Designing Associativity

2st assignment

Geo_location

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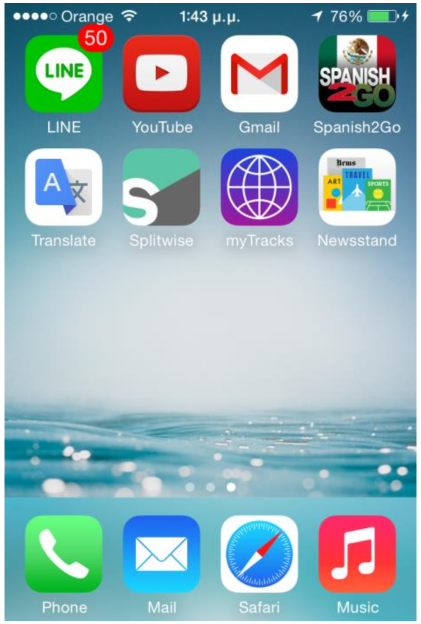
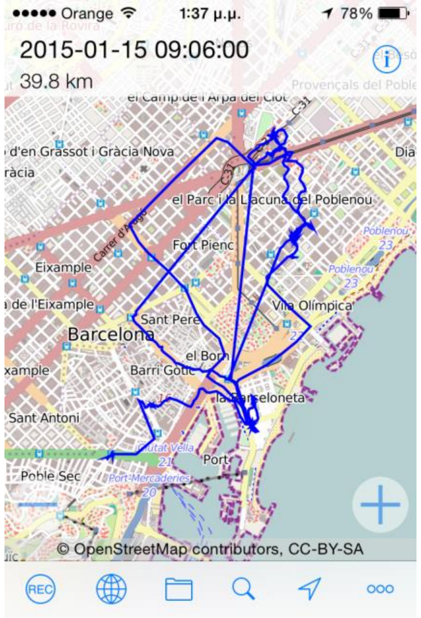
Institute for
advanced
architecture
of Catalonia

Tracking and exporting data

Step 1

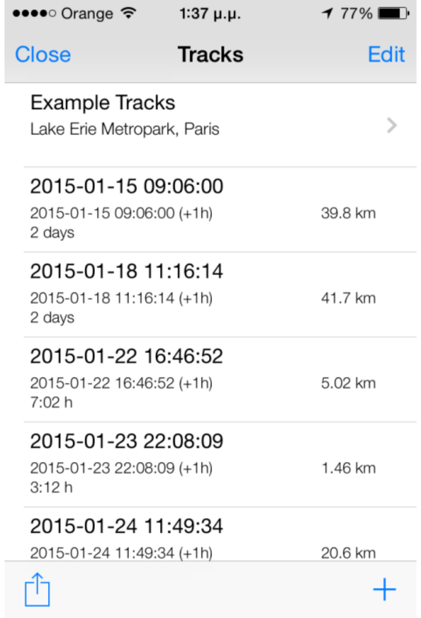
We tracked ourselves with two smart phones every day from 15-1-2015.




●●●●● Orange 1:37 μ.μ. 78%
Barcelona
Eixample
Sant Pere
el Born
Barri Gòtic
Fort Pienc
Vila Olímpica
la Barceloneta
Sant Antoni
Poble Sec
el Parc i la Llacuna del Poblenou
d'en Grassot i Gràcia Nova
Port
© OpenStreetMap contributors, CC-BY-SA
REC

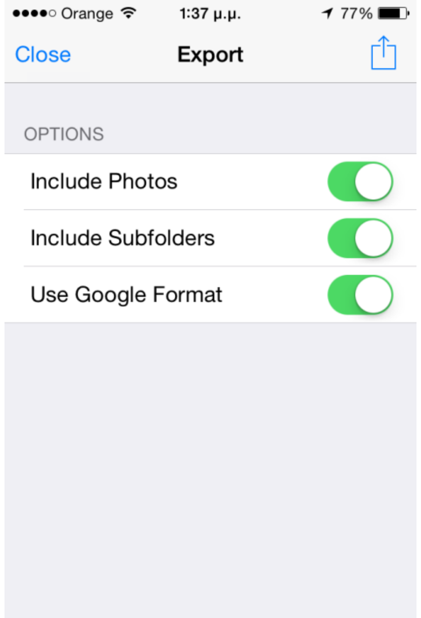
2015-01-15 09:06:00

39.8 km



Example Tracks
Lake Erie Metropark, Paris

2015-01-15 09:06:00 2015-01-15 09:06:00 (+1h) 2 days	39.8 km
2015-01-18 11:16:14 2015-01-18 11:16:14 (+1h) 2 days	41.7 km
2015-01-22 16:46:52 2015-01-22 16:46:52 (+1h) 7:02 h	5.02 km
2015-01-23 22:08:09 2015-01-23 22:08:09 (+1h) 3:12 h	1.46 km
2015-01-24 11:49:34 2015-01-24 11:49:34 (+1h)	20.6 km

