



DEPARTMENT OF COMPUTER SCIENCE

GEOGRAPHICAL INFORMATION SYSTEM (GIS)

SCS3204

INTRODUCTION TO GIS

BY

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Course Description

This course is to provide both a solid theoretical understanding and a comprehensive practical introduction to the use of geographic information systems, GIS-related terminologies and spatial data basics for the analysis and solution of different environmental problems. It introduces common image processing software packages and how to use them,

Course Outcome

By the end of the course, you should be able to:

- Demonstrate an understanding of the GIS
- Show knowledge of the basic principles underlying the GIS/model-based management systems
- Demonstrate skills in GIS problem-solving techniques for sustainable planning and management
- Input data in a GIS software tool
- Design, create, maintain, and data integrate in a GIS software



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- Indy Hurt, Keith C. Clarke. (2010). GIS Exercise Workbook for Getting Started with Geographic Information Systems. Prentice Hall; 5 edition. ISBN-10: 0321697960, ISBN-13: 978-0321697967





GEOGRAPHICAL INFORMATION SYSTEM (GIS)

A system that creates, manages, analyses and maps of all types of data. GIS connects all types of data to a map with all descriptive information hence providing a foundation for mapping and analysis that is used in science and almost all types of industry. GIS help users to understand patterns, relationships and geographical relationships in data.

A GIS can be viewed as a computer-based system used in the collection, maintenance, storage, analysis, output, and distribution of spatial data and information. It quantifies these locations by recording their coordinates, numbers that describe the position of these features on earth.

A geographic information system (GIS) is a computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface

Spatial data is **any type of data that directly or indirectly references a specific geographical area or location**. Sometimes called **geospatial data** or **geographic information**, spatial data can also numerically represent a physical object in a geographic coordinate system.





COMPONENTS OF GIS

GIS applications include both hardware (GIS devices) and software systems. These software applications may include cartographic data, photographic data, digital data, or data in spreadsheets.

Devices used in GIS

GIS data collection devices include the following:

Digitizers: Hardware device that receives analog information, such as sound or light, and records it digitally. Usually, the information is stored in a file on a computing device. GIS professionals can use digitizers to easily capture, store, analyze, and manage data while in the field. Examples of digitizers are digital cameras, tablets, scanners.

GPS Units: Any device used to receive information from GPS satellites and calculating your geographical position. The Geographical Positioning Unit (GPS) was originally developed by US government for military use but now any one can use GPD device. Commonly used in surveying and mapping.

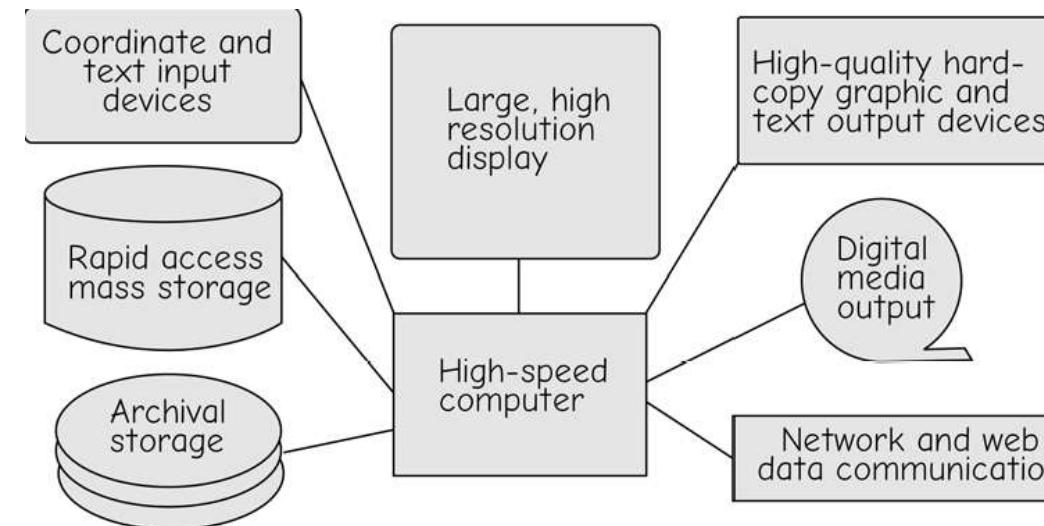
Mobile devices: Various mobile devices with professional GIS features are used as GPS hardware used in data collection





Devices used in GIS

Desktop Computer - You'll need a large-display monitor, lots of RAM (more than 4 GB recommended), and plenty of extra space on the hard drive where you can upload your data for later use



Key features for your GIS desktop computer

Printer – Incredibly useful because they allow you to bring your digital map into the physical world. Once you print a map you can hang it on the office wall, distribute to your teams, or simply keep as reference





Categories of Data used in GIS

Cartographic data

Data already in map form, and may include such information as the location of rivers, roads, hills, and valleys. Cartographic data may also include survey data and mapping information that can be directly entered into a GIS.

Photographic data

Photographic interpretation is a major part of GIS. Photo interpretation involves analyzing aerial photographs and assessing the features that appear.

Digital data

Digital data can also be entered into GIS. An example of this kind of information is computer data collected by satellites that show land use—the location of farms, towns, and forests.

Spreadsheet

GIS can also include data in table or spreadsheet form, such as population demographics. Demographics can range from age, income, and ethnicity.





GIS Software Applications

GIS software provides the tools to manage, analyze, and effectively display and disseminate spatial information. We need tools to view and edit these data, manipulate them to generate and extract the information we require, and produce the materials to communicate the information we have developed.

Main functions of GIS software include:

(1) Data Entry

- Manual data capture
- Digital data capture
- Data import

(3) Data Management

- Documentation
- Compression
- Summarizing
- copy, emerge

(5) Output

- hardcopy Printing
- Graphic design
- Map design
- Export format generation

(2) Editing

- Feature editing
- Automated error detection
- Attribute editing

(4) Analysis

- Attribute query
- Spatial query
- buffering
- terrain analysis





Common GIS applications

ArcGIS – the most common software suite in the GIS family. It is not open source though therefore, important to get licensed version in order to enjoy all its functions. ArcGIS was developed by Environmental Systems Research Institute (ESRI) Avoid software piracy. It supports multiple data formats, many data types and structures, and literally thousands of possible operations that may be applied to spatial data.

QGIS - Is an open-source software project, an initiative under the Open Source Geospatial Foundation. The software is a collaborative effort by a community of developers and users. QGIS is free, stable, changes smoothly through time, with the source code available so that it can be extended as needed for specific tasks.

GeoMedia - originally developed and supported by Intergraph, Incorporated. GeoMedia offers a complete set of data entry, analysis, and output tools. A comprehensive set of editing tools may be purchased, including those for automated data entry and error detection, data development, data fusion, complex analyses, and sophisticated data display and map composition

MapInfo - MapInfo is a comprehensive set of GIS products developed by the MapInfo Corporation. Map-Info products are used mainly in GIS business and municipal applications.



Common GIS applications Cont...

Idrisi - Idrisi is a GIS system developed by the Graduate School of Geography of Clark University. It provides both image processing and GIS functions. Idrisi has been developed and maintained at an educational and research institution, and was initially used primarily as a teaching and research tool.

Manifold - Manifold is a relatively inexpensive GIS package with a surprising number of capabilities. Manifold combines GIS and some remote sensing capabilities. Basic spatial data entry and editing support are provided, as well as projections and raster analysis, image display and editing, and output. Manifold GIS providing sophisticated image editing capabilities in a spatially referenced framework.

Maptitude - Maptitude is a GIS product focused primarily on spatial analysis in a business environment. Tools support market identification through the integration of income, demographic, and sales data, allocation and store location through transportation analysis, and logistics planning.

AUTOCAD MAP 3D - AUTOCAD is the world's largest-selling computer drafting and design package. Produced by Autodesk, Inc. It supports engineering disciplines including surveying and civil engineering.





Common GIS applications Cont...

GRASS - Geographic Resource Analysis Support System, is a free, open source GIS that runs on many platform and originally developed by the U.S. Army Construction Engineering Laboratory (CERL). It commonly used in research.

MicroImages - MicroImages produces and supports a range of products, including software to edit and view spatial data, software to create digital atlases, and software to publish and serve data on the internet.

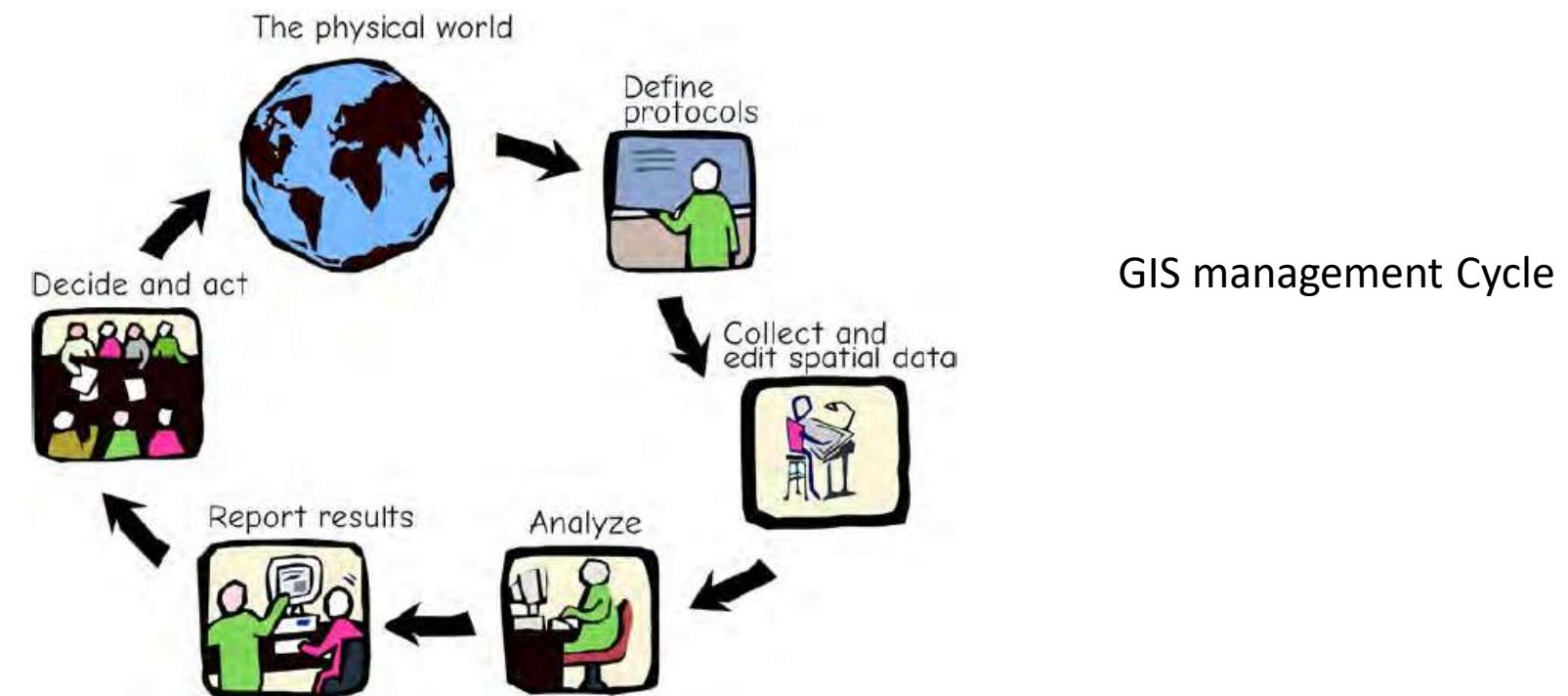
ERDAS (Earth Resources Data Analysis System) – Was originally developed as an image processing system. The original purpose of the software was to enter and analyze satellite image data. It can be used in commercial spatial data analysis.

Bentley Map - Bentley Systems has developed spatial analysis software for mobile device through enterprise levels, with a strong focus on flexible, integrated infrastructure design and development. Bentley has evolved into a general set of tools, including field data collection, photography, map composition, database management, analysis, and reporting.



Common GIS applications Cont...

Smallworld - Smallworld, currently owned by General Electric Energy, is a product suite focused primarily on power and other utility management, and other network systems. Primarily targeted for large organizations, the suite supports common spatial data formats, field data entry, complex, topological network models, integration with corporate databases, component and network design.





IMPORTANCE OF GIS IN REAL LIFE SITUATIONS

- ❑ A GIS is also particularly useful at displaying spatial data and reporting the results of spatial analysis. GIS technology can be used **compare the locations of different things in order to discover how they relate to each other**. For example, using GIS, a single map could include sites that produce pollution, such as factories, and sites that are sensitive to pollution, such as wetlands and rivers.
- ❑ GIS is essential tool in government and security organisations. It is a powerful tool **used in fighting crime**. Using GIS technology, security experts can easily trace thieves in their hiding locations
- ❑ GIS regularly help in the day-to-day **management of many natural and man-made resources**, including sewerage, water, power, and transportation networks.
- ❑ GIS allow us **to analyze the relative spatial location of important geographic features**. Spatial analyses in a GIS may aid in ensuring sustainable recreation, environmental protection, and other benefits
- ❑ GIS help us **identify and address environmental problems by providing crucial information** on where problems occur and who are affected by them. GIS help us identify the source, location, and extent of adverse environmental impacts, and may help us devise practical plans for monitoring, managing, and mitigating environmental damage.



- GIS can be used in the **location of viable remnant plant and animal populations** relative to current and future human land uses . Analysis of such information is helpful in planning for continued survival of such species.
- GIS of recently has become **an important tool used emergency services**, flood protection, disaster assessment and management. It can be helpful in the location and identification disaster victims. The GIS matches the address to the nearest emergency service station, a route is then immediately generated based on the street network and traffic, and emergency crews dispatched from the nearest station. It can also be used to land mark disaster incidents and threats that form early warning systems in disaster management.
- **GIS hospitals and government transport functions.** For example emergency vehicles such as ambulances in developed world commonly dispatched and routed using GIS.
- GIS may be used to **document change, mitigate damage, and effectively manage our natural resources.** For example GIS images can be used to track eruptions of mountains and such data cab be used in planning evacuation of affected people and mapping of the damages caused.
- Many businesses adopt GIS for **increased efficiency in the delivery of goods and services**. Retail businesses locate stores based on a number of spatially related factors.
- GIS aid telecommunication companies **to track fraud teams in mobile money payments** in various locations basing on the provided coordinates.



- ❑ Global Navigation Satellite Systems (GNSS), is now **incorporated into cars, planes, boats, and trucks to guide people** find shortest routes, avoid traffic and reach their final destinations in time.
- ❑ GIS may **aid in disaster assessment and recovery**. Emergency response and longer term rebuilding efforts may be improved by spatial data collection and analysis
- ❑ Images taken from aircraft and satellites provide a rich source of data, which may be Interpreted and converted to information that can **be used in research and other studies**
- ❑ GIS are also widely used in **planning and development**. Spatial information about villages, town and cities can be used as source of information for planning and development of a country. Such information may include water sources, sewerage, mean of transport, banks, schools, universities etc.
- ❑ GIS help the **government in property records management and taxation**. For example GIS can be used to locate various houses and their owners in a city upon which taxes can be determined.
- ❑ GIS are **widely used to improve public health**. Air pollution is a major cause of sickness and death. GIS can be used to locate and map air pollution points in a community. Analysis of such information by public health experts results in improvement of the public health of the people.







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LECTURER 2

GIS FUNDAMENTALS

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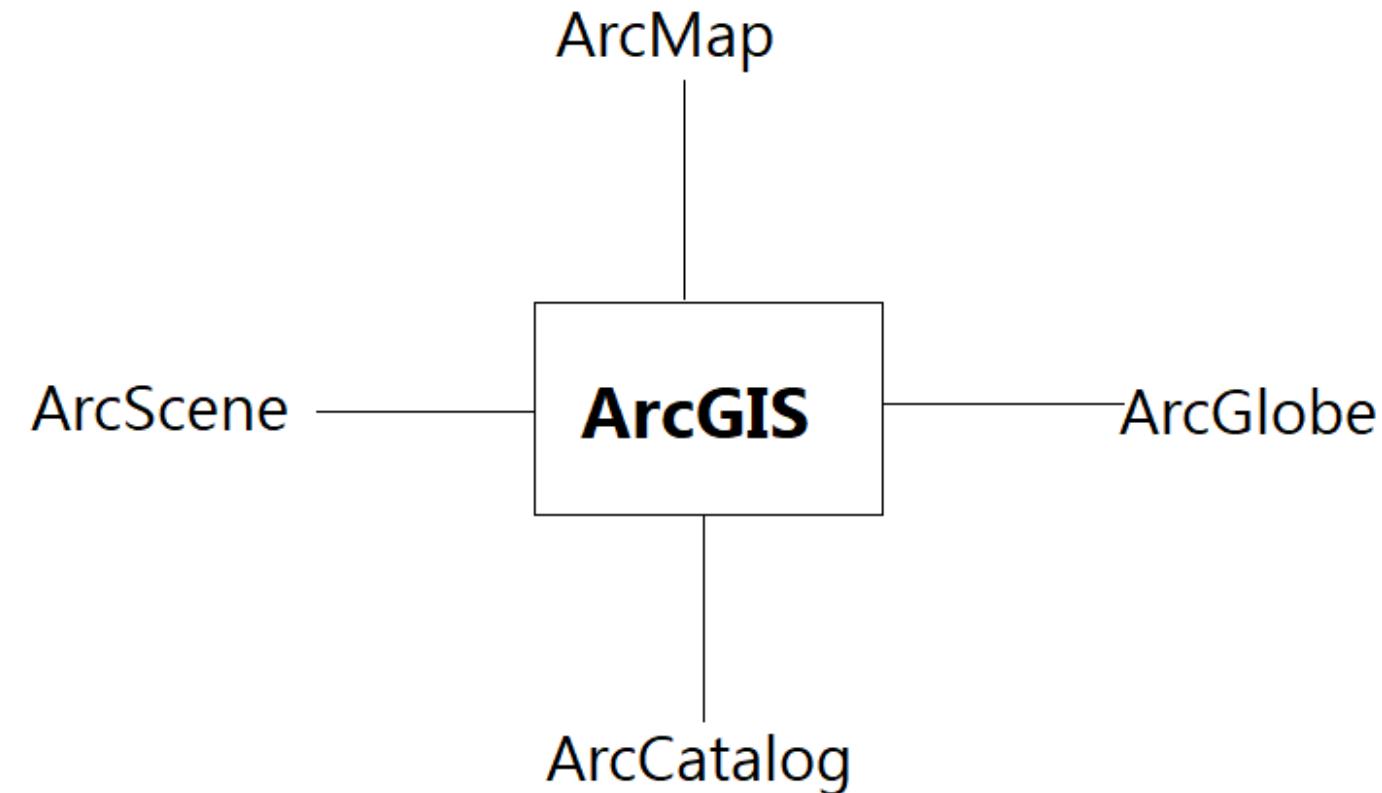
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ARCGIS DESKTOP APPLICATION

ArcGIS Desktop software is comprised of a set of integrated applications, which are accessible from the Start menu of your computer. These include:





1. ARCMAP

ArcMap is the central application used in ArcGIS. ArcMap is where you display and explore the datasets for your study area, where you assign symbols, and where you create map layouts for printing or publication. ArcMap is also the application you use to create and edit datasets.

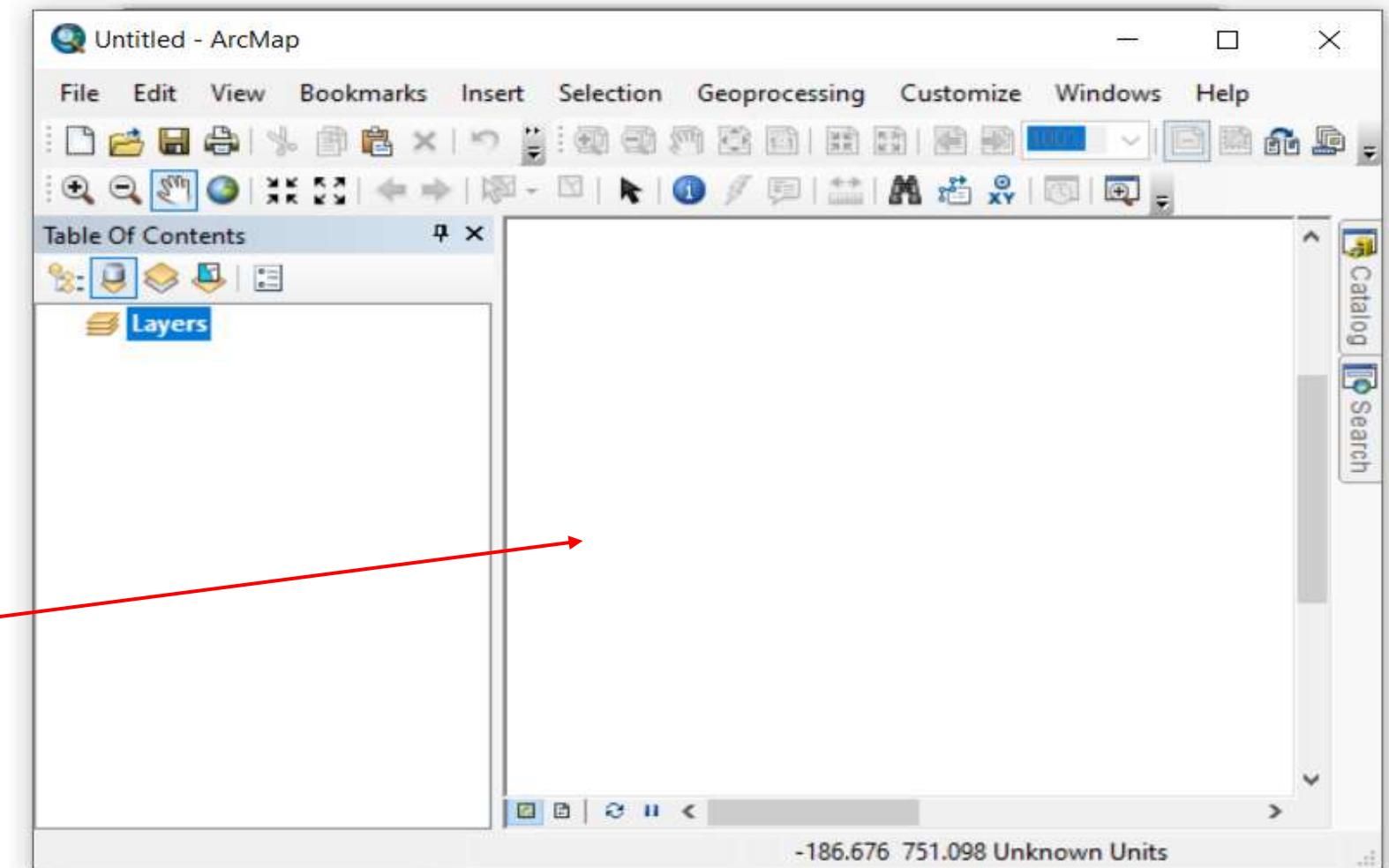
Functions of ArcMap

- ***Work with maps*** - exploring information, navigate around your map documents, turn layers on and off, query features to access the rich attribute data that is behind the map.
- ***Print maps*** —Maps can be printed using arcMap
- ***Compile and edit GIS datasets*** – Provides functions for editing your map documents and making updates
- ***Analysis*** - Arcmap can be used querying or analysis of GIS data and automating some tasks
- ***Organizing your documents*** - ArcMap includes the Catalog window that enables you to organize all of your GIS datasets and geodatabases, your map documents and other ArcGIS files, your geoprocessing tools, and many other GIS information sets
- ***Publish maps*** - ArcMap provides a simple user experience for publishing your map documents as map services using ArcGIS Server or ArcGIS Online.
- ***Share maps with other users*** —ArcMap includes tools that make it easy to share GIS datasets with other users.



How to open ArcMap

1. Click the Start button on the Windows taskbar.
2. Point to Programs.
3. Point to ArcGIS.
4. Click ArcMap.



New ArcMap Screen



Common types of Files used in ArcMap

- ***Geodatabase*** – Geodatabases define, manage, process and store all the types of data that can be used in ArcGIS (i.e., feature, rasters, relationships, measurements, attributes, etc) inside either a Microsoft Access database (.mdb) or a full relational database (SQL Server)
- ***Shapefiles*** - shapefile format is a widely adopted standard and comprises three or more associated files stores various shapes. They use .shp or shx extension.
- ***Layer*** – (.lyr) stores symbology, symbology classifications, labeling properties, scale dependency, and definition.
- ***Coverages*** – “A coverage stores a set of thematically associated data considered to be a unit. It usually represents a single layer, such as soils, streams, roads, or land use.
- ***Image formats*** – ArcGIS accepts and uses a variety of image files (.tiff, .jpg, .jp2, .png, etc).
- ***Text files*** commonly for storing (with x,y coordinates)
- ***Map document (.mxd)*** A map used to store maps on a file on disk with extension mxd. Each map document contains the specifications for the map layers, the page layout, and all other map properties. Map documents make it easy to save, reuse, and share your work in ArcMap. ArcMap uses .mxt extension as the default for templates created





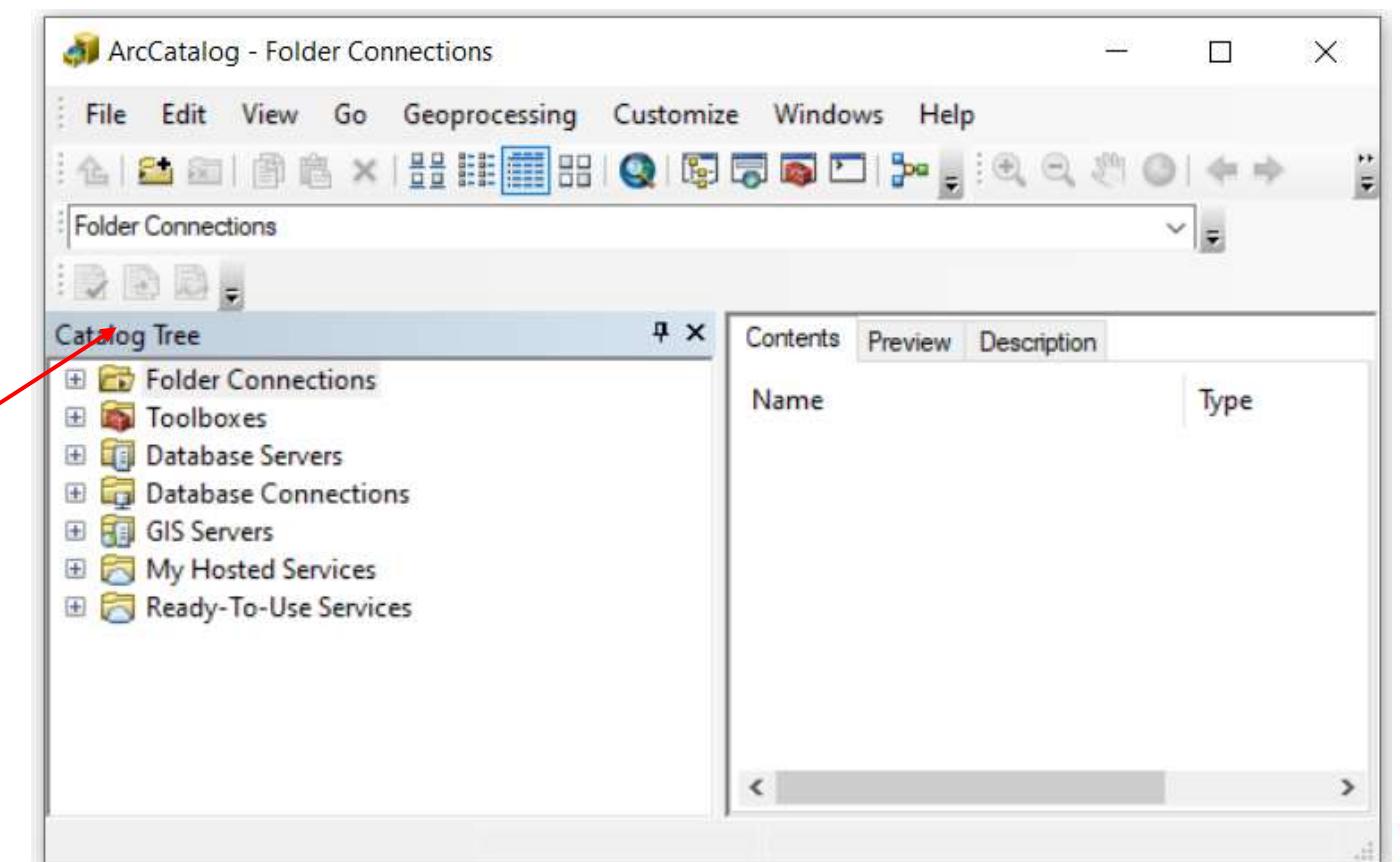
2. ARCCATALOG

ArcCatalog is the program you use to organize and manage various datasets and documents in ArcGIS. This program allows you browse, search, discover view, manage and administer datasets in ArcGIS. It is the equivalent of windows explorer.

