# Assignment 04

# LiDAR Remote sensing

# LAS Tools Demonstration

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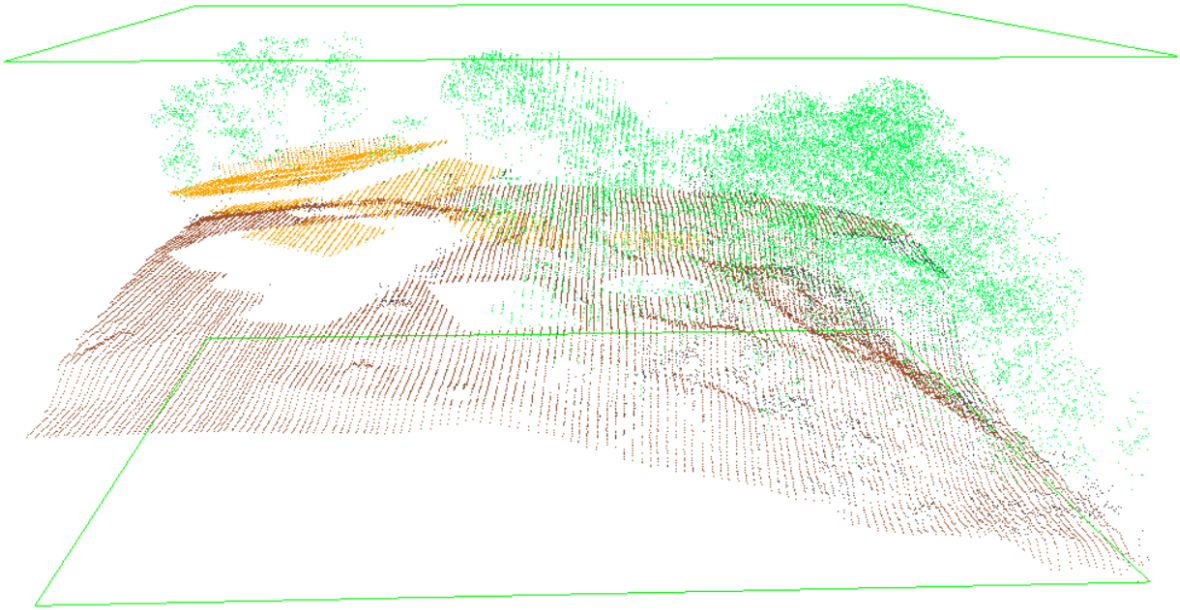
## Demonstration of LAS Tools using Command prompt

