



__ QGIS User Group CH __

Mini-Workshop “Representation of LTOP Data in QGIS”

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Intro



Ideas for a next workshop? <https://forms.gle/fj7Qi3fNRwv6nADl8>

Contents



Basic concepts of the LTOP representation:

- Read custom file formats with Python
 - *Read LTOP coordinates (.koo), measurements (.mes) and results (.prn) files*
- Create memory layers in QGIS (using PyQGIS)
 - *Create a layer for each above-mentioned file*
- Apply advanced styles with geometry generators
 - *Draft advanced styles for measurements and error ellipses*

Glossary



Short glossary German ↔ French ↔ English:

Näherungskoordinaten	Coordonnées provisoires	Approximate coordinates
mittlere Fehlerellipsen	ellipses d'erreur moyenne	
(Netz-)lagerung	positionnement du réseau	

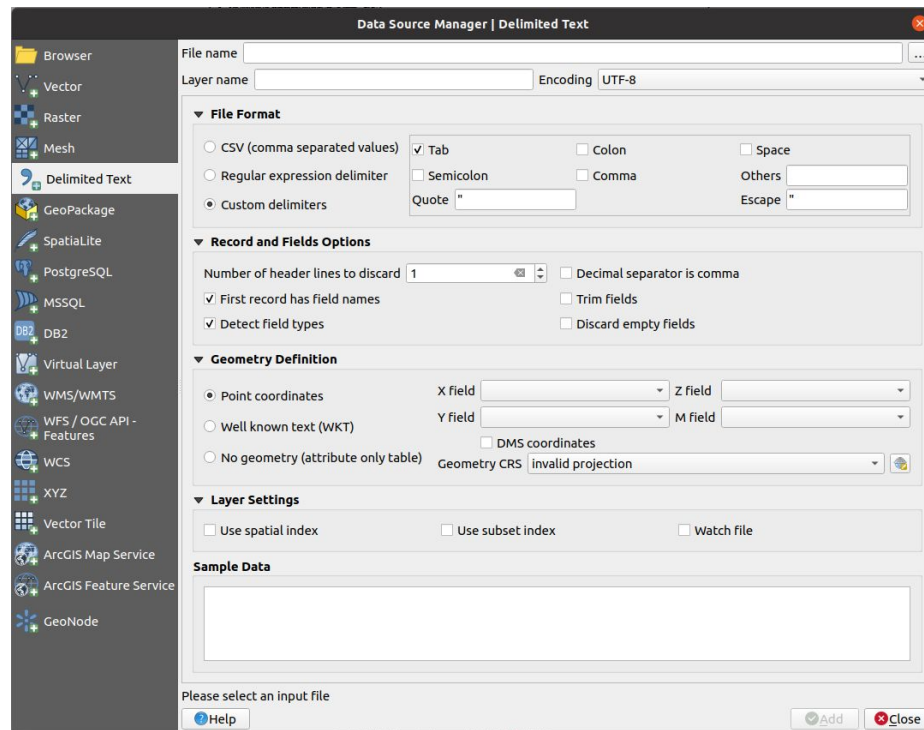
Read custom file formats, but why?



- QGIS has powerful delimited text format options
 - “Add Delimited Text Layer”
- Advanced CSV options provided by the OGR CSV driver:
<https://gdal.org/drivers/vector/csv.html>

But:

- LTOP files are not really delimited text files ...





Read custom file formats, but how?

- Scripting in Python console
- Python Plugins and Processing scripts
- PyQGIS in standalone scripts outside of QGIS with or without GUI

The screenshot shows the Python Console window in QGIS. The console is open to a file named `read_measurements.py`. The script contains the following code:

```
1 # Path to LTOP .koo file with approximate coordinates
2 koo_file = './home/adrian/Dropbox/Documents/QGIS_Workshop
3 # Path to LTOP .mes file with the geodetic measurements
4 mes_file = './home/adrian/Dropbox/Documents/QGIS_Workshop
5
6 # Create a memory layer to store the approximate coordin
7 # see https://docs.qgis.org/3.16/en/docs/pyqgis_develope
8 koo_layer = QgsVectorLayer("Point?crs=epsg:2056&index=ye
9 # Get the data provider for this layer
10 koo_provider = koo_layer.dataProvider()
11
12 # Add fields for point name, easting and northing
13 # see also the example in the documentation:
14 # https://docs.qgis.org/3.16/en/docs/pyqgis_developer_co
15 koo_provider.addAttributes([QgsField("Punktname", QVaria
16                               QgsField("Rechtswert", QVariant.Double
17                               QgsField("Hochwert", QVariant.Double
18 # Tell the vector layer to fetch changes from the provid
19 koo_layer.updateFields()
20
```

The console also shows a help message for the `iface` object:

```
1 Python Console
2 Use iface to access QGIS API interface or Type
  help(iface) for more info
3 Security warning: typing commands from an un
  trusted source can harm your computer
4
>>>
```

The status bar at the bottom of the window shows the following information: Coordinate: -2.509,-0.962, Scale: 1:24, Magnifier: 100%, Rotation: 0.0°, Render: checked, EPSG:2056.



