PHASE 2_1ST SESSION ARCGIS TRAINING AT KU GIS LABS:
GIS APPLICATIONS – USING ARCGIS AS A TOOL FOR GIS
1ST SESSION REPORT: 7TH JULY - 11TH JULY 2014
SCHOOL OF ENVIRONMENTAL STUDIES COMPUTER LAB (EF3)

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This training was an advance stage of the basic introduction that was offered to the group on 11th June to 13th June 2014. The Training started on the 7th July 2014 as scheduled but with a low staff turnout of 5 participants with one apology.

The main objective of the training was to show the participants that although we think of a GIS as a single integrated system of hardware and software, it is typically made up of 5 different components: The People, Geographic Data, The Software, The Hardware and The Data Management Platforms (Servers and Databases) that operate in an integrated way to handle, process, manipulate and use geospatial data. Key in the training was creation of feature classes and populating them with field data. Data collection in the field was a rewarding experience to the participants.

Participants picking coordinates of a Water Tap near Moi Library
Pre-evaluation forms were given to the participant to fill. The pre-evaluation was aimed at assessing if the participants attended the basic training course, with all having attended. To evaluate which Esri product they used after the basic training. Only one participant used the ArcGIS extension. This unlike the expectation of the trainers was not good as most of the basic approaches have to be summarized to bring them up to speed with what they did. What they would like to learn most from a list of choices and what is their expectations at the end of the training. All expected to be able to use the software in research, and their profession.

The 5 registered members of staff who turned for the training were introduced to components and stages of GIS by Professor Onywere.

**Objectives**

The main objective was to show the participants that although we think of a GIS 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 aimed at introducing the participant to:

i. what are the components of GIS

ii. what are the stages of GIS

iii. what is ENVI 5.1

This was achieved through an overview of the components of GIS 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.

A true GIS consists of 6 stages which can be viewed as subsystems in the operation of the total 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

Computer automation is used to at all stages
An overview of development of a GIS system was explained and a summary of the same is illustrated in Figure 1.

This opened the door for the introduction to Geodatabase and how to create a Personal Geodatabase using the ArcCatalog. Thereafter creating Features in the Geodatabase that will be used to populate data from field and digitization exercises.
Figure 1: Development of a GIS System.

The steps of creating a Geodatabase were simple but with an explanation to make sure the participant understood the need for the best practice. This mirrored the same approach that was used in the introduction to ArcCatalog as a management tool for ArcGIS. Figure 2 shows the first step of creating a Geodatabase.

Figure 2: Creating a Personal Geodatabase.
The flow of the training combined the doing and the explanation in a step by step approach where the participants created their own Personal Geodatabase. New Feature classes were created into the KU_Project Geodatabase with KU_Roads (Figure 3), WaterPoints and KU_Image Features created into the Geodatabase.

![New Feature Class](image)

Figure 3: Creating KU_Roads Feature Class.

Figure 4 shows a complete Personal Geodatabase with 3 Feature Classes created and ready to receive data.

![ArcCatalog - E:KU_GIS\Student\KU_Project.mdb\Ku_Image](image)

Figure 4: KU_Project Personal Geodatabase with 3 Features.
The afternoon sessions ended with data type explanation 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. How to import them into the Geodatabase, to edit them and present them in a map.

**Day 2**

In the second day of training the participants were introduced to GPS concept. This being one of the devices to capture Geographic data is a must now to the end user. The Satellite constellation and how they transmit geospatial data to the handheld receiver 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 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 6 orbital planes, inclined 55 degrees to the equator. They orbit at altitudes of about 20,000 km, with orbital periods of 12 hours.
Figure 5: Simulated GPS Satellite during the training session.

The User Segment.
Consists of all earth-based GPS receivers used for civilian & military purposes. Receivers vary greatly in size and complexity. A Civilian GPS receiver from Garmin was used for this training and all the menus and interfaces of the handheld were introduced as the participant get the feel of the device in Figure 6.

Figure 6: Garmin GPSmap 62s.
Immediately after this session, the participant went to the field to start data collection. WaterPoints around the 8-4-4 building formed the first target group of data to be picked for that day’s session. 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 ones used for demo in class. The participants were shown how the number of satellite locked to by the receiver influence the accuracy of the position. In this case 3m is the accuracy of the device shown in Figure 6. Points were picked and recorded using different code for water Tanks and water Taps. Figure 7 below shows participants using the hand held GPS to pick water tap.

![Figure 7: Participants picking coordinates of a Water tap near Moi Library.](image)

After Field session in the morning, the afternoon was spent downloading the points picked and converting the GPX file to Features using the ArcCatalog Conversion Tool (Figure 8).
The converted point were then Imported into WaterPoints Feature Class in the KU_Project Personal Geodatabase. Symbolizing of the Points was done and the layer superimposed to KU_Boundary extent which was earlier digitized from the KU_Image. The points fell to their respective place with the accuracy that was accepted.

**Day 3/Day 4**

The following day training was interrupted by the president’s visit to Kenyatta University.

On the fourth day the two parking lots at Biochemistry and Student Computer Center were picked with the handheld GPS the same way as was done to the WaterPoints. The points were downloaded and converted to feature class as earlier explained using the water points. The KU_Image was georeferenced using corner point of the KU_Boundary and fine tuned using the
building Layer available from another set of data of Nairobi. This made the training more exciting when the features of on the KU_Imag and those picked with GPS field excises matched perfectly.