### Command for las view:

```
>lasview -i house.las
```



**lasinfo is a command-line tool from LASTools that provides a detailed report on the contents of a LIDAR file in LAS format. It can be used to obtain information about the number of points, point spacing, point classification, and other attributes of the LIDAR data.**

```
>lasinfo -i house.las
```

```
lasinfo (230330) report for 'house.las'
reporting all LAS header entries:
  file signature:             'LASF'
  file source ID:             0
  global_encoding:            0
  project ID GUID data 1-4:   00000000-0000-0000-0000-000000000000
  version major.minor:        1.2
  system identifier:          'LAStools (c) by Martin Isenburg'
  generating software:        'las2las (version 130506)'
  file creation day/year:     151/2012
  header size:                227
  offset to point data:       321
  number var. length records: 1
  point data format:          1
  point data record length:   28
  number of point records:    57084
  number of points by return: 37047 12918 5615 1299 191
  scale factor x y z:         0.01 0.01 0.01
  offset x y z:               0 0 0
  min x y z:                  309227.00 6143455.00 451.40
  max x y z:                  309268.99 6143496.99 471.39
variable length header record 1 of 1:
  reserved             43707
  user ID              'LASF_Projection'
  record ID            34735
  length after header  40
  description          'by LAStools of Martin Isenburg'
    GeoKeyDirectoryTag version 1.1.0 number of keys 4
      key 1024 tiff_tag_location 0 count 1 value_offset 1 - GTModelTypeGeoKey: ModelTypeProjected
      key 3072 tiff_tag_location 0 count 1 value_offset 32755 - ProjectedCSTypeGeoKey: WGS 84 / UTM 55S
      key 3076 tiff_tag_location 0 count 1 value_offset 9001 - ProjLinearUnitsGeoKey: Linear_Meter
      key 4099 tiff_tag_location 0 count 1 value_offset 9001 - VerticalUnitsGeoKey: Linear_Meter
reporting minimum and maximum for all LAS point record entries ...
  X            30922700   30926899
  Y           614345500  614349699
  Z               45140      47139
  intensity           9      16103
  return_number       1          7
  number_of_returns   1          7
  edge_of_flight_line 0          0
  scan_direction_flag 0          0
  classification      1          6
  scan_angle_rank   -11          3
  user_data           0        134
  point_source_ID     5          5
  gps_time 11570.850892 11572.206750
number of first returns:        37047
number of intermediate returns: 7242
number of last returns:         36605
number of single returns:       23810
WARNING: there are 13 points with return number 6
WARNING: there is 1 point with return number 7
overview over number of returns of given pulse: 23810 14656 13130 4494 915 72 7
histogram of classification of points:
           3579  unclassified (1)
          25545  ground (2)
          20885  high vegetation (5)
```

## Command for Converting the LAZfile to .las

```
>laszip -i house.laz -o house.las
```

## Command for conversion: .txt

```
>las2txt -i house.laz -o house.txt
```

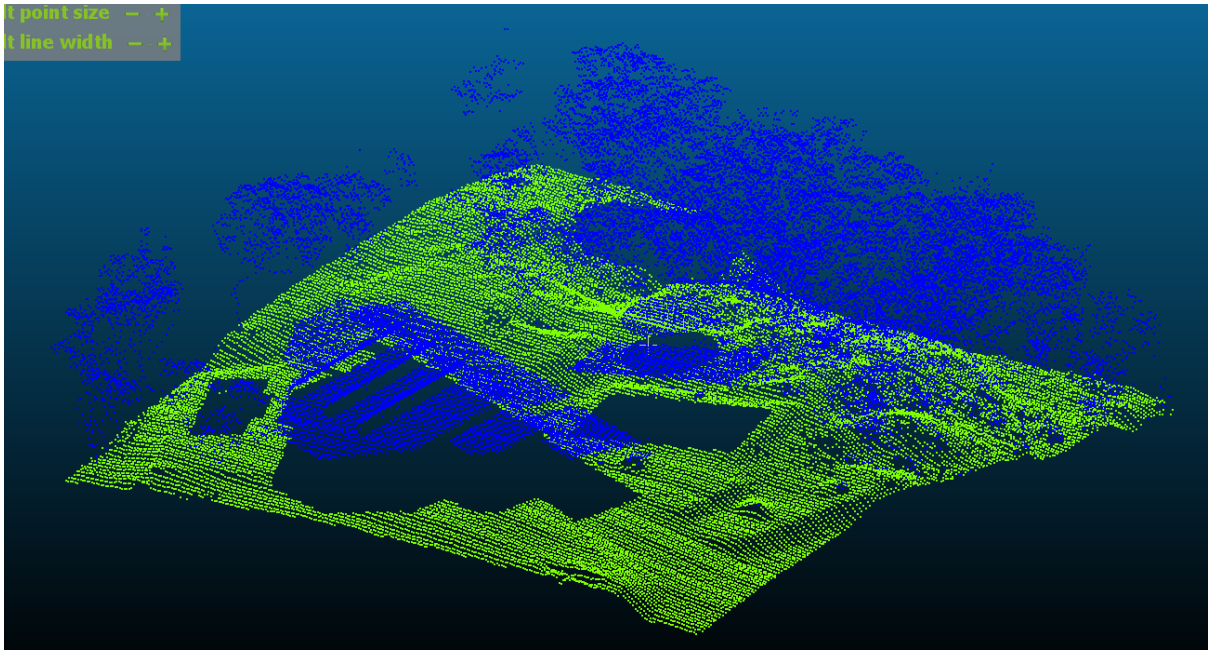
The below figure shows that size of the file before and after conversion