Read custom file formats, but how in general?

- Open a file to read
- Loop over all lines
- Search for format-specific keywords
 - requires to study the custom file format!
- If keyword found in line:
 - parse line e.g. split, trim, extract strings, geometries etc.
- Else if keyword not found in line:
 - go to next line



Read custom file formats, but how in detail?

Coordinates file (.koo):

- Combination of delimited text (space) and fixed width columns
- Lines starting with \$\$ are comments
- Otherwise each line is one point
- In Python: each line is a String and each String is an array of characters
- => split line at corresponding column and strip spaces



Read custom file formats, but how in detail?

Measurements file (.mes):

- Lines starting with \$\$ are comments
- Lines starting with ST indicates the start of a new station
 - Extract the station name and
 - Store the station to a variable and go to the next line
- Lines starting with RI, ZD, DS indicates an observation to a target
 - Split and strip the line and
 - Create a linestring from the current station to this target



Read custom file formats, but how in detail?

Measurements file (.prn):

- Skip a lot of lines :) up to the header line that contains "MITTL. FEHLERELLIPSEN"
 - set `read_table` to true
- Skip the following decoration and header lines
- *Then* read the line and extract point name, coordinates, semi-axes of error ellipses
- Read until the end of the table indicated by a header line
 - set `read_table` to false

Create memory layers



See

https://docs.qgis.org/3.16/en/docs/pyqgis_developer_cookbook/vector.html#from-an-instance-of-qgsvectorlayer

```
1  from qgis.PyQt.QtCore import QVariant
2
3  # create layer
4  vl = QgsVectorLayer("Point", "temporary_points", "memory")
5  pr = vl.dataProvider()
6
7  # add fields
8  pr.addAttributes([QgsField("name", QVariant.String),
9                    QgsField("age", QVariant.Int),
10                   QgsField("size", QVariant.Double)])
11 vl.updateFields() # tell the vector layer to fetch changes from the provider
12
13 # add a feature
14 fet = QgsFeature()
15 fet.setGeometry(QgsGeometry.fromPointXY(QgsPointXY(10,10)))
16 fet.setAttributes(["Johny", 2, 0.3])
17 pr.addFeatures([fet])
18
19 # update layer's extent when new features have been added
20 # because change of extent in provider is not propagated to the layer
21 vl.updateExtents()
```



Apply Advanced Styles: the Geometry Generators

What are geometry generators? According to the official QGIS documentation section 12.2.2.2.5. [sic!]:

Available with all types of symbols, the geometry generator symbol layer allows to use expression syntax to generate a geometry on the fly during the rendering process. The resulting geometry does not have to match with the original geometry type and you can add several differently modified symbol layers on top of each other.

Extensive list of functions that can be used:

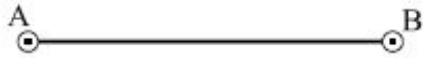
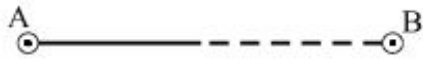
https://docs.qgis.org/3.16/en/docs/user_manual/working_with_vector/functions_list.html#geometry-functions

- all kind of “typical” GIS methods like buffer, centroid, make_point, make_line, x_min, x_max etc. available



Apply Advanced Styles: Geodetic Measurements

Representations of geodetic measurements:



Legende zu den in diesem Kapitel folgenden Abbildungen:

Richtungsmessung von A nach B

Richtungsmessung vom A nach B und umgekehrt

Richtungs- und Distanzmessung von A nach B und umgekehrt



Apply Advanced Styles: Geodetic Measurements

Rule-based renderer:

- Rule for “DS”: Schrägdistanz
 - Draw a rectangle at the center of the line with constant size:

```
line_substring( $geometry, ($length / 2 - 3), ($length / 2 + 3))
```

- Rule for “RI”: Richtungsmessung
 - Draw a solid line from the start to the middle of the line
 - Draw a dashed line from the middle to the end of the line
 - Requires two symbol layers:

```
line_substring( $geometry, 0, ($length / 2))
```

```
line_substring( $geometry, ($length / 2), $length)
```



Apply Advanced Styles: Error Ellipses

Single symbol renderer:

- Symbol layer for semi-axes A

```
make_line(  
  $geometry,  
  make_point( $x + (sin(radians(0.9*"AZI_A")) * "MFA"),  
              $y + (cos(radians(0.9*"AZI_A")) * "MFA" ) )  
)
```

- Symbol layer for semi-axes B

```
make_line(  
  $geometry,  
  make_point( $x + (sin(radians(0.9*"AZI_A") + pi()/2) * "MFB" ),  
              $y + (cos(radians(0.9*"AZI_A") + pi()/2) * "MFB" ) )  
)
```

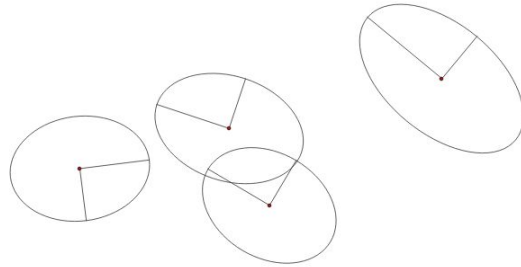


Apply Advanced Styles: Error Ellipses

Single symbol renderer:

- Symbol layer for ellipse

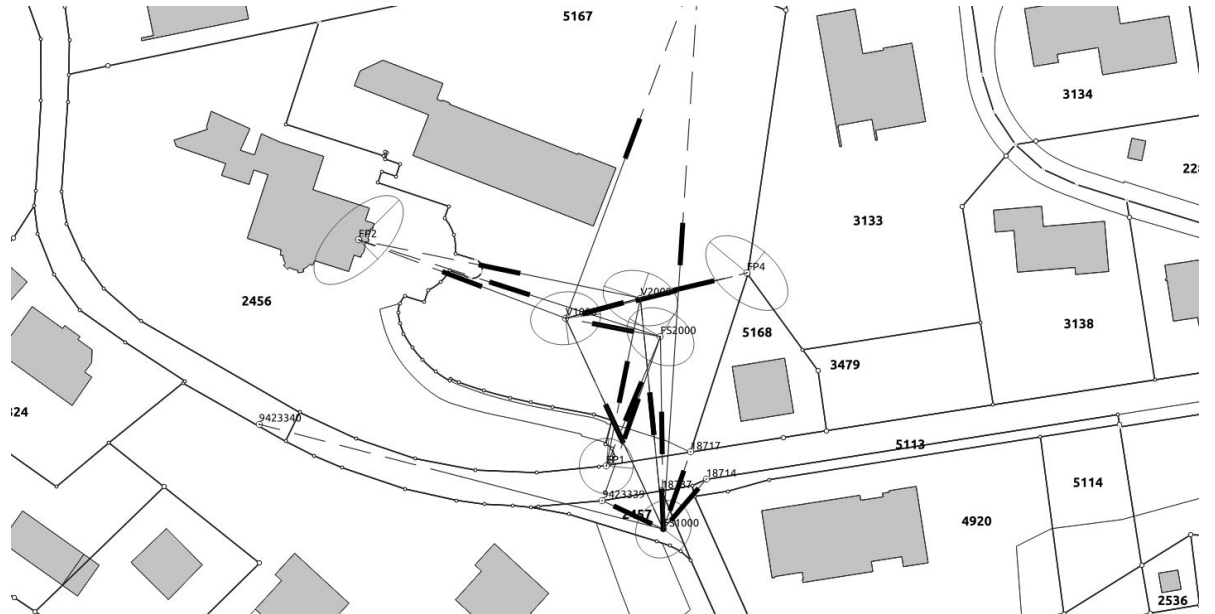
```
make_ellipse( $geometry, "MFA" , "MFB" , "AZI_A" * 0.9)
```



Hands-on



- Open scripts
- Adapt file paths to your system
- Run the scripts
- Apply the styles



Hands-on Advanced



Ideas to improve the scripts:

- Measurements file (.mes): Add the zenith angle measurements to the virtual layer
- Add the Äussere Zuverlässigkeits Rechtecke
- FileWatcher with QFileSystemWatcher
- Results file (.prn): Drop the NULLBERN point (default in output, but not needed)

Outlook and Open Discussion



What's next?

- QLTOP, Bachelor thesis at heig-vd in 2020
- Who is working on related topics with QGIS?
- Launch a sponsoring project in 2022?



Literature

- Explanation LTOP .mes file format:
https://geodesy.geo.admin.ch/reframe/ltop_fmt_descr_de.html#MESS
- LTOP user manual:
<https://www.swisstopo.admin.ch/en/geodata/applications/geosoftware/ltop.html>
- PyQGIS:
https://docs.qgis.org/3.16/en/docs/pyqgis_developer_cookbook/index.html