USE OF THE GEOINFORMATION SYSTEMS IN URBAN CADASTRE

A brief course for beginners

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INTRODUCTION

This course is for listeners whose activities are related to the creation of territorial management documentation. Its purpose is to acquaint listeners with the specifics and capabilities of geographical information systems, to provide basic skills for developing urban planning documentation in GIS.

The course covers the technical aspects of the documentation development process, such as territory analysis, initial data processing, territory objects geometry and attributes creation, and preparing documentation for print.

The course consists of 4 modules duration approximately 7 hours each. In order to assimilate the information received after each module, the student must do some home assignment.

Teaching during lectures is performed on the training materials provided by the course leaders. For better understanding and consolidation of the acquired skills, it is advisable for students to perform independent tasks on their own materials, such as * .shp or * .gdb files of territory topographic surveying, textual data of the results of environmental monitoring, etc.

In the absence of such materials, the student will be provided with training datasets for self-study.

The laptop running Microsoft Windows XP Professional or higher, Linux Debian 9.x / Ubuntu 18.04 or higher, MacOS X or higher is recommended to take the classes.

The full list of supported operating systems is available at https://qgis.org/en/site/forusers/alldownloads.html

Preferred Computer Requirements:
Processor Type - Intel Dual Core 1.80 Ghz / Amd Athlon X2 and above;
RAM: 4GB and above.

If needed, this course can be expanded and deepened for listeners who wish to gain additional knowledge to apply in their field.

COURSE STRUCTURE

MODULE 1.

Working environment settings in QGIS.
Duration: 7 hours

Content:

- Acquaintance with geographic information systems, in particular GIS QGIS:
  Examples of the GIS use for land analysis, creation of urban planning documentation and in land management systems.
- Installing QGIS:
  QGIS official website overview. Downloading the installation file. Installation options.
- Acquainting the interface:
  QGIS main window structure, an overview of panels menu.
- Interface customization:
  Customizing panels view and hotkeys.
- Project folders structuring:
  A clear project data structure as the key to an effective workflow.
- Plugins connection:
  The concept of plugin (module). Common QGIS plugins overview. Variants of plugins downloading - via repository and .zip format. Plugin activation and deactivation. Plugin connection example.
- Creation of a new project:
  The concept of a project. How to create a new project? Overview and comparison of project formats * .qgs, * .qgz. Setting project variables - a concept of a variable, what it is used for, how to set it up.
- Creation of new layers in a work environment. The concept of a layer. Working with vector data formats * .shp, * .gpkg, * .sqlite. Raster layers.
- Customization of attribute tables forms. Customization of attribute table fields label, drop-down lists, checkboxes, and other.
- Layer styles settings and new symbols creation:
  Overview of the Style Management module. A point, polygonal, and linear symbols creation options. Examples for understanding the difference between the layer object geometry and its symbol representation. Saving styles, copying and moving styles between layers.

An overview of the different layers symbols setting modes (Single character, Rule based symbol, Categorized characters, etc.);

Module 1 result:

Skills in setting up a work environment for a new project.

Home assignment (~ 3 hours):

*Users should create a system of their project folders based on the given on the lecture structure folders. Create a * .gpkg database with a set of layers needed for future work, customize the styles and shapes of database layers.*

MODULE 2.

Preparing data for the work. Downloading and verifying data. Duration in 7 hours.

Content:

- External data layers connection: How to connect ArcGIS databases and other databases formats. Conversion data from ArcGIS database into other GIS-formats for working in QGIS environment and other GIS.
- CAD Data Conversion and Connection:
  Connecting CAD data to GIS, converting CAD data to GIS formats, bringing data to an existing data set structure, working with text encoding formats.
- Object geometry verification:
  Checking geometry correctness and fixing invalid geometry.
- Connecting to external maps, such as State Geocadastre, Google, OSM, Bing, ESRI, Wikimedia, Stamen maps, etc.
- Working with coordinate reference systems (CRS):
  The concept of a coordinate reference system;
  Configuring and viewing coordinate reference systems in QGIS. Overview of * .prj and * .proj4 files;
  Converting data with different CRS into the project CRS.
- Working with data collection plugins:
  Geocoding, HQGIS, QuickOSM plugins.
  Plugin Connection. Overview of Geocoding (object geocoding), QGIS (object geocoding), QuickOSM (downloading data from OpenStreetMap) plugins. Using the plugins.
- The concept of snapping. Ways to customize snapping for all layers and a single layer.
- How to georeferencing project sketches, soil map rasters, etc.
  Downloading and overview of Freehand raster georeferencer and Raster georeferencer plugins. Georeferencing rasters using these plugins. Anchor points replacement.
- Raster vectorization with standard GIS tools:
  Working with the digitization toolbar.
- Layer object labels settings. Ways to set up layer object labels for the entire layer and the layer`s single objects.
- Extra settings for the point geometry symbols offset without geometry editing.
- Exporting data to other formats for storing geospatial data, exporting an attribute table (or selection) to a text file (* .csv).