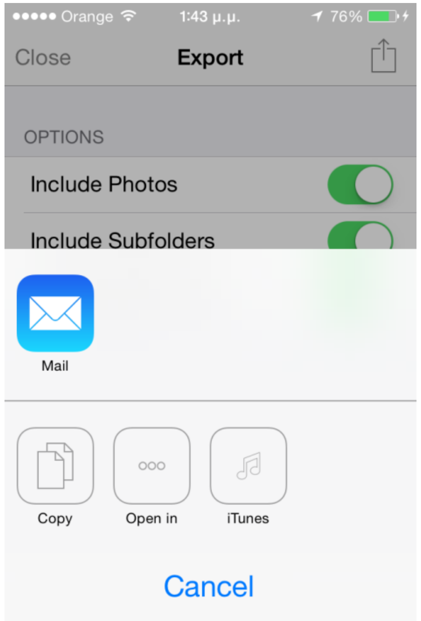


OPTIONS

Include Photos ●

Include Subfolders ●

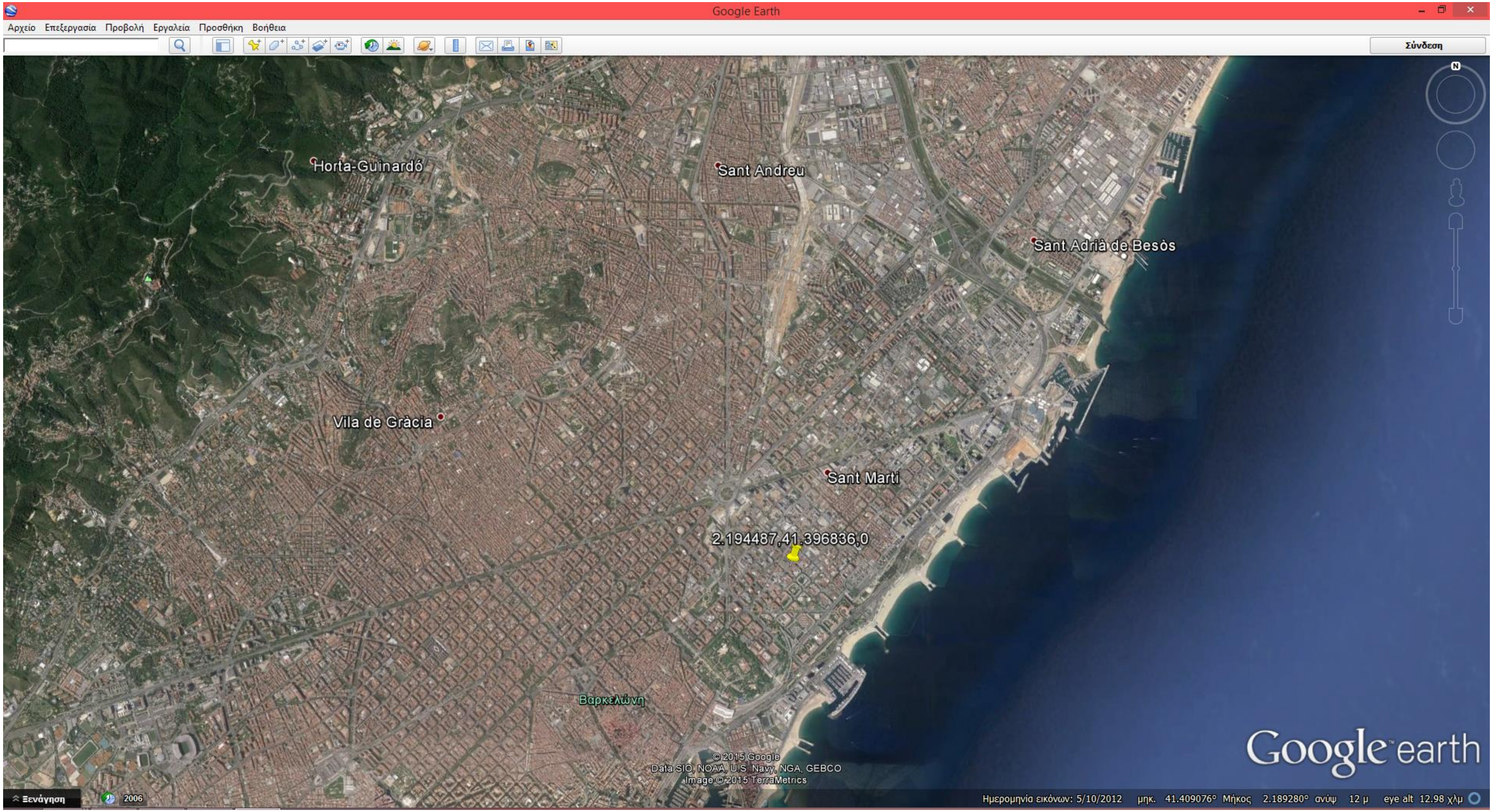
Use Google Format ●



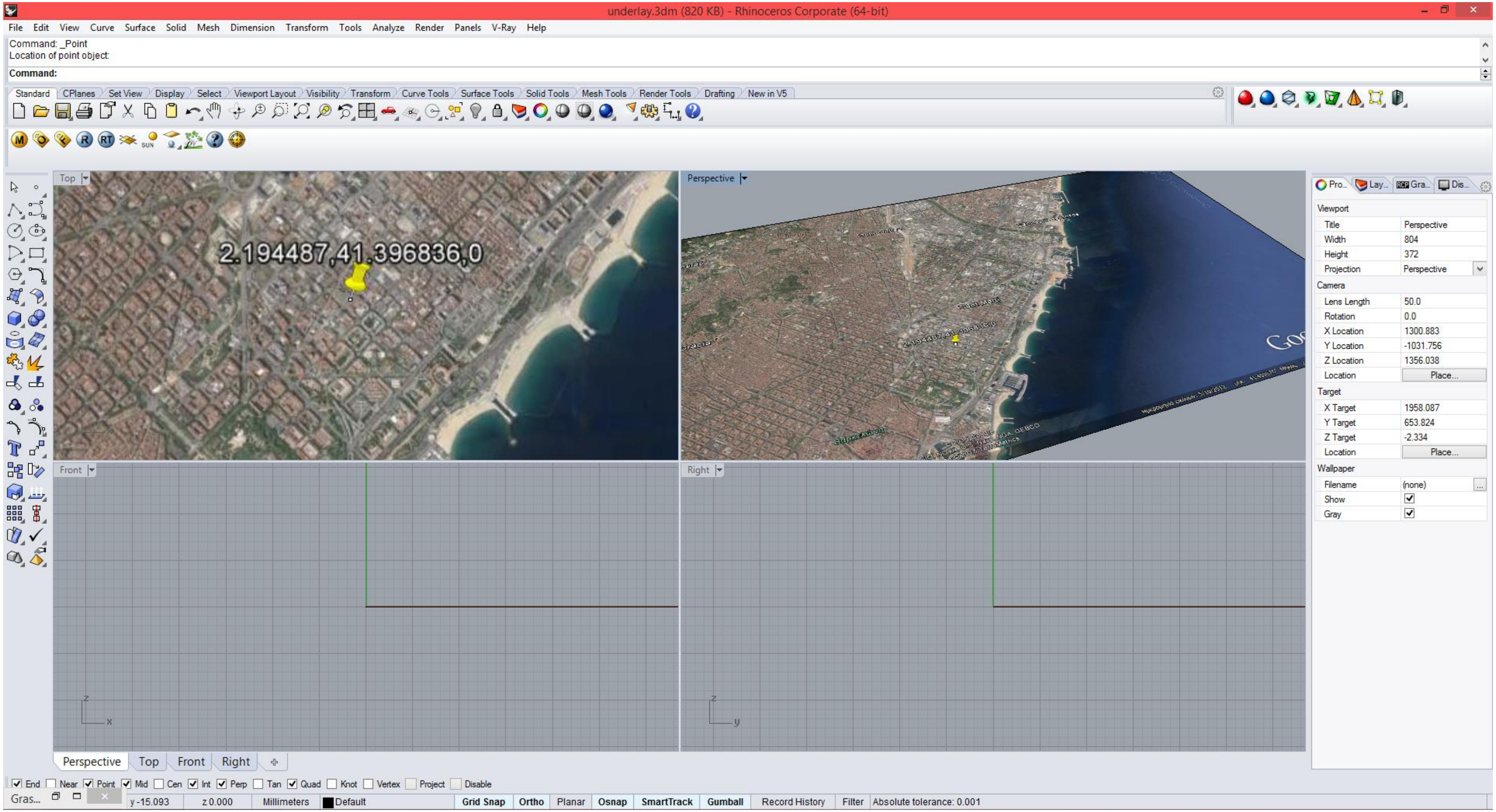
Preparation of the underlay image

Step 1

Get a picture from Google Earth with the coordinates of a point, in this case IAAC.


Google Earth
Αρχείο Επεξεργασία Προβολή Εργαλεία Προσθήκη Βοήθεια
Σύνδεση
N
Horta-Guinardó
Sant Andreu
Sant Adrià de Besòs
Vila de Gràcia
Sant Martí
2.194487,41.396836,0
Βαρκελώνη
© 2015 Google
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2015 TerraMetrics
Google earth
Ξενάγηση
2006
Ημερομηνία εικόνων: 5/10/2012 μηκ. 41.409076° Μήκος 2.189280° ανύψ 12 μ eye alt 12.98 χλμ

Step 2
Place the image in rhino and draw a point.



underlay.3dm (820 KB) - Rhinoceros Corporate (64-bit)

```
Command: _Point
Location of point object:
Command:
```

2.194487,41.396836,0

Viewport	
Title	Perspective
Width	804
Height	372
Projection	Perspective
Camera	
Lens Length	50.0
Rotation	0.0
X Location	1300.883
Y Location	-1031.756
Z Location	1356.038
Location	Place...
Target	
X Target	1958.087
Y Target	653.824
Z Target	-2.334
Location	Place...
Wallpaper	
Filename	(none)
Show	☑
Gray	☑

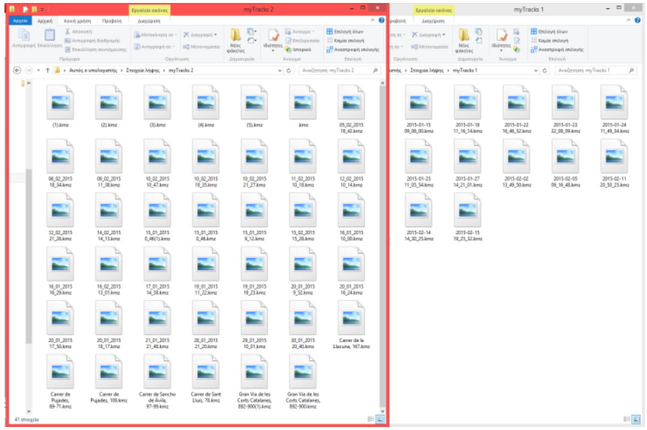
☑ End □ Near ☑ Point ☑ Mid □ Cen ☑ Int ☑ Perp □ Tan ☑ Quad □ Knot □ Vertex □ Project □ Disable

y -15.093 z 0.000 Millimeters Default Grid Snap Ortho Planar Osnap SmartTrack Gumball Record History Filter Absolute tolerance: 0.001