| | | | |
|---|---|---|---|
| house.las | 15-04-2023 18:02 | LAS File | 1,562 KB |
| house.laz | 05-11-2017 23:35 | LAZ File | 279 KB |
| house.txt | 15-04-2023 17:41 | Text Document | 1,617 KB |

## Separating the ground and non ground points

### Command for conversion:

```
>lasground -i house.las -o out.las -step 4 -sub 1 -drop_z_below 0.1 -extra_fine
```

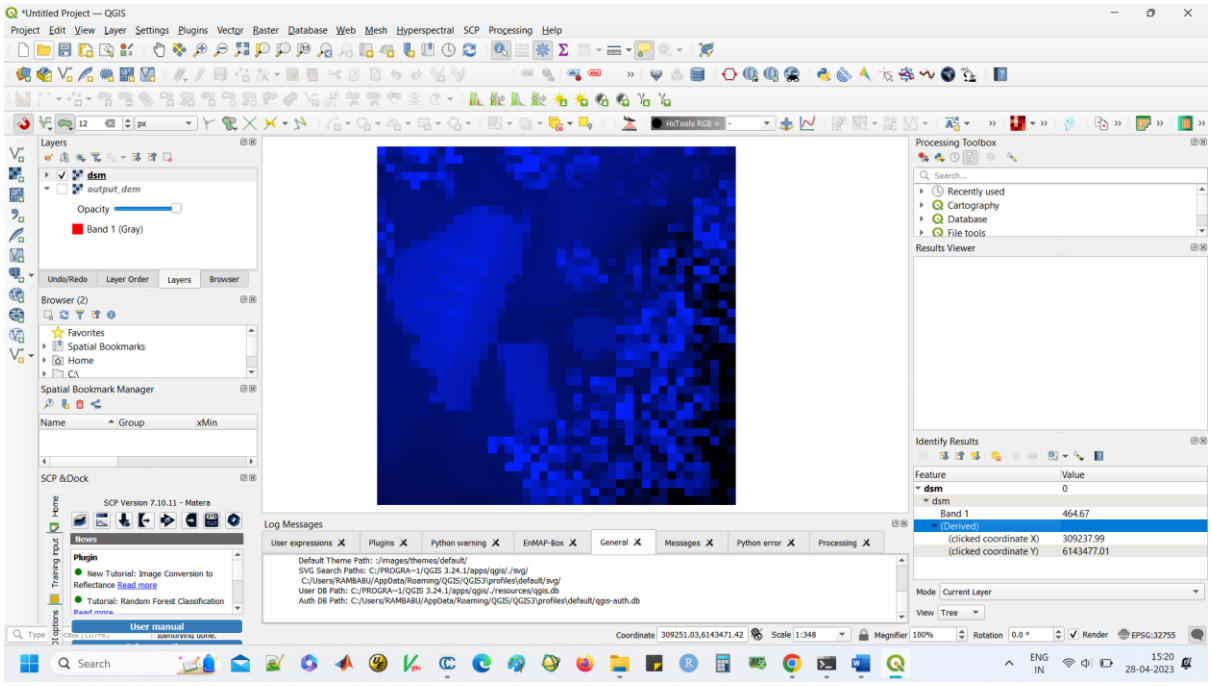



A Digital Surface Model (DSM) is a type of DEM that represents the height of the highest point on the Earth's surface within each cell of the model. DSMs are typically created using remote sensing data, such as LIDAR or photogrammetry, and can include vegetation and man-made structures in addition to the ground surface.