How to open ArcCatalog

1. Click the Start button on the Windows taskbar.
2. Point to Programs.
3. Point to ArcGIS.
4. Click ArcCatalog

ArcCatalog



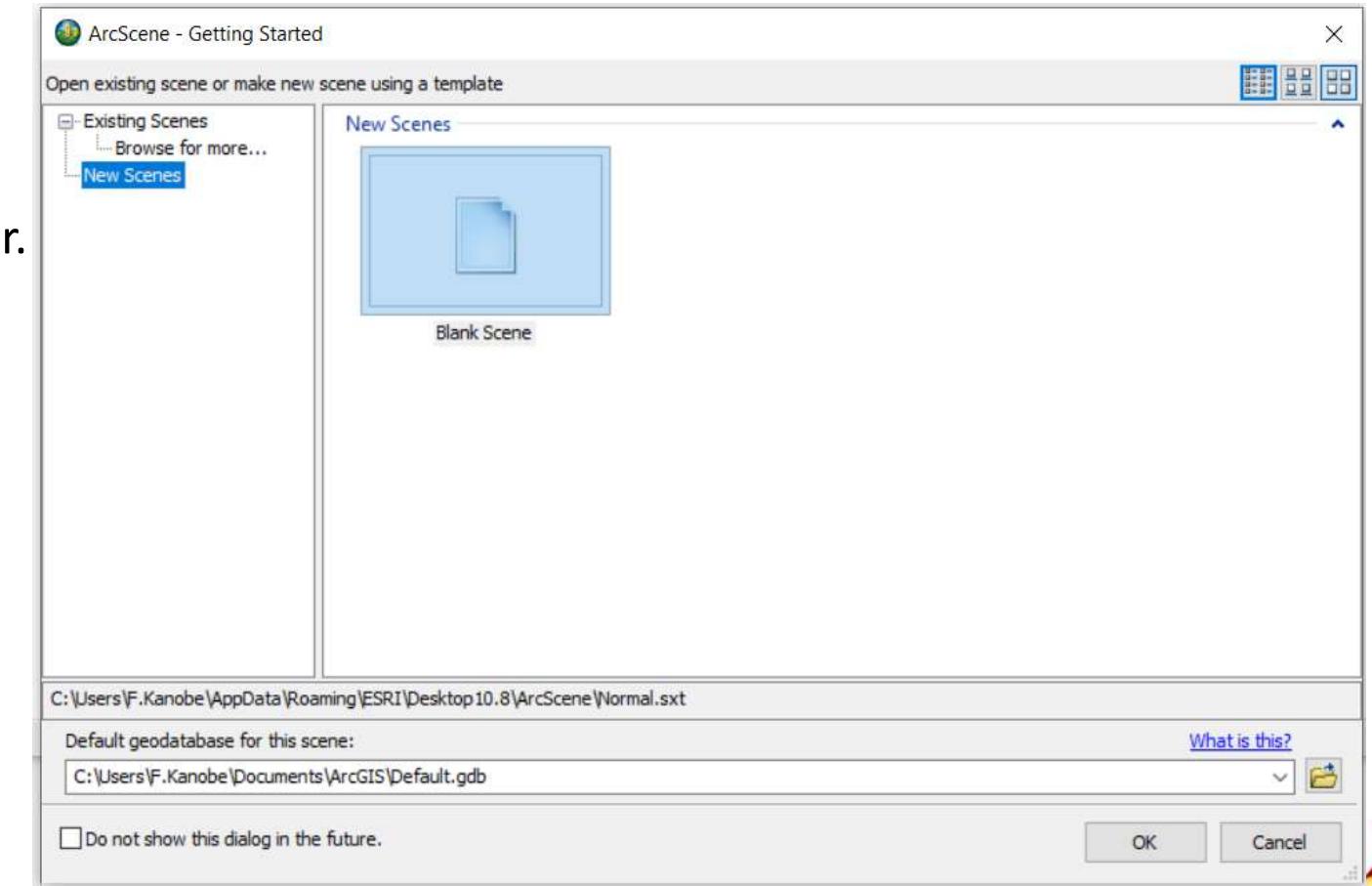


3. ARCSCEENE

ArcScene is a 3D visualization application that allows you to view your GIS data in three dimensions. ArcScene allows you to overlay many layers of data in a 3D environment.

How to open ArcScene

1. Click the Start button on the Windows taskbar.
2. Point to Programs.
3. Point to ArcGIS.
4. Click ArcScene





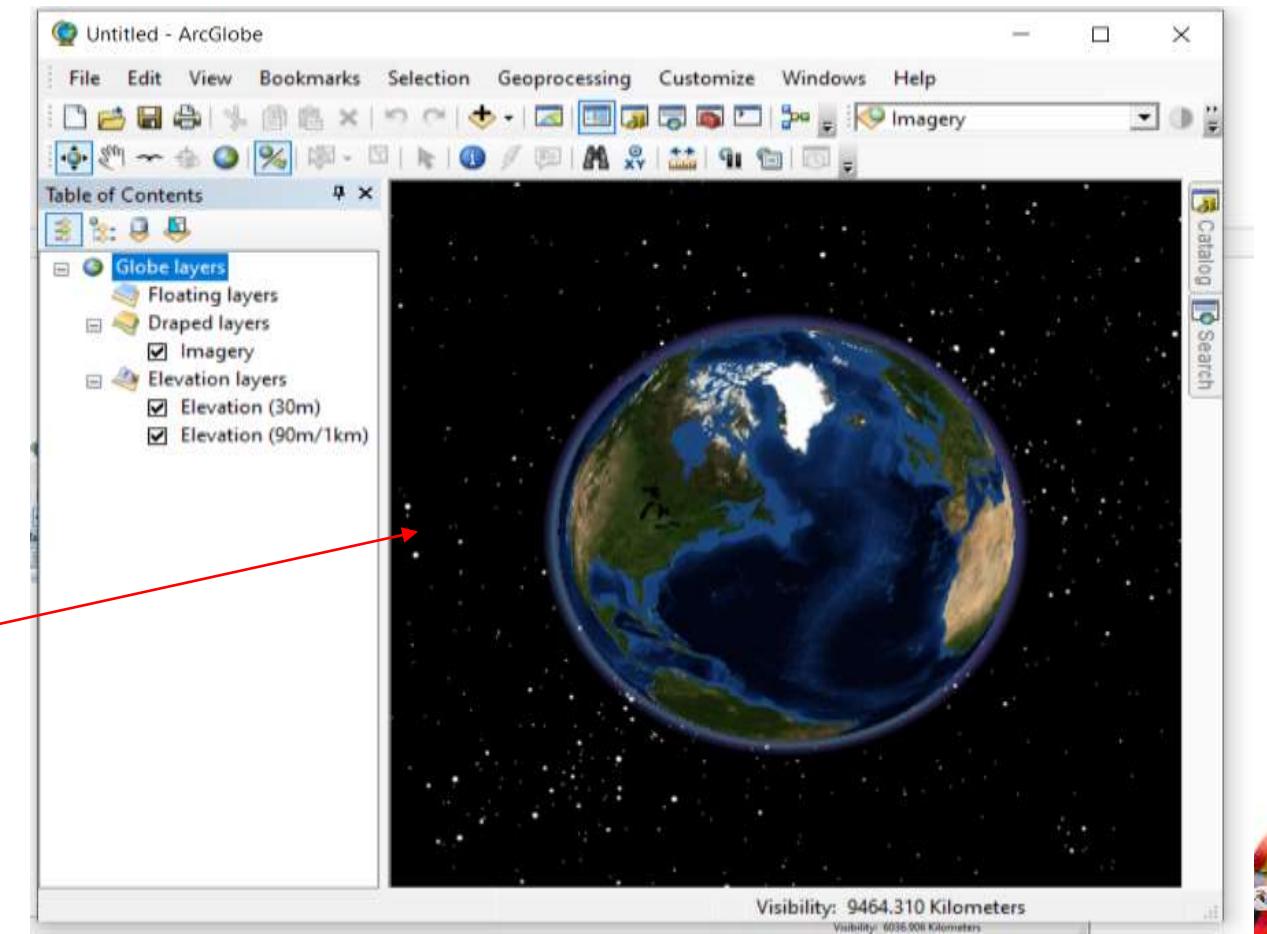
4. ARCGLOBE

ArcGlobe is a 3D visualization application that allows you to view large amounts of GIS data on a globe surface. ArcGlobe provides a new and unique way to view and analyze your GIS data. Spatially referenced data is placed on a 3D globe surface, displayed in its true geodetic location.

How to open ArcGlobe

- 1) Click the Start button on the Windows taskbar.
- 2) Point to Programs.
- 3) Point to ArcGIS.
- 4) Click ArcGlobe

ArcGlobe





ESSENTIAL TERMS TO KNOW IN ARCMAP

Layer

A map layer defines how a GIS dataset is symbolized and labeled in your map views. Each layer represents geographic data in ArcMap such as a particular theme of data. Example map layers include streams and lakes, terrain, roads, political boundaries, parcels, building footprints, utility lines etc. Layers can have different features that can be used differentiate them for example:

- *Point* (e.g., buildings, landmarks). Zero-dimensional.
- *Line*, or arc (e.g., roads and streets, streams, railroads, power lines). One-dimensional.
- *Polygon* (e.g., political entities, census geographies such as tracts). Two-dimensional.
- *Raster images* (e.g., an aerial photograph, scanned topographic map, or an elevation model).

Table of contents

The table of **contents** lists all the layers on the map and shows what the features in each layer represent. The check box next to each layer indicates whether its display is currently turned on or off. The order of layers within the table of contents specifies their drawing order in the data frame from bottom to top



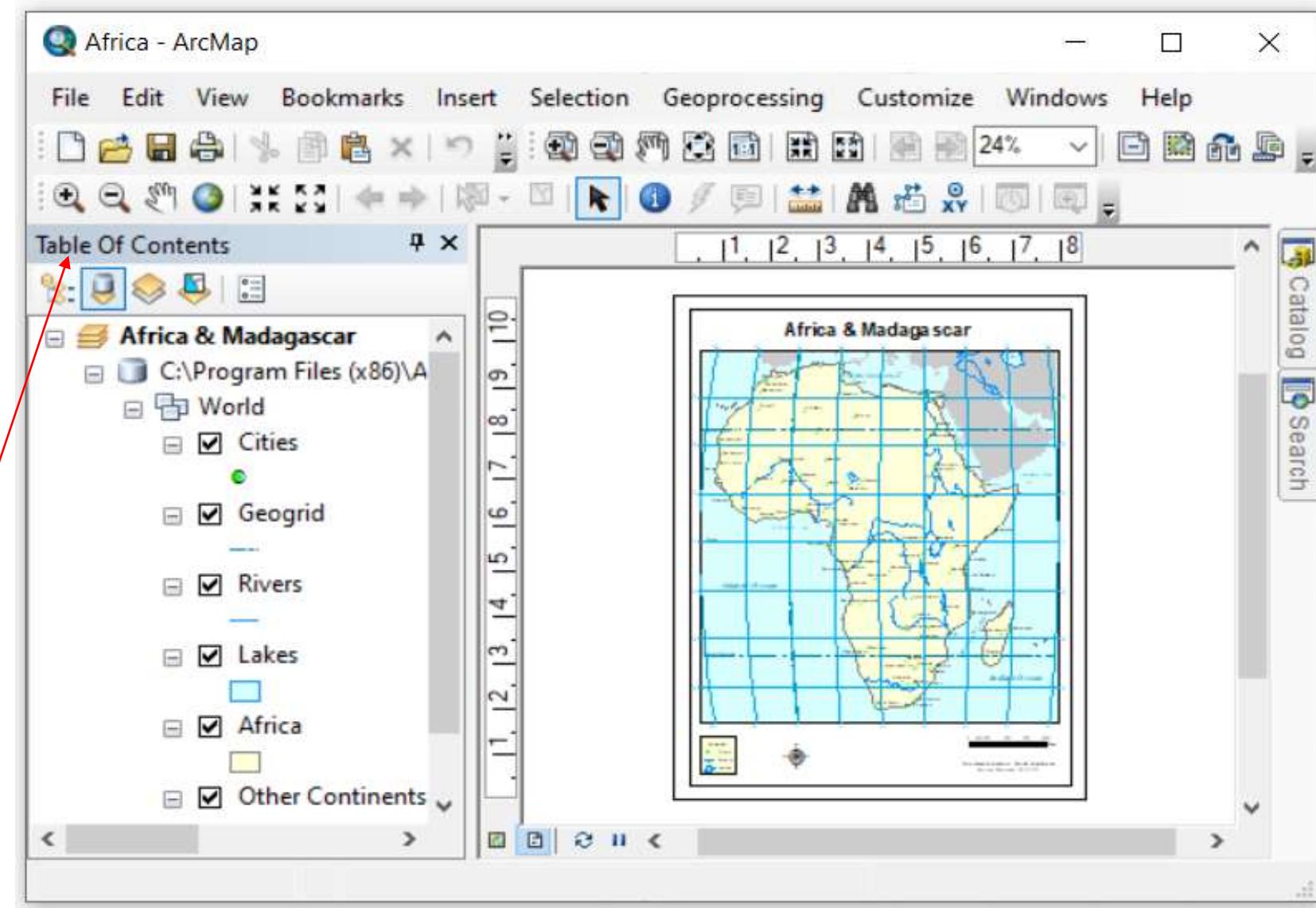


Africa - ArcMap

File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help

Table Of Contents Catalog Search

Table of Contents



The screenshot shows the ArcMap interface with a map of Africa and Madagascar. The 'Table Of Contents' pane on the left lists several layers: 'Africa & Madagascar', 'C:\Program Files (x86)\A', 'World', 'Cities', 'Geogrid', 'Rivers', 'Lakes', 'Africa', and 'Other Continents'. The 'Cities', 'Geogrid', 'Rivers', 'Lakes', 'Africa', and 'Other Continents' layers have checkboxes next to them, and all six are checked. A red arrow points from the text 'Table of Contents' at the bottom left towards the 'Table Of Contents' button in the ArcMap window. The main map view shows the continent with a blue grid overlay.



Labels

Labels are text strings that are used to label features within map layers. Properties define the attribute column used as the source of the text string and how the label is portrayed in your map.

Basemap

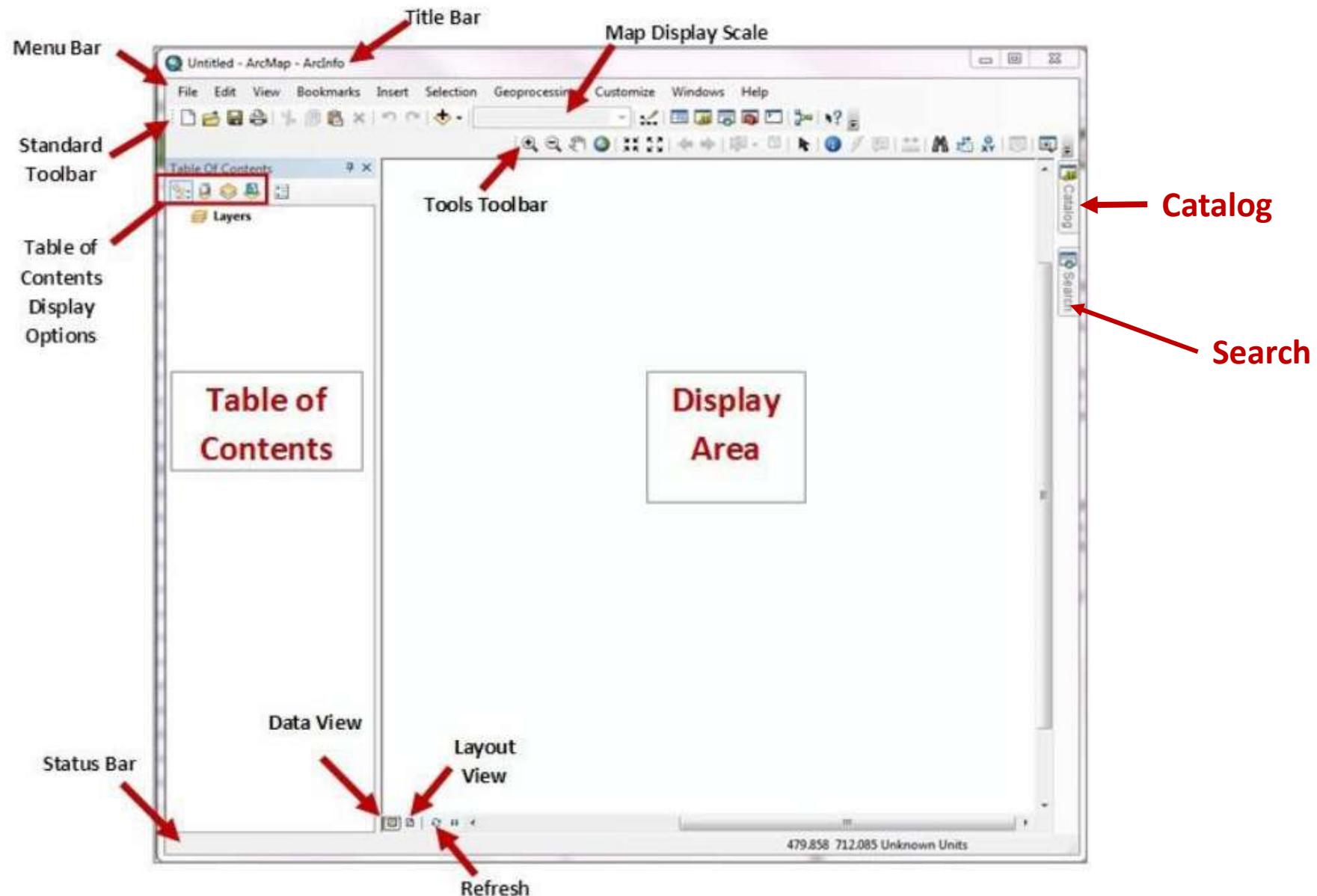
A collection of GIS data that form the background setting for a map. The function of the basemap is to provide background detail necessary to orient the location of the map. Typical GIS data make up the layers for a basemap: streets, boundaries, waterways, and aerial or satellite images.

Theme – IS a single layer of data for example Housing

View - is a collection of themes



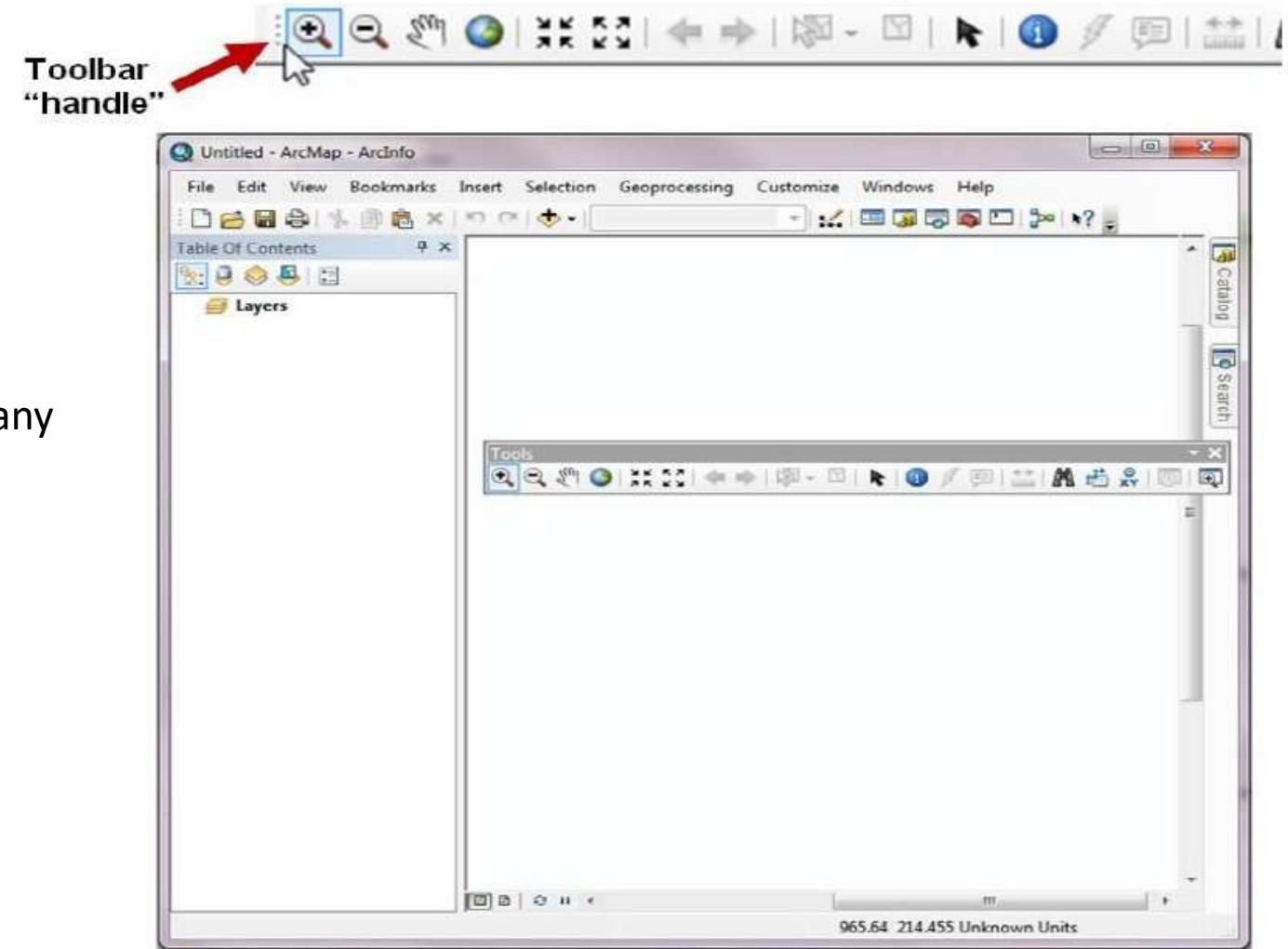
ArcMap Interface





ArcMap Interface

The ArcMap interface is composed several tool bars such as the standard tool bar, tools tool bar etc. Each tool bar perform a number of functions. Use your mouse to point to each of the icons on the tool bars to discover their functions.





Description of the Key Interface items of ArcMap

Menu Bar – Displays all items of the main menu of the application such File, Edit, Bookmarks

Table of contents – Used as a panel to **display different layers**. The table of contents can also be displayed from Windows n the main menu, so is the **Catalog** and **Search**. Note that Catalog can be opened in a **separate Window** but it is convenient to access it via ArcMap. The catalog is helpful when one want to connect or access contents from different folders with ease.

To open files using Catalog, simply navigate to the file you want to open and drag it into the ArcMap display area.

The search panel on Windows is **very useful for searching for tools** used in ArcMap. However, for new users of the application, it may not be of great importance because one does not know what to search. It is advisable that new users of the application use the tool box to explore the tools or functions within the system.





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LECTURER 3

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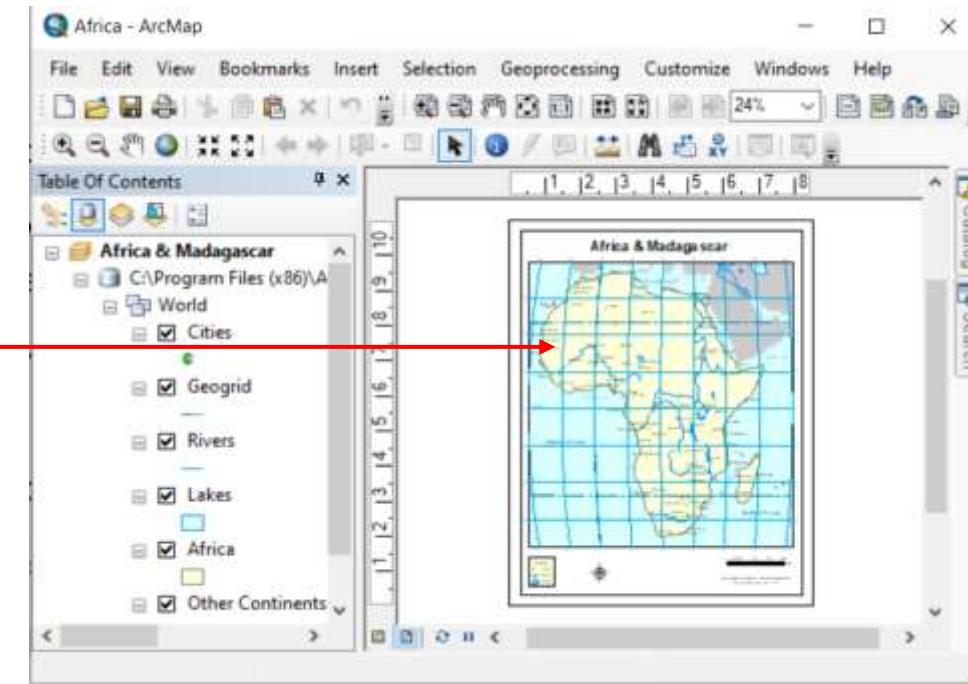
Opening an Existing Map in ArcMap

ArcGIS installs template maps that can be used in ArcMap. Some of these templates are stored in MapTemplates on your drive C. For example to open the map of Africa take the following steps:

Click **File** on ArcMap main menu/ program files (x86)/ArcGIS/Desktop 10.8/MapTemplates/Traditional Layouts/ World/ Africa

It opens the map of Africa as displayed below

Sample Existing Map in ArcGIS

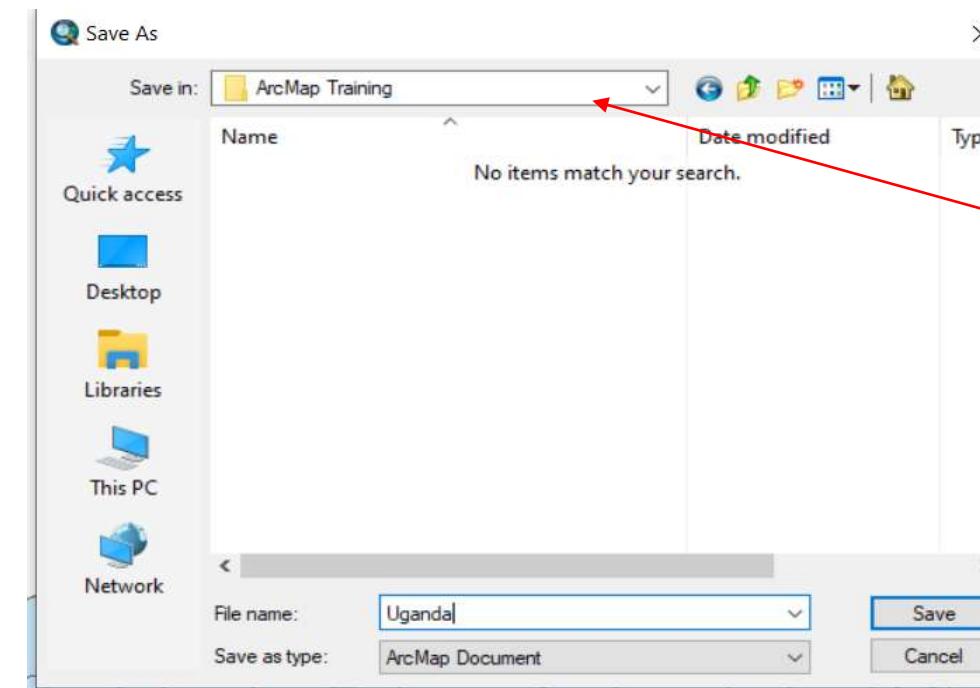




Saving a map to a new Location

ArcMap allows you to save an existing map to a new location of your choice. Create a new folder called ArcMap training. We shall save the map of Africa opened in our new created folder.