Preparation of the data files

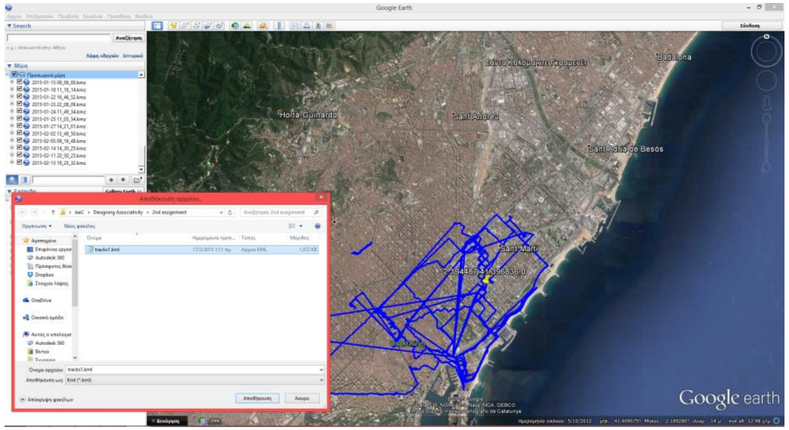
Step 1

We have two different sets of data from two trackers. When extracted from the applications the data comes as a series of .kmz files.

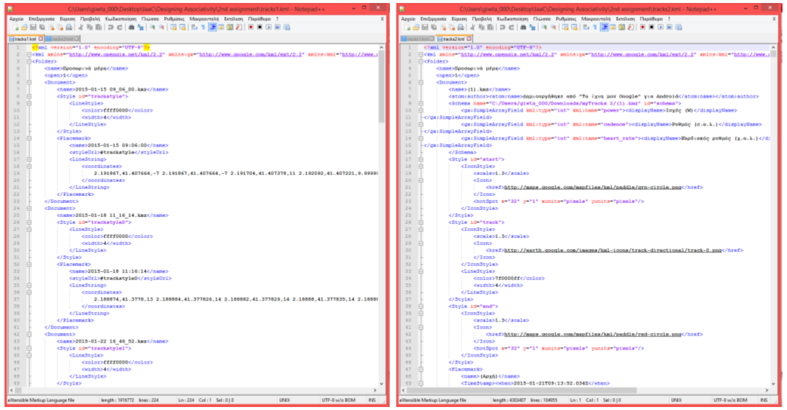


Step 2

In order to transform the .kmz files to .kml files that can be read in Grasshopper, we open the whole set of data in Google Earth and see the routes. Then we save the “places” as tracks1.kml and tracks2.kml, so that we have the whole sets of data in one file.



Those two sets of data cannot be combined in Notepad ++ because tracks1.kml file comes from an iOS application and tracks2.kml from an Android application and they have a different format so that they have to be treated differently in Grasshopper.


C:\Users\giwta_000\Desktop\IaaC\Designing Associativity\2nd assignment\tracks1.kml - Notepad++

```
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://www.opengis.net/kml/2.2" xmlns:gx="http://www.google.com/kml/ext/2.2" xmlns:kml="http://www.
<Folder>
    <name>Προσωρινά μέρη</name>
    <open>1</open>
    <Document>
        <name>2015-01-15 09_06_00.kmz</name>
        <Style id="trackstyle">
            <LineStyle>
                <color>ffff0000</color>
                <width>4</width>
            </LineStyle>
        </Style>
        <Placemark>
            <name>2015-01-15 09:06:00</name>
            <styleUrl>#trackstyle</styleUrl>
            <LineString>
                <coordinates>
                    2.191867,41.407664,-7 2.191867,41.407664,-7 2.191704,41.407378,11 2.192092,41.407321,9.9999
                </coordinates>
            </LineString>
        </Placemark>
    </Document>
    <Document>
        <name>2015-01-18 11_16_14.kmz</name>
        <Style id="trackstyle0">
            <LineStyle>
                <color>ffff0000</color>
                <width>4</width>
            </LineStyle>
        </Style>
        <Placemark>
            <name>2015-01-18 11:16:14</name>
            <styleUrl>#trackstyle0</styleUrl>
            <LineString>
                <coordinates>
                    2.188874,41.3778,13 2.188884,41.377826,14 2.188882,41.377829,14 2.18888,41.377835,14 2.1888
                </coordinates>
            </LineString>
        </Placemark>
    </Document>
    <Document>
        <name>2015-01-22 16_46_52.kmz</name>
        <Style id="trackstyle1">
            <LineStyle>
                <color>ffff0000</color>
                <width>4</width>
            </LineStyle>
        </Style>
```

eXtensible Markup Language file   length : 1918772   lines : 224   Ln : 224   Col : 1   Sel : 0 | 0   UNIX   UTF-8 w/o BOM   INS

C:\Users\giwta_000\Desktop\IaaC\Designing Associativity\2nd assignment\tracks2.kml - Notepad++

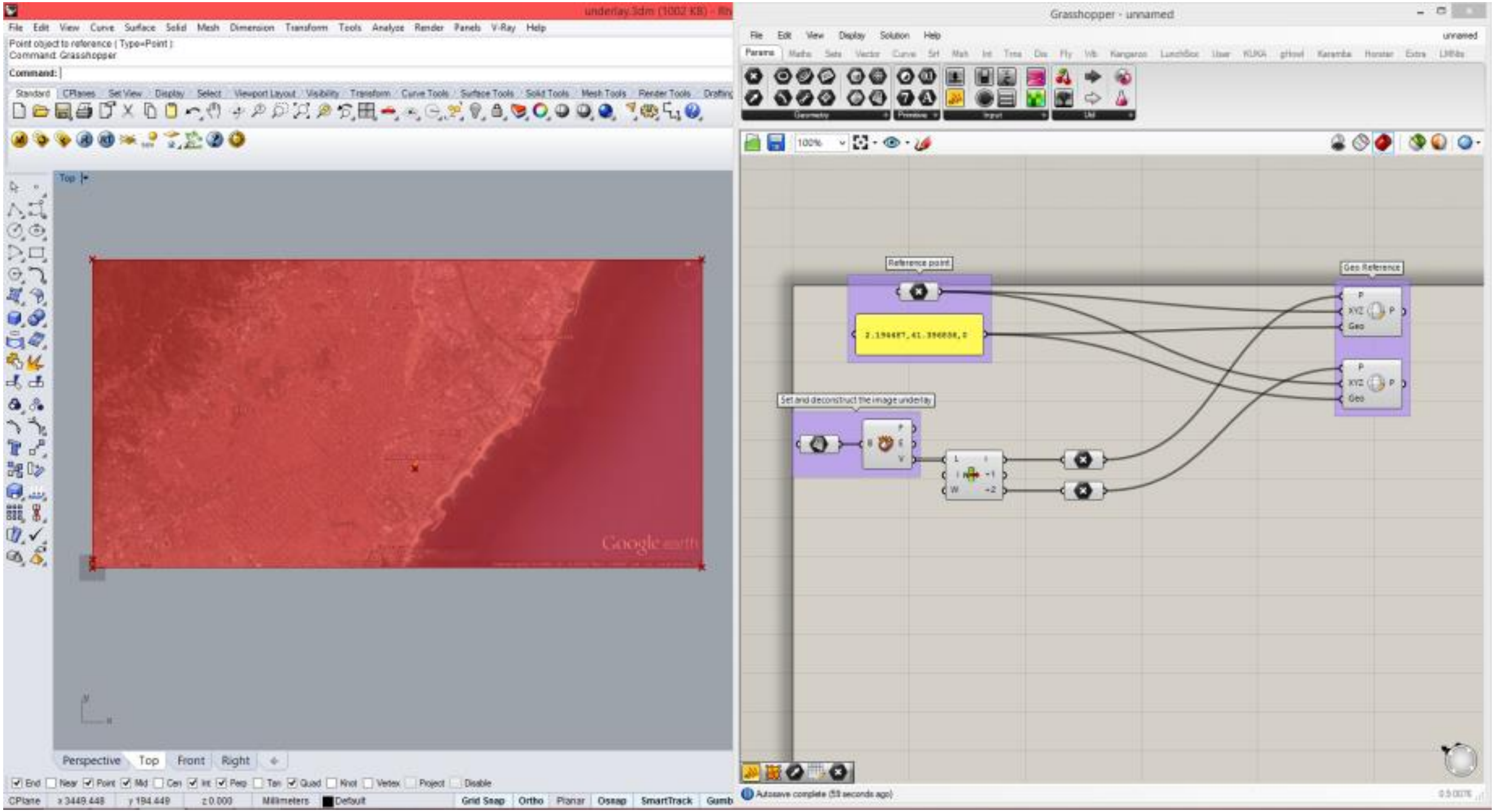
```
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://www.opengis.net/kml/2.2" xmlns:gx="http://www.google.com/kml/ext/2.2" xmlns:kml="http://www.
<Folder>
    <name>Προσωρινά μέρη</name>
    <open>1</open>
    <Document>
        <name>(1).kmz</name>
        <atom:author><atom:name>Δημιουργήθηκε από "Τα ίχνη μου Google" για Android</atom:name></atom:author>
        <Schema name="C:/Users/giwta_000/Downloads/myTracks 2/(1).kmz" id="schema">
            <gx:SimpleArrayField kml:type="int" kml:name="power"><displayName>Ισχύς (W)</displayName>
</gx:SimpleArrayField>
            <gx:SimpleArrayField kml:type="int" kml:name="cadence"><displayName>Ρυθμός (σ.α.λ.)</displayName>
</gx:SimpleArrayField>
            <gx:SimpleArrayField kml:type="int" kml:name="heart_rate"><displayName>Καρδιακός ρυθμός (χ.α.λ.)</d
</gx:SimpleArrayField>
        </Schema>
        <Style id="start">
            <IconStyle>
                <scale>1.3</scale>
                <Icon>
                    <href>http://maps.google.com/mapfiles/kml/paddle/grn-circle.png</href>
                </Icon>
                <hotSpot x="32" y="1" xunits="pixels" yunits="pixels"/>
            </IconStyle>
        </Style>
        <Style id="track">
            <IconStyle>
                <scale>1.3</scale>
                <Icon>
                    <href>http://earth.google.com/images/kml-icons/track-directional/track-0.png</href>
                </Icon>
            </IconStyle>
            <LineStyle>
                <color>7f0000ff</color>
                <width>4</width>
            </LineStyle>
        </Style>
        <Style id="end">
            <IconStyle>
                <scale>1.3</scale>
                <Icon>
                    <href>http://maps.google.com/mapfiles/kml/paddle/red-circle.png</href>
                </Icon>
                <hotSpot x="32" y="1" xunits="pixels" yunits="pixels"/>
            </IconStyle>
        </Style>
        <Placemark>
            <name>(Αρχή)</name>
            <TimeStamp><when>2015-01-21T09:13:52.034Z</when>
```

