2020년도 공간정보공학 실습 – 공간정보 및 측량자료의 처리

(레포트와 공간정보파일 **2020년 6월 18일(23:59)**까지 ETL에 제출)

1. Required Downloads

- Google Earth Desktop: https://www.google.com/earth/versions/
- QGIS: https://qgis.org/en/site/forusers/download.html
  * Download 3.12 (QGIS Standalone Installer Version 3.12)

2. Required Submissions on ETL (Save all of the following files in a zip folder)

- QGIS Part 2: DEM (*.geotiff or *.tif)
- QGIS Part 3: Map layout (PDF)
- QGIS Part 4: Cut & fill volume (*.geotiff or .tif), target (.shp), volume results (.txt or .xml)

*Note: This manual is only a guide to the tutorial. Other methods using QGIS tools are also accepted, but the same number of required files must be submitted.

Tutorial Process

Google Earth and GPS Visualizer

(1) Choose an area, **anywhere** in the world, that you are interested in creating a DEM for.
(2) Add Path → Click on the Google Earth map to create a new data point in the path. Continuously hold down the left-click button and drag the mouse to create multiple data points in the path.
(3) After recording a sufficient amount of data points, save the new path. Find the path file on the left tab under "Places" and right-click to save the path file as .kml or .kmz. (*Both are valid)
(4) Upload the .kmz or .kml file on https://www.gpsvisualizer.com/elevation and convert & add elevation. Make sure the output is set to "Plain Text".
(5) Download the converted output data by clicking the link "Click to download _____.txt"

QGIS Part 1: DEM Raster Creation

(1) Import .txt file
Layer → Add Layer → Add Delimited Text Layer
- File Format : "Custom delimiters" and select "Tab"
- Make sure under "Geometry Definition", the option "Point coordinates" is selected and "X field" is "longitude" and "Y field" is "latitude"
- Output file is named and saved as "**elevation**"

* Check to make sure "Geometry CRS" = EPSG: 4326 – WGS 84

(2) Re-project features from latitude/longitude to meters
🔍 Processing → Toolbox : In the Processing Toolbox, search for "Reproject layer" → Under "Vector general"
- Source CRS = Project CRS, Target CRS = WGS / UTM 52N (for South Korea)

(3) Spatial interpolation to create the DEM **(file is named as "dem")**
🔍 Processing → Toolbox : In the Processing Toolbox, search for "Natural Neighbour" → Under "SAGA Raster creation tools"
- Set "Attribute" = "Altitude", "Method" = "[1] Sibson", "Output extent" = "Use Layer Extent" → "Use extent from" and select "**elevation**", "Cellsize" = 30, "Fit" = "[1] cells", "Grid" = Filename.

QGIS Part 2: OSM Vector Overlay and GIS Applications

*Download QGIS Plug-in "QuickOSM"
Plugins → Manage and Install Plugins
🔍 Under "All Plugins", search "QuickOSM". Click the search entry and press "Install Plugin"

(1) Import OSM data using QuickOSM
Vector → QuickOSM → QuickOSM
- Key : "building", In : "Layer Extent" : Elevation grid file "**elevation**"
- Press "Run query" once all of the parameters have been filled
- Save OSM building shape files as "**building**" as .shp format

(2) Vectorize data
🔍 In the "Processing Toolbox", search "Raster pixels to polygons" : Under "Vector creation"
- Raster layer = "**dem**"
- Save as .shp format

(3) Reproject the building shape files
🔍 Processing → Toolbox : In the Processing Toolbox, search for "Reproject layer" → Under "Vector general"
- Source CRS = Project CRS, Target CRS = WGS / UTM 52N (for South Korea)

(4) Clip the OSM shape files to the extent of the raster DEM file
Vector → Geoprocessing Tools → Clip
- Input layer = "**building**", Overlay layer = "**dem**"

(5) Adjust the properties of the DEM file
*Right-click the DEM file → Properties → Symbology
- Render type = Singleband pseudocolour → Adjust color ramp → Change values in legend according to elevation values in plotted DEM

(6) Adjust the attributes of the building shape file "**building**"
*Right-click the Building file → Properties → Labels → Single Labels

(7) 3D Visualization of GIS layers
View → New 3D Map View
- Click the wrench icon (last icon on the right) to navigate to properties of the 3D view
- Terrain → Type = DEM (Raster Layer), elevation = "**dem**"