A Digital Terrain Model (DTM) is a type of DEM that represents the elevation of the bare ground surface without including any objects on top of it, such as buildings or vegetation. DTMs are typically created by filtering out all non-ground points in a LIDAR point cloud or by subtracting a DSM from a DEM.

### Digital Surface model generation with both ground and non groud points:

```
>las2dem -i house.las -step 1.0 -o dsm.tif
```

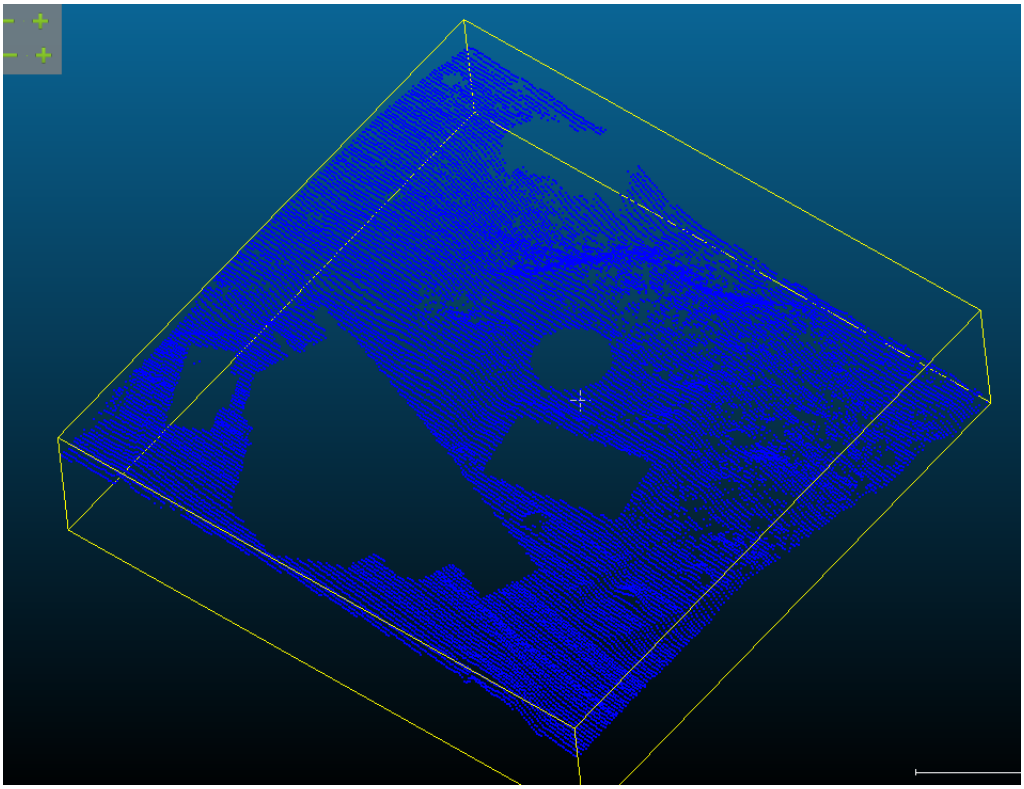



## DSM ASCII file:

```
ncols 42
nrows 42
xllcorner 309227.000000
yllcorner 6143455.000000
cellsize 1.000000
NODATA_value -9999.0
466.41 460.62 460.79 464.26 466.09 468.40 463.42 459.58 466.69 459.62 459.74 459.96 459.63 459.90 460.36 464.84 466.32 464.97 462.05 463.84 464.29 464.54 460.51 460.39 463.11 460.23 460.35
462.70 459.42 459.23 461.08 462.57 467.55 459.64 462.43 466.10 468.18 460.00 459.98 459.70 459.68 461.56 460.97 460.71 467.76 467.74 463.76 461.27 460.74 460.41 464.44 464.35 464.96 460.18
459.08 464.99 460.81 460.53 459.60 459.69 459.85 462.67 459.97 459.83 459.81 459.95 459.97 459.71 459.88 463.12 466.91 466.55 467.62 461.02 464.18 460.46 463.96 463.00 462.37 462.39 460.09
459.25 459.41 461.78 465.35 465.35 467.92 463.09 465.47 462.33 459.85 459.85 459.92 459.97 459.98 459.78 459.96 464.34 462.06 460.57 464.02 462.98 460.42 463.00 460.42 461.30 461.01 460.11
459.63 459.62 459.96 459.99 468.55 459.91 459.86 461.64 463.89 459.96 459.92 459.96 459.98 459.98 459.98 459.81 459.93 462.45 464.23 464.34 460.40 460.42 461.30 462.05 460.32 460.29 460.18
459.53 459.96 459.98 459.99 459.98 459.99 459.93 459.91 462.71 459.98 459.99 460.04 459.99 459.98 459.99 459.98 459.95 459.93 459.87 459.93 460.38 460.42 460.53 460.45 460.41 460.38 460.30
461.26 459.84 459.97 459.98 459.99 459.99 460.00 459.97 460.52 460.29 459.98 460.00 459.97 460.00 460.06 459.96 459.97 459.96 459.97 459.94 460.20 460.45 460.49 460.48 460.43 460.38 460.33
461.33 459.78 459.98 459.98 459.97 459.99 460.00 459.97 460.00 460.00 461.42 463.43 464.04 461.93 461.68 459.88 459.92 461.09 460.32 459.93 460.09 460.58 460.50 460.47 460.39 460.33 460.22
