12TH ARCGIS TRAINING REPORT
ARCgis TRAINING AT 8-4-4 EF3 GIS COMPUTER LAB: 6TH -10TH OCTOBER 2014

USING ARCGIS - APPLICATIONS

DAY 1

The training programme from 6th – 10th Oct. 2014 was the fourth and final advanced training to be offered to participants, who had undergone basic introduction training. It marked the end of the scheduled trainings which were approved by the VC and that ran from June - October. The structure of a GIS Platform and the data model in a GIS were explained as consisting of Point, Line, Polygon and Image data features. The role and the structure of the Geodatabase was also explained and used to develop personal Geodatabase. The participant were trained on the use of the GPS receiver as one of the devices to capture Geographic data.

Using GPS to capture geographic features (data) and recording attribute information of the points.

After the field data collection participants prepared a map showing various features within the central part of KU. All map elements that make a complete map were inserted with each
participant working on their own map. The resulting maps were exported to Tiff format after appending personal names to the maps. One of such product is shown.

Map of the central part of KU showing plots of collected points
Day 1

Pre-evaluation forms were given to the participant to fill and aimed at assessing if participants attended the basic training course, with all having attended. To evaluate which Esri product they used after the basic training. 15 participants had continued to practice using ArcGIS software. The basic introduction were summarized to bring them up to speed with what they had done before.

Objectives

The main objective was to show the participants that although GIS is thought as a single integrated system of hardware and software, it is typically made up of a variety of different components: The people, Geographic data, the software, the hardware and the data management platforms (Servers and Databases).

The other objectives of the advance training aimed at introducing the participant to:

i. What are the components of GIS

ii. What are the stages of GIS

iii. What is ArcGIS as a tool for remote Sensing and GIS.

Participants were introduced to the components, shown in Figure 1 to make them understand the connectivity of GIS and other components with the real world.
This was achieved through an overview of the components of GIS as having five primary components namely:

1. People, computer staff, experts from various science disciplines, GIS operators, GIS experts, applications developers;
2. Data, which may be of type spatial, temporal, or attribute;
3. Engines that perform various data storage, retrieval, analysis, reporting, and communication functions;
4. Interfaces such as UNIX, GUIs having widgets based on toolboxes such as Xwindows or MOTIF, Microsoft Windows; and
5. Hardware, including workstations and networks, Geodatabase, digitizers, plotters, and communications devices.

The stages of GIS was also introduced and explained in a step by step to make it clear to the participants. Participants were made to understand that; a true GIS consists of 6 stages which can be viewed as subsystems in the operations of the whole system:
1. Data acquisition, surveys and research operation
2. Data input and Data storage (data and image processing)
3. Data processing (analysis and modelling)
4. Data output (editing, computation, reports and public relations)
5. Data use (continuous observation by the use of land properties and feedback)
6. Management of spatial data.

Computer automation is used to at all stages and therefore, an overview of developing a GIS system was explained and a summary is illustrated in Figure 2.

**Figure 2: Stages of developing a GIS System.**

After a short tea break, participants were taken through Geodatabases to prepare them in organizing geospatial information. Geodatabase is a data model for representing geographic information using standard relational database technology. It supports the storage and management of geographic information in standard database management system tables.
Geodatabase work across a range of DBMS architectures and come in many sizes with varying numbers of users. Two types of Geodatabase architectures are available: Personal Geodatabase and multiuser Geodatabase.

This opened the door on how to create a Personal Geodatabase using the ArcCatalog. Thereafter, creating Features class in the Geodatabase that was be used later to populate data from field and digitization exercises. The steps of creating a Geodatabase were simple but with explanations to make sure that participants understood the need for the best practice when developing a GIS system. This mirrored the same approach that was used in the introduction to ArcCatalog as a management tool for ArcGIS. Figure 3 shows the first step of creating a Personal Geodatabase.