Save : "dem" from (3) as a .geotiff file (.tif file is also accepted)

QGIS Part 3: Exporting GIS Map Visualizations

(1) Create a new map layout
Project → Layout Manager
- Under "New from Template", press "Create" for a new "Empty layout"
- Name the new layout if needed

(2) Create map images of the DEM and 3D view
Include a map of the DEM, OSM building data with name attributes, scale bar, legend, and north arrow. **Also place your name and student number at the top of the map.**
Add Item → Add Map and Add Item → Add 3D Map
Add Item → Add Scale Bar, Legend, North Arrow
*Each new feature can be adjusted by changing the "Item Properties"

(3) Export layout as PDF
Layout → Export as PDF file

Save : Layout PDF file from (3) with name and student number

QGIS Part 4: Surveying Applications

(1) Choose a region of interest with a significant variation in elevation (Slope > 5°)
In the "Processing Toolbox", search "slope" : Under "Raster terrain analysis"
- Elevation layer = "**dem**"

Raster → Raster Calculator
- In the "Raster Calculator Expression", insert **"Slope > 5".**
- Make sure to add "Output layer" under "Result Layer" and press "OK"

(2) Create a vector layer for the region of interest
Layer → Create Layer → New Shapefile Layer
- Set filename of shapefile layer as "**target**". "Geometry type" = "Polygon", CRS = "WGS 84 / UTM zone 52N"
- Right-click newly created shapefile layer and press "Toggle Editing". Then press "ctrl+." as a keyboard shortcut to add a new polygon feature.

*** Try to create the polygon within the area of Slope>5**

(3) Extract DEM for "**target**" region
Raster → Extraction → Clip Raster by Mask Layer
- Input layer = "**dem**", Mask layer = "**target**" (shape file created in (2))
- Source CRS = WGS 84 / UTM Zone 52N, Target CRS = WGS 84 / UTM Zone 52N
- Save filename as "**clipped**"

* Make sure to check "Keep resolution of input raster"

(4) Find total volume of "**clipped**"
In the "Processing Toolbox", search "Raster surface volume": Under "Raster analysis"
- Input layer = "**clipped**"
- Base level = 0
- Method = "Count Only Above Base Level"
- Check "Surface Volume Report" for volume, pixel count, and area
- Calculate the average elevation (계획고) and round to 3 decimal points → Include the calculated elevation in the results (round to 3 decimal points)

(5) Find cut/fill volume (절토/성토)
Raster → Raster Calculator
- In the "Raster Calculator Expression", insert **"clipped > average elevation" (calculated from (4)).** →

Save as "**cut**" (절토)

- In the "Raster Calculator Expression", insert **"clipped <= average elevation" (calculated from (4)).** → Save as "**fill**" (성토)

Raster → Conversion → Polygonize (Raster to vector)

- Input layer = "**cut**"
- Right-click on polygonized file → Attribute table
- Save filename as "**cut_vec**"
- **Delete "ID" as necessary for cut**

*** Repeat this step for "fill"**

Raster → Extraction → Clip Raster by Mask Layer

- Input layer = "**dem**", Mask layer = "**cut**"
- Source CRS = WGS 84 / UTM Zone 52N, Target CRS = WGS 84 / UTM Zone 52N

* Make sure to check "Keep resolution of input raster"

*** Save filename as "cut_vol" after extracting the .tif file (Export → Save As…)**

- Format = "GeoTIFF"
- File name = **"cut_vol"**

🔍 In the "Processing Toolbox", search "Raster surface volume" : Under "Raster analysis"

- Base level = **average elevation (calculated from (4))**
- Method = "Count Only Above Base Level"
- Check "Surface Volume Report" for volume, pixel count, and area

*** Repeat this step for "fill" (Save extracted file as "fill_vol")**

Save the following files (Total: 4 files)

- **Both "cut_vol" and "fill_vol" files from (5) as .tif files**
- **"clipped" from (4) as .geotiff or .tif file**
- **"Raster surface volume" results for "clipped", "cut_vol", and "fill_vol" from (4) and (5). Each file should include volume, pixel count, and area. In the text results, "Clipped" should also include the calculated average elevation from (4).**

  *Save all of the results in a text or excel file