Click File on the main menu/*Select Save AS/ Browse and open your new folder (ArcMap training)/type file name/ click save*



Saving existing map
to new location



Working with Layers

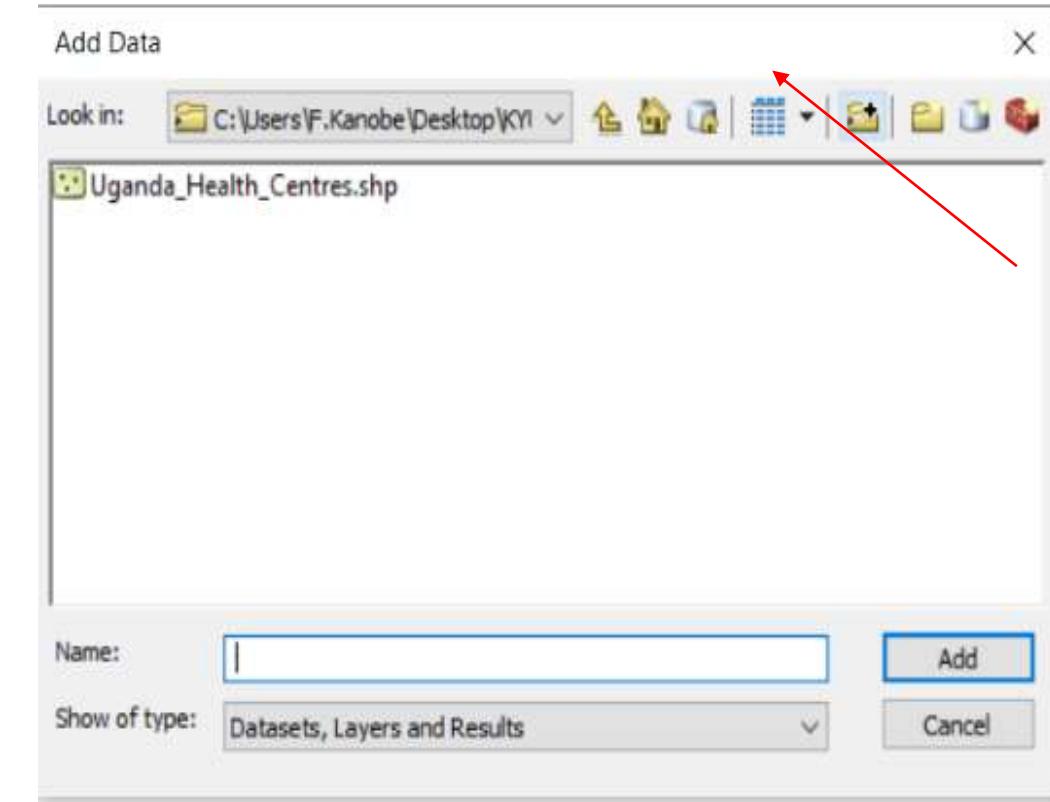
Layers basically make references to data sources such as points, lines, polygons shapefiles and raster images. Map layers are commonly displayed in the table of contents (ToC). The table of contents will always appear of the left hand side of the ArcMap window.

Adding (Connecting) and Removing (Disconnecting) Map Layers in ArcMap

- Click Add new data Icon



- In the add Browser, click to the **Connect to folder button**
- **Browse** to the folder to connect to and open the shapefile you want to open
- **Note:** After you have done this, you will always be easily and directly connect to the data folder when searching or saving map layer.



Connect to
Folder Button

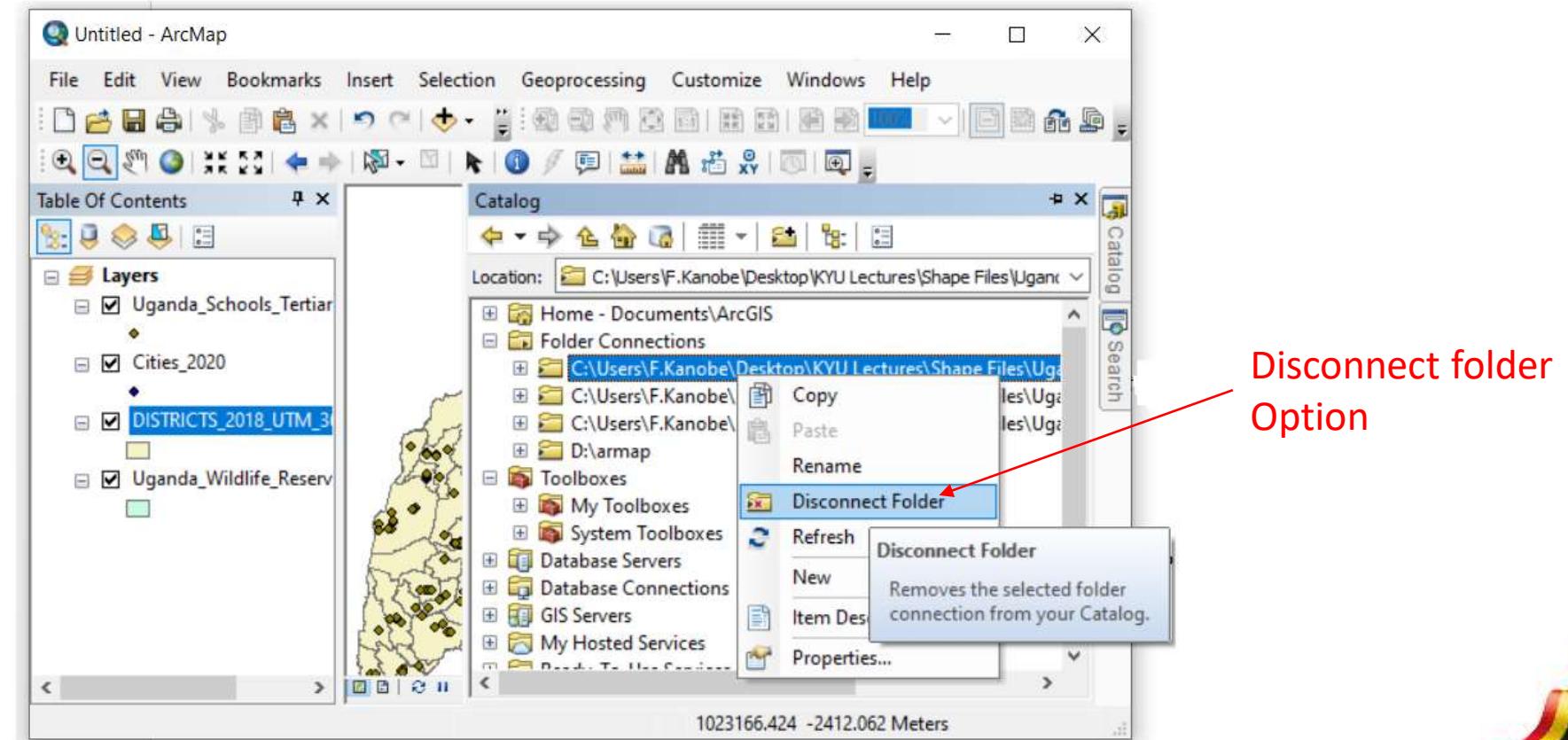


Disconnecting Map Layers

You may want to disconnect or remove your fold connection from catalog. Simply do the following:

Steps:

1. Open Catalog
2. Right Click the *folder Connection* you want to remove
3. Select Disconnect Folder



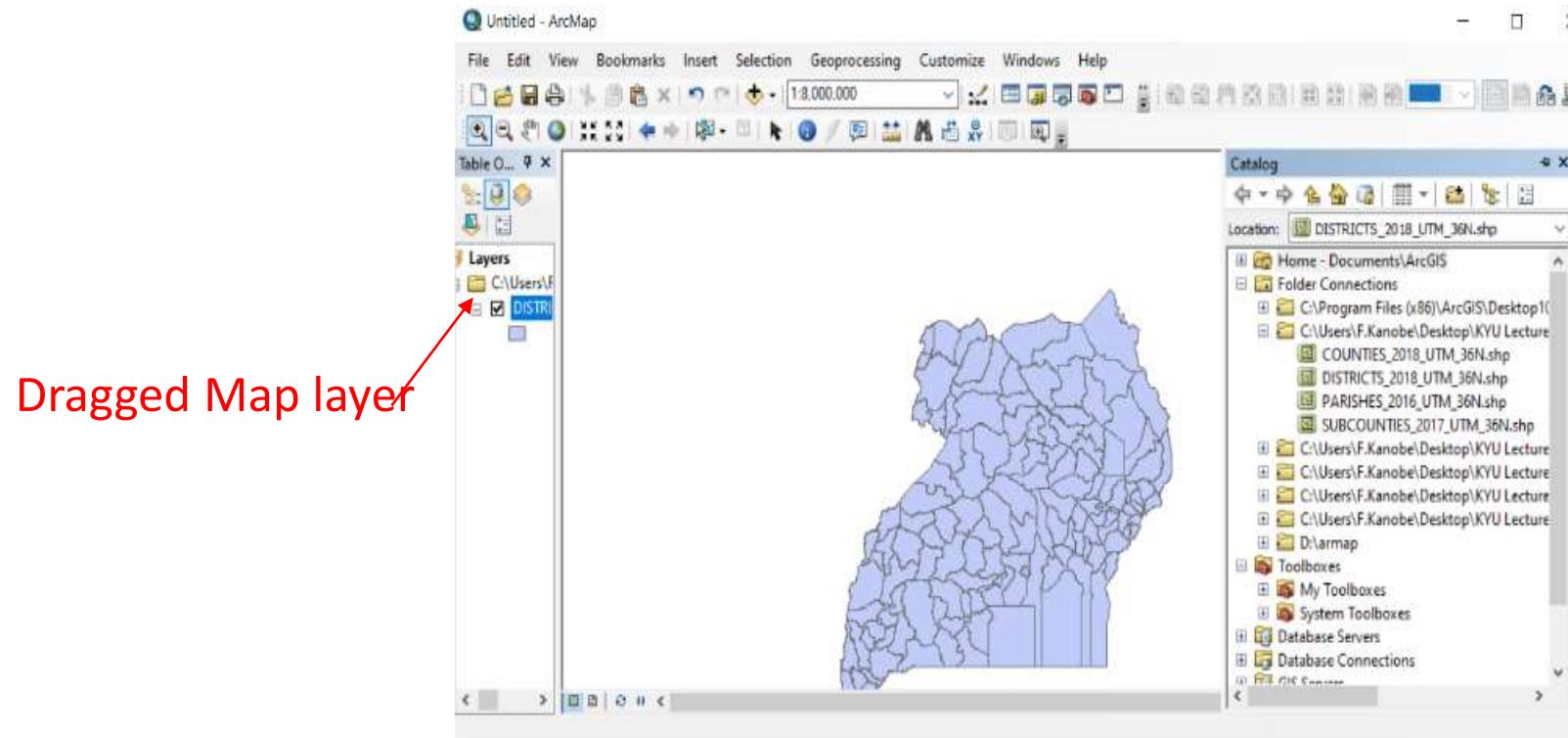


Placing Map layers in ToC using Catalog Window

The catalog window has many functions that permits users to use, explore and maintain GIS data.

One of the common operations in Catalog windows is the drag and drop once you have connected your folders containing the data.

- 1. Open Catalog window**
- 2. Browse the connected folder containing the GIS data you want to view**
- 3. Drag and drop the shapefile into the table of contents**

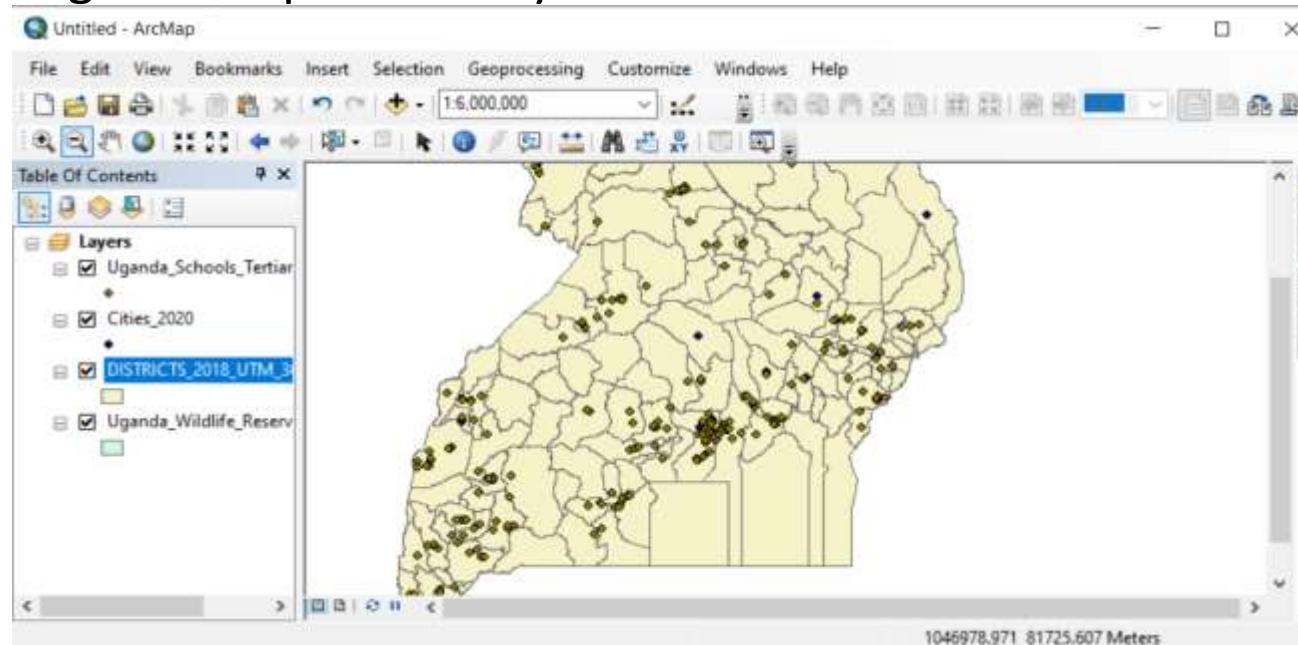




Changing the Layers Display Order

ArcMap allows users to add more than one year in the ToC in a predefined order depending on the layer that was placed in the ToC panel. Nevertheless, it permits reorganizing and change the display of layers based on the users' preference. Steps

1. Open add more than two layers in the table of contents say: *Uganda tertiary institutions*; *Uganda wild life reserves* and *Uganda Cities 2020*.
2. Make sure the List by drawing Order button in the ToC is selected
3. Drag and drop the item you want to relocate from the current position to a new location



In the ToC change the existing map layers to appear in the following order from the top:

- 1) Uganda Wildlife reservations
- 2) Uganda School Tertiary institutions
- 3) District boundaries 2018
- 4) Cities 2020



Changing the Map Layers Color and Symbols

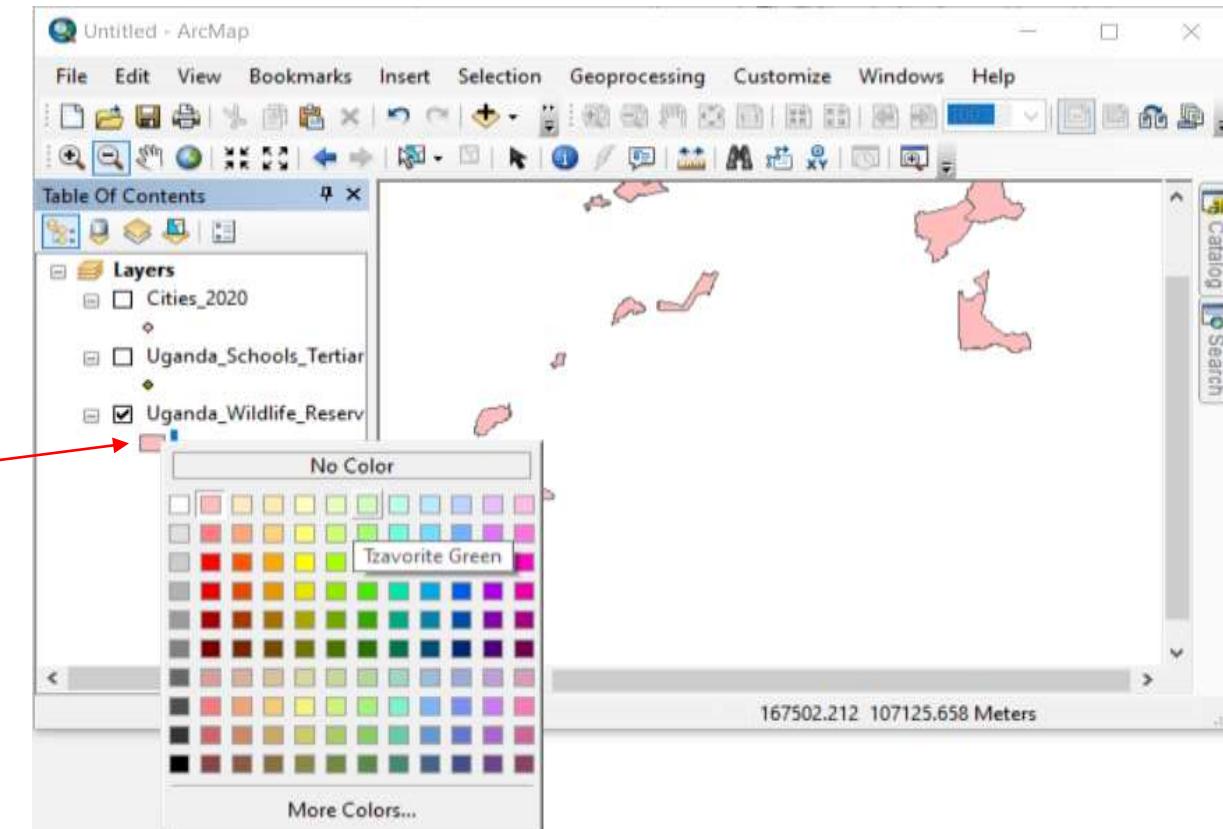
In ArcGIS has functionalities for changing the colors and symbols of Map layers. The ArcMap users can change colors of existing Map layers to their preference and save them in new location under new file names. In the example, we shall change the color of Uganda Wild Reserve Map layer to new colors

Place the Uganda Wild Reserve in the Table of Contents using the Drag and Drop – Catalog method

Right Click the Legend below the Map layer

Select the preference color

Legend in
the ToC

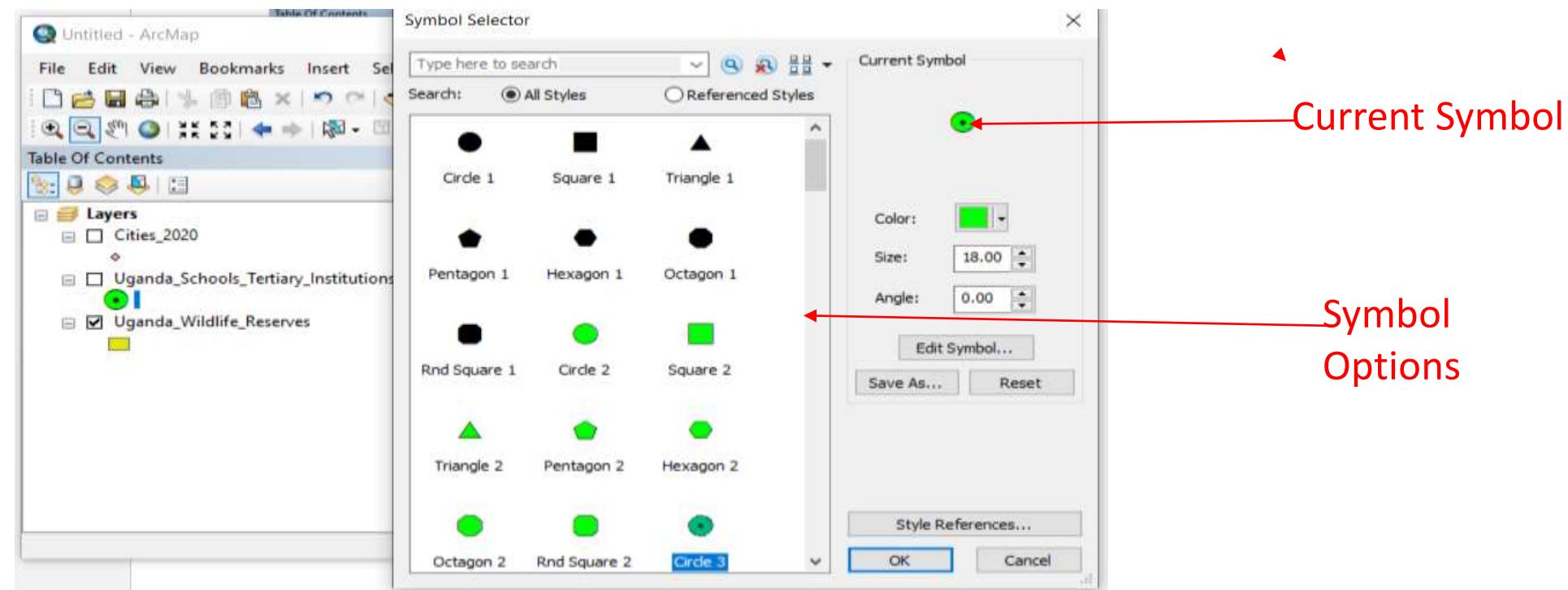




Changing Symbols using Uganda Schools Tertiary Institutions

In the previous Map layers note that Cities and Uganda schools tertiary institutions have symbols. ArcMap has functionalities that allow users to use symbols of their preference.

- 1) Place the Uganda Schools Tertiary institutions layer in the table of contents via Catalog Window
- 2) Click the **Legend symbol** just below the name of the opened Map layer
- 3) A new windows of symbols is displayed indicating the **current symbol**. Select a new symbol you want to use and click **OK**



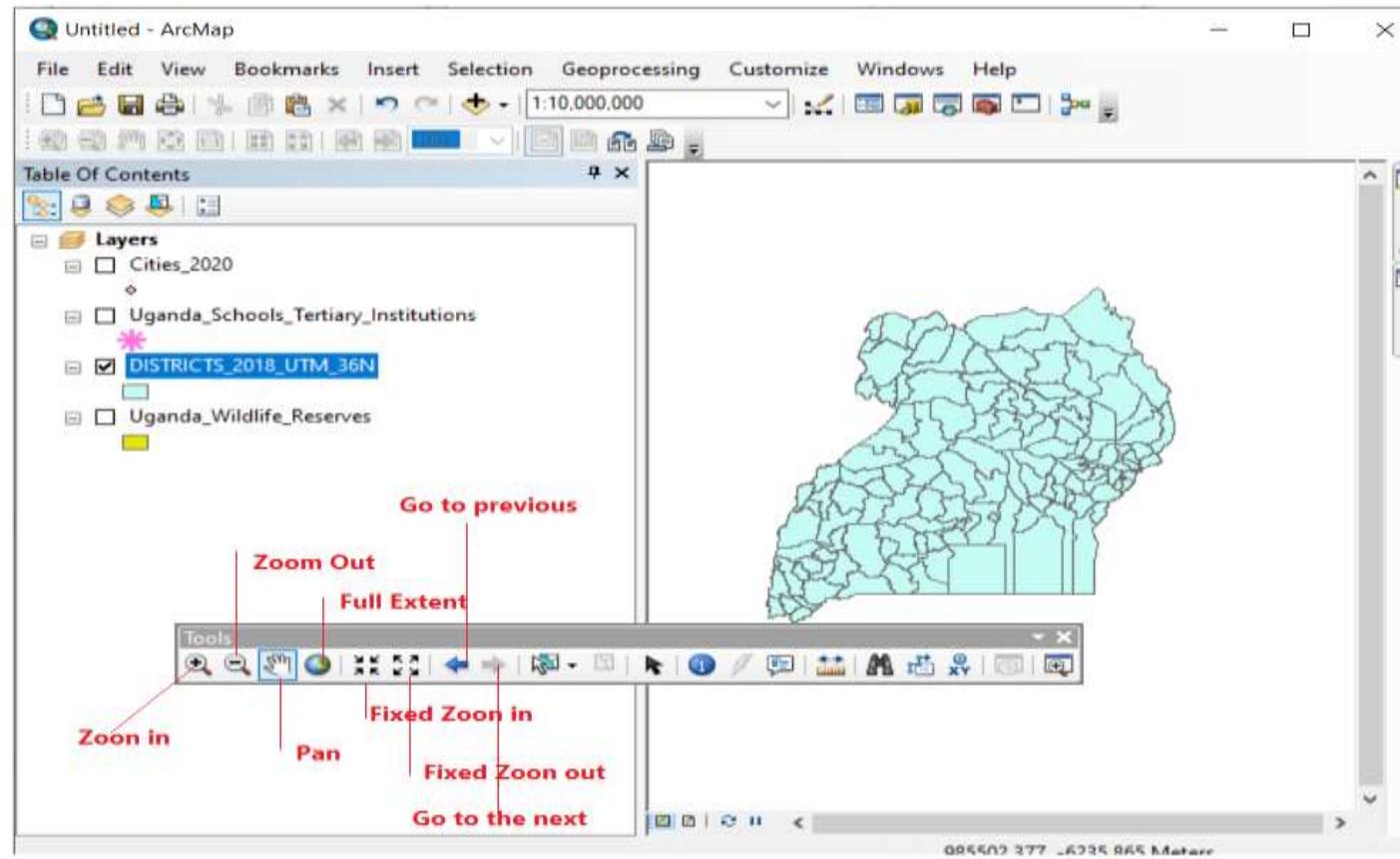


Navigating your Map in ArcMap

By default map layers are displayed in the ToC in full view extent format. ArcGIS however, permits users to zoom in, zoom out and including use of other functionalities to move around your map.