eXtensible Markup Language file   length : 4303407   lines : 104955   Ln : 1   Col : 1   Sel : 0 | 0   UNIX   UTF-8 w/o BOM   INS

Data processing in Grasshopper

Step 1

Set the reference point of the underlay image
and the GEO reference points.

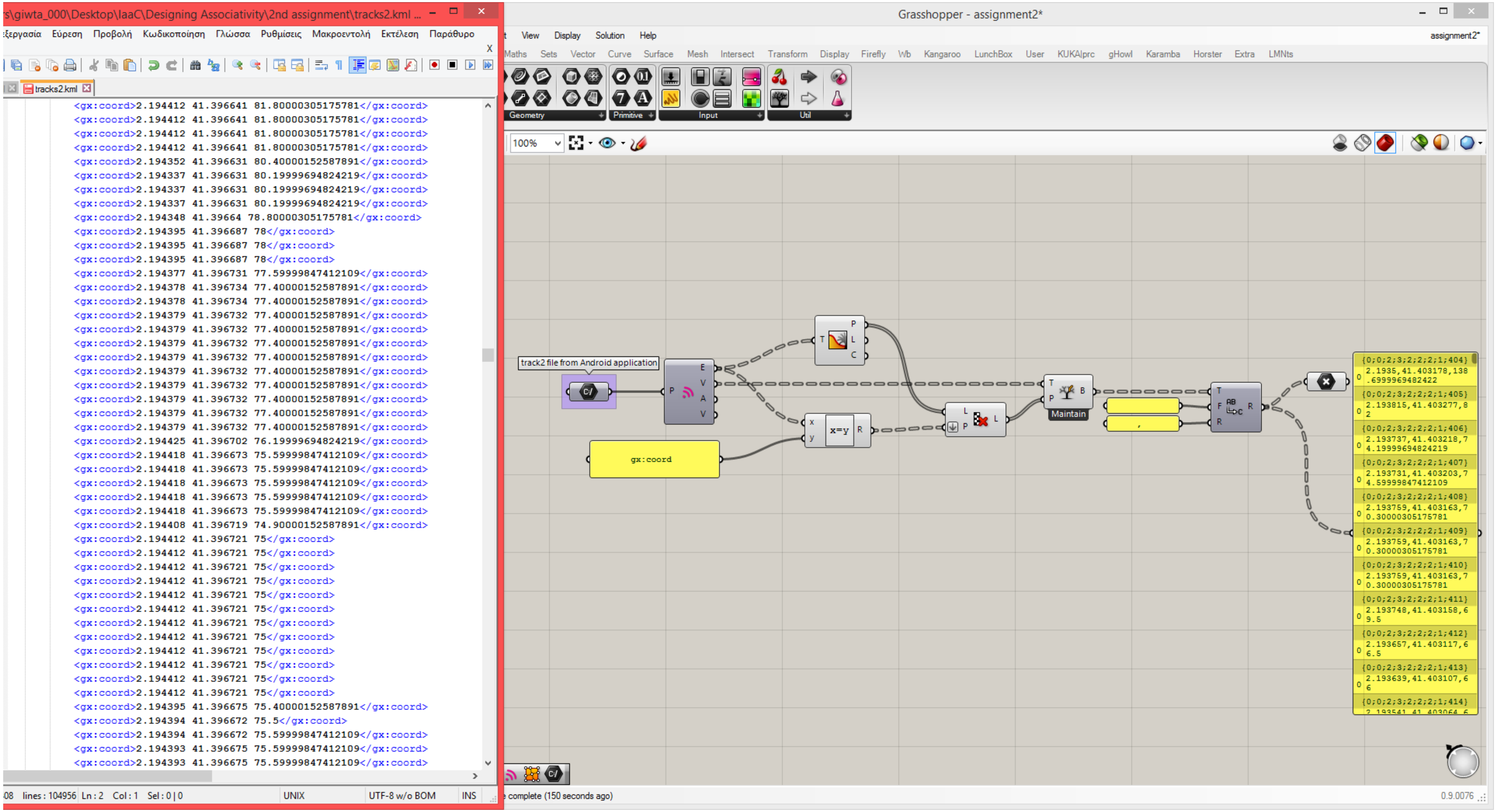


Point object to reference (Type=Point):
Command: Grasshopper
Command:

underlay.3dm (1002 KB)
File Edit View Curve Surface Solid Mesh Dimension Transform Tools Analyze Render Panels V-Ray Help
Standard CPlanes Set View Display Select Viewport Layout Visibility Transform Curve Tools Surface Tools Solid Tools Mesh Tools Render Tools Drafting
Top
Perspective Top Front Right
End Near Point Mid Cen Int Perp Tan Quad Knot Vertex Project Disable
CPlane x 3449.448 y 194.449 z 0.000 Millimeters Default Grid Snap Ortho Planar Osnap SmartTrack Gumball
Grasshopper - unnamed
File Edit View Display Solution Help
Params Maths Sets Vector Curve Srf Mesh Int Trns Dis Fly Wb Kangaroo LunchBox User KUKA gHowl Karamba Horster Extra LMNts
Geometry Primitive Input Util
100%
Reference point
2.194487,41.396858,0
Geo Reference
P XYZ Geo P
Set and deconstruct the image underlay
Autosave complete (53 seconds ago)