462.88 460.99 459.97 459.98 460.00 460.00 460.00 460.00 460.43 463.60 463.78 463.91 464.06 464.20 464.35 463.05 460.34 462.29 459.95 459.87 460.17 460.45 460.52 460.45 460.40 460.30 460.17
460.11 465.14 459.93 459.99 460.00 459.99 460.00 460.94 462.59 463.68 463.82 463.97 464.10 464.26 463.90 463.26 463.18 463.01 459.95 459.86 460.17 460.47 460.44 460.44 460.35 460.17 460.04
464.77 461.09 459.85 460.00 460.00 459.99 462.16 463.02 463.60 463.72 463.86 464.01 464.15 464.29 463.35 463.22 463.08 461.03 459.86 459.90 460.31 460.43 460.40 460.39 460.29 460.12 459.89
461.95 463.60 459.85 460.00 462.32 463.24 463.85 463.66 463.66 463.78 463.92 464.06 464.20 464.35 463.30 463.17 463.02 461.06 459.91 460.00 460.41 460.38 460.60 462.43 460.14 459.89 459.66
459.61 464.14 461.94 463.02 463.15 463.29 463.41 464.28 464.34 464.19 463.98 464.12 464.26 464.33 463.25 463.11 462.97 459.82 459.87 460.24 460.39 463.99 461.16 464.27 464.04 459.57 459.35
461.56 459.75 462.97 463.07 463.21 463.31 463.47 463.60 463.74 464.43 464.86 464.72 464.56 463.33 463.20 463.06 462.93 459.78 459.91 460.33 460.32 465.38 462.39 461.36 461.25 462.91 459.00
464.22 460.04 463.00 463.12 463.24 463.85 463.71 463.64 463.80 463.93 464.08 464.23 464.92 463.28 463.14 463.02 462.89 459.81 460.15 460.31 460.32 461.54 462.72 463.28 464.67 464.33 458.88
461.51 462.10 463.04 463.17 463.29 463.43 462.90 464.37 464.23 464.04 464.13 464.26 463.37 463.23 463.09 462.95 460.28 459.91 460.31 460.26 460.25 460.32 462.79 463.31 461.04 461.92 464.62
459.76 462.95 463.08 463.24 463.34 463.48 463.61 463.76 464.07 464.91 464.75 464.61 463.32 463.18 463.05 459.91 459.81 460.10 460.27 460.28 460.26 460.26 460.27 462.16 461.11 460.11 458.95
459.74 463.00 463.11 463.27 463.89 463.72 463.68 463.81 463.95 464.10 464.24 463.98 463.27 463.12 462.99 460.91 459.88 460.11 460.21 460.26 460.27 460.23 460.00 459.76 459.83 459.00 458.96
459.73 460.65 463.17 463.31 463.44 464.37 464.42 464.26 464.08 464.15 464.29 463.35 463.21 463.07 462.92 459.77 459.80 459.90 459.96 460.02 459.93 459.78 459.57 459.33 459.02 458.98 458.96
459.74 459.79 463.23 463.36 463.50 463.63 463.77 463.91 464.97 464.82 464.67 463.29 463.15 463.01 460.81 459.75 459.62 459.62 459.52 459.47 459.46 459.44 459.27 459.00 459.70 458.90 458.96
```

## Command for keeping the ground points only :

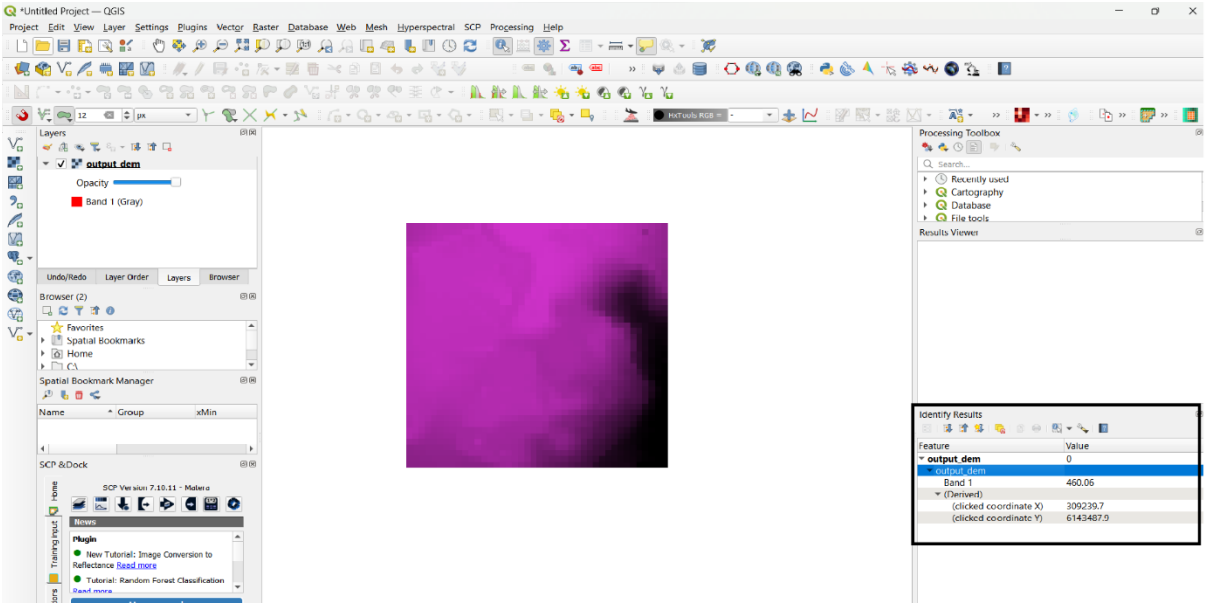
```
>lassplit -i house_non_ground.las -o output_directory -keep_class 2
```



## DEM generation from the ground separated points

```
>las2dem -i ground_only.las -o output_dem.tif -step 1 -cores 4
```

## Visualisation in QGIS




## Visualisation in Google Earth Pro


The lasthin command is used in LASTools to thin a LAS/LAZ point cloud by removing points that are considered redundant or unnecessary

```
lasthin -i input.las -o output.las -step 1.0
```