Place the Uganda Districts 2018 Map layer in the ToC via Catalog, it opens in full extent view

Use the navigation functions to explore your layer as follows:



Note

Zoon In

Zoon in by clicking the Once



Zoon Out



Zoon out by Clicking Once

Fixed Zoon in

Fixed Zoon in zooms in a fixed distance from the center of the current display



Click the map to zoom a centered on the point you click





Fixed Zoom Out



Fixed Zoom out zooms out a fixed distance from the center of the current zoomed display

Pan



Pan shifts the current map display without altering the current map scale

- Click the Pan Button
- Move the cursor anywhere into the map display
- Hold down the left mouse button and drag the mouse in any direction

Full Previous and Next Extent Views

Full Extent – Displays all layers in the ToC regardless whether they are turned on or off. Click the full extent button



Previous Extent - It returns the map to its previous extent. Use the Previous extent Button to move the map to its previous extent



Next Extent – This moves forward to the sequence of zoomed extents you have viewed. Use the next extent Button to move the next extent.





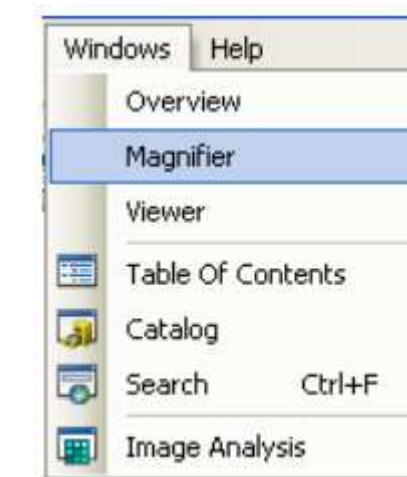
Additional Navigation Functions in ArcMap

ArcMap provides three additional map windows to view the spatial data on your map:

- 1) Magnifier window** - The Magnifier window works like a magnifying glass: as you pass the window over the data, you see a magnified view of the location under the window
- 2) Viewer window** - A Viewer window behaves like an independent view onto the map, and you can use any of the ArcMap interactive tools inside the window.
- 3) Overview window.** The Overview window uses a box to show the extent of your display view within the total extent of your data. You can use the Overview window to navigate the map in the Data view display.

Note

Windows Overview, Magnifier and Viewer are only active in when Map layer is in Data view mode. Hence cannot be used in Data Layout





Measuring Distance on a Map

Maps have coordinates that enables users to measure distance along their paths using a mouse and course. However, while map coordinates are in specific units such as meters , the user can change the default unit to units of preference and may be applicable in particular situation.

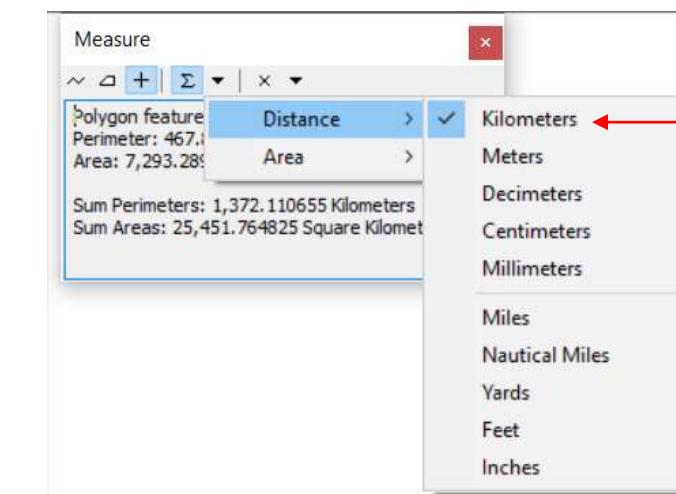
How to change Measurements

- Open Map of Uganda showing districts 2018
- Click in **Full Extent**
- On the Tools Bar select **Measure**



- Place your cursor in ArcMap Window
- Select **Choose Units.**

Note that the current Unit in use will have a right Mark ✓. Select the unit you want to use



Measure

Current Unit

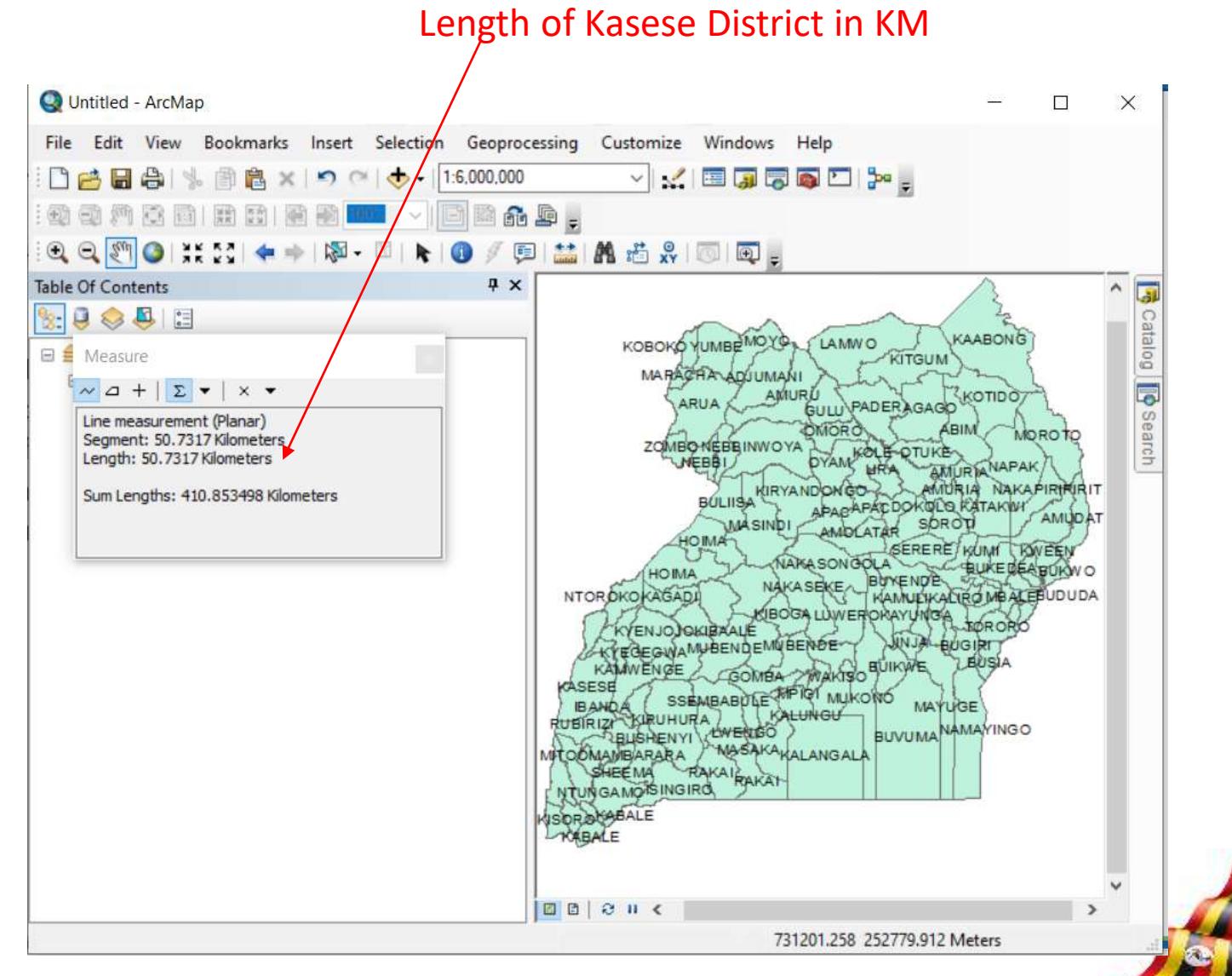


Measuring the Distance of a District on a Map

In the map of Uganda showing 2018 districts, we are going to measure the length of Kasese District.

Steps:

- Open the Uganda Map 2018 districts
- Select **Full Extent** display
- Change the Unit of distance measure in **KM**
- Select measure **Line**
- Move the Mouse in a straight Line from the beginning to the edge of Kasese district and thereafter **double click**
- Close the **Measure Window**



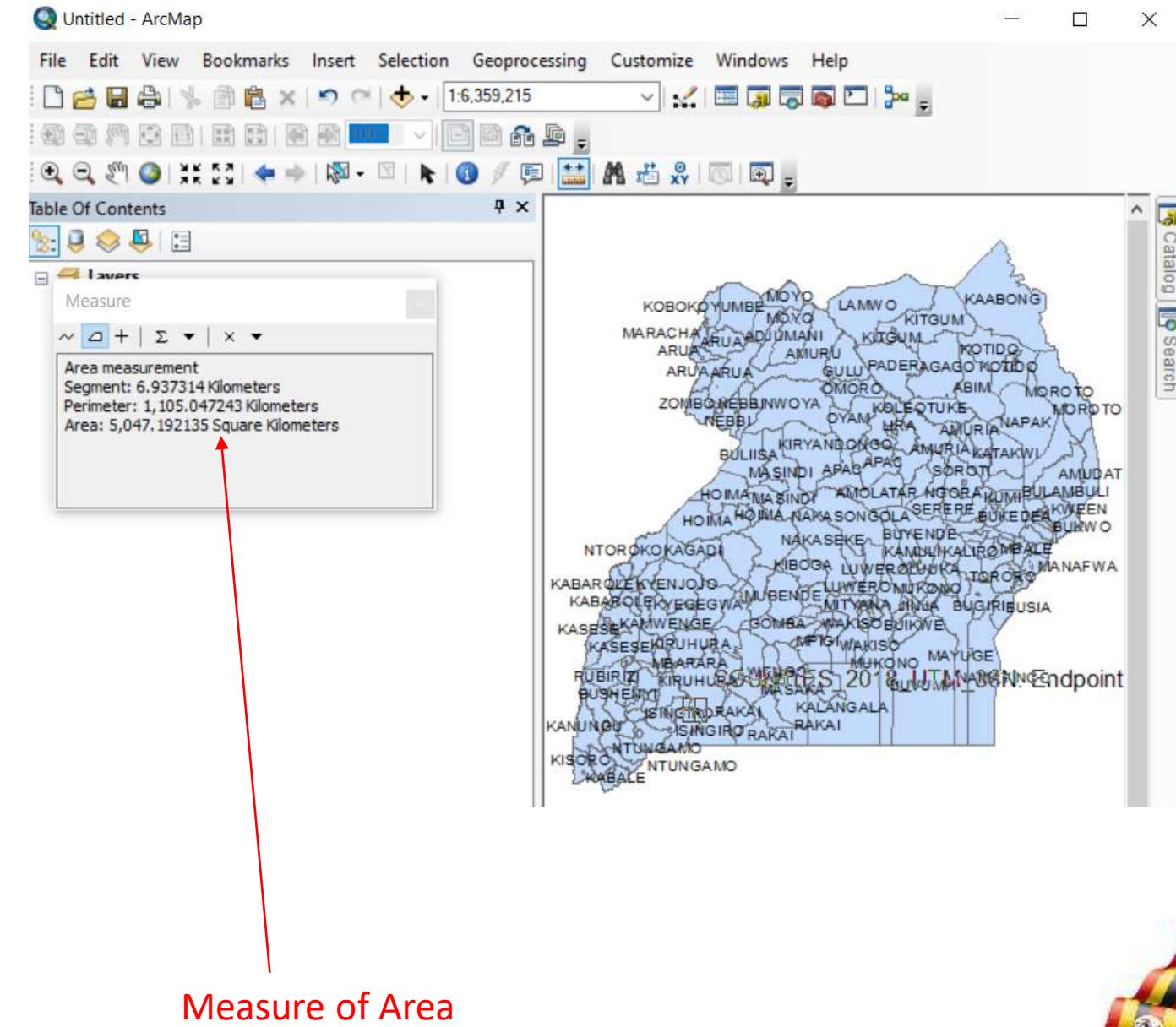


Measuring An Area on a Map

In the map of Uganda showing 2018 districts, we are going to measure an Area of Kabong District.

Steps:

- Open the Uganda Map 2018 districts
- Select **Full Extent** display
- Change the Unit of distance measure in **KM**
- Select measure **Area**
- Move the Mouse to the Area of the district you want to measure thereafter **double click**
- Close the **Measure Window**





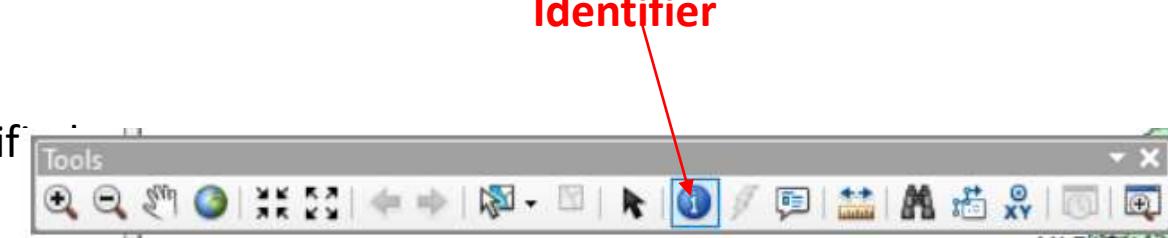
Using Identifier in ArcMap

The identifier helps users of ArcMap to find detailed information about a feature displayed in ArcMap, The identifier is located on the Tools toolbar. The Identify tool allows you to see the **attributes** of your data and is an easy way to learn something about a location in a map.

Clicking the Identify tool on a location inside a data frame will present the attributes of the data at that location. When identifying features with the Identify tool, the attributes are presented in a feature-by-feature, layer-by-layer manner in the Identify window.

Steps

- Open the map layer containing the features to be identified
- Click Identifier on the Tools toolbar
- Click in the Map containing to features to be identified (Buvuma District)





Identify

Identify from: <Top-most layer>

- COUNTIES_2018_UTM_36N
 - BUVUMA

Location: 515.099 -31.324 Kilometers

Field	Value
FID	30
Shape	Polygon
F15Regions	CENTRAL II
DName2016	BUVUMA
CName2016	BUVUMA ISLAND
SName2016	BUVUMA TOWN COUNCIL
costituenc	BUVUMA ISLANDS COUNTY
CC	BUVUMABUVUMA ISLAND
COUNTRY	UGANDA

Sample Identifier details for
Buvuma District in Uganda



Finding Features in Map Layers

Using the find toolbar on the Tools bar, users of ArcMap can discover features and attributes of Map Layers in the ArcMap window. The find tool can as well be used to flash the feature, zoom, select, unselect and identify. We shall use the Uganda Counties Map layer to demonstrate this function.

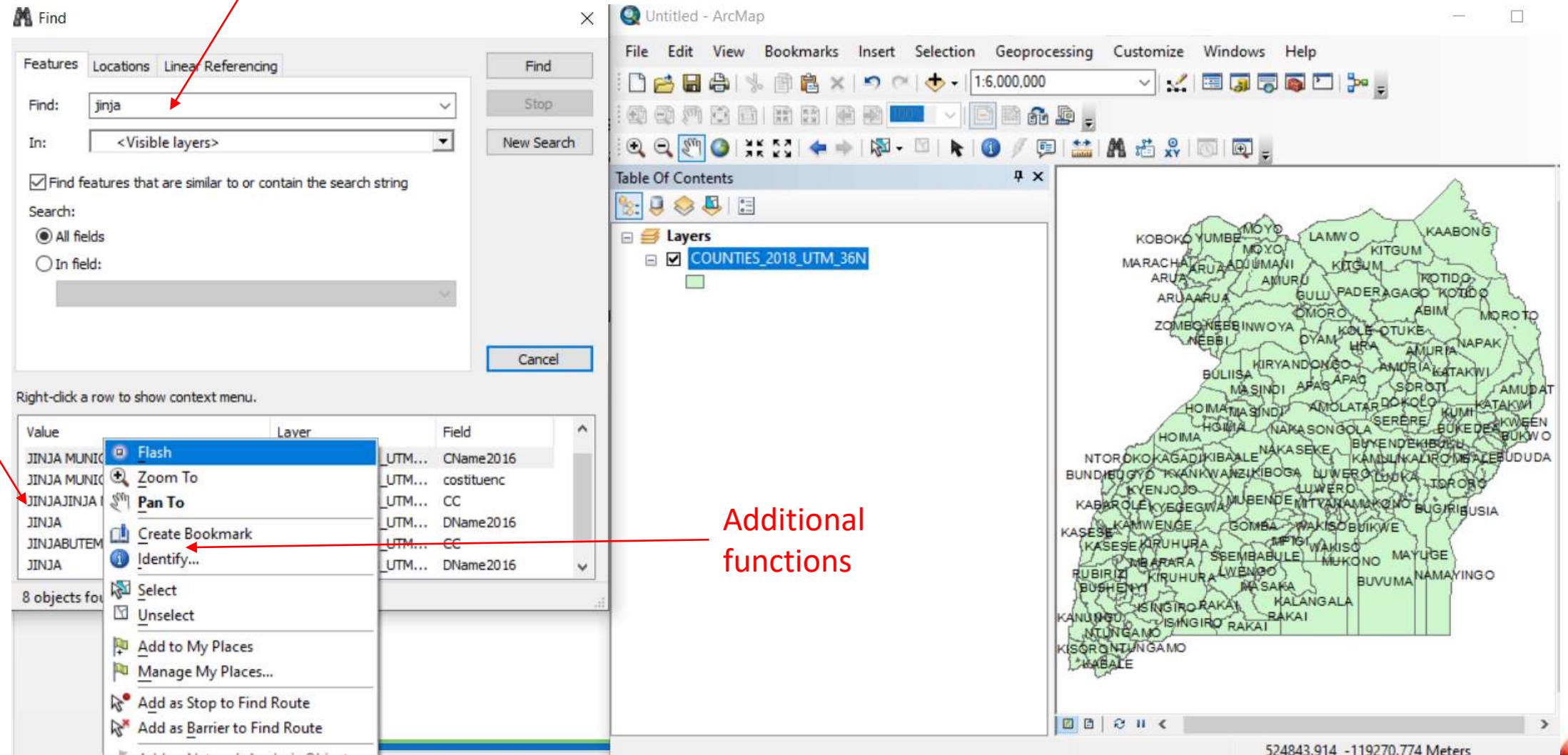
Steps:

- Open Uganda Counties Map Layers via the catalog Window
- Click Find  located on the Tools Bar.
- Type Jinja in the find and Click Find.
- Jinja County and all its attributes are displayed
- Right Click any of the features for example JinjaButembe and apply the following functions one after another:
 - Flash
 - Zoom
 - Pan to
 - Identify
 - Select
 - Unselect





Illustration of Find function in ArcMap



The screenshot illustrates the use of the Find function in ArcMap. The 'Find' dialog box is open, showing the search term 'jinja' entered in the 'Find:' field and '**Visible layers**' selected in the 'In:' dropdown. A red arrow points from the text 'Illustration of Find function in ArcMap' to the 'Find:' input field.

The main ArcMap interface shows a map of Uganda with county boundaries. The counties are labeled with their names. A red box highlights the 'COUNTIES_2018_UTM_36N' layer in the Table Of Contents.

A context menu is open over a county labeled 'JINJA'. The menu items include:

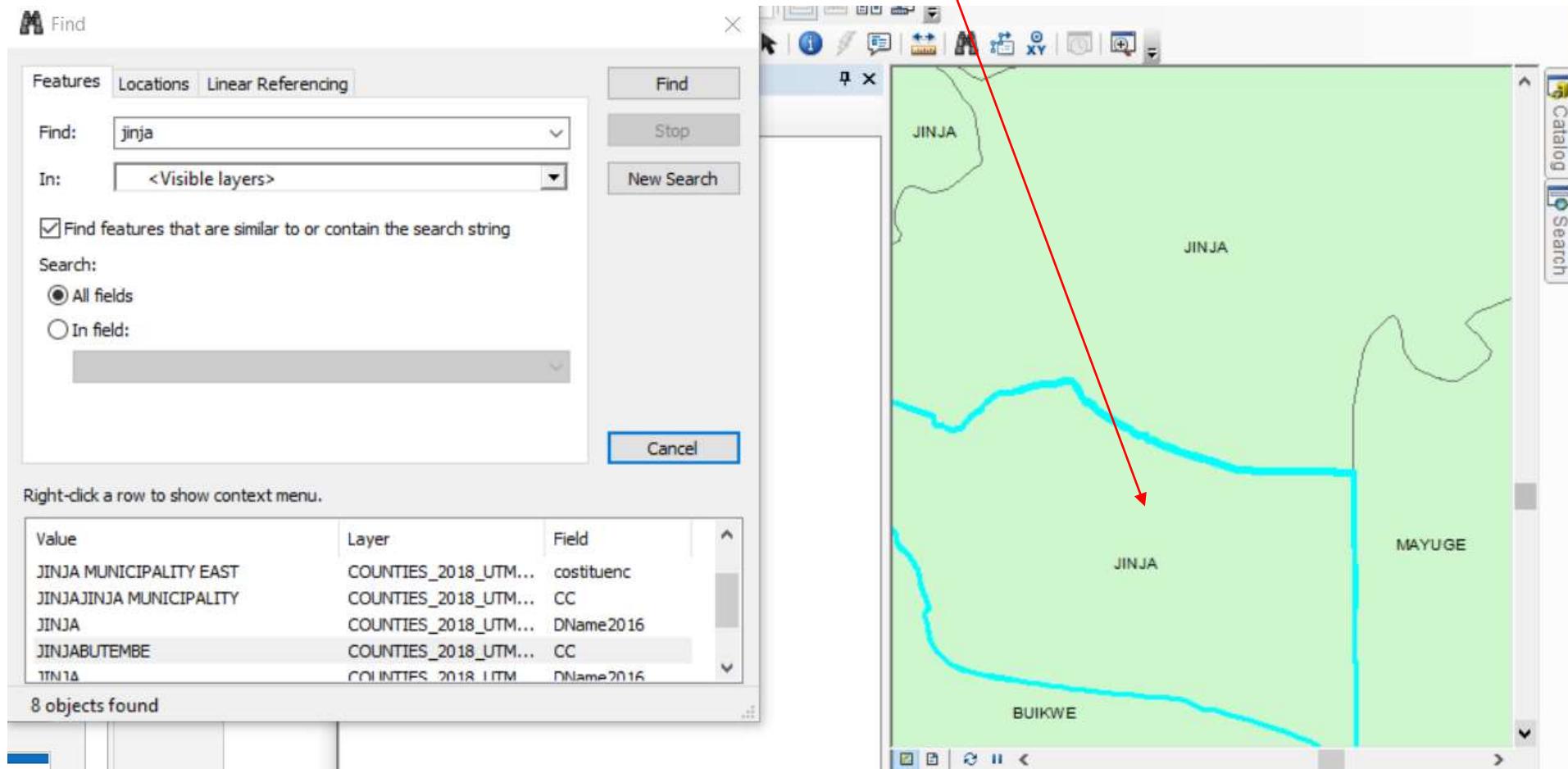
- Flash
- Zoom To
- Pan To
- Create Bookmark
- Identify...** (highlighted with a red arrow)
- Select
- Unselect
- Add to My Places
- Manage My Places...
- Add as Stop to Find Route
- Add as Barrier to Find Route

A red arrow points from the text 'Attributes of the feature' to the 'Identify...' option in the context menu.

A red arrow points from the text 'Additional functions' to the 'Create Bookmark' option in the context menu.



Illustration of Zoom and Selection of JinjaButembe



The screenshot illustrates the process of finding and selecting a specific geographical feature named "JinjaButembe" using QGIS.

Search Results Dialog:

- Find:** jinja
- In:** <Visible layers>
- Find features that are similar to or contain the search string
- All fields
- In field:

Right-click a row to show context menu.

Value	Layer	Field
JINJA MUNICIPALITY EAST	COUNTIES_2018_UTM...	constituenc
JINJA JINJA MUNICIPALITY	COUNTIES_2018_UTM...	CC
JINJA	COUNTIES_2018_UTM...	DName2016
JINJABUTEMBE	COUNTIES_2018_UTM...	CC
JINJA	COUNTIES_2018_UTM...	DName2016

8 objects found

Map View:

A map of a county boundary is shown in light green. The boundary is highlighted in cyan. A red arrow points from the search results dialog to the cyan-highlighted portion of the boundary, indicating the selected feature.

Labels visible on the map include: JINJA, JINJA, JINJA, MAYUGE, BUIKWE.