Step 2

Process the data from tracks2.kml by isolating only the coordinates of the points.



s\giwta_000\Desktop\IaaC\Designing Associativity\2nd assignment\tracks2.kml ...
ξεργασία Εύρεση Προβολή Κωδικοποίηση Γλώσσα Ρυθμίσεις Μακροεντολή Εκτέλεση Παράθυρο
tracks2.kml

```
<gx:coord>2.194412 41.396641 81.80000305175781</gx:coord>
<gx:coord>2.194412 41.396641 81.80000305175781</gx:coord>
<gx:coord>2.194412 41.396641 81.80000305175781</gx:coord>
<gx:coord>2.194412 41.396641 81.80000305175781</gx:coord>
<gx:coord>2.194352 41.396631 80.40000152587891</gx:coord>
<gx:coord>2.194337 41.396631 80.19999694824219</gx:coord>
<gx:coord>2.194337 41.396631 80.19999694824219</gx:coord>
<gx:coord>2.194337 41.396631 80.19999694824219</gx:coord>
<gx:coord>2.194348 41.39664 78.80000305175781</gx:coord>
<gx:coord>2.194395 41.396687 78</gx:coord>
<gx:coord>2.194395 41.396687 78</gx:coord>
<gx:coord>2.194395 41.396687 78</gx:coord>
<gx:coord>2.194377 41.396731 77.59999847412109</gx:coord>
<gx:coord>2.194378 41.396734 77.40000152587891</gx:coord>
<gx:coord>2.194378 41.396734 77.40000152587891</gx:coord>
<gx:coord>2.194379 41.396732 77.40000152587891</gx:coord>
<gx:coord>2.194379 41.396732 77.40000152587891</gx:coord>
<gx:coord>2.194379 41.396732 77.40000152587891</gx:coord>
<gx:coord>2.194379 41.396732 77.40000152587891</gx:coord>
<gx:coord>2.194379 41.396732 77.40000152587891</gx:coord>
<gx:coord>2.194379 41.396732 77.40000152587891</gx:coord>
<gx:coord>2.194379 41.396732 77.40000152587891</gx:coord>
<gx:coord>2.194379 41.396732 77.40000152587891</gx:coord>
<gx:coord>2.194379 41.396732 77.40000152587891</gx:coord>
<gx:coord>2.194425 41.396702 76.19999694824219</gx:coord>
<gx:coord>2.194418 41.396673 75.59999847412109</gx:coord>
<gx:coord>2.194418 41.396673 75.59999847412109</gx:coord>
<gx:coord>2.194418 41.396673 75.59999847412109</gx:coord>
<gx:coord>2.194418 41.396673 75.59999847412109</gx:coord>
<gx:coord>2.194418 41.396673 75.59999847412109</gx:coord>
<gx:coord>2.194408 41.396719 74.90000152587891</gx:coord>
<gx:coord>2.194412 41.396721 75</gx:coord>
<gx:coord>2.194412 41.396721 75</gx:coord>
<gx:coord>2.194412 41.396721 75</gx:coord>
<gx:coord>2.194412 41.396721 75</gx:coord>
<gx:coord>2.194412 41.396721 75</gx:coord>
<gx:coord>2.194412 41.396721 75</gx:coord>
<gx:coord>2.194412 41.396721 75</gx:coord>
<gx:coord>2.194412 41.396721 75</gx:coord>
<gx:coord>2.194412 41.396721 75</gx:coord>
<gx:coord>2.194412 41.396721 75</gx:coord>
<gx:coord>2.194412 41.396721 75</gx:coord>
<gx:coord>2.194412 41.396721 75</gx:coord>
<gx:coord>2.194395 41.396675 75.40000152587891</gx:coord>
<gx:coord>2.194394 41.396672 75.5</gx:coord>
<gx:coord>2.194394 41.396672 75.59999847412109</gx:coord>
<gx:coord>2.194393 41.396675 75.59999847412109</gx:coord>
<gx:coord>2.194393 41.396675 75.59999847412109</gx:coord>
```

08 lines : 104956 Ln : 2 Col : 1 Sel : 0 | 0 UNIX UTF-8 w/o BOM INS

Grasshopper - assignment2*
View Display Solution Help
assignment2*
Maths Sets Vector Curve Surface Mesh Intersect Transform Display Firefly Wb Kangaroo LunchBox User KUKA|prc gHowl Karamba Horster Extra LMNts
Geometry
Primitive
Input
Util
100%
track2 file from Android application
gx:coord
x=y
Maintain
,

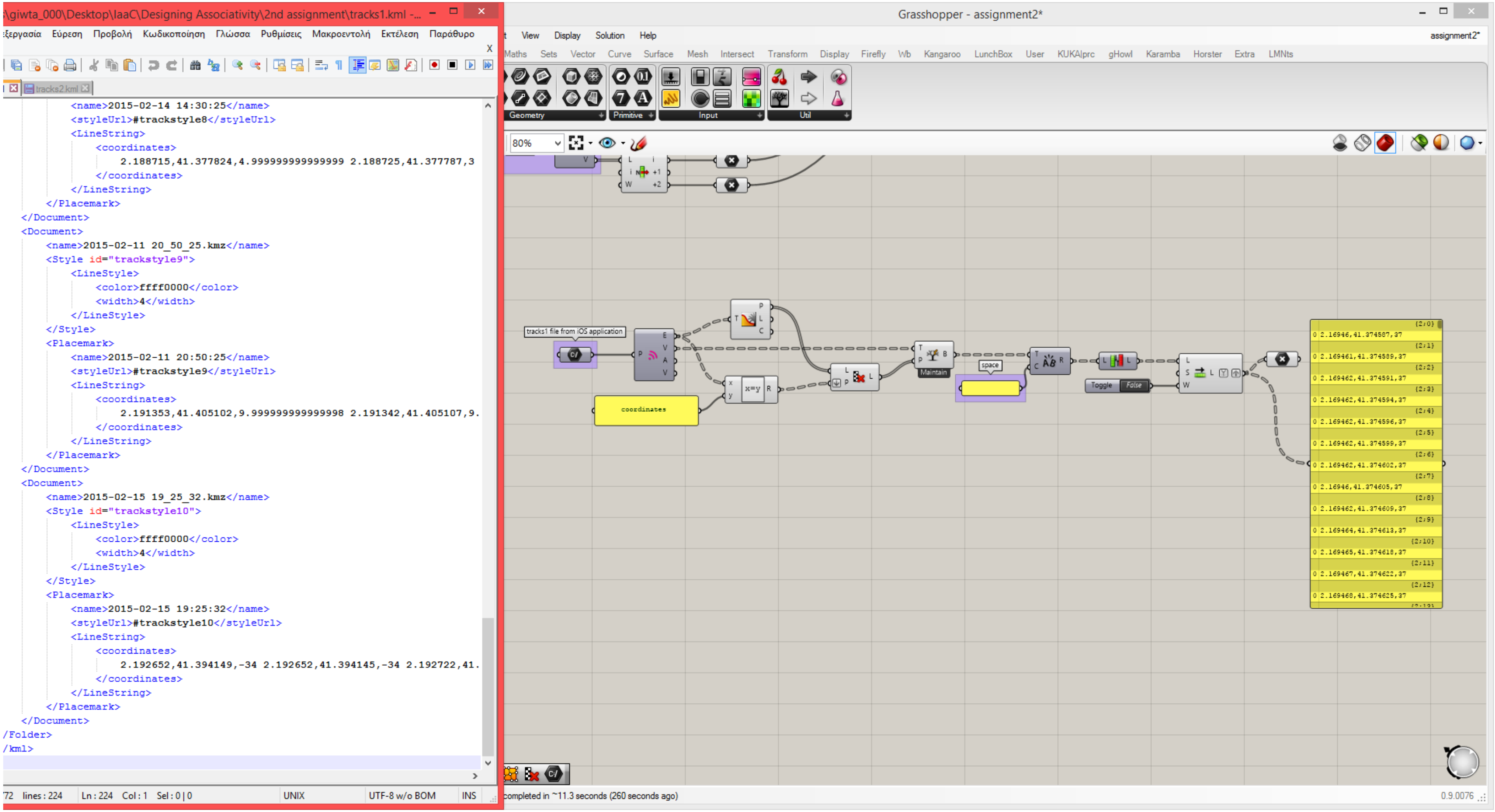
```
{0;0;2;3;2;2;2;1;404}
0 2.1935,41.403178,138.6999969482422
{0;0;2;3;2;2;2;1;405}
0 2.193815,41.403277,82
{0;0;2;3;2;2;2;1;406}
0 2.193737,41.403218,74.19999694824219
{0;0;2;3;2;2;2;1;407}
0 2.193731,41.403203,74.59999847412109
{0;0;2;3;2;2;2;1;408}
0 2.193759,41.403163,70.30000305175781
{0;0;2;3;2;2;2;1;409}
0 2.193759,41.403163,70.30000305175781
{0;0;2;3;2;2;2;1;410}
0 2.193759,41.403163,70.30000305175781
{0;0;2;3;2;2;2;1;411}
0 2.193748,41.403158,69.5
{0;0;2;3;2;2;2;1;412}
0 2.193657,41.403117,66.5
{0;0;2;3;2;2;2;1;413}
0 2.193639,41.403107,66
{0;0;2;3;2;2;2;1;414}
2.193541,41.403064,6
```

complete (150 seconds ago)

0.9.0076

Step 3

Process the data from tracks1.kml by isolating only the coordinates of the points.



\giwta_000\Desktop\IaaC\Designing Associativity\2nd assignment\tracks1.kml -...
Επεξεργασία Εύρεση Προβολή Κωδικοποίηση Γλώσσα Ρυθμίσεις Μακροεντολή Εκτέλεση Παράθυρο
tracks2.kml
72 lines : 224 Ln : 224 Col : 1 Sel : 0 | 0 UNIX UTF-8 w/o BOM INS
Grasshopper - assignment2*
View Display Solution Help
assignment2*
Maths Sets Vector Curve Surface Mesh Intersect Transform Display Firefly Wb Kangaroo LunchBox User KUKA|prc gHowl Karamba Horster Extra LMNts
Geometry Primitive Input Util
80%
tracks1 file from iOS application
coordinates
space
Maintain
Toggle False
0.9.0076

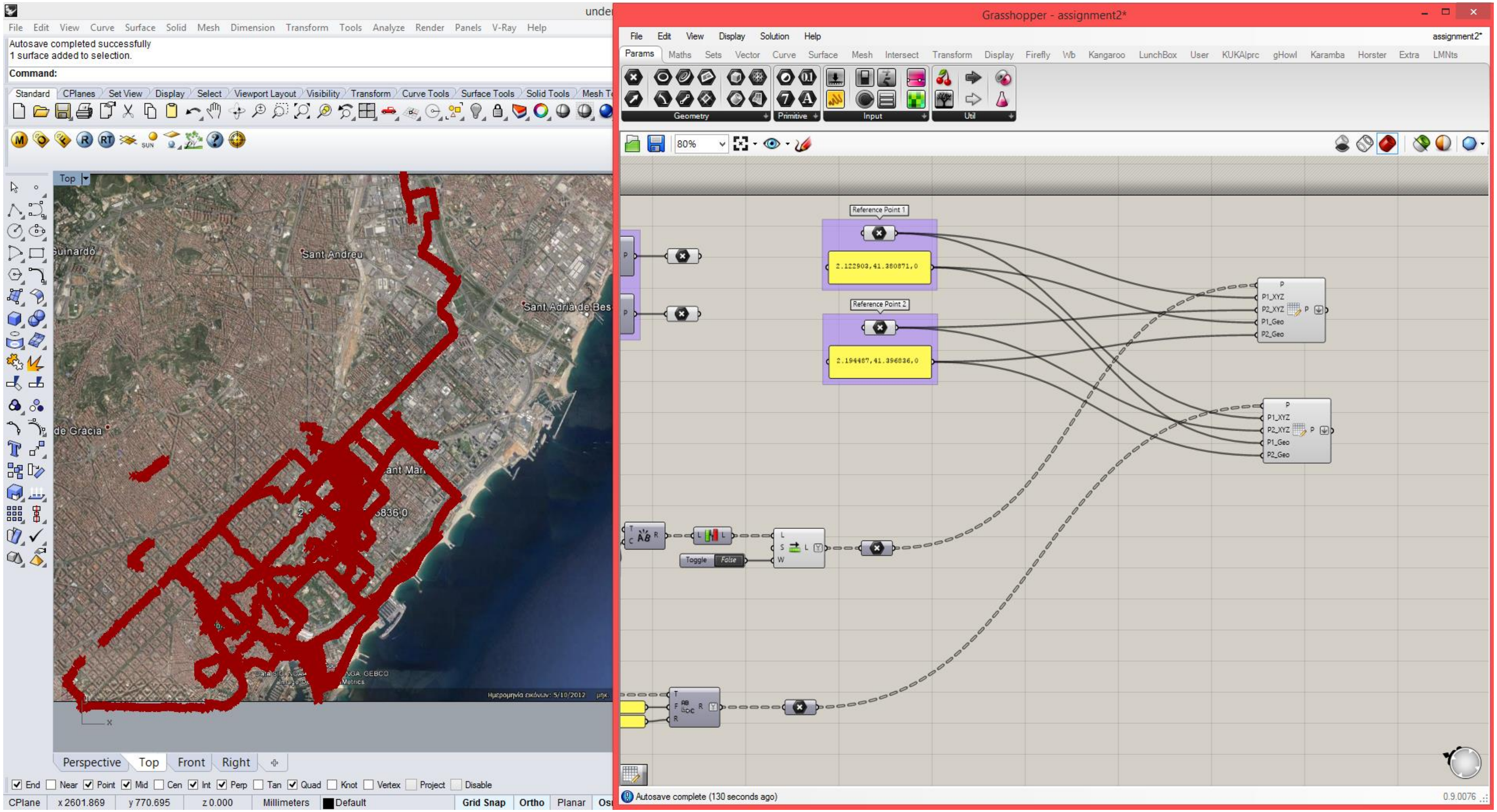
```
            <name>2015-02-14 14:30:25</name>
            <styleUrl>#trackstyle8</styleUrl>
            <LineString>
                <coordinates>
                    2.188715,41.377824,4.999999999999999 2.188725,41.377787,3
                </coordinates>
            </LineString>
        </Placemark>
    </Document>
    <Document>
        <name>2015-02-11 20_50_25.kmz</name>
        <Style id="trackstyle9">
            <LineStyle>
                <color>ffff0000</color>
                <width>4</width>
            </LineStyle>
        </Style>
        <Placemark>
            <name>2015-02-11 20:50:25</name>
            <styleUrl>#trackstyle9</styleUrl>
            <LineString>
                <coordinates>
                    2.191353,41.405102,9.999999999999998 2.191342,41.405107,9.
                </coordinates>
            </LineString>
        </Placemark>
    </Document>
    <Document>
        <name>2015-02-15 19_25_32.kmz</name>
        <Style id="trackstyle10">
            <LineStyle>
                <color>ffff0000</color>
                <width>4</width>
            </LineStyle>
        </Style>
        <Placemark>
            <name>2015-02-15 19:25:32</name>
            <styleUrl>#trackstyle10</styleUrl>
            <LineString>
                <coordinates>
                    2.192652,41.394149,-34 2.192652,41.394145,-34 2.192722,41.
                </coordinates>
            </LineString>
        </Placemark>
    </Document>
/Folder>
/kml>
```

```
                              {2;0}
0 2.16946,41.374587,37
                              {2;1}
0 2.169461,41.374589,37
                              {2;2}
0 2.169462,41.374591,37
                              {2;3}
0 2.169462,41.374594,37
                              {2;4}
0 2.169462,41.374596,37
                              {2;5}
0 2.169462,41.374599,37
                              {2;6}
0 2.169462,41.374602,37
                              {2;7}
0 2.16946,41.374605,37
                              {2;8}
0 2.169462,41.374609,37
                              {2;9}
0 2.169464,41.374613,37
                             {2;10}
0 2.169465,41.374618,37
                             {2;11}
0 2.169467,41.374622,37
                             {2;12}
0 2.169468,41.374625,37
```

completed in ~11.3 seconds (260 seconds ago)

Step 4

Finally, in order to get more accurate positioning of the points, we change the reference system and we use two different reference point instead of one and the GEO to XYZ component.



Autosave completed successfully
1 surface added to selection.
Command:

Reference Point 1: 2.122903,41.380871,0

Reference Point 2: 2.194487,41.396836,0

☑ End □ Near ☑ Point ☑ Mid □ Cen ☑ Int ☑ Perp □ Tan ☑ Quad □ Knot □ Vertex □ Project □ Disable

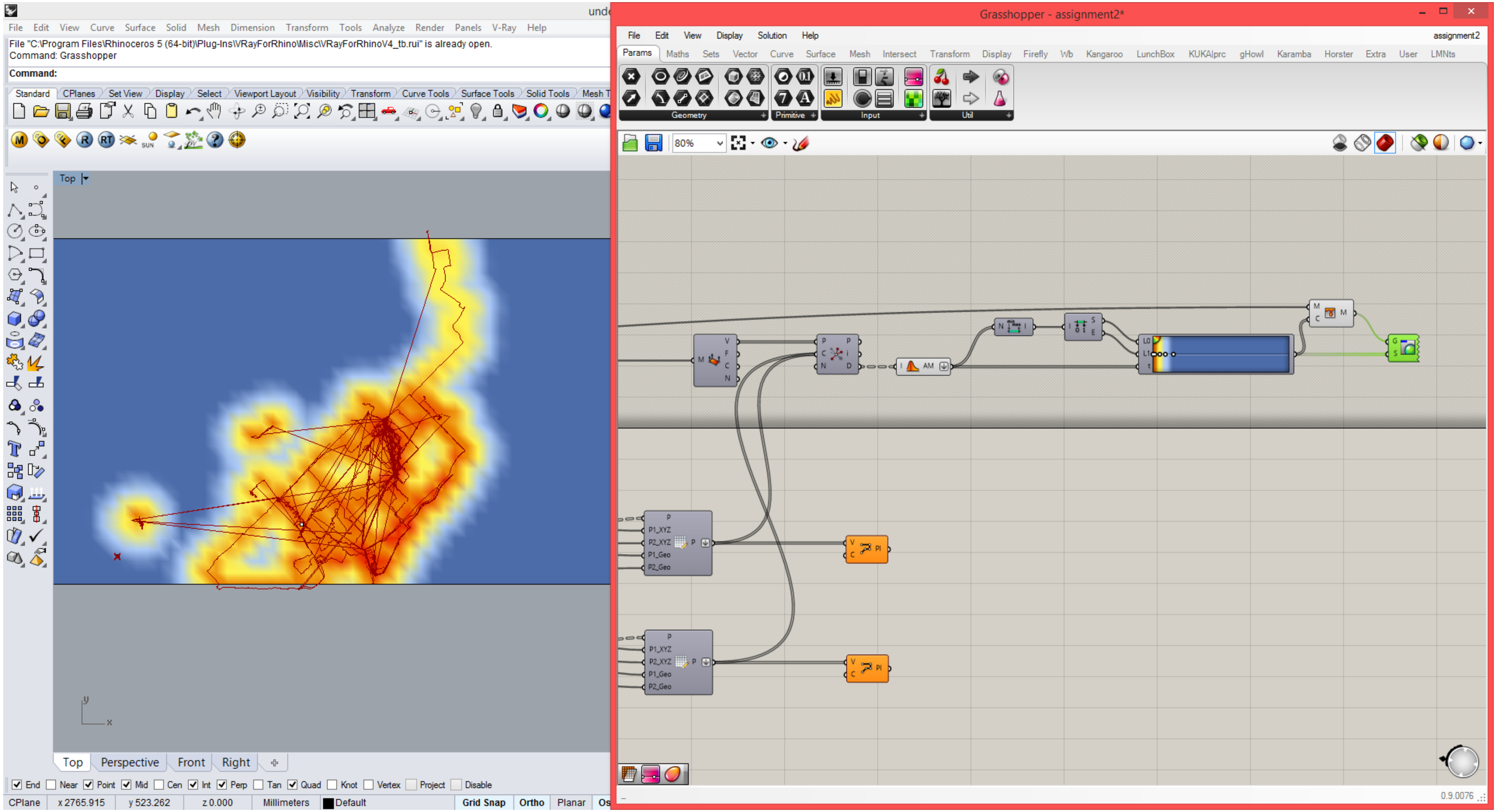
CPlane | x 2601.869 | y 770.695 | z 0.000 | Millimeters | ■ Default | Grid Snap | Ortho | Planar | Osi

Autosave complete (130 seconds ago)

File Edit View Curve Surface Solid Mesh Dimension Transform Tools Analyze Render Panels V-Ray Help
Standard CPlanes Set View Display Select Viewport Layout Visibility Transform Curve Tools Surface Tools Solid Tools Mesh T
Top
Guinardó
Sant Andreu
Sant Adrià de Bes
de Gràcia
ant Mar
Perspective Top Front Right
Grasshopper - assignment2*
File Edit View Display Solution Help
assignment2*
Params Maths Sets Vector Curve Surface Mesh Intersect Transform Display Firefly Wb Kangaroo LunchBox User KUKAlprc gHowl Karamba Horster Extra LMNts
Geometry Primitive Input Util
80%
P
P1_XYZ
P2_XYZ
P1_Geo
P2_Geo
Toggle False
L S W
T F R
0.9.0076

Step 5

Create a mesh and colour it according to the proximity of the mesh vertices to the points of the tracks.

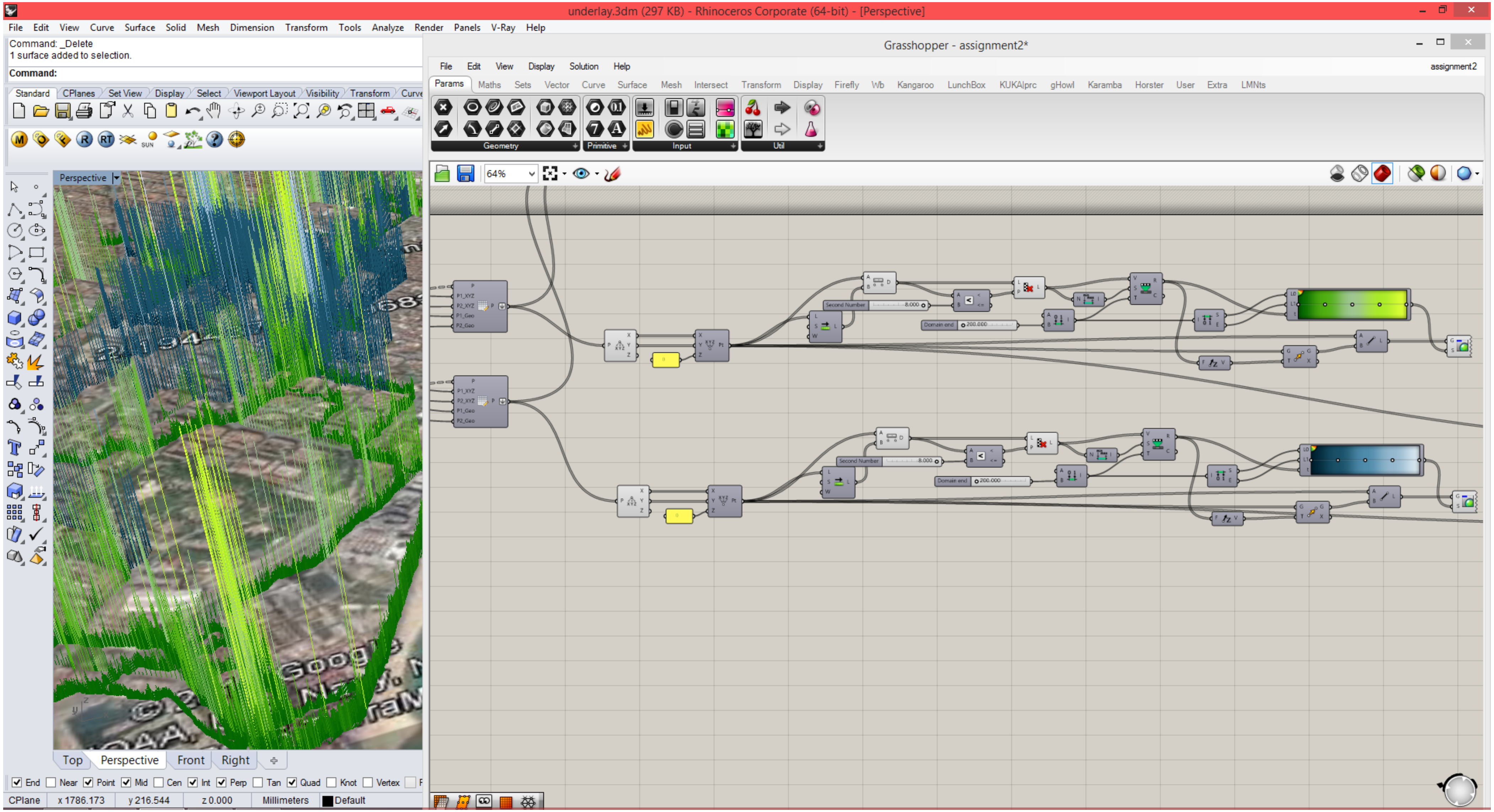


```
File "C:\Program Files\Rhinoceros 5 (64-bit)\Plug-Ins\VRayForRhino\Misc\VRayForRhinoV4_tb.rui" is already open.
Command: Grasshopper
Command:
```

File Edit View Curve Surface Solid Mesh Dimension Transform Tools Analyze Render Panels V-Ray Help
Standard CPlanes Set View Display Select Viewport Layout Visibility Transform Curve Tools Surface Tools Solid Tools Mesh T
Top
Top Perspective Front Right
☑ End □ Near ☑ Point ☑ Mid □ Cen ☑ Int ☑ Perp □ Tan ☑ Quad □ Knot □ Vertex □ Project □ Disable
CPlane x 2765.915 y 523.262 z 0.000 Millimeters Default Grid Snap Ortho Planar Os
Grasshopper - assignment2*
File Edit View Display Solution Help
assignment2
Params Maths Sets Vector Curve Surface Mesh Intersect Transform Display Firefly Wb Kangaroo LunchBox KUKA|prc gHowl Karamba Horster Extra User LMNts
Geometry Primitive Input Util
80%
P1_XYZ
P2_XYZ
P1_Geo
P2_Geo
AM
0.9.0076

Step 6

Create vertical lines that correspond to the speed of moving at each specific point by measuring the distances between one point and its next.



underlay.3dm (297 KB) - Rhinoceros Corporate (64-bit) - [Perspective]

Command: _Delete
1 surface added to selection.
Command:

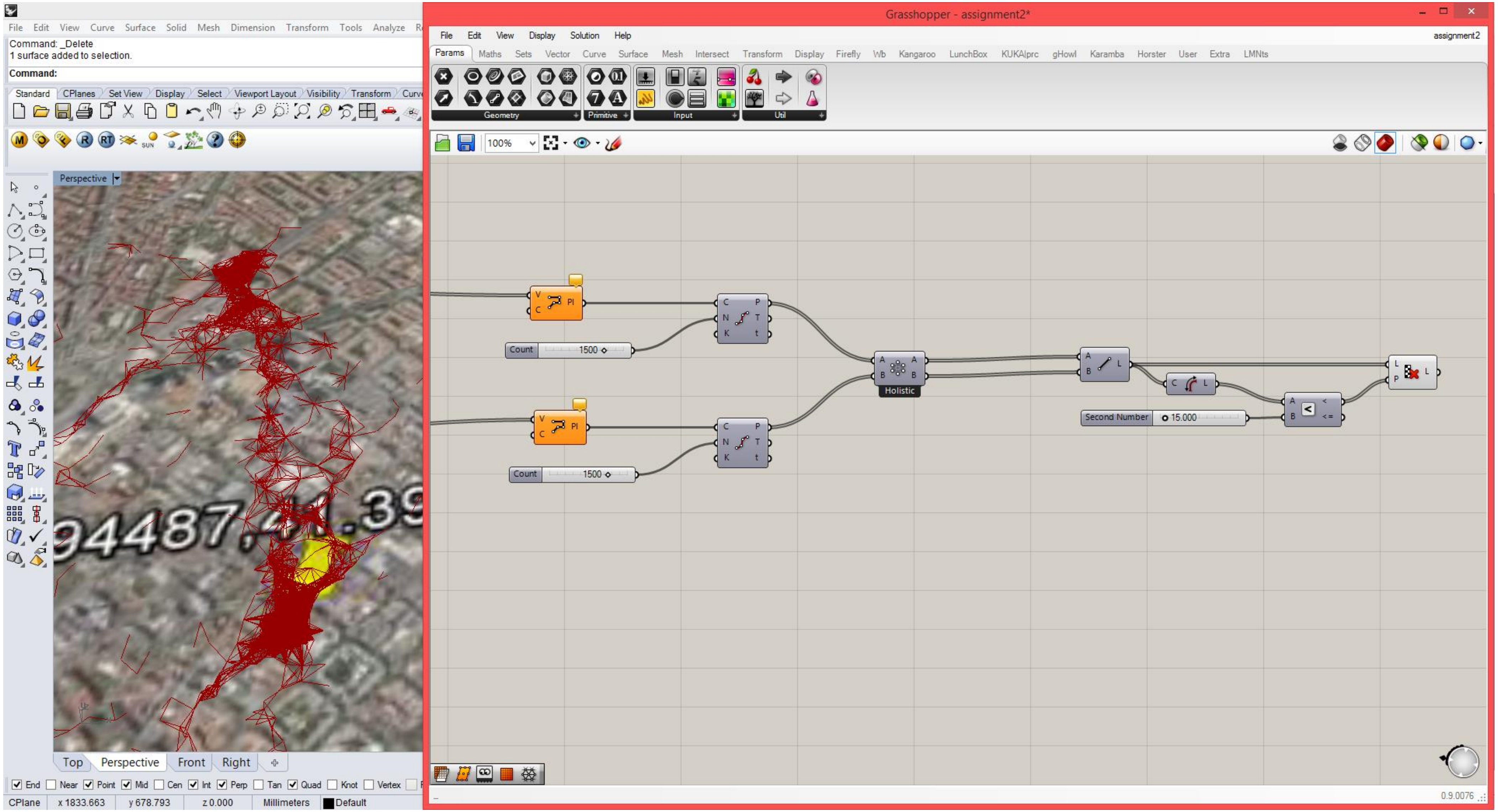
Grasshopper - assignment2*

☑ End □ Near ☑ Point ☑ Mid □ Cen ☑ Int ☑ Perp □ Tan ☑ Quad □ Knot □ Vertex

CPlane x 1786.173 y 216.544 z 0.000 Millimeters Default

Step 7

Create a system of lines that connect the points of the two different tracks that are nearer than a specific distance.
Different distances can be tested with a slider.



Command: _Delete
1 surface added to selection.
Command:

Count 1500

Count 1500

Second Number 15.000

File Edit View Curve Surface Solid Mesh Dimension Transform Tools Analyze
Standard CPlanes Set View Display Select Viewport Layout Visibility Transform
Perspective
Top Perspective Front Right
☑ End □ Near ☑ Point ☑ Mid □ Cen ☑ Int ☑ Perp □ Tan ☑ Quad □ Knot □ Vertex
CPlane x 1833.663 y 678.793 z 0.000 Millimeters Default
Grasshopper - assignment2*
File Edit View Display Solution Help
assignment2
Params Maths Sets Vector Curve Surface Mesh Intersect Transform Display Firefly Wb Kangaroo LunchBox KUKAlprc gHowl Karamba Horster User Extra LMNts
Geometry Primitive Input Util
100%
V C Pl
C N K P T t
A B A B
Holistic
A B L
C L
A B < <=
L P L
0.9.0076

Step 8

Create the final visualization of the image.