PHASE 2_3RD SESSION REPORT KU GIS LABS
ARCGIS TRAINING: USING ARCGIS (APPLICATIONS)
18TH - 22ND AUGUST 2014 SCHOOL OF ENGINEERING COMPUTER LAB

USING ARCGIS (APPLICATIONS)
The five day training workshop on Using ArcGIS and specifically targeting its application was organized at the School of Engineering and Technology Computer lab. This training followed the three day training of introduction to GIS (ArcCatalog and ArcGIS Tools) that had been offered to the same group earlier on. The participants were introduced to further GIS Concepts and shown 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 steps of creating a Geodatabase were explained to make sure that participants understood the need for best practice when developing a GIS system. The Participants then created a Personal Geodatabase. Different empty feature classes were then created and used to populate the Geodatabase. Participants shown how to populate the feature classes with features of specified themes. And how to populate the Geodatabase with data from other sources. ENVI as a tool for remote Sensing and GIS and how it is interfaced in ArcGIS were also explained.

CLASSIFIED IMAGE SHOWING MUTHAIGA GOLF COURSE-PANGANI/MATHARE VALLEY AREA

DAY 1

This was the second advance training to be offered to participants, who had undergone the 3 day basic introduction training. Training started on the 18th of August 2014 as scheduled with a staff and student turn up of 11 participants. This was low partially due to the fact that all the participants were not in session and most members of staff were busy marking exams.

Pre-evaluation forms were given to the participant to fill. The pre-evaluation was aimed at assessing if participants who had attended the basic introduction training course had made further progress through
personal practice using the Esri ArcGIS products. 5 participants had used the ArcGIS software and practiced extensively. This unlike the staff report was impressive. 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 as a tool for remote Sensing and GIS.

The 11 participants who turned up for the training were introduced to the components and stages of GIS by Prof. Onywere (Figure 1).

![Figure 1: Prof. Onywere introducing participants to components and stages of GIS.](image)
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. 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 an overview of developing a GIS system was explained. A summary of the same is illustrated in Figure 2.

This opened the door for introduction to Geodatabase and how to create a Personal Geodatabase using the ArcCatalog. Thereafter, creating Features Class in the Geodatabase that will be used to populate data from the field and through digitization exercises.
The steps of creating a Geodatabase were explained 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 3 Feature Classes created and ready to be populated with data.

Figure 5: KU_Project Personal Geodatabase with 3 Features.
The afternoon sessions ended with data type explanation to prepare for the data to be input into the created feature classes. Point, Line, Polygon and Image data types were all explained in detail. An explanation was also made on how to import features into the Geodatabase, to edit features and present features in a map.

DAY 2

In the second day of training the participants were introduced to GPS concept. The GPS receiver being one of the device to capture Geographic data in the field, is becoming a must know to the end user. Satellite constellation and how they transmit geospatial coordinates to the handheld GPS receiver was demonstrated. The three components of a 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.

Figure 7: Garmin GPSmap 62s.

Immediately after the theory session, participants went out to the field to start data collection. Before the first GPS point could be recorded, the GPS receivers were put in normal mode to receive the actual satellite signal (Figure 8) 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. Garmin GPSmap 62s is 3m accuracy.
The participants were divided to five groups each having 2 participants. Each group picked data for different features. Tracks and playing Fields, a section of the railway line formed some of the features to be picked. Points were picked and recorded using different feature codes. Figure 9 below shows participants being shown how to pick a point of a feature using the hand held GPS receiver to mark a point.
The weather was not friendly as it was raining in the better part of the morning. But nevertheless the groups managed to get windows of clear weather to pick field data when the rains stopped.

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 10). 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.

![Figure 10: GPX to Features Conversion Tool](image)

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 point collected on Day 3 were Imported into respective Feature Class in the KU_STUDENT2 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, the 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 and population of features that the groups picked on site. Figure 11 below shows a snapshot of the personal Geodatabase tables, opened in Microsoft access.

Figure 11: KU_STUDENT2 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 12) 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.

![Figure 12: Digitization of features using KU Image](image)

DAY 5
The morning session was set to start with introduction to ENV 5.1. After installation of the trial software 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 overview of the software using slides prepared from previous lessons.

Figure 13 shows a slide of how to start ENVI 5.1 from all program files. This is one of the slide that was previously captured when the trial licenses were still working.

![Figure 13: Starting ENVI 5.1](image)

ArcGIS 10.1 was used to do a supervised classification using a QuickBird 0.5 m high resolution image. Figure 13 show part of the high resolution image used for this exercise. Thika superhighway near the Utalii College can be seen very clearly. The Residence houses of the National Youth Service (NYS) is on the top left corner of the image while the blue foot bridge at the Traffic Police Headquarters is clearly visible. Note the high density settlement of Mathare Slum to the bottom left of the image. Participants were taken through the process of identifying features and using them to generate training sample signature files and saving the training samples for use in the classification.
The training samples shown in Figure 15 were used to create a signature file that was used for Maximum likelihood supervised classification.

The 14 classes resulted to the classified image shown in Figure 16, illustrating the ability of using trained sample to classify features in the entire image.
Exploring through a Zoom of the classified image showed how features can be identified. The forest, Open field, the build environment, the water ponds and the roads showed quite some contrasting features also easy to identify from their location and shape. Figure 17 is a Zoom-in to Muthaiga Golf course as classified from the Maximum Likelihood Classifier. Note the contrast between the leafy suburbs of Muthaiga (top left half of image) and the high density settlements of Mathare area (bottom right half of the image).
Figure 17: Classified image showing Muthaiga Golf Course-Pangani/Mathare Valley area. Thika super Highway is clearly seen cutting through the image.

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

Instead of breaking for Lunch, the participant proposed to go all the way to the end so that they break early instead of going for lunch and coming back for 1 hour or 2 for the afternoon session.

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 18 is a map prepared by one of the participants.
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. One of such interest was the application of GIS in fashion and design floated by Juliet Isika. She also pointed out that in each and every school seminar, a GIS session should be slotted in to sensitize the Deans on the need of using GIS in research.

Juliet did not just stop there, but she actually made her two maps outside the training session for her study area. One map (Figure19), showing distribution of fashion and design training institution in Nairobi while another map (Figure 20) showing cotton growing areas in Kenya.
Figure 19: Distribution of fashion and design training institutions in Nairobi
Figure 20: Cotton Growing Areas in Kenya