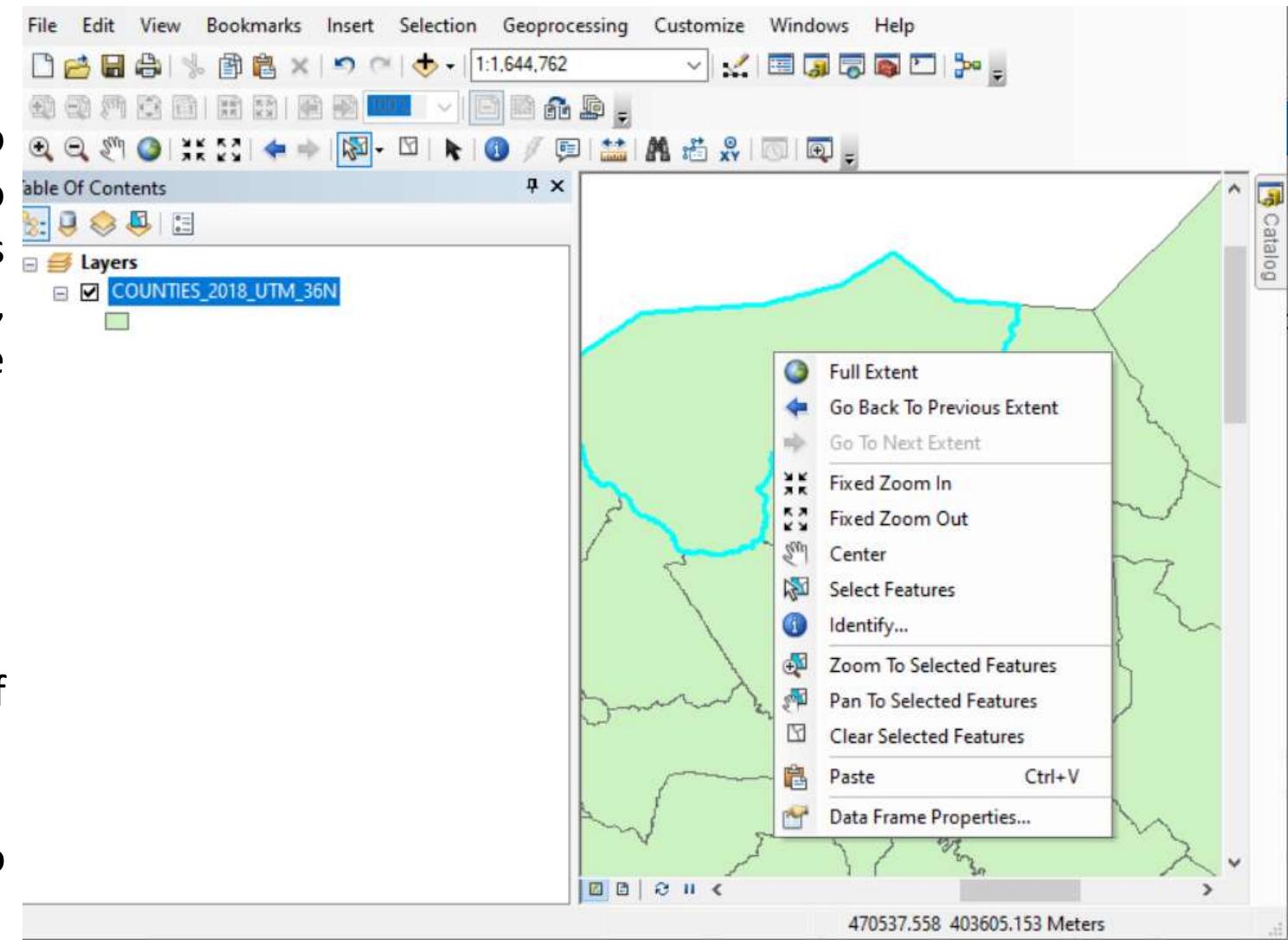


Select Function in ArcMap

The select function can be used to highlight subset of features on your map to use in subsequent exploration or analysis of data. Other functions such as Zoom in, Zoom Out, identify can be applied also the selected sub features of your map

Steps

- Open Uganda District Borders Map
- Choose Select tool on the tools Bar
- Click any of the districts in the Map of Uganda
- Note that it is highlighted
- Right click the selected area and try to Zoom in, Zoom Out, Identify







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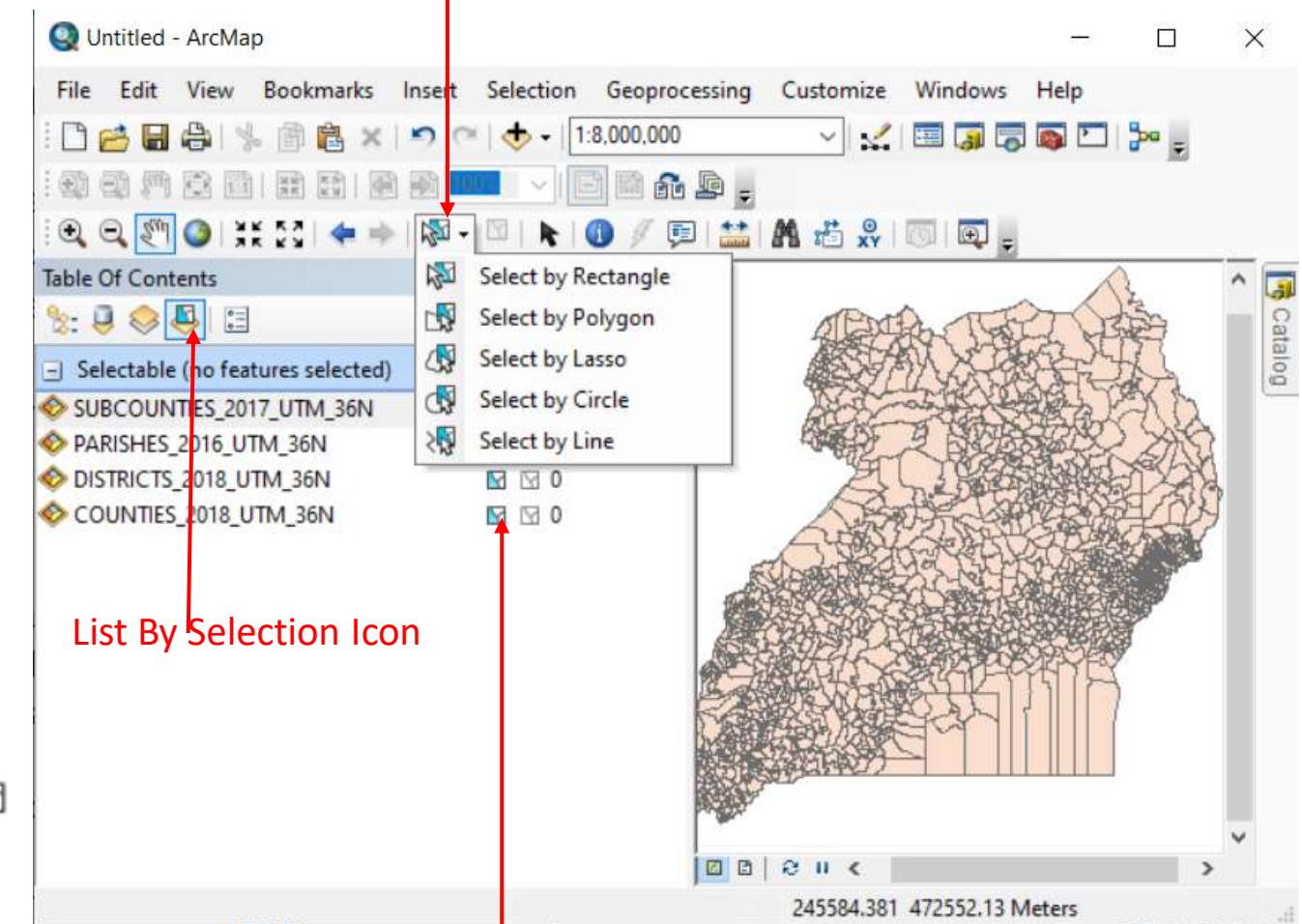


Setting Selectable Map Layers

When working with many layers in the ToC, you can determine which layers you want to select features from by disabling some layers that might not be put to use. Once you set layers selectable ArcMap will only enable you to highlight layers from the selectable layers

Steps

- Open the layers in your Table of Contents for example: Districts, Counties, Sub counties
- Click on the Icon of List by Selection in the ToC 
- Click off the Selection Boxes for *Parishes* and *Counties*
- ArcMap sets the ticked boxes layers as unselectable layers. 
- Click the Select Feature function 
- Choose by graphic you want to use such Rectangle, Polygon, Circle or Line as you wish



Selection Box



File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help

1:6,000,000

Table Of Contents

Selected

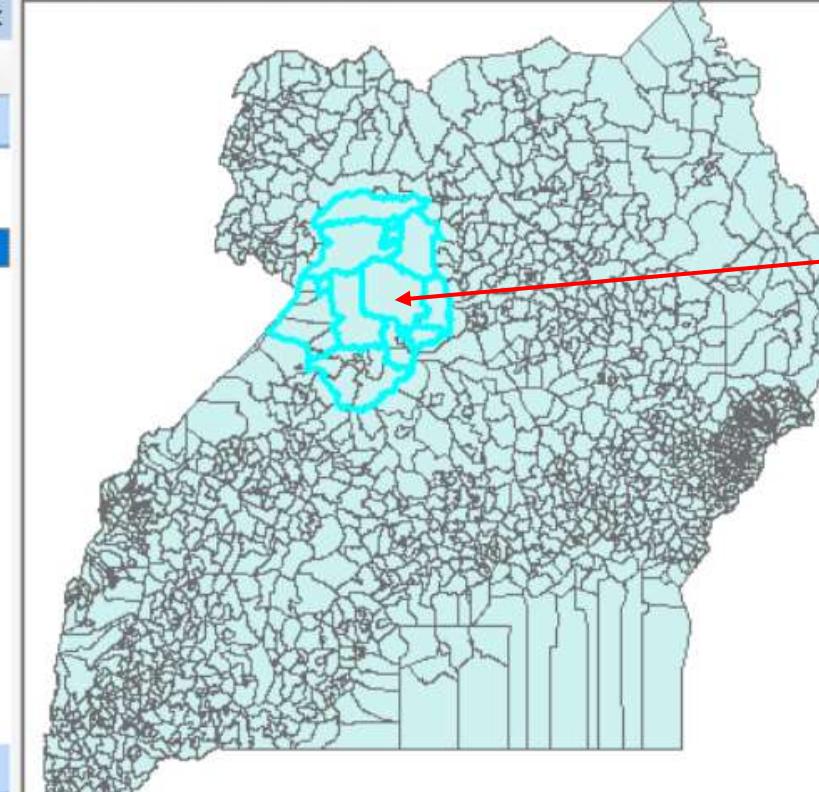
- SUBCOUNTIES_2017_UTM_36N 7
 - BULIISA
 - KIRYANDONGO
 - MASINDI
 - NWOYA
 - NWOYA
 - NWOYA
 - NWOYA
- DISTRICTS_2018_UTM_36N 4
 - BULIISA
 - KIRYANDONGO
 - MASINDI
 - NWOYA

Not Selectable

- PARISHES_2016_UTM_36N 0
- COUNTIES_2018_UTM_36N 0

Number of features selected: 11

733472.205 270439.572 Meters



Search

Selectable Layers

Not selectable Layers

Selected Districts and Subcounties



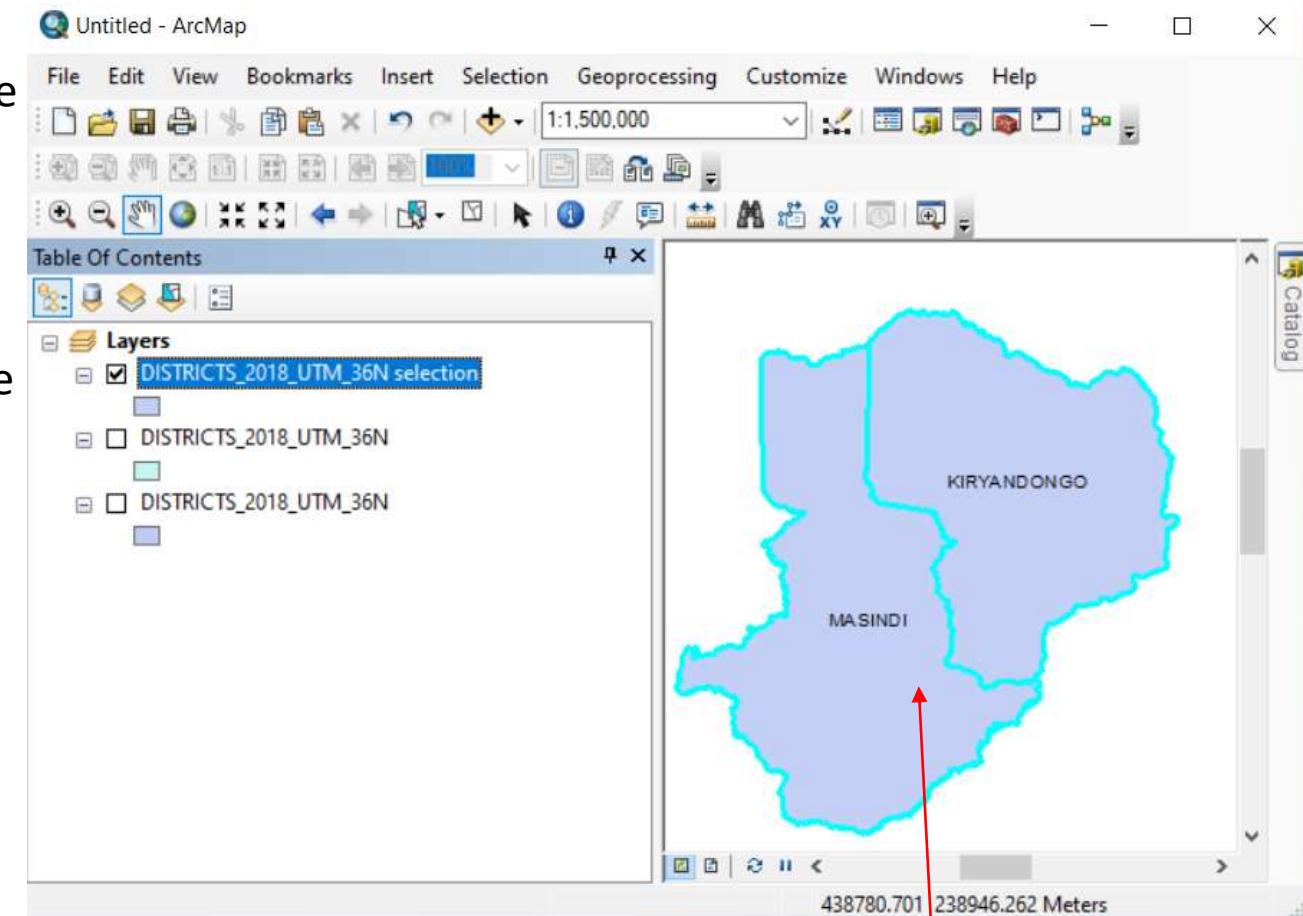


Creating New Layers from Selected Map Layer

In ArcMap, you can create new layer using the selected features in the mother layer. For example you can create layers for particular district from a particular mother layer that has all districts

Steps

- Select the features of your choice as illustrated in the previous slides
- **Right Click** the mother layer say district in the ToC
- **Click Create layer** from selected features
- A new layer is created. Use the ToC to put off some layers so that you can display the new created layer.



New Created District Layers for Masindi and Kiryandogo



Working with Attributes Tables

Attribute Tables are commonly associated with spatial data that forms the map layer and the attribute values contained.

The Attribute tables can be used to find and query data in ArcMap. Attribute tables can be a tabular file containing information about a set of geographic features, usually arranged so that each row represents a feature and each column represents one feature attribute.

To Open Attribute table for existing Map layer, take the following steps:

- **Right Click the Map layer in ToC** you want to see the attribute table for example districts
- Click on **Open Attribute Table**
- Navigate to the any record of your choice in the table and Click its Row record.
- Note that the selected record is also highlighted in the Map Layer. Right Click – Zoom, identify, Pan and use the tools tool bar to take measurements

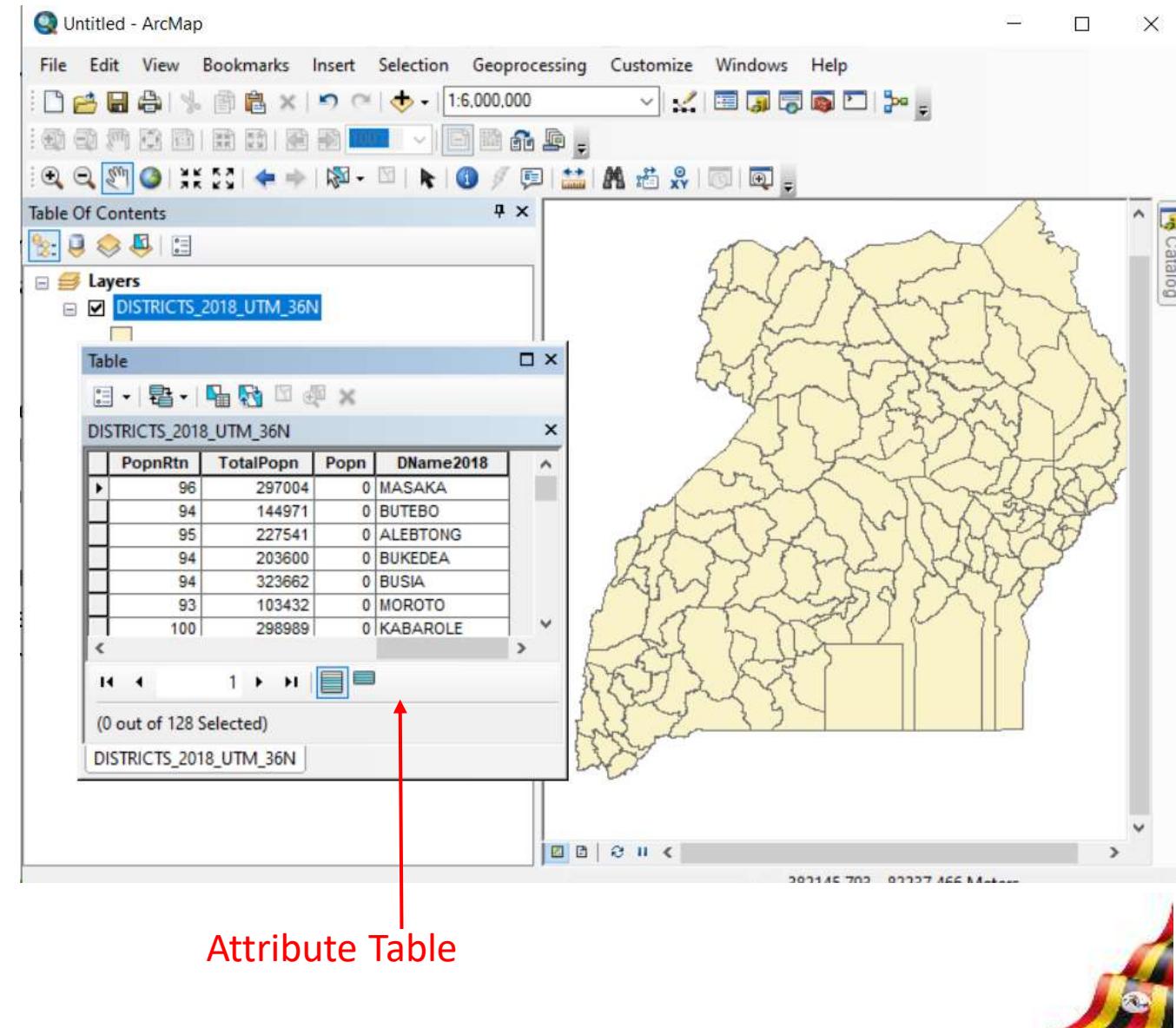
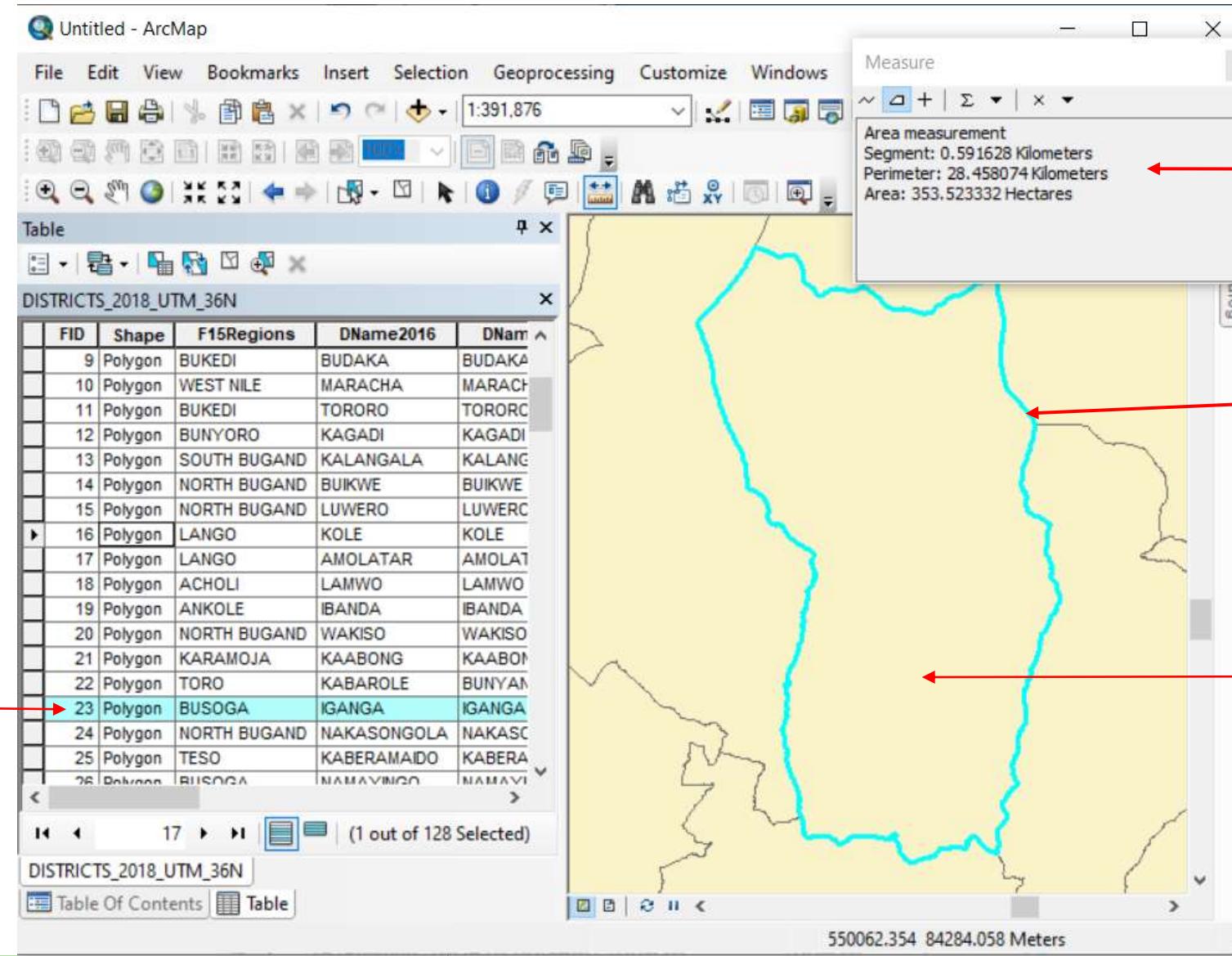




Illustration of some of the functions carried out in Attribute Table



The screenshot illustrates several functions in ArcMap:

- Selected Record in the attributes table:** A red arrow points to the 23rd row of the attribute table, which is highlighted in light blue. This row corresponds to the selected feature on the map.
- Selecting feature in the attribute table:** A red arrow points to the 23rd row of the attribute table, which is highlighted in light blue. This row corresponds to the selected feature on the map.
- Zooming in the attributes table feature:** A red arrow points to the 23rd row of the attribute table, which is highlighted in light blue. This row corresponds to the selected feature on the map.
- Using Measure of the selected record from attribute table:** A red arrow points to the "Measure" tool window. The window displays:
 - Area measurement
 - Segment: 0.591628 Kilometers
 - Perimeter: 28.458074 Kilometers
 - Area: 353.523332 Hectares

FID	Shape	F15Regions	DName2016	DNam
9	Polygon	BUKEDI	BUDAKA	BUDAKA
10	Polygon	WEST NILE	MARACHA	MARACH
11	Polygon	BUKEDI	TORORO	TORORC
12	Polygon	BUNYORO	KAGADI	KAGADI
13	Polygon	SOUTH BUGAND	KALANGALA	KALANG
14	Polygon	NORTH BUGAND	BUKWE	BUKWE
15	Polygon	NORTH BUGAND	LUWERO	LUWERC
16	Polygon	LANGO	KOLE	KOLE
17	Polygon	LANGO	AMOLATAR	AMOLAT1
18	Polygon	ACHOLI	LAMWO	LAMWO
19	Polygon	ANKOLE	IBANDA	IBANDA
20	Polygon	NORTH BUGAND	WAKISO	WAKISO
21	Polygon	KARAMOJA	KAABONG	KAABON
22	Polygon	TORO	KABAROLE	BUNYAN
23	Polygon	BUSOGA	IGANGA	IGANGA
24	Polygon	NORTH BUGAND	NAKASONGOLA	NAKASC
25	Polygon	TESO	KABERAMAIDO	KABERA
26	Polygon	BUSOGA	NAMAYINGO	NAMAVI

Using Measure of the selected record from attribute table

Selecting feature in the attribute table

Zooming in the attributes table feature



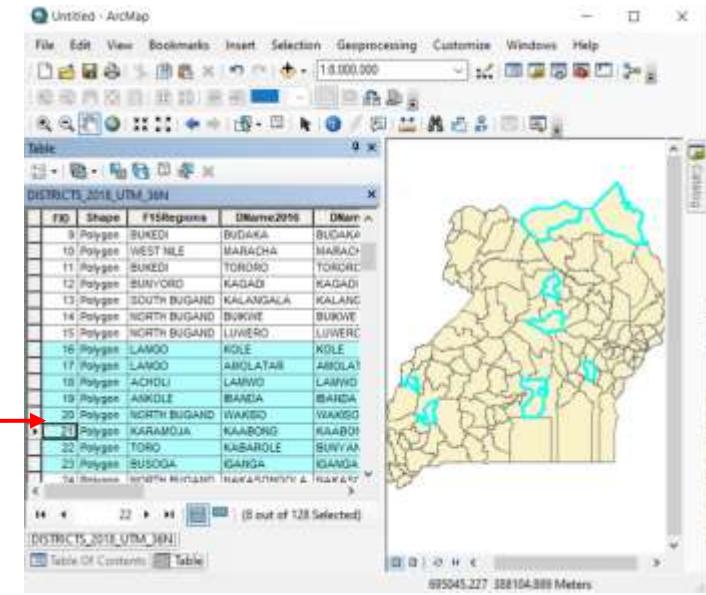
Selecting Multiple Records in the Attribute Table

ArcMap allows user to select more than one record in the attributes table in two ways:

Selecting sequential records in attributes table

- Click to the first record to start selection
- Hold the shift Key on your key board
- Click the last record to be select. All records from the first to the last are selected.

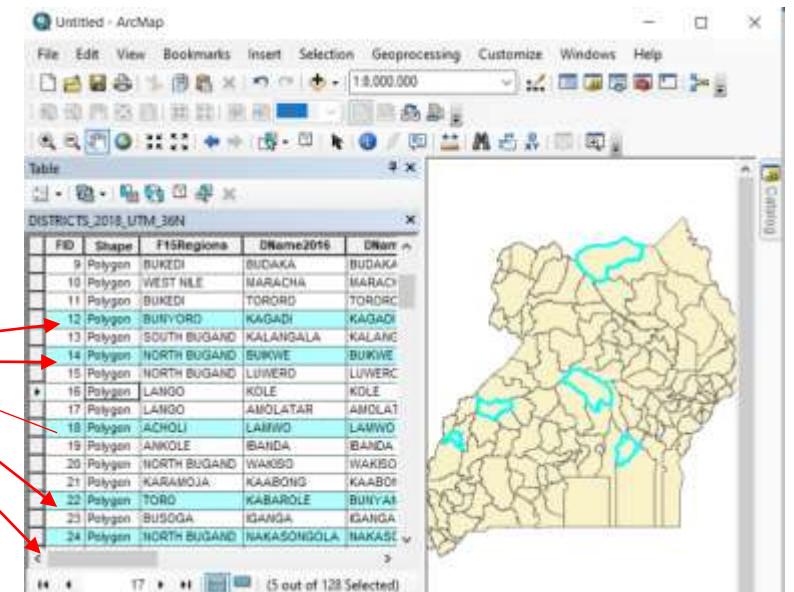
Records selected sequentially



Selecting unsequential records in attributes Table

- Hold Ctrl key on your key board
- Scroll and click on any record that you want to select in your attributes table

Unsequential selection of records

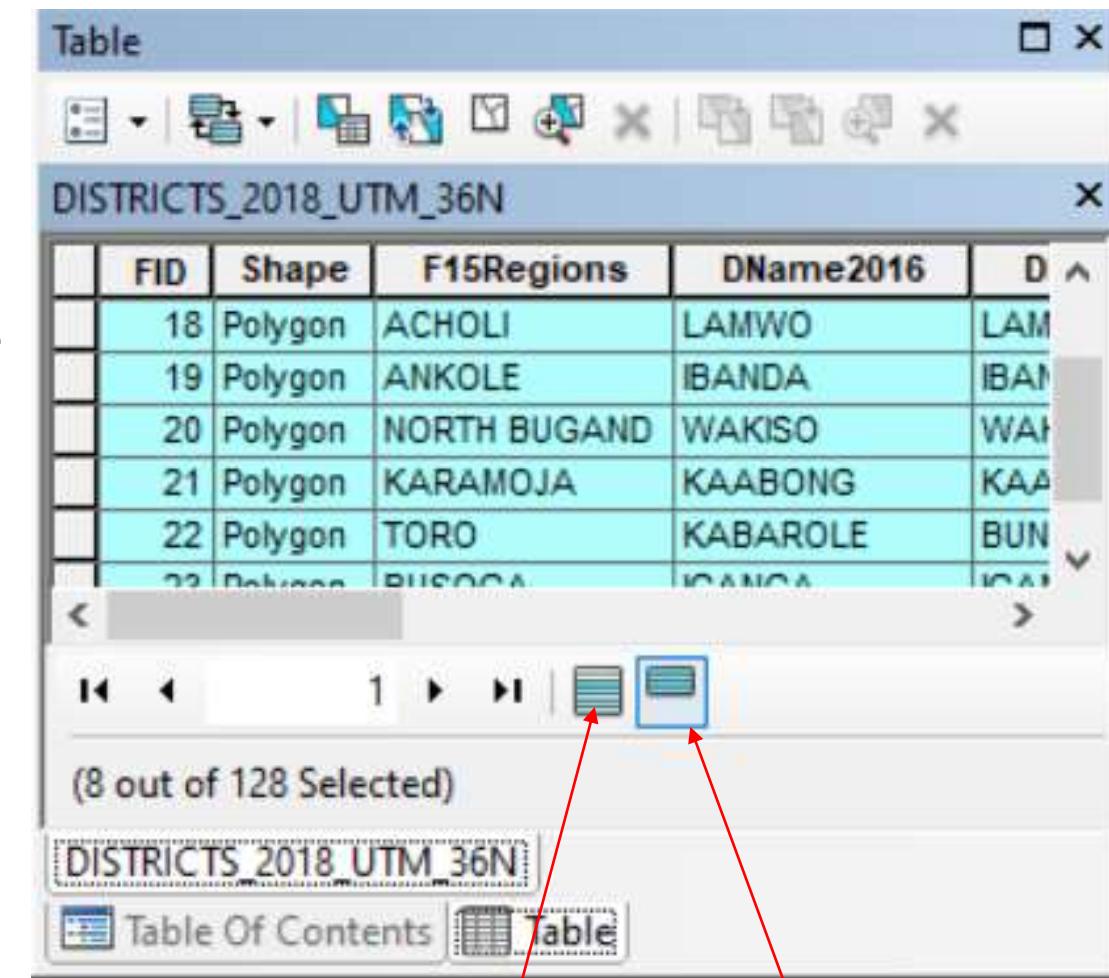




Switching between All records and selected Records

While in the attributes table, one may want to display only the selected records.

- Use the selected record Icon to view only the selected records. 
- To view all records click on the All records Icon 



FID	Shape	F15Regions	DName2016	D
18	Polygon	ACHOLI	LAMWO	LAM
19	Polygon	ANKOLE	IBANDA	IBAM
20	Polygon	NORTH BUGAND	WAKISO	WAH
21	Polygon	KARAMOJA	KAABONG	CAA
22	Polygon	TORO	KABAROLE	BUN
23	Polygon	BUSOGA	IGANGA	ICAI

All records are displayed

Displays only selected records



Switching Selections

With ArcMap, you can switch sections of the map layers that have been selected in the attributes table, select all records and unselected records.

The attributes table has an area for options found on the extreme left hand side.



Click the **Table options button**  in the Attributes table

Try the following options: **Find** to search for any feature, **Switch selection** to navigate between selection, **Select All** to select all records and **Clear selection** to unclear all selected records

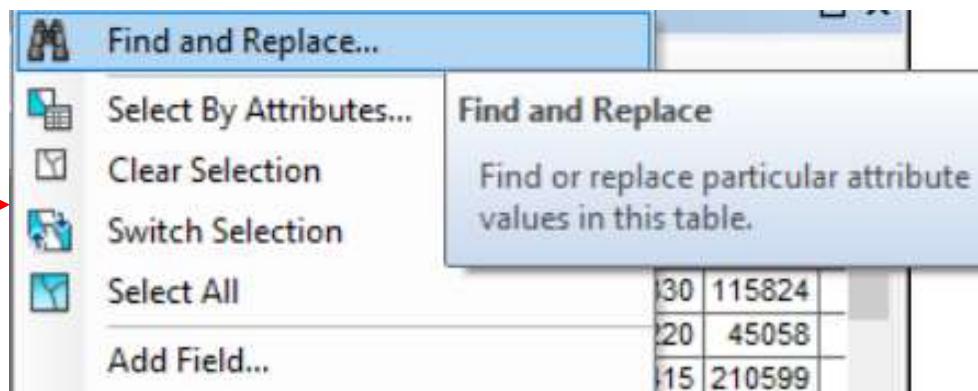


Table options button

FID	Shape	F15Regions	DName2016	D
0	Polygon	SOUTH BUGANDA	MASAKA	MAS
1	Polygon	BUKEDI	PALLISA	BUT
2	Polygon	LANGO	ALEBTONG	ALE
3	Polygon	TESO	BUKEDEA	BUK
4	Polygon	BUKEDI	BUSIA	BUS
5	Polygon	KARAMOJA	MOROTO	MOR



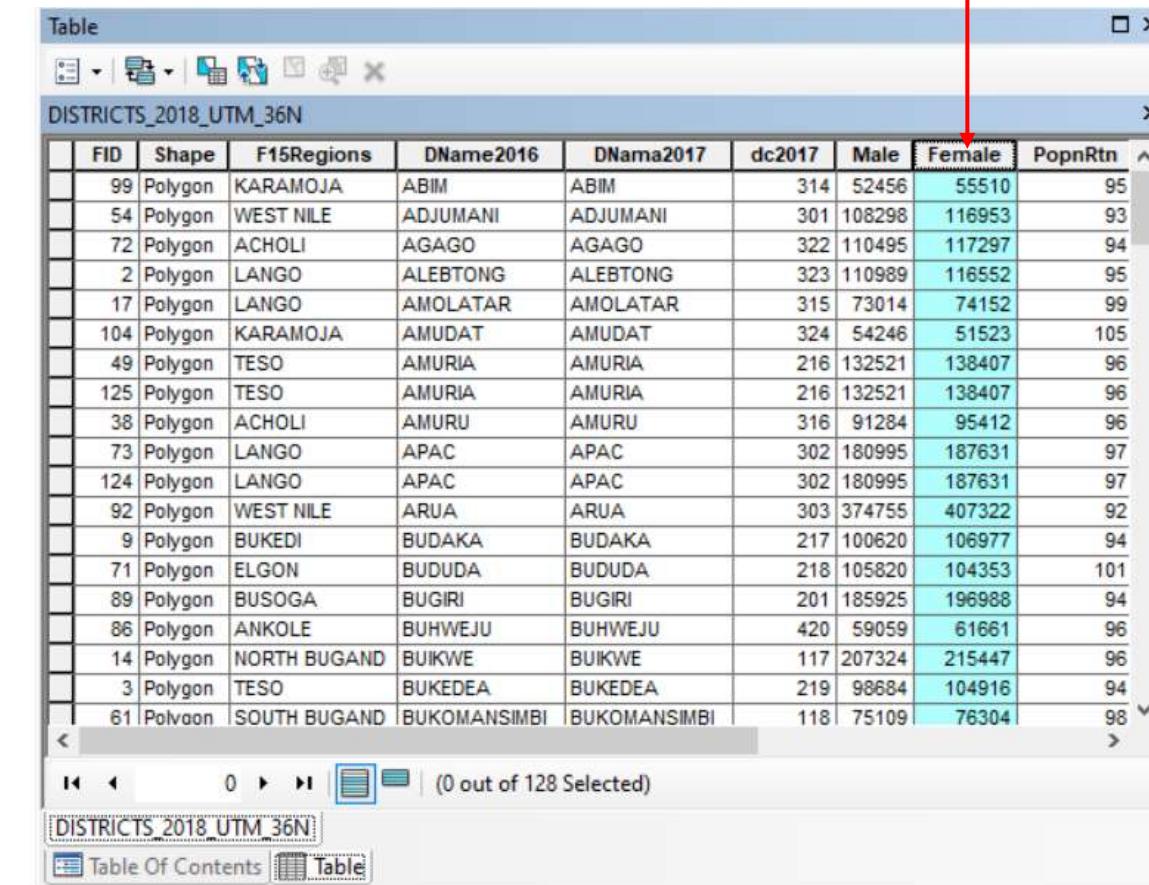
Moving or relocating fields in the Attributes Table

ArcMap permits users to rearrange fields in the attributes table using the drag and drop method. For example in the District Map layer you can move the column for **Female** to appear before **Male**. Note that all corresponding data are moved.

Steps:

- Open the District Map Layer in the ToC
- **Right Click** District in the TOC
- Open **Attributes Table**
- **Click and Drag and Release** the Female headings to the Left hand side. Note now it appears before Male

Click and Drag to the left hand side



The screenshot shows the ArcMap 'Table' window for the 'DISTRICTS_2018_UTM_36N' layer. The table has 12 columns: FID, Shape, F15Regions, DName2016, DName2017, dc2017, Male, Female, PopnRtn, and a header row. A red arrow points from the text 'Click and Drag to the left hand side' to the 'Female' column header, indicating where it should be moved. The 'Female' column currently appears after the 'Male' column. The data rows show various district names and their corresponding values across the other fields.

FID	Shape	F15Regions	DName2016	DName2017	dc2017	Male	Female	PopnRtn
99	Polygon	KARAMOJA	ABIM	ABIM	314	52456	55510	95
54	Polygon	WEST NILE	ADJUMANI	ADJUMANI	301	108298	116953	93
72	Polygon	ACHOLI	AGAGO	AGAGO	322	110495	117297	94
2	Polygon	LANGO	ALEBTONG	ALEBTONG	323	110989	116552	95
17	Polygon	LANGO	AMOLATAR	AMOLATAR	315	73014	74152	99
104	Polygon	KARAMOJA	AMUDAT	AMUDAT	324	54246	51523	105
49	Polygon	TESO	AMURIA	AMURIA	216	132521	138407	96
125	Polygon	TESO	AMURIA	AMURIA	216	132521	138407	96
38	Polygon	ACHOLI	AMURU	AMURU	316	91284	95412	96
73	Polygon	LANGO	APAC	APAC	302	180995	187631	97
124	Polygon	LANGO	APAC	APAC	302	180995	187631	97
92	Polygon	WEST NILE	ARUA	ARUA	303	374755	407322	92
9	Polygon	BUKEDI	BUDAKA	BUDAKA	217	100620	106977	94
71	Polygon	ELGON	BUDUDA	BUDUDA	218	105820	104353	101
89	Polygon	BUSOGA	BUGIRI	BUGIRI	201	185925	196988	94
86	Polygon	ANKOLE	BUHWEJU	BUHWEJU	420	59059	61661	96
14	Polygon	NORTH BUGAND	BUIKWE	BUIKWE	117	207324	215447	96
3	Polygon	TESO	BUKEDEA	BUKEDEA	219	98684	104916	94
61	Polvaon	SOUTH BUGAND	BUKOMANSIMBI	BUKOMANSIMBI	118	75109	76304	98

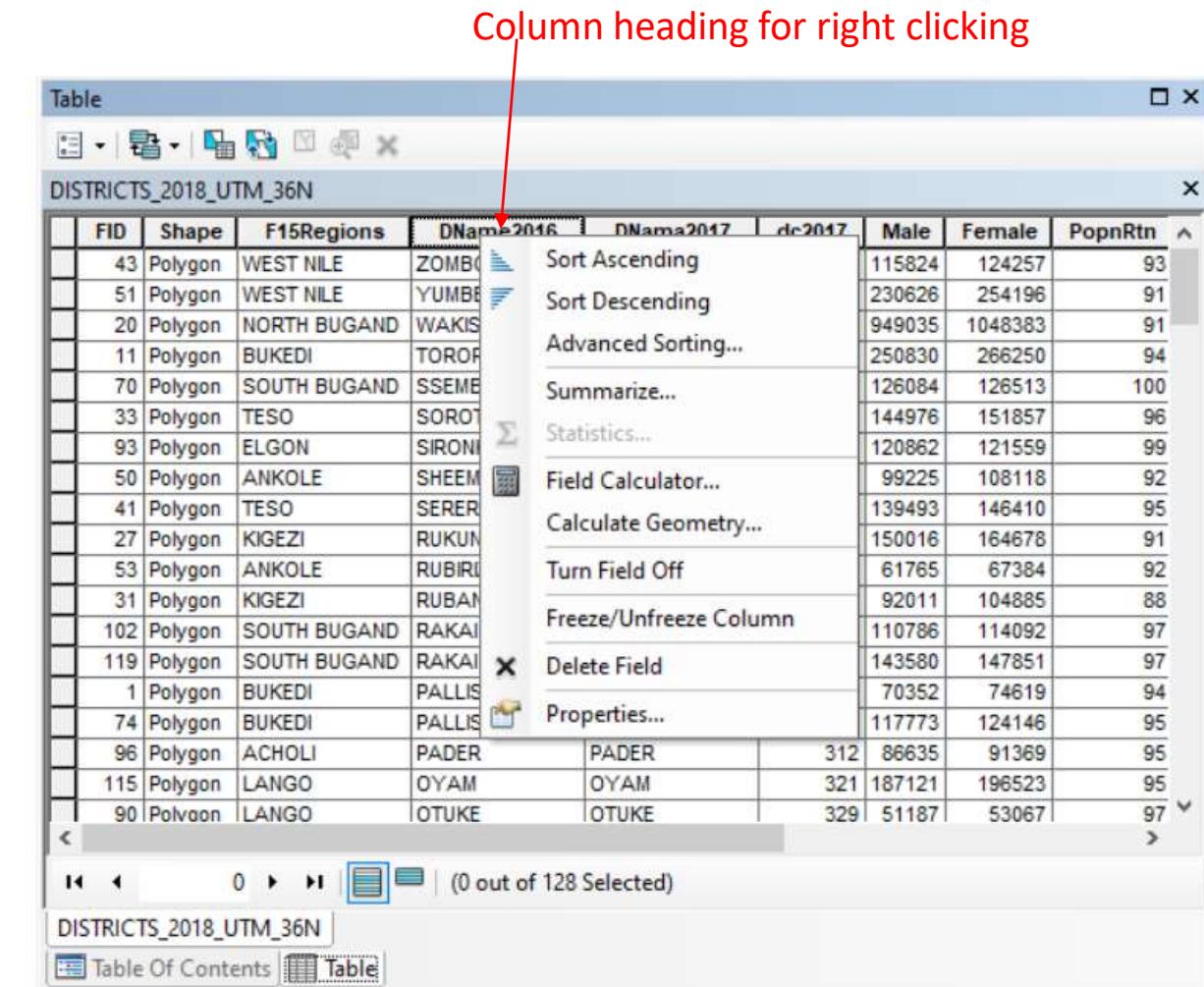


Sorting Fields in the Attributes Table

ArcMap allows sorting of fields in the attributes table either in ascending or descending order as per the users' preference. Once fields are sorted, all associated data in the records correspond accordingly. For example districts can be sorted in ascending order in the district table.

Steps

- Place the District map layer in the table of contents
- **Right Click District** in the ToC
- Select **Open attributes Table**
- Right Click the column heading for the district
- Select either **Ascending** or **descending**



The screenshot shows the ArcMap 'Table' window for the 'DISTRICTS_2018_UTM_36N' layer. A context menu is open over the 'DName2016' column header. A red arrow points from the text 'Column heading for right clicking' to this header. The menu options include: Sort Ascending, Sort Descending, Advanced Sorting..., Summarize..., Statistics..., Field Calculator..., Calculate Geometry..., Turn Field Off, Freeze/Unfreeze Column, Delete Field, and Properties... . The table displays various district information such as FID, Shape, F15Regions, DName2016, DName2017, dc2017, Male, Female, and PopnRtn.

FID	Shape	F15Regions	DName2016	DName2017	dc2017	Male	Female	PopnRtn
43	Polygon	WEST NILE	ZOMBIA			115824	124257	93
51	Polygon	WEST NILE	YUMBE			230626	254196	91
20	Polygon	NORTH BUGANDA	WAKISI			949035	1048383	91
11	Polygon	BUKEDI	TOROF			250830	266250	94
70	Polygon	SOUTH BUGANDA	SSEME			126084	126513	100
33	Polygon	TESO	SOROT			144976	151857	96
93	Polygon	ELGON	SIRONI			120862	121559	99
50	Polygon	ANKOLE	SHEEM			99225	108118	92
41	Polygon	TESO	SERER			139493	146410	95
27	Polygon	KIGEZI	RUKUN			150016	164678	91
53	Polygon	ANKOLE	RUBIRU			61765	67384	92
31	Polygon	KIGEZI	RUBAN			92011	104885	88
102	Polygon	SOUTH BUGANDA	RAKAI			110786	114092	97
119	Polygon	SOUTH BUGANDA	RAKAI			143580	147851	97
1	Polygon	BUKEDI	PALLIS			70352	74619	94
74	Polygon	BUKEDI	PALLIS			117773	124146	95
96	Polygon	ACHOLI	PADER	PADER	312	86635	91369	95
115	Polygon	LANGO	OYAM	OYAM	321	187121	196523	95
90	Point	LANGO	OTUKE	OTUKE	329	51187	53067	97

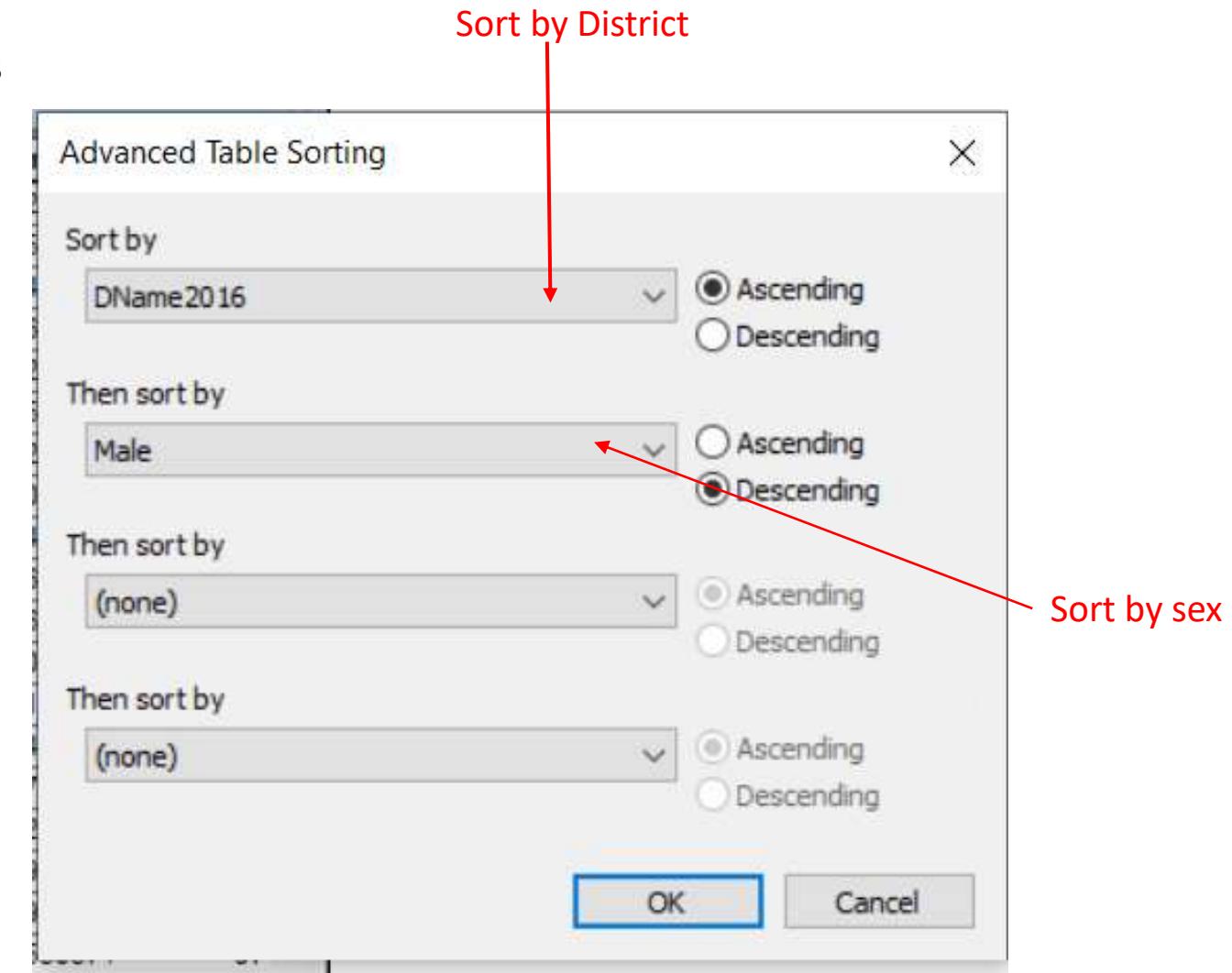


Advanced Sorting of Fields

At time one may need to reognise fields in series of order where some fields under particular column headings have several related fields. For example you want to sort districts in ascending order and in each district you sort sex in descending order. In this situation district becomes the field to sort followed by sex

Steps

- Place the District map layer in the table of contents
- **Right Click District** in the ToC
- Select **Open attributes Table**
- Right Click the column heading for the district
- Select Advanced sorting
- Select **Sort by district - Ascending**
- Select **Sort by sex - Descending**





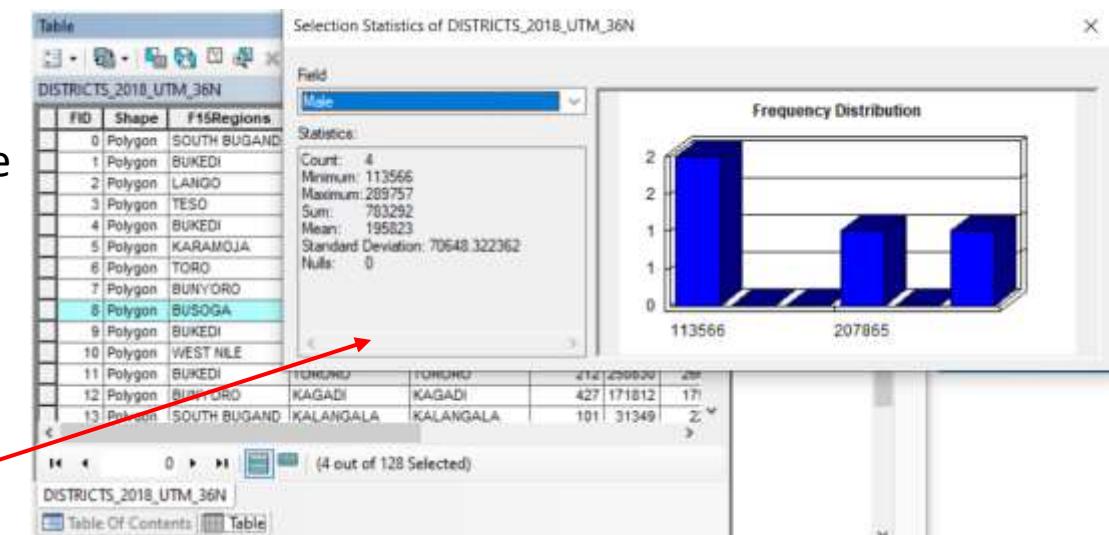
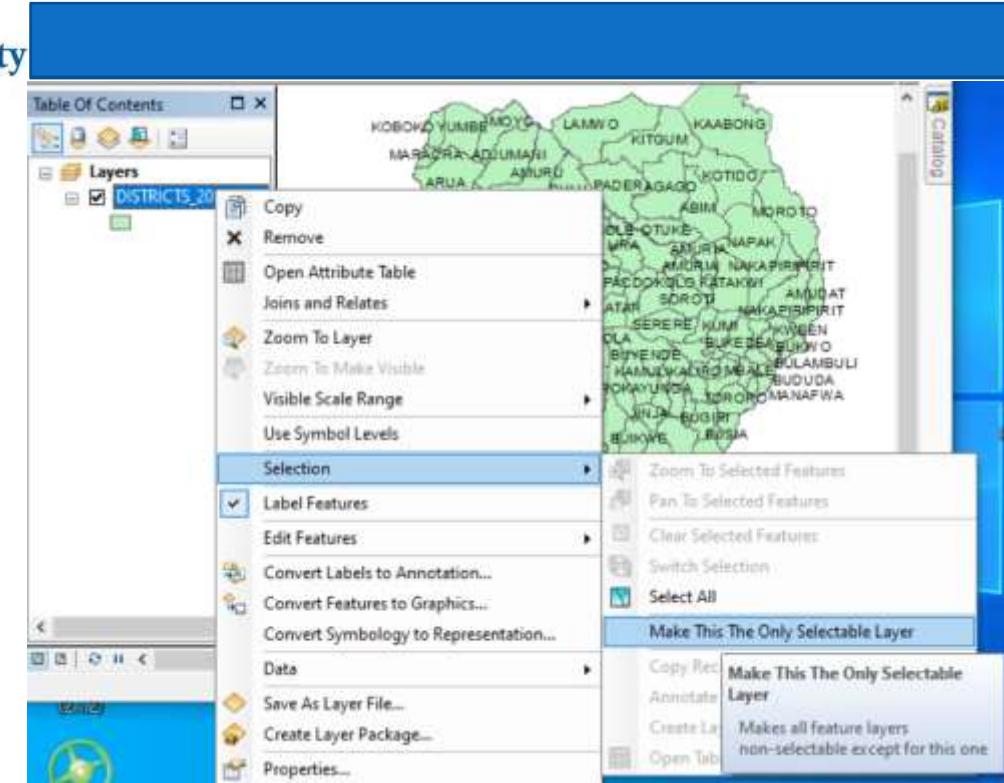
Getting Statistics in the attributes Table

We can obtain descriptive statistics such as mean, max, min, sum and standard deviation in columns that store numeric data in the attributes table. A histogram is also provided showing how the column's values are distributed. Statistics are calculated for all numeric columns in the table. We shall use the districts map layer to get some descriptive statistics on male, female and total population.

Steps

- Place the Districts Map layer in full extent in the ToC
- Right Click District in the ToC
- Choose Make this as the only selectable layer
- Hold Shift key and use select features tool to select the districts of Jinja, Masaka, Mable
- In the ToC Right Click District
- Choose Open attributes table
- Right click the column heading for total population
- Select Statistics

Statistics



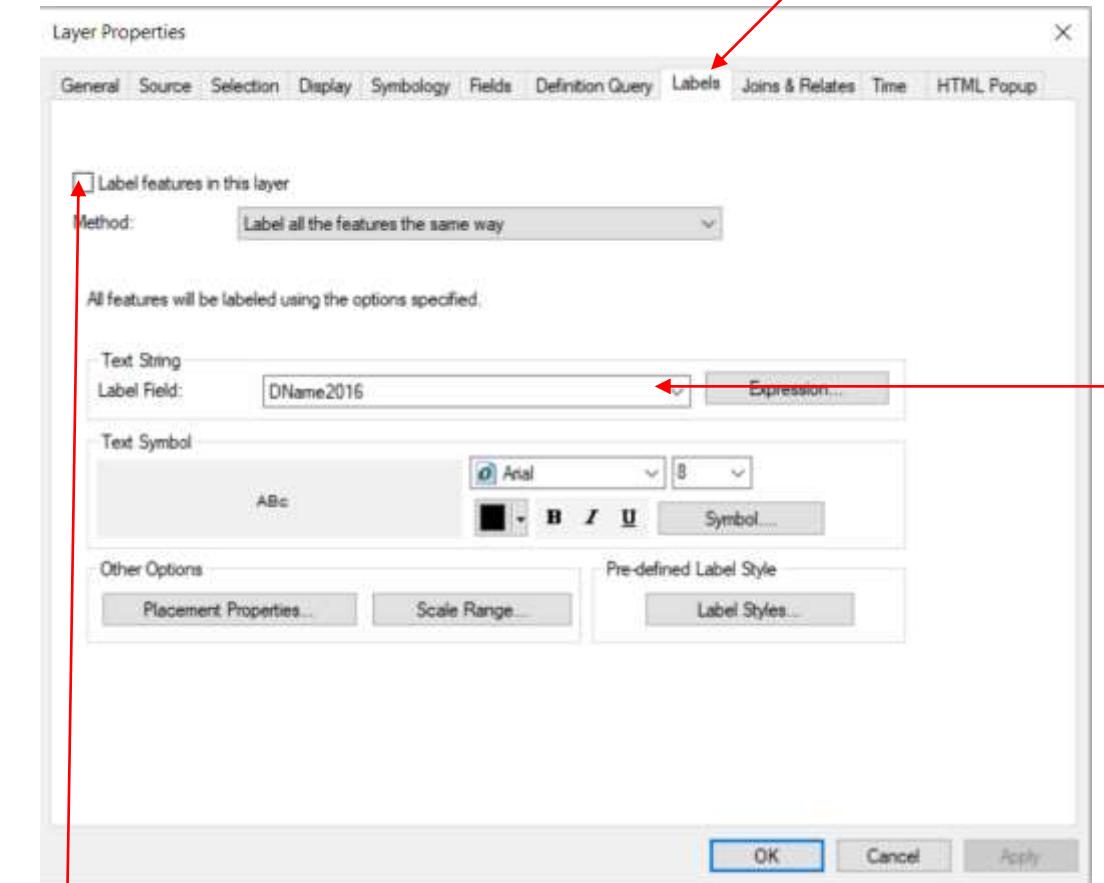


Label Features

Labels are text items on a map layer that are delivered from one or more feature attributes that are displayed in the ArcMap windows depending on the scale. For example in the map of layer of districts you may want to display male population for each district

Steps

- Place the district shapefile in the ToC
- Right Click Districts layer in the ToC
- Select properties
- Select the Label Tab
- Select the label field you want to display e.g Male
- Check the Label features in this Layer check box
- Click Apply



Label Features in this Layer Check Box

Label Tab

Label field





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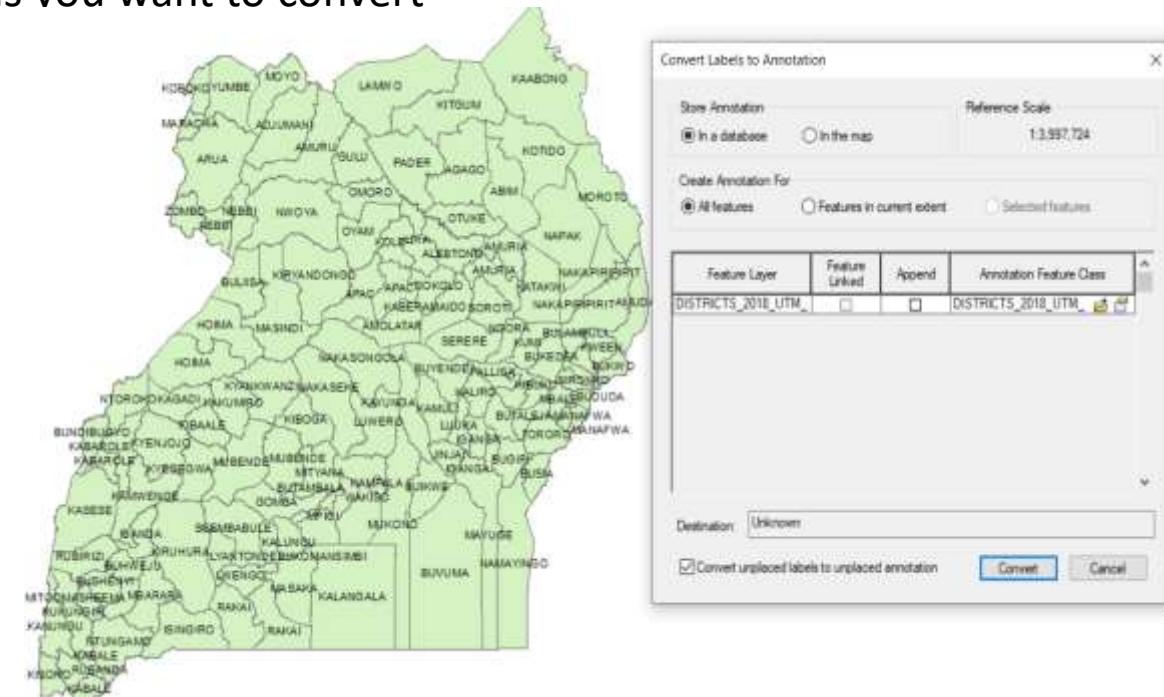


Moving Labels to Annotations

Converting labels to annotations is commonly used when one wants to relocate a label from one area to another. The labels can be either converted for the entire map layer, selected part of the layer or zoomed selected area.

Steps:

- Right click the Layer in the table of contents containing the labels you want to convert
- Select convert label to annotations
- Select in the map option and features in the current extent
- Click Convert 
- Click the Select elements icon
- Click on the label you want to relocate and drag to new location





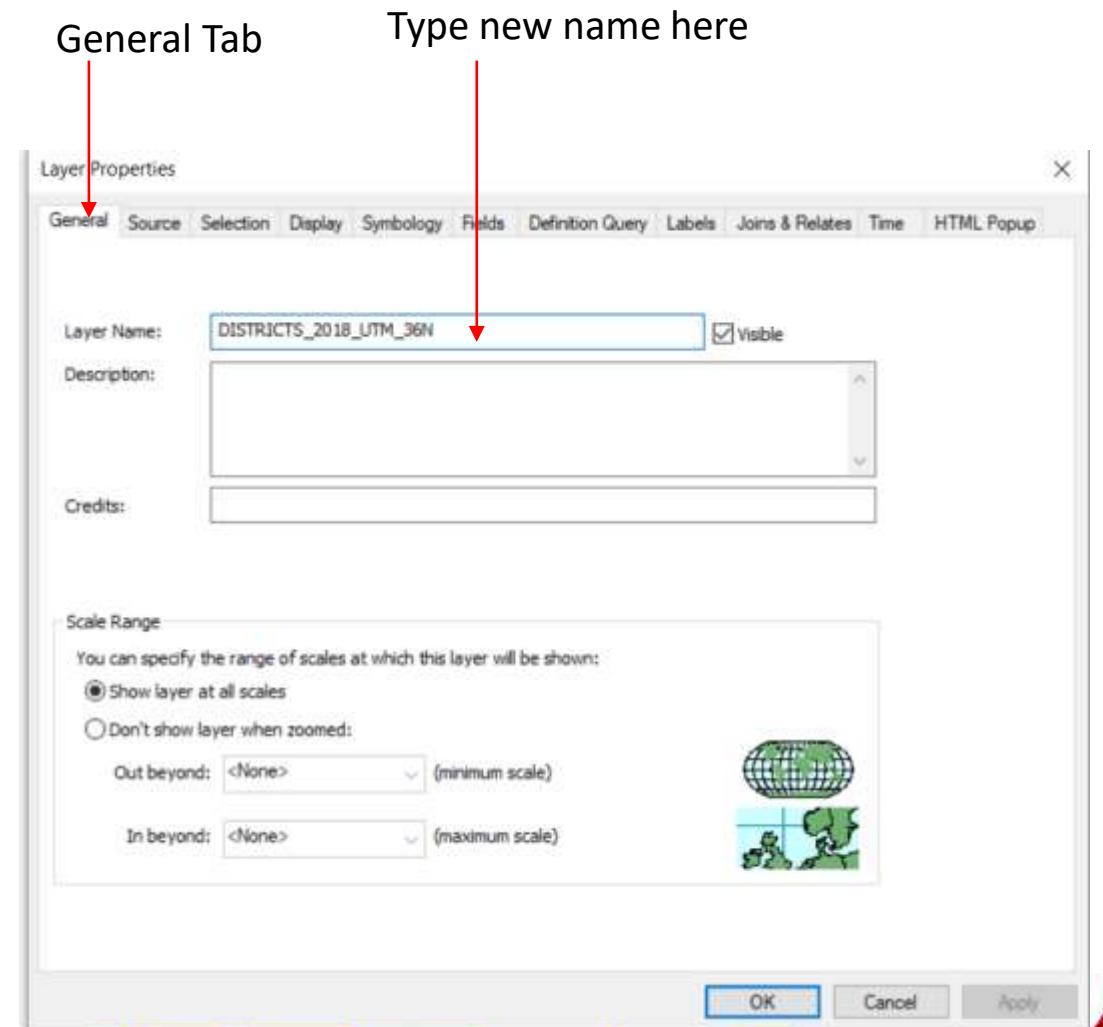
Renaming Map Layers Name

ArcMap permits users to rename the map layer without using the windows explorer. You can change the name of your map layer to the most appropriate name desired

Steps

Place the map layer you want to rename in the table of contents for example districts of Uganda

- Right click the map layer in the ToC
- Click properties
- Click the General Tab
- In the layer name, the current name is displayed
- Type the new name you want and click OK





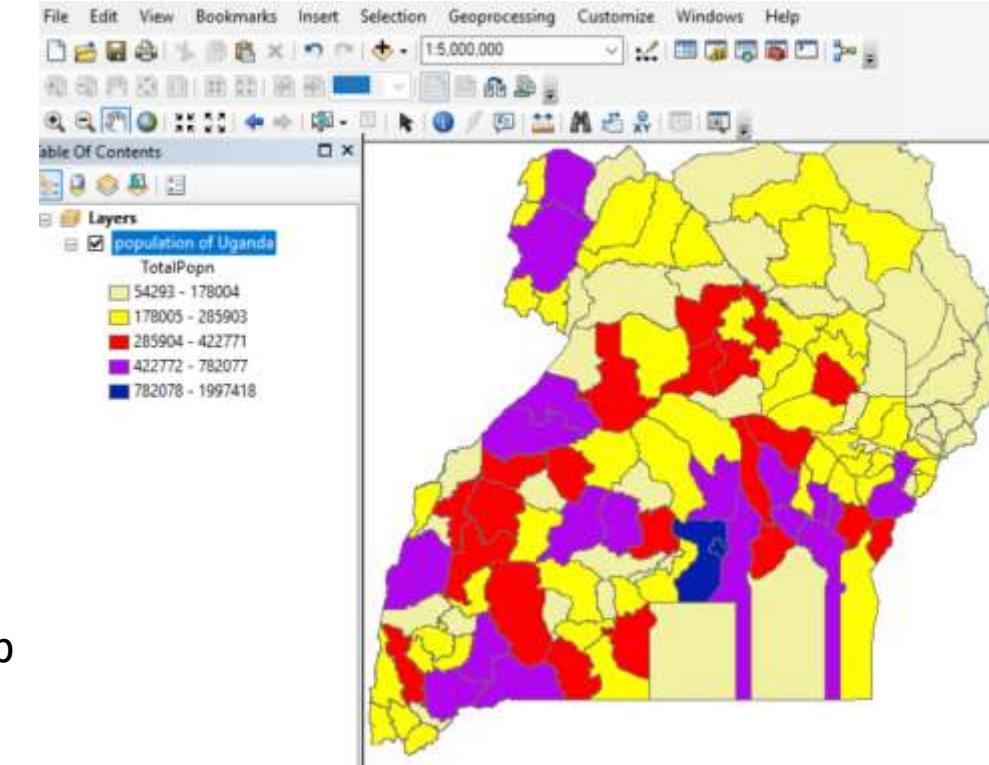
Creating a Map from Available Map Layers

You can create new map from available map layers in ArcMap. The most common maps designed using available layers include:

{1} Choropleth Map – It uses color polygon codes to convert information about an area. In a choropleth map, polygons are colored or shaded to represent attribute values. We shall use the District map later to create choropleth map for population

Steps

- Launch ArcMap
- Add Uganda Districts in the TOC via catalog
- Right Click your map layer (Uganda Districts) in the table of contents
- Click Properties
- Click General Tab
- In the Layer's name type population of Uganda to change the layer map from Districts
- In the ToC Right Click Population of Uganda, Click Properties
- Click Symbology Tab
- In the Show Box Click Quantities and Graduated color
- In the field box Click the value for Population
- Select the Color Ramp
- Click OK



Designed Map of Uganda showing Population





Saving your Choropleth Map

Once you have completed designing your map layer. It can be saved as an independent and new map extracted from the mother layer.

Steps

- Flick File on the Main menu
- Select Save As
- Browse and identify location where to save your Choropleth Map
- Give it a new file name eg. Uganda districts by pop.
- Click Save

Save As Options

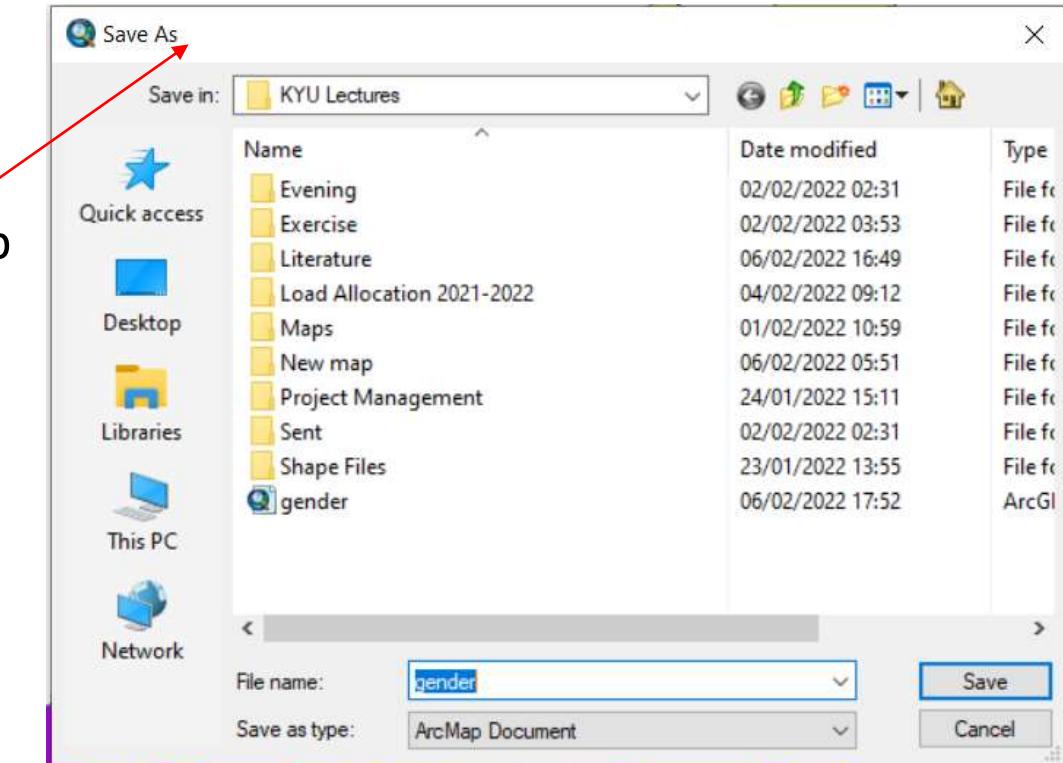




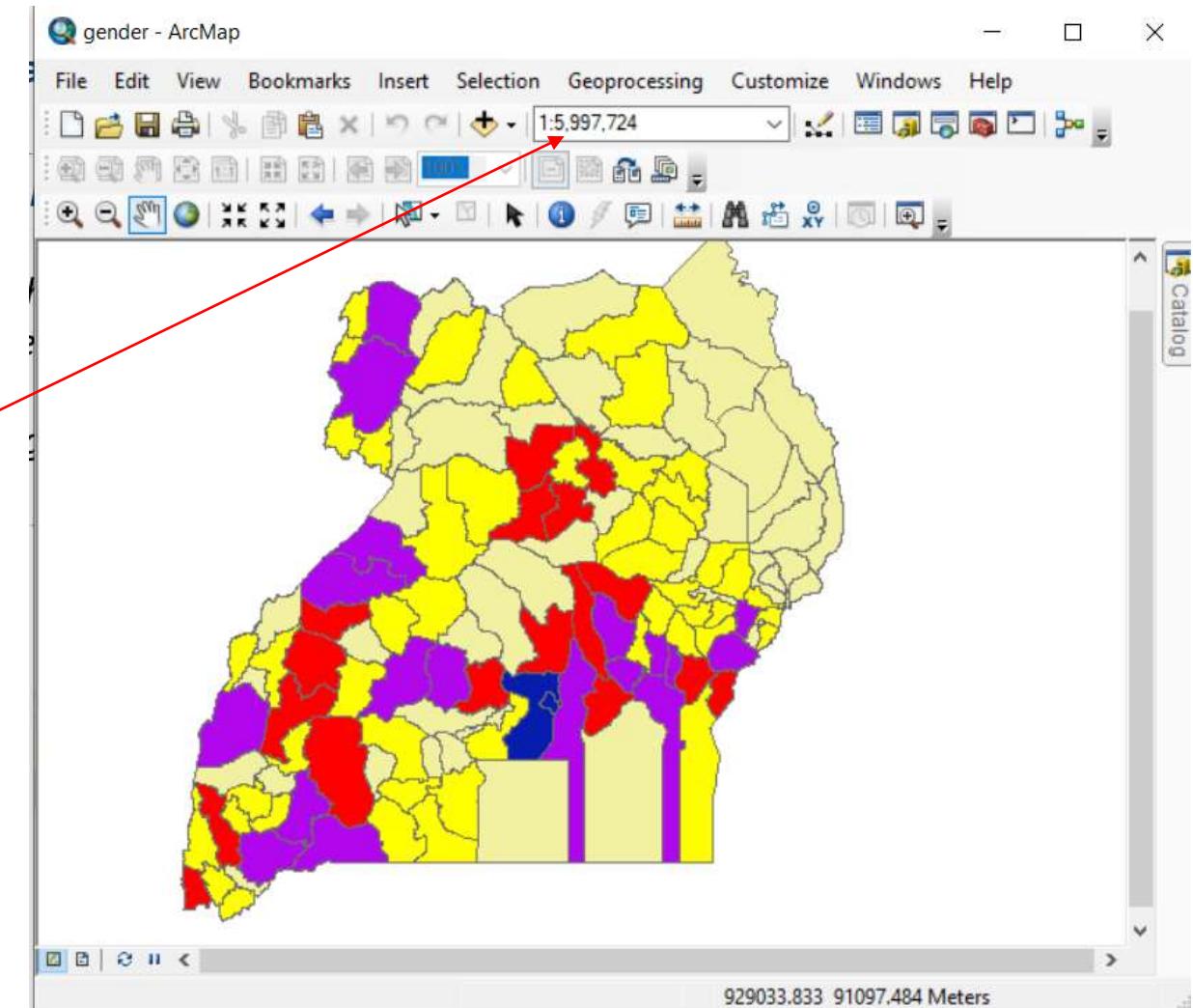
Illustration of some of the functions carried out in Attribute Table

Changing Map layer Scale

ArcMap users can change the scale of the existing layer in the simplest way by typing the new scale directly in the Scale text Bar

Place your map layer say Uganda Districts in the ToC

Type new Scale here

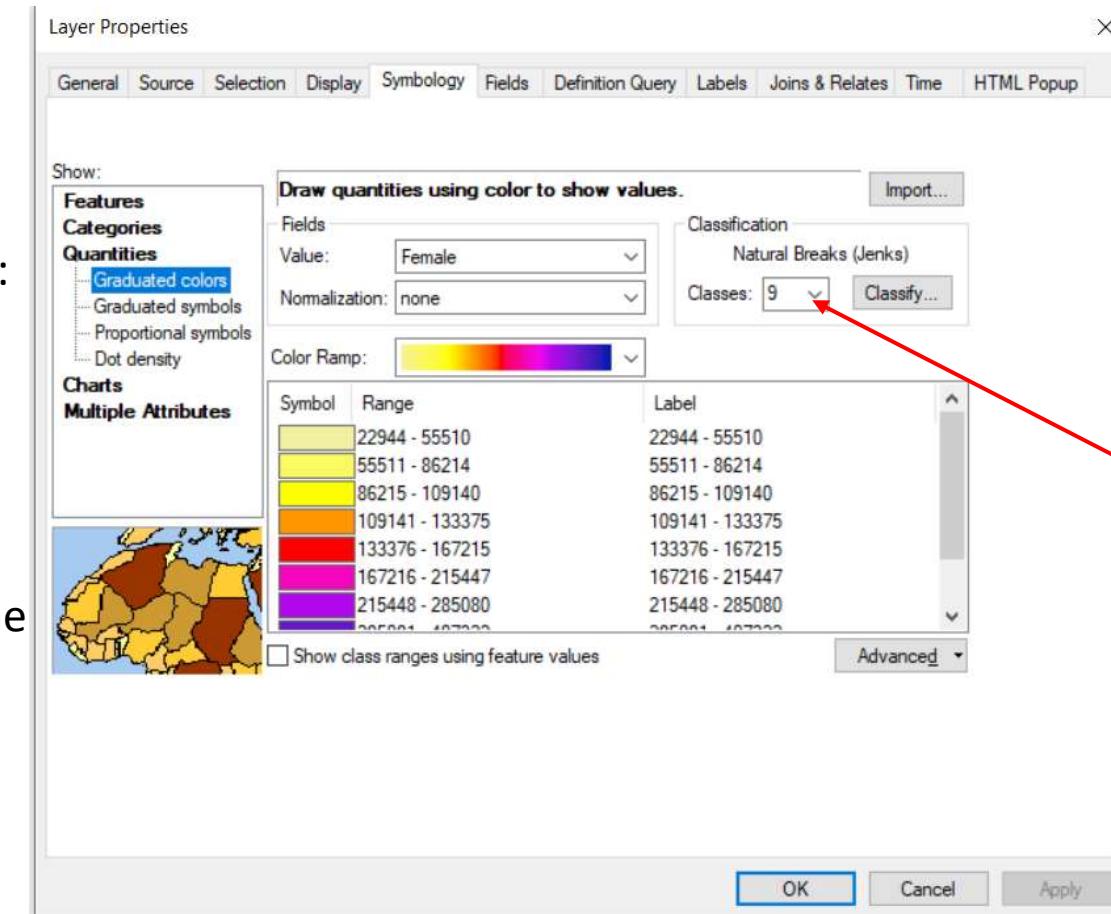




Creating Custom Classes in Legend

When you create a map layer, note that ArcMap automatically sets the legend using the default value in classification. In the previous new Choropleth map layer created, the default value was five. To set your custom classes in the legend, take the following steps:

- Open your Choropleth Map previous designed (Population of Uganda) in the ToC
- Right Click your Map layer in the ToC
- Click Properties
- Under Classification drop down menu select a value e.g. 9 then Click Apply and OK



Select
Classification
Value



Displaying Descriptive statistics Using Classification

Users of ArcMap can as well display descriptive statistics of Geoata using the classification function

Steps

- Open your Choropleth Map previous designed (Population of Uganda) in the ToC
- Right Click your Map layer in the ToC
- Click Properties
- Under Classification drop down menu select a value
- Click Classify

Click Classify

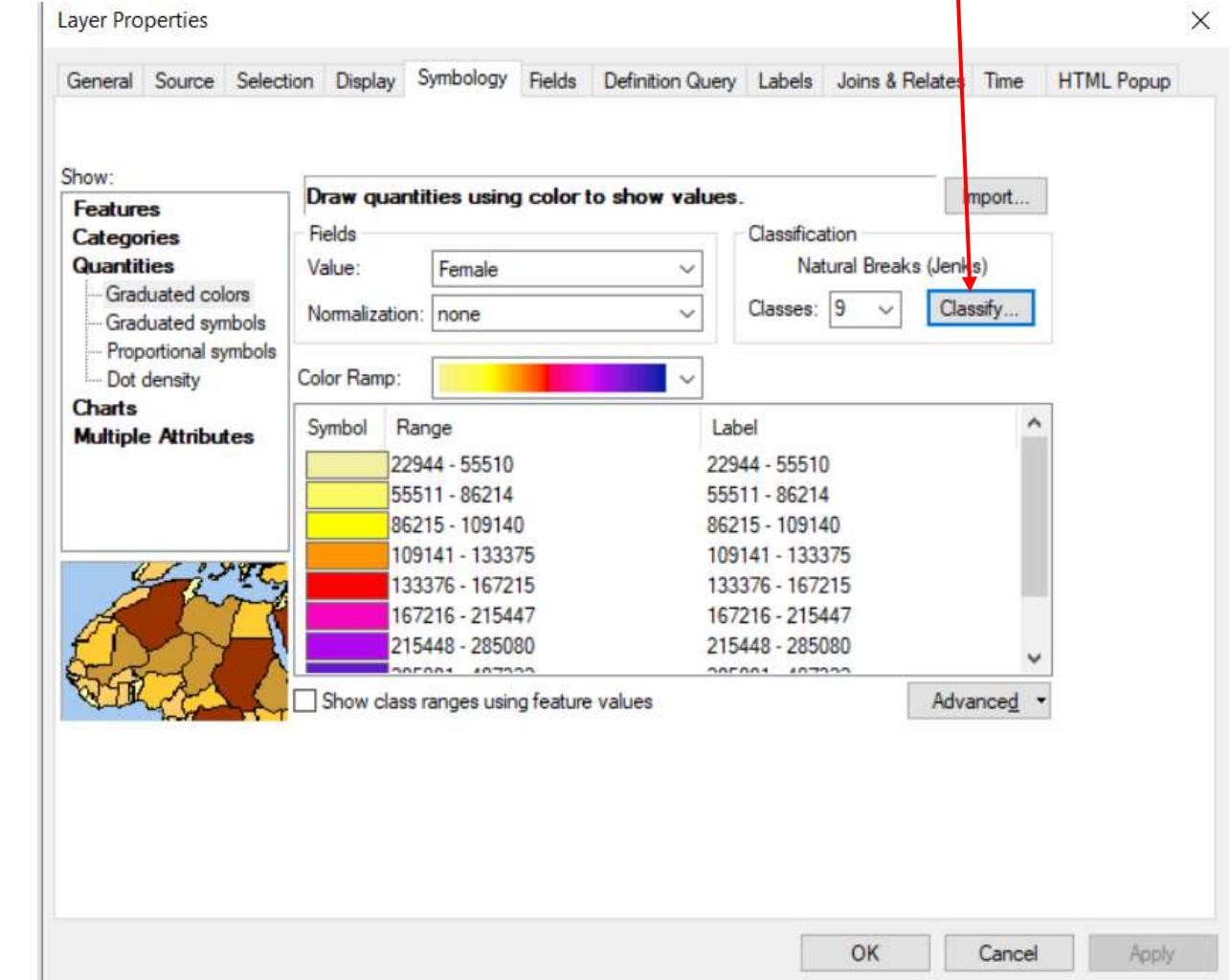
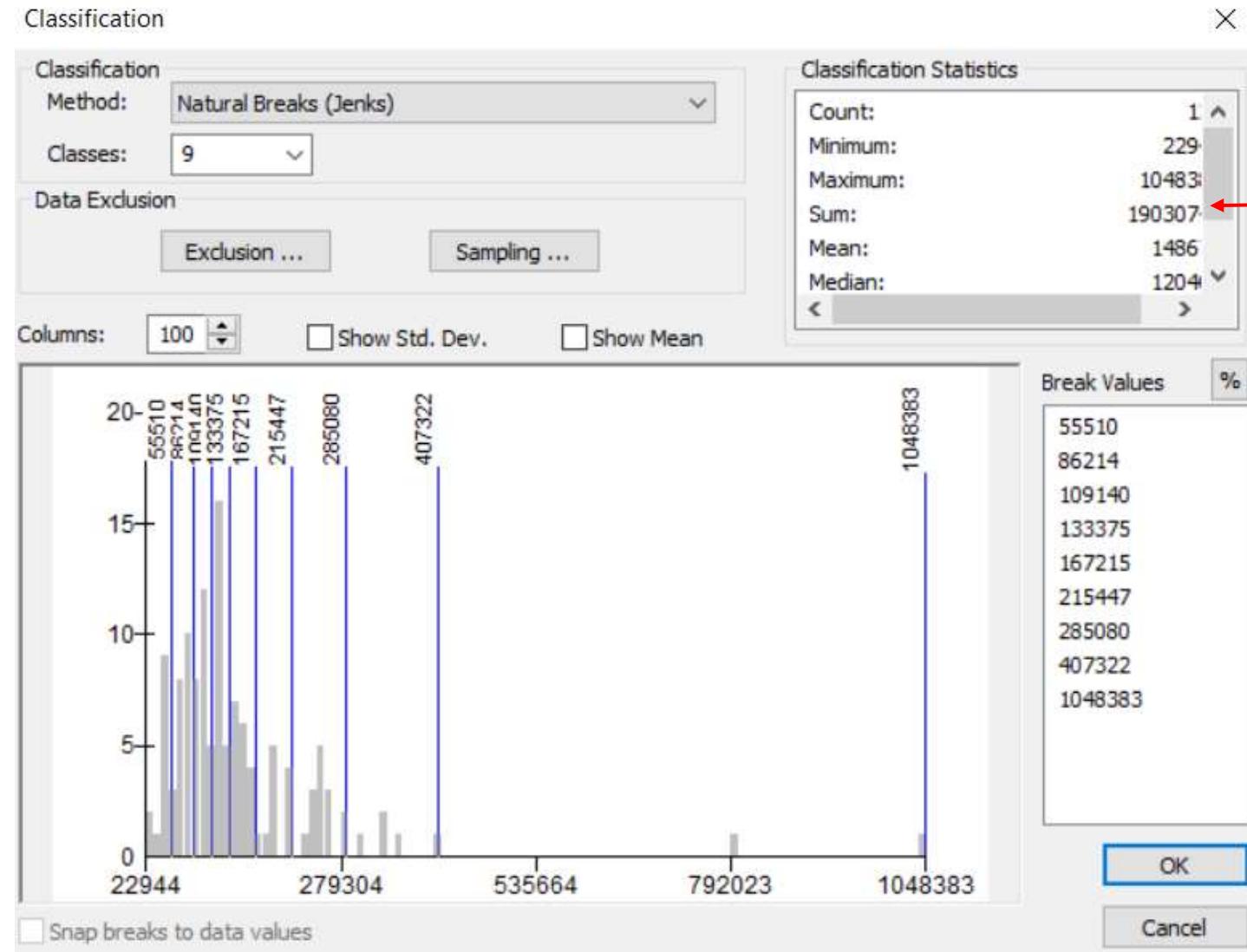




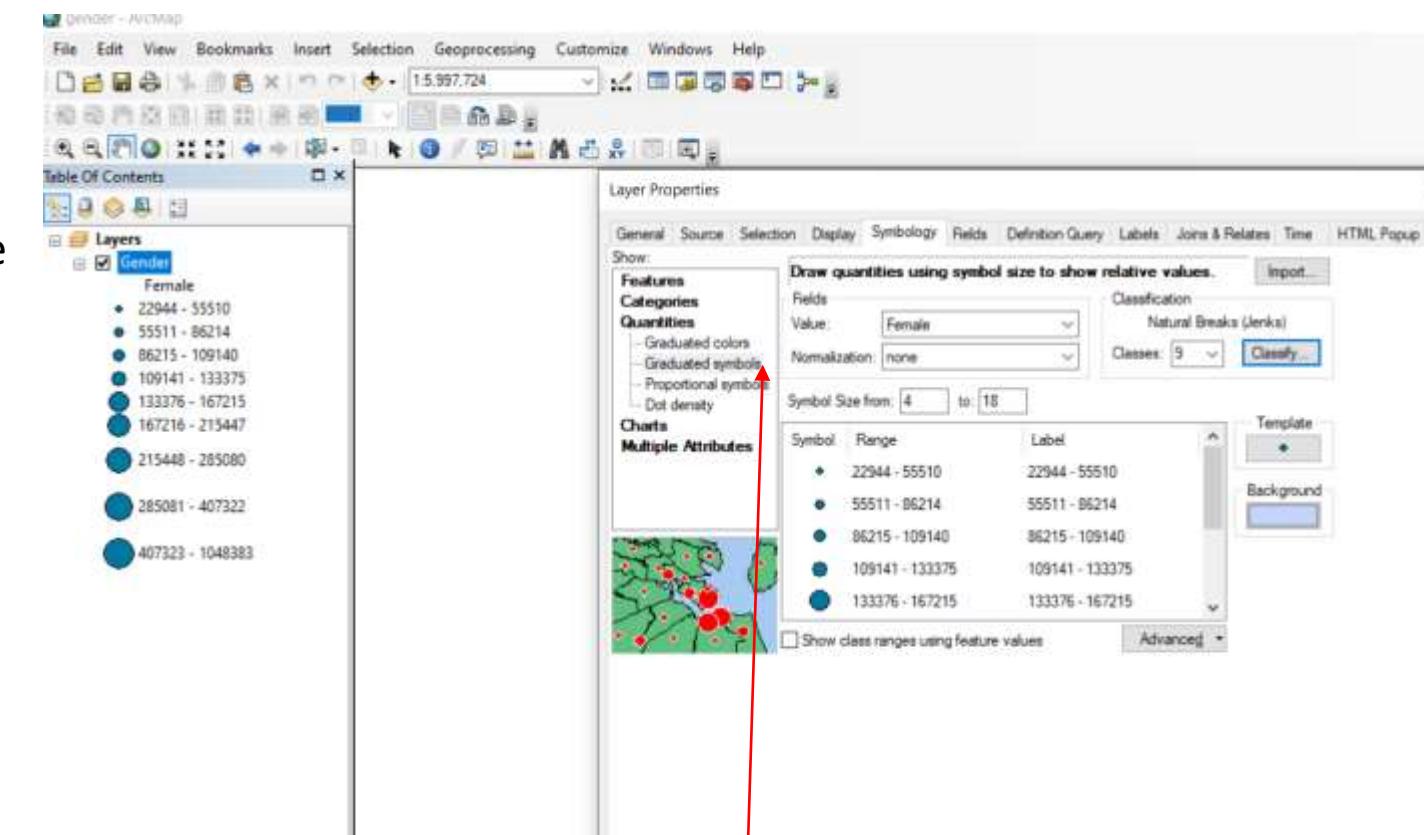
Illustration of Descriptive Statistics via Classification





(2) Point Feature Maps – These use point markers to display spatial patterns in point data. To create point Map take the following steps:

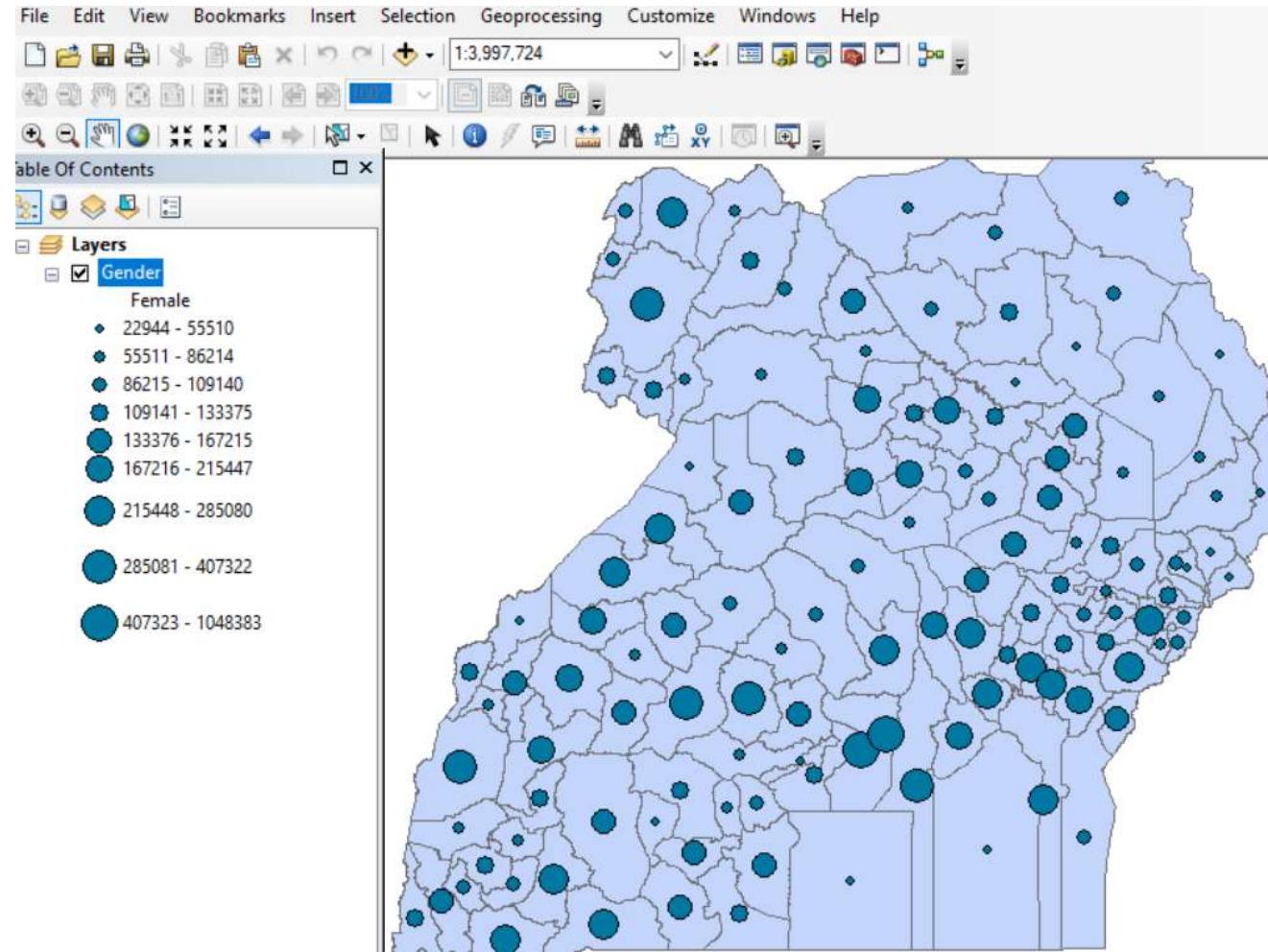
- Launch ArcMap
- Add Uganda Districts in the TOC via catalog
- Right Click your map layer (Uganda Districts) in the table of contents
- Click Properties
- Click General Tab
- In the Layer's name type population of Uganda to change the layer map from Districts
- In the ToC Right Click Population of Uganda, Click Properties
- Click Symbology Tab
- In the Show Box Click Quantities and Graduated Symbols
- In the field box Click the value for Population
- Select the Color Ramp
- Click OK



Select Graduated Symbols



Illustration of Point Featured Map





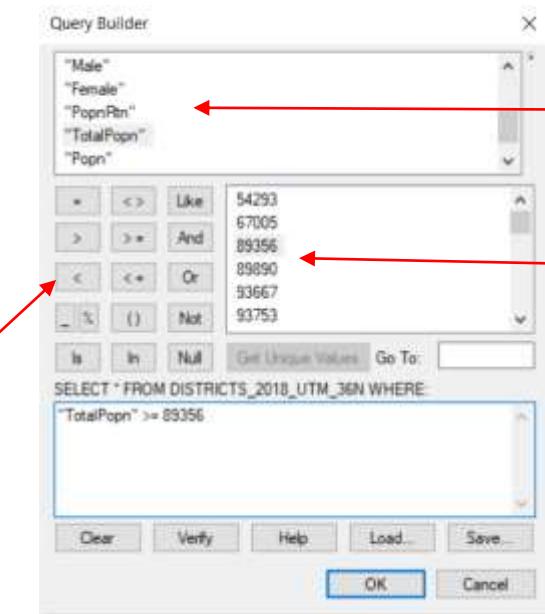
Creating Queries in ArcMap

Queries are used to determine which features a Map layer displays. Queries extra features to display based on the set parameters. In the District Map layer you may want to display only districts with total population less or equal to 80000

Steps

- Place the district Map layer in the ToC
- Right Click the district Map Layer in the table of contents
- Click Properties
- Click Definition Query Tab
- Click Query builder
- Double Click Totalpop
- Select \leq operator
- Click Get Unique Values
- Double Click the Value you want to use
- Click Ok, Apply

Operators

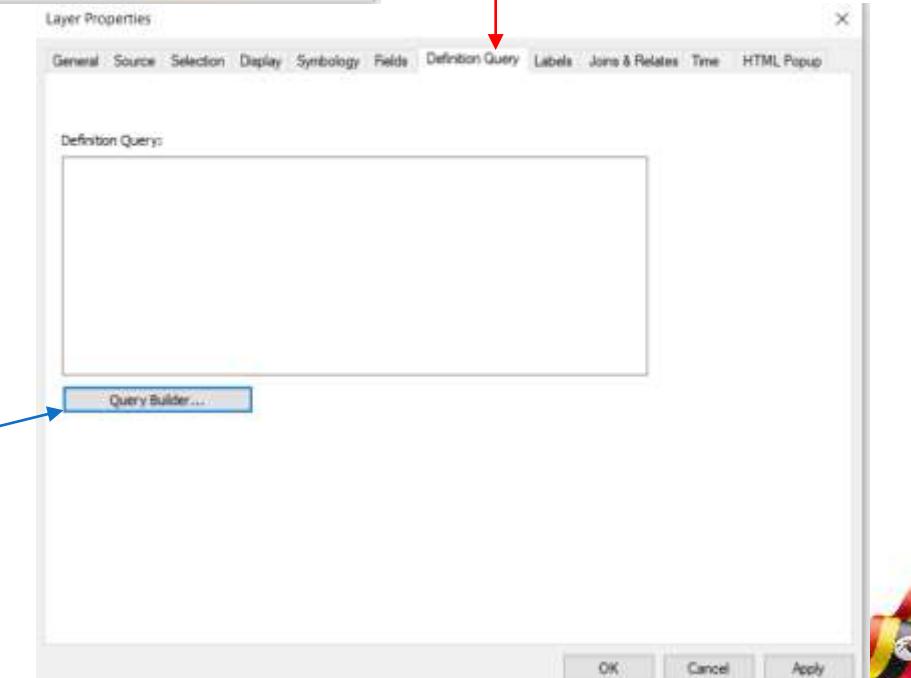


Fields

Values

Definition Query Tab

Click Query Builder

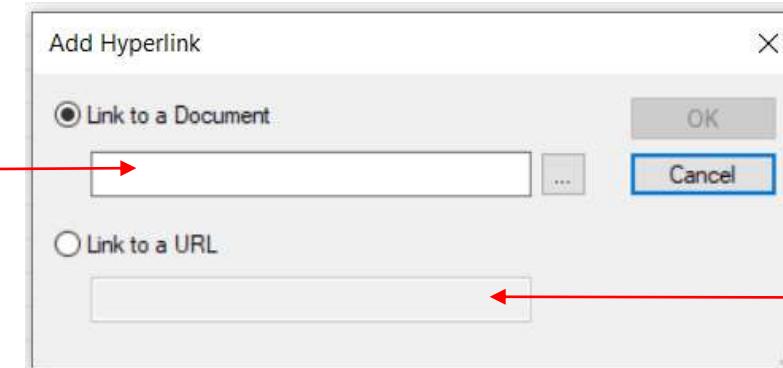




Creating Hyperlink

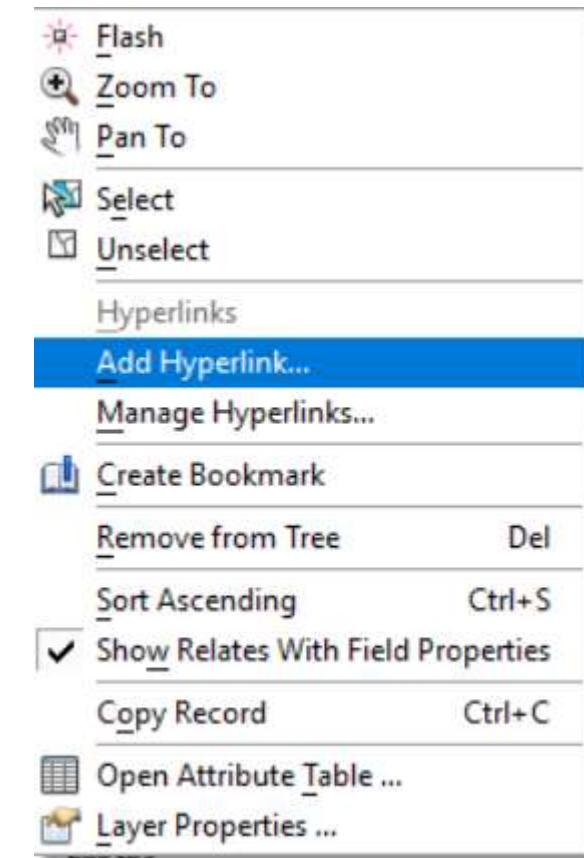
Hyperlink is commonly a button or text or image that points to another location. ArcMap allows users to create hyperlinks to other location such as websites. For example to create a hyperlink for Jinja district take the following steps

- Place the Uganda District map layer in the ToC
- On the tools toolbar click identify icon
- Click on Jinja city
- In the Identify window, Right Click Jinja City
- Click Add Hyperlink
- Select either to Document or URL
- Browse the document to link or Type URL to be linked



Linking to Document

Linking to URL



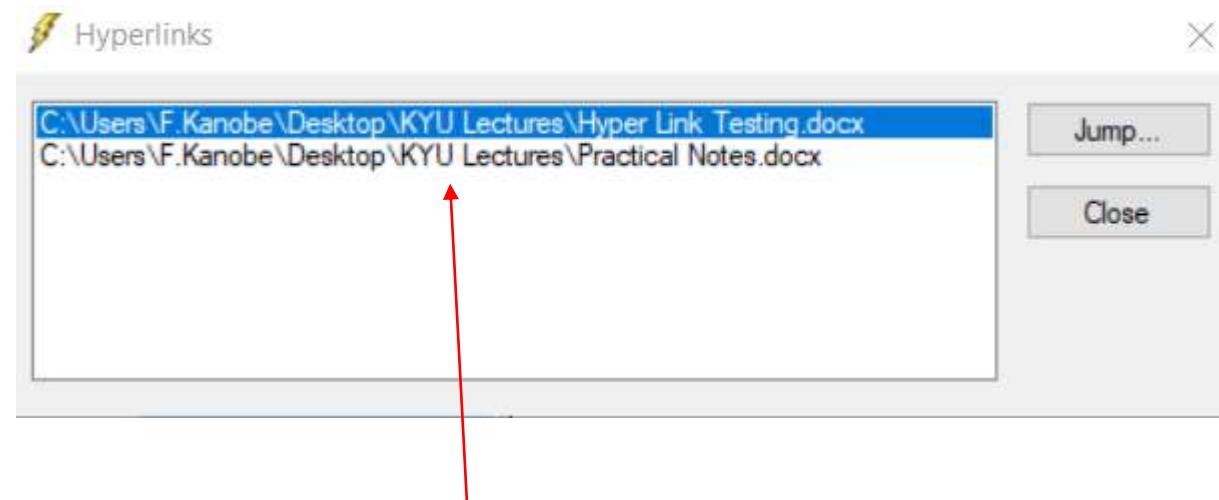


Launching Hyperlink

To open your created Hyperlink take the following steps”

On the Tools bar Click the Launch Hyperlink Button 

Place the course in map layer feature where you created the Hyperlink and Click Once



Hyperlinked Documents

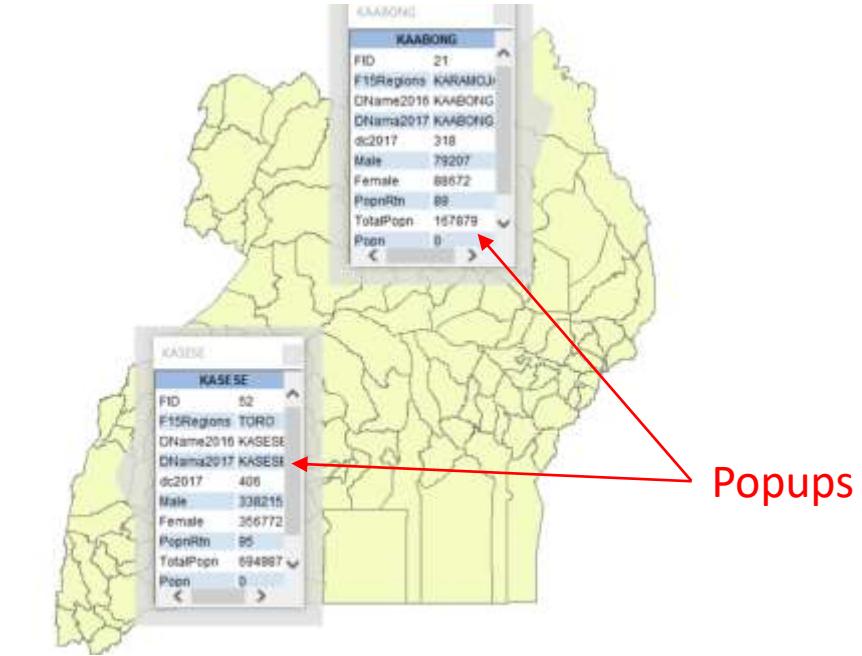




Creating Pop Up in ArcMap

Pop Ups are commonly used as short cuts for displaying attributes of features in a Map Lay. To create your Pop up for from the Uganda District Map Layer take the following steps:

- Place the Uganda District Map layer in the ToC
- Right Click the layer
- Click Properties
- Click the HTML popup
- Make sure the following Boxes are checked ✓
 - Show content for this layer using HTML popup
 - As a table of the visible fields
 - Display coded value descriptions in all HTML
- Click Apply and OK
- Right Click the layer in the ToC
- Click Properties
- Click on the Fields Table and uncheck the fields you do not want to be visible , OK
- On the Tools toolbar Click on the HTML popup icon
- Move your cursor to any District of your choice and Click



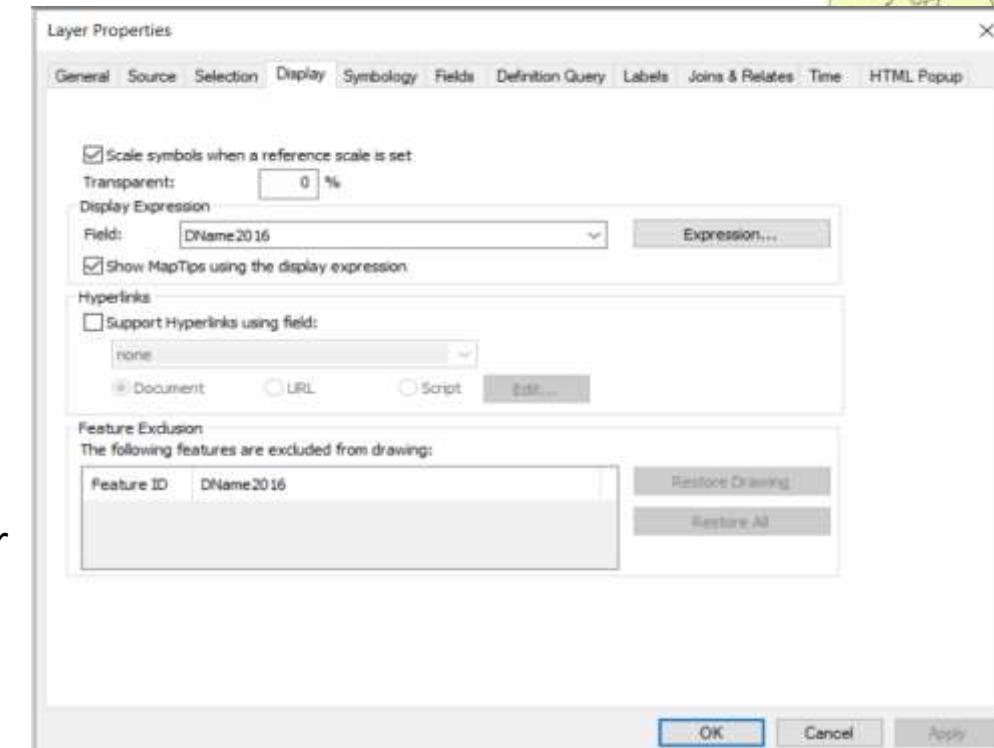


Creating Map Tips

Map tips are used for disclosing and displaying labels text for map layers in ArcMap. Once you have created the Map tips, any label for features in your map layer are displayed.

Steps

- Place your District Map layer in the table of contents
- Right Click the District Map layer
- Click Properties'
- Click Display Tab
- Check the Show the Map tips using display expression check Box
- Click Ok
- Move the features in your Map layer





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