Module 2 result:

Skills in connecting and downloading geospatial data from different sources, bringing them into the project structure for further use during master plan development.

Home assignment (~ 2 hours):

Users should prepare source datasets for their project using the algorithm outlined in the lecture.

MODULE 3.

Analysis of the studied area.

Duration is 7 hours.

Content:

- Digital elevation model (DEM) creation.
- Working with object Z coordinates:
  Select the Z coordinate from the DEM to assign it to an existing vector geometry.
- DEM analysis:
  Obtaining data about engineering and construction conditions. Use of catchment areas information.
- Working with a raster calculator:
  Finding suitable sites for construction, earthwork volume estimation, slope exposition..
- Data filtering and selection (by attributes and spatials relations).
- Expressions. Ways to update existing field values and create new fields with the specified data type using expressions.
- Statistics calculations. Ways to calculate statistics of road areas, engineering network length, suitable construction areas, etc.
- Operation on objects geometry. Buffers building, geometry addition, difference, a merge of geometries, etc.
- Tools for object geometry working with - create, edit, and copy objects;
  Create objects using Shape digitizing geometry templates. Additional digitizing tools. Editing existing geometry. Using hotkeys during working with geometry. Simultaneous topological editing of several layers;
- Geometry conversion. Conversion of line to polygon, polygon to line, creation of centroids.

Module 3 result:

Skills in vector and raster data analysis, geometric objects creation using advanced digitization tools.

Home assignment (~2 hours):

Users should create accessibility zones around specified objects of the initial dataset (prepared as a result of previous lessons). Create a DEM and perform some spatial analysis operations over it.

MODULE 4.

Creating project decisions, unloading of calculations in external formats, preparing projects for paper maps printing.

Duration is 7 hours.

Content:

- Acquaintance with the principles of object creation. Understanding how to create geometric objects and how to use different drawing methods in daily work.
- Creating road network axes.
  Correct topology of the road network as a basis for fast and high quality work.
- Obtaining data about road slope, road station points elevation for road planning.
- Drawing of road red lines. Variants of technique performance.
- Drawing of infrastructure objects, territories.
- Accessibility zones (isochrones) creation for the main cultural and domestic purpose objects - fire depots, schools, medical institutions, etc.
- Planning restriction zones creation.
- Working with a Graphical modeler (What is a Graphical modeler? Creation of model on the example of automation of DEM creation and assigning Z coordinates to the roads).
- Calculation of the territories areas ratio using attributes of vector layers.
- Uploading calculations to .xls, csv.
- Publishing the project online.
- Print map templates preparing (What is a map Print Template? How to Create a New Template? Map Layout interface overview. Adding different elements on the map. Customizing print map template. Atlas printing.);
- Print a project (Preparing a project map for print).

Result of module 4:

Skills obtained: processing and analyzing data for textual part of urban planning documentation; integration of separate operations into consecutive workflows for work automatization during urban planning documentation, urban planning documentation graphical schemes printing; geospatial datasets of urban planning documentation publishing on the Internet.

Home assignment (~ 2 hours):

Using the knowledge and methodologies gained, listeners should project spatial decisions, compile them on a graphical schema for printing, and publish maps on the Internet.

COURSE RESULTS

Experience in processing geospatial data and creating urban planning documentation using standard QGIS tools:

- Setting up a new project;
- Source data analysis;
- Objects geometry creation;
- Automation of repetitive tasks using processing models;
- Outturn of urban planning documentation for submission to a customer.