![Figure 3: Creating a Personal Geodatabase.](image)

The flow of the training combined doing and explanations in a step by step approach where participants created their own Personal Geodatabase. New Feature classes were created into the Student_5 Geodatabase with KU_Shop Outlets (Figure 4), WaterPoints and KU_Image Features created into the Geodatabase.
Figure 4: Creating KU_ShopOutlets Feature Class.

Figure 5 shows a complete Personal Geodatabase with Feature Classes created and ready to receive data.

Figure 5: Student_5 Geodatabase with Features Classes.

The afternoon sessions ended with data type explanation (Figure 6) to prepare for the data to be put into the created feature classes. Point, Line, Polygon and Image data types were all explained in details and how to import data into the Geodatabase, to edit the data and present it in a map.
DAY 2

In the second day of the training participants were introduced to GPS concept. The GPS receiver being one of the device to capture Geographic data, is becoming a must know to the end users. Satellite constellation and how they transmit geospatial coordinates to the handheld receivers was demonstrated. The three components of GPS were explained to the users, so that they can understand how and where the satellite data are controlled from.

The control segment:

The Control Segment consists of five monitoring stations, the main purpose being to monitor & correct positions of satellites, the atomic clocks & data transmission. The USA Department of Defence (DOD) monitoring stations track all GPS signals for use in controlling the satellites and predicting their orbits.

The space Segment
Consist of 24 earth orbiting satellites (21 operational & 3 spare). The satellites are arrayed in six (Figure 7) orbital planes, inclined 55 degrees to the equator. They orbit at altitudes of about 20,000 km, with orbital periods of 12 hours.

![GPS Satellite constellation and Simulated GPS receiver during the training session.](image)

**Figure 7: 24 GPS Satellite constellation and Simulated GPS receiver during the training session.**

**User Segment**

Consists of all earth-based GPS receivers used for civilian & military purposes. Receivers vary greatly in size and complexity. Five Civilian GPS receivers from Garmin were used for this training and all menus and interfaces of the handheld receiver were introduced as participants got the feel of the devices.

Figure 8, shows the GPSmap 62s hand held Garmin receiver used for this training being setup for filed data collection. Participants were taken through the setups of the device to make sure they understood how the receiver works.
Immediately after the theory session, participants went outside the classroom environment to allow the GPS receivers lock to the actual satellite. Some explanations were made to help participant understand the best location to receive maximum number of satellites to improve point accuracy.

And just before the first point could be recorded, the GPS receivers were put in normal mode to receive the actual satellite as opposed to simulated mode used for demo in class. Participants (Figure 9) were shown how number of satellites locked to by the receiver influences the accuracy of point positioning. Garmin GPSmap 62s is 3m accuracy on normal mode but can get a 2m accuracy while in combination with GLONASS satellite systems.

Thereafter participant were organized to group and allowed to set their devices to make sure they understood how they will use the devices in the actual data collection. Attribute data forms which were to be used to record the attribute information for the features picked were distributed to the five groups. The groups were then set free to start the data collection exercise.
There were 5 groups each having 6 participants (the size of the group having been determined by the number of GPS Receivers at the trainer’s disposal) and collecting data for different features. Main roads, playing Fields, shopping centers formed some of the data features to be collected. Points were picked and recorded using different feature codes. Figure 10 below shows participants using the hand held GPS receiver to mark a point outside the 8-4-4 parking lot.
Different groups took different directions to capture their points as shown in Figure 11 below.

Figure 11: Participants in the field collecting feature points coordinates as the record attribute information of the points

After Field session in the morning, the afternoon was spent downloading points picked and converting the GPX file to Features using the ArcCatalog Conversion Tool (Figure 12). This made the participants have a shy of relieve to realize that upon picking data from the field, it will just be easy to connect the cable and download the points to the correct files.

Figure 12: GPX to Features Conversion Tool
Each group (Figure 13) worked on their features data and later on all feature classes were combined and converted from GPX to feature classes. The combined feature classes were emailed to each student to make sure that they all had the same data which included all features that were picked by all the groups.

