +1667752393274,4.667853283462812 | +1667752395288,5.742005778495553 | +1667752397292,4.207917393099646 | +1667752399294,3.9916782804948774 | +1667752401308,4.320995173007556 | +1667752403311,4.613180528152743 | +1667752405326,5.2162002585200415 | +1667752407339,11.640502786701365 | +1667752409346,6.266414942742005 |

1667752411356 ,11.219997813281138 | | 1667752413370 ,4.962318929278752 | |
 1667752415385 ,7.273207447539779 | | 1667752417397 ,6.643957550882826 | |
 1667752419407 ,6.399512124687645 | | 1667752421415 ,5.086019691205874 | |
 1667752423426 ,4.643813202357686 | | 1667752425442 ,9.644229710307455 | |
 1667752427455 ,4.591350680720192 | | 1667752429469 ,4.78370085

This meant these sections were the ones added up they would equal ~171

5.7718243		
6.4067748		
5.8326267		
5.9254115		
4.4336831		
3.535059		
2.0857626		
6.7173254		
3.8679861		
5.2298309		
4.5094045		
4.6678533		
5.7420058		
4.2079174		
3.9916783		
4.3209952		
4.6131805		
5.2162003		
11.640503		
6.2664149		
11.219998		
4.9623189		
7.2732074		
6.6439576		
6.3995121		
5.0860197		
4.6438132		
9.6442297		
4.5913507	SUM	
4.7837009	170.2305	

Which is correct when rounding up 170.2305

Meaning that the 1 minute = 60,000 UNIX millisecond window works, which can be generalized to the $5 * 60,000 = 30,000$ UNIX millisecond time window.

Testing FRP operation for Feet to Meter Conversion:

```
// Altitude to Meter Conversion - Map
STextField alt = new STextField("");
Cell<String> textAlt = alt.sUserChanges.map(t -> {
    Double temp = Double.valueOf(t) * 0.3048;
    String out = String.valueOf(temp);
    return out;
}).hold(initValue: "");
SLabel altInMeters = new SLabel(textAlt);
```

This is the altitude code that converts feet to meters

A modified GUI will be made to display the altitudes passed into the application and verified

```
alt2 = Double.valueOf(altInMeters.getText());
System.out.println(ev.name + "| " + latitudes[9] + ev.latitude+ longitudes[9]+ ev.longitude+ alt1 + alt2);

double updatedDistance = distance(latitudes[9], ev.latitude, longitudes[9], ev.longitude,
    alt1, alt2);

System.out.println(distTravelled[9]+distance(latitudes[9], ev.latitude, longitudes[9], ev.longitude,
    altitudes[9]*0.3048, ev.altitude*0.3048));
distTravelled[9] += updatedDistance;
System.out.println(distTravelled[9]);
```

This makes it so the distance will be compared with the FRP operation and a normal ev.altitude call (multiplied by 0.3048)

The screenshot shows a Java Swing application titled "GPS GUI". It features a "GPS Management" section with a "Last Tracker Updated" label. Below this, there is a table listing various trackers with their IDs, latitudes, and longitudes. A "Filtered List" section on the right displays the same data. At the bottom, there is a "Longitude/Latitude Control Panel" with input fields for minimum and maximum latitude and longitude, and a "Set Defined Range" button.

It can be seen that the calculations are the same. Which means that the distance feet to meter map FRP conversion is working correctly.