11TH ARCGIS TRAINING REPORT
ARCGIS TRAINING AT 844 EF3 GIS COMPUTER LAB: 22ND -26TH SEPTEMBER 2014

USING ARCGIS - APPLICATIONS

The ArcGIS Application Training on 22nd – 26th September 2014 was the third advance GIS training to be offered to KU Staff, who had undergone basic introduction training in previous sessions. The Training attracted 15 participants. This was partially due to the fact that the semester session was on and most members of staff were busy with their lecture class preparations. The training took place at the 844 EF3 GIS Computer Lab. Nad the filed mapping was done at the KU Lower Zone

Participants adjusting GPS receivers outside 844 Building, at the car park area
Day 1

Pre-evaluation forms aimed at assessing participants who had attended the basic training course were given to the participant to fill. This evaluated if the participants continued to use the Esri ArcGIS Products and which one they used after the basic training. Only 10 participants used the ArcGIS software which was encouraging. The basic introductions were summarized to bring them up to speed with what they did.

Objectives

The main objective was to show the participants that although we think of GIS as a single integrated system of hardware and software, it is typically made up of a variety of 5 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 ENVI 5.1 / ArcGIS as a tool for remote Sensing and GIS.

The 15 participants who turned for the training were introduced to the components and stages of GIS by Prof. Onywere, shown in Figure 1.

![Figure 1: Prof. Onywere introducing components and stages of GIS.](image)

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 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 of the same is illustrated as in Figure 2.

This opened the door for introducing the participants to Geodatabase and how to create a Personal Geodatabase using the ArcCatalog. Thereafter participants were equipped with how to create Features Classes in the Geodatabase that will be used to populate data from the field and digitization exercises.
Figure 2: Development of a GIS System.

The steps of creating a Geodatabase were simple but with an explanation to make sure that participants understood the need for 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.
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 KU_Project Geodatabase with KU_Roads (Figure 4), WaterPoints and KU_Image Features created into the Geodatabase.

Figure 4: Creating KU_Roads Feature Class.

Figure 5, shows a complete Personal Geodatabase with Feature Classes created and ready to receive data.
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 the training the participants were introduced to GPS concept. The GPS receiver being one of the device to capture Geographic data was explained as a must know tool to use to the end user. Satellite constellation and how they transmit geospatial coordinates to the hand-held 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 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 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 6: Simulated GPS Satellite 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 7, shows the GPSmap 62s hand-held Garmin receiver used for this training.
Immediately after the theory session, participants went out to the field to start data collection. 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 (Figure 8). The participants were shown how the number of satellite locked to by the receiver influence the accuracy of the position. Garmin GPSmap 62s is 3m accuracy.
The participants were divided to five groups 3 participants each and assigned to collect GPS coordinates and point data for different features. Tracks, Playing Fields, Eateries mainly in KU lower zone formed some of the data features to be collected. Points were picked and recorded using different feature codes. Figure 9 and 10 below shows participants using the hand held GPS receiver to mark a point outside the 8-4-4 parking lot and at the playing fields.
Figure 9: Participants marking coordinates of a point at the parking lot outside 8-4-4.

Figure 10: Participants in the field
After the Field sessions in the morning, the afternoon was spent downloading points picked and converting the GPX file to Features using the ArcCatalog Conversion Tool (Figure 11). This made the participant have a siege 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.

![GPX to Features Conversion Tool](image)

**Figure 11: GPX to Features Conversion Tool**

Each group 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.
DAY 3

The converted points were then imported into respective Feature Class in the KU_STUDENT_4 PERSONAL GEODATABASE. Attribute tables of feature classes picked on site were edited in Excel spreadsheets to populate more information on the description of the features. Symbolization of Point features was retrained to emphasize the importance of using symbols in maps. 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 and that required spatial representation. Figure 12 below shows a snapshot of the personal Geodatabase tables, opened in Microsoft access.
Figure 12: KU_STUDENT4 Database in Microsoft Access

DAY 4

The day started with opening an Esri online account for each participant. Participants attempted the online exercise 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.

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.

Figure 13: Digitization of features using KU Image

DAY 5

The morning session was set to start with introduction to ENV 5.1. After installation of the trial softwares in all the participants’ computers, it was unfortunate that the trial licenses had expired and therefore the software could not start even on a demo mode. Participants were taken through a theoretical over view of the software using slides prepared from previous lessons. Figure 14 shows a slide of how to start ENVI 5.1 from all program files. This is one of the slides that was previously captured when the trial licenses were still working.
Figure 14: Starting ENVI 5.1

ArcGIS 10.1 was used to perform a supervised classification using a Quickbird 0.5 m high resolution image. Figure 15 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.

Figure 15: A section of Thika Superhighway seen from the 0.5m Quick Bird image
Training samples shown in figure 16 were used to create a signature file to be used for Maximum likelihood supervised classification.

Figure 16: Training Sample Manager

The 14 classes resulted in the following classified image (Figure 17), showing the ability of using trained sample to classify features in the entire image.

Figure 17: 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 18 shows Muthaiga Golf course as classified.

![Figure 18: Classified image showing Muthaiga Golf Course](image)

The participant appreciated the power in image classification that ArcGIS can offer especially when dealing 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 19: KU_Map showing different features: prepared by one of the participants