Figure 13: Groups converting their GPS point to GPX features following the steps on the screen

DAY 3

The converted point were then Imported into respective Feature Class in the Student_5 Personal Geodatabase. Attribute tables of feature classes picked on site were edited in Excel spreadsheets to populate attribute information on the description of the features. Edited attribute tables were then joined using a common primary key. In this case point number of the feature was used as a primary key.

Using Esri online data, base-maps available were used to download a Kenyatta University image of 15m resolution. The existing KU_Boundary was then used to clip the downloaded KU_Image. The KU_Image was georeferenced in preparation for digitization of features that the groups picked on site. In the process of georeferencing Solomon Mwenda explained to participants the steps followed in georeferencing to make them understand the principles of geospatial correlation.
Figure 14 below shows a snapshot of Student_5 personal Geodatabase tables, opened in Microsoft access.

![Figure 14: Student_5 Geodatabase opened in Microsoft Access](image)

**Figure 14: Student_5 Geodatabase opened in Microsoft Access**

**DAY 4**

The day started with opening an Esri online account for each participant. Participants attempted the online exercise (Figure15) on **getting started** with GIS and each got a certificate from Esri after getting a pass mark of 80%. This gave participants a lot of energy to complete all the other online exams on their own time to maximize the number of online certificates that are available.

![Figure 15: Participants attempting Esri online exercise as they consult each other](image)

**Figure 15: Participants attempting Esri online exercise as they consult each other**
The georeferenced KU_Image (Figure 13) was then used to digitize features like the roads and buildings which were not picked using the GPS. GPS points picked on site were superimposed on the KU_Image and map preparation exercise started. Participants prepared their maps and edited the features picked from site. Symbolization was done to give point features more symbols that represent their real world e.g. the tree and eatery points.

![Digitization of features using KU Image](image)

**Figure 16: Digitization of features using KU Image**

**DAY 5**

The morning session participants were taken through a theoretical overview of the software using slides prepared from previous lessons of ENV 5.1. This was because the trial licenses had expired and therefore the software could not start even on demo mode. Figure 17 shows a slide of how to start ENVI 5.1 from all program files. This is one of the slides that were previously captured when the trial licenses were still working.
ArcGIS 10.1 was used to perform a supervised classification using a Quick bird 0.5 m high resolution image. Figure 18 show part of the high resolution image used for this exercise. Thika superhighway near the Utali College can be seen very clearly. Participants were taken through the process of creating training samples, signature file and saving the training samples for reuse.
Training samples shown in figure 19 were used to create a signature file to be used for Maximum likelihood supervised classification.

![Training Sample Manager](image19)

**Figure 19: Training Sample Manager**

The 14 classes resulted to the following classified image (Figure 20), showing the ability of using trained sample to classify features in the entire image.

![Maximum Likelihood classification image](image20)

**Figure 20: Maximum Likelihood classification image**
Zooming into the classified image show how features can be identified even without the high resolution image at the background. Figure 21 shows Muthaiga Golf course as classified.

![Classified image showing Muthaiga Golf Course](image)

**Figure 21: Classified image showing Muthaiga Golf Course**

The participant appreciated the power in image classification that ArcGIS can offer especially when deal with massive data like the satellite imageries.

The training ended with post evaluation forms being filled to evaluate the training program. A one to one interaction of trainers and participants elucidated a lot of interest by the participants on how they will be able to use the ArcGIS to implement their research projects. Many participants started to request more access to the software on their laptops to be able to work outside the labs for their research projects.

The map that was partially prepared was edited and symbols inserted to represent their true features. All map elements to make a complete map were inserted at this stage and each participant worked on their own map. The resulting maps were exported to Tiff format after appending personal names to the maps. Figure 19 is a map prepared by one of the participants.
Figure 22: KU_Map showing different features: prepared by one of the participants