The afternoon session culminated with opening an Esri global account for each participant to get ready to read online and do the exercises given by Esri. The participants were taken step by step on how to approach the online materials and later on do the exercises.

Poor internet connection and time did not allow them do any test but it was agreed that they do the first exercise as a group the following day first thing in morning.

**Day 5 and 6**

The fifth day of training started off with symbolizing the water points to differentiate the water tanks and the taps. This was done by editing the attribute table of each feature class and putting the map in place. The Parking lots polygons were created by joining GPS points picked and editing the resulting polygons using the Georeferenced image at the background. This gave the participant a lot of exposure to feature editing and digitization. The KU_Roads of the area of interest that were missing from the archived data of Nairobi were digitized. The Polyline feature construction tool was used for this task. The map was shelved for a while to give the participant room to finish the online exercises.

This became a good way of revising what was trained in the introduction to ArcGIS basics. All participants finished the First exercises of *Getting Started with GIS* online and each got a certificate bearing his/her name from Esri. The joy of having a achieved this certificate was painted all over the participants faces. They promised to do the remaining exercises on their own after the training session.

The afternoon session ended the training with introduction to ENVI 5.1 software tailored for advance Remote Sensing and image processing.
As was done in the introduction to ArcCatalog and ArcMap, ENVI was started from Start, All programs Files Envi 5.1 folder and then Envi application.

![Starting ENVI 5.1 from All Programs file](image)

**Figure 9: Starting ENVI 5.1 from All Programs file**

To prepare the working directories for working with Envi 5.1 the participant were taken through the process of setting the preference, and setting the Default directories of input and output data, temporary directory to be used for the temporary session by the application among others. This is likened to Folder connection in ArcCatalog. A session of this step is shown in Figure 10 where each participant set the respective directory in their Student working folders.

![Setting Preferences for default directories.](image)

**Figure 10: Setting Preferences for default directories.**
After this was set, images that were used in the introduction to basic Remote Sensing were added layer by layer to allow the participant experience the Envi application loaded with data. Figure 11 shows a loaded image and the Layer manager of the application on the left while the right side shows the toolbox.

![Envi 5.1 with a loaded image with one Band.](image)

Explanation of the interface was done for each menu and tab. Similarities with ArcMap were also explained where possible e.g. the Layer manager in Envi 5.1 being similar to the Table of Content in ArcMap and the Catalog Tree in ArcCatalog.
After this, it was deemed important to take a simpler path where participants don’t get overwhelmed by the number of icons available in this interface. This necessitated the use of ENVI classic, which has menus organized for specific tasks and has only one main Tool Bar. Figure 12 shows ENVI Classic tool bar at the top and the path where the classic is installed.

![Figure 12: The Envi Classic and the Main Tool bar.](image)

A similar approach like was done with Envi main application was followed to set the default directories using the ENVI Classic. The interfaces though looking a bit different, had the same approach. Figure 13 shows the interface of System Preference in ENVI Classic.

![Figure 13: ENVI Classic system Preferences.](image)
After the paths were set, the image was added and this resulted to the image in Figure 14 being viewed in three windows: Window display, the zoom and scroll.

![Figure 14: Window display, Scroll and the Zoom.](image)

The exercises for that session ended with adding 7 layers in Layer Stacking input file and changing the color to false color composite for layer 4, 3, and 2 to RGB respectively. This allowed the participant to start seeing an image similar to what they used during the basic introduction to Remote Sensing. Reordered Stacked Available Bands List is shown in Figure 15 with RGB color selected for layer 4:3:2.
Figure 15: Stacked Layer changed to RGB for 4, 3 and 2.

The resulting staked image with RGB layers on display is shown in Figure 16. The participant appreciated the power and similarities of ENVI and ArcGIS as tools for GIS.
Post evaluation forms were filled to evaluate the training. After the evaluation of it came out that most of the participants would like more practical application to be given. Some felt that they need more advanced course after the application. A make up class to cover the day lost introduced the participants to image classification using Envi for the Unsupervised and ArcMap for supervised classification. The aim of this exercise was to allow the participant have the exposure of image analysis using the stacked image shown in Figure 16.
The theory part of image classification was introduced using Envi 5.1 classic and the resulting unsupervised Isodata classification is shown in Figure 17.

Figure 17: Unsupervised Isodata image classification.

This was an entry point for participant to explore products packed in Envi Classic software. The supervised classification was done using ArcMap with the same set of data. Features that
participant wanted to see classified were used as training sample to create a signature file. The resulting supervised classified map was later prepared in layout view to give the participant a good grip of the work flow from start to finish when dealing with satellite images. The resulting map is shown in Figure 18 with the items used to classify the image.

Figure 18: Supervised classified Map.

The most stressed point on this exercise is how to digitize the samples to create the signatures which will classify features according to their spectral characteristics. Although the above image is a 30m Resolution, there was a lot that the participants could identify with a lot of certainty.
This is because during the introduction to Remote Sensing basics, extensive explanation of how different feature reflect light in the Electromagnetic spectrum was given.

Finally the afternoon ended with the preparation of the KU_Utilities map with features picked on site displayed. Buildings around the 8-4-4 were all labeled. Figure 18 shows one of the end product map prepared by one participant.

Figure 19: KU.Utilities Map prepared by one of the Participants.