



Exercise 0: Introduction to ArcGIS/ArcMap

1. Introduction

ArcGIS, the most widely used GIS software in the world, is an integrated collection of software for compiling, visualizing, analyzing, and presenting geographic information. This lab exercise is intended to familiarize you with ArcMap, one component of the ArcGIS collection. ArcMap lets you create and interact with maps. In ArcMap, you can view, edit and analyze geographic data. Your task is to produce a readable and visually pleasing map of Sweden and its neighboring countries following the given instructions.

2. Working with ArcMap

Getting started

The files you will use during this lab are located as the following zip file:

<http://www.infra.kth.se/courses/AG2411/IntroArcGIS.zip>

Download the file to your own folder. Once you have copied the file, right click it and choose Extract All. Follow the procedure to extract the files to your own folder.

Start ArcMap by clicking the Windows Start button and then navigate to:

All Programs → *ArcGIS* → *ArcMap*.

ArcMap will ask you what you would like to start with. Choose a *New Empty Map* and press OK. Now ArcMap has started with a new empty map and should look like Figure 1.

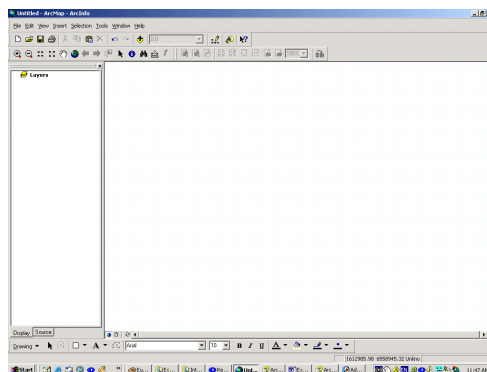


Figure 1. Start ArcMap with a new empty map.

ArcGIS Terminology

Geographic information is displayed on a map as **layers**. Each **layer** represents a particular type of feature such as cities, streams, lakes, or highways. Layers are listed in the ArcMap **table of contents**, the white rectangle on the left of the screen, and displayed in the **map view**, the bluish rectangle on the right part of the screen in Figure 1.

The **table of contents** lists all the layers on the map and shows what the features each layer represent. The check box next to each layer indicates whether the layer is currently displayed in the map view or not.

Layers can be further organized into **data frames**. A data frame simply groups the layers that you want to display together. Each **data frame** is listed at the top of the table of contents as "*Layers*", but you can change the name to something more meaningful. You may want to add more data frames when you want to compare layers side by side or create inserts and overviews.

When a map has more than one data frame, one of them is the active data frame. The **active data frame** is the one you're currently working with. When you add a new layer to a map, it is added to the active data frame. You can always tell which data frame is active because it's highlighted on the map and its name is shown in bold text in the table of contents (see the example in Figure 2).

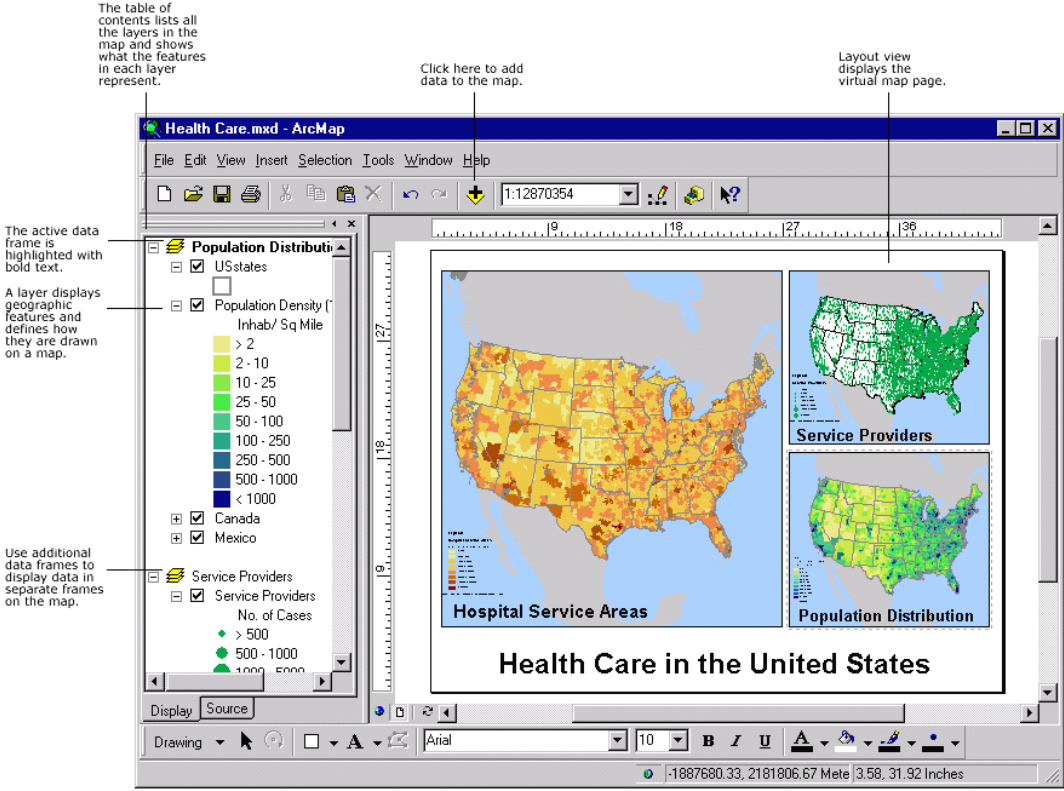




Figure 2. Layers, table of contents, data frames and map view.

Adding and displaying geographic data

ArcMap can work with different types of geographic data. One of the most commonly used data types is shape file (with extension .shp), a vector data representation. Geographic features in vector format are represented as points, lines or polygons.

Add data to your map view by either pressing the Add Data button  or selecting *File -> Add Data*. Look in your own directory and add the shape file with country boundaries (*Country_Boundaries.shp*). If your directory is not listed, add it by using the Connect To Folder button . In the map view you will see a map of Sweden and its neighbouring countries. In the table of contents you will see that you have one layer named *Country_Boundaries*. Add other layers to your map by using the same procedure and importing all the shape files that you have in your working directory (major cities, rivers, water bodies, and streets and railroads). You can turn a layer on and off by checking and unchecking the box next to the layer's name in the table of contents.



Below the name of each layer there is a colour legend of the features shown in this layer. You can turn this off and on by clicking on the + or – sign next to the layer's name. You can change the colour of a legend by clicking on the legend.


The **order of the layers** in the table of contents defines the order in which they are displayed. The layer at the bottom of the **table of contents** is displayed at the bottom of a map and the layer at the top of the **table of contents** is drawn on top of all other layers. Thus it is wise to put the layers that form the background of your map, such as the ocean, at the bottom of the table of contents. Try moving the country boundaries layer to the top of the list and see how the other layers disappear behind it. Now move it back down to the last.



ArcMap provides two different ways to view a map: a data view and a layout view. When you want to browse or work with the geographic data on your map, choose data view. Layout view should be used when you are preparing your map to hang on the wall, put in a report, or publish on the Web. You can choose between the two views by selecting *View -> Data view* or *View -> Layout View* from the menu. Try this and then return to data view.

Moving around the map

As you work with a map, you can easily change how you view the data it contains. When you are browsing a map, you may want to pan and zoom around the data to investigate different areas and features.

Zooming: Click the Zoom-In button  or Zoom-Out button  on the Tools toolbar. Move the mouse pointer over the map display and click once to zoom around a point. Alternatively, click and drag a rectangle defining the area you want to zoom-in or zoom-out.


Panning: Click the Pan button  on the Tools toolbar. Move the mouse pointer over the map display and click and drag the pointer.

You can move back and forward one display by clicking the Back  or Forward  Extent buttons on the Tools toolbar. Try this.

You can also zoom to the extent of a layer: right-click the layer or layers you want to zoom to in the table of contents, then click *Zoom To Layer*. Or you can zoom to the full extent of your map by choosing *View -> Zoom Data -> Full Extent* from the menu.

Saving your work

You save a map as a document and store it on your hard disk. If you have not saved the map before, you will need to name it with a name that adequately describes its contents. ArcMap automatically appends a file extension (.mxd) to your map name. In general, it is a good idea to save your map periodically while editing it just in case something unexpected happens.


You can save the map by either pressing the Save button  on the Tools toolbar or choosing *File -> Save* from the menu.

The data displayed on a map is not saved with it. Map layers reference the data sources in your GIS database. This helps to keep map documents relatively small in size. If you plan to distribute your map to others, you need to give them access to both the map document and the data your map refers to.

Exploring data on the map


Sometimes just looking at a map is not enough. You need to query data to solve problems. ArcMap allows you to explore the data on the map and get the information you need. You can explore data in various ways. For example, you can:

- point to features to find out what they are,
- find features that have a particular characteristic or attribute,
- examine all the attributes of a particular layer or
- measure distances on the map.

Identifying features by pointing to them: click the Identify button  on the Tools toolbar. Click the mouse pointer over the map feature you want to identify. The features in all visible layers under the pointer will be identified. Do this by clicking on Stockholm and see what happens. Now click on Gotland (be careful not to click on Visby).

Viewing a layer's attribute table: in the table of contents, right-click the layer for which you want to display the attribute table (do this for Country Boundaries). Click *Open Attribute Table* and observe what happens. Explore the table.


Question 1: Which country on the map is landlocked?

Finding features with particular attributes: Click the Find button  on the Tools toolbar. Click the *Features* tab. Type the string you want to find in the *Find text* box. Click the *In layers* dropdown arrow and click the layer you want to search. Uncheck *Find features that are similar to or contain the search string* if the string must match exactly. Search for the string in all fields, in a specific field, or in the primary display field. Click *Find*. Mark all found features in the list of the Find window by pressing *Ctrl* while clicking on them with the mouse.

Right click on them and select them. Use the identify feature procedure to see which features you found. Zoom in if necessary or hide/display the layers that might mislead you when trying to identify features.

Question 2: Which rivers in the area are navigable?

Measuring distance: first you need to set the correct distance units for your data frame. Right-click on your data frame (“Layers”) and choose *Properties*. Choose the *General* tab and set the *Display units* to kilometres. Click OK.

Now click the Measure button  on the Tools toolbar. Use the mouse pointer to draw a line representing the distance you want to measure. The line can have more than one line segment. Double-click to end the line. The distance is displayed on the grey bar on the lower left side of your window. Try measuring distances between various features on the map. Use the identify features procedure first in order to see which features (cities, rivers, lakes) you are using as your measuring points.

Question 3: What is the distance between Helsinki and Oslo if you measure it via Stockholm?

Symbolisation and colours

When you first display your layers in the map view, ArcMap assigns colours randomly to the layers. Sometimes you could end up with red rivers and yellow lakes. Your features are not labelled either, so you may have to use the identify feature procedure in order to locate where Oslo is, for example. In order to make your map a real map, you need to adapt the colours of the features, choose the correct symbols for the features and add the labels on the map.

These can be done by **editing the properties of each layer**. Open the properties window for a layer by right clicking on the layer's name in the table of contents and then selecting *Properties*.

All the layers you are currently working with show unique features, i.e., using single symbol/color for cities, countries, lakes, etc. You may want to, however, display a particular layer using several colours (for example, different colours for different countries), while display others with the same colour (e.g., blue colour for all rivers). This can be done by showing categorized data in the property window.

Displaying the data with one color:

- In the table of contents, right-click the layer you want to change symbol/color and click *Properties*.
- Click the *Symbology* tab.
- Click on the large button representing the symbol you want to change and choose an appropriate symbol for it. Or if you do not like any preset symbols, choose the colour and other properties of the feature. Then click OK.

Edit your map so that your roads, rivers and water bodies get an appropriate colour.

Displaying the data with several colors:

- In the table of contents, right-click the layer you want to display with several colors and click *Properties*.
- Click the *Symbology* tab.
- Click *Categories*. ArcMap automatically selects the Unique Values option.
- Click the *Value Field* dropdown arrow and click the field that contains the values you want to map.
- Click the *Color Scheme* dropdown arrow and choose a color scheme that you like.
- Click *Add All Values*. This adds all unique values to the list. Alternatively, click the *Add Values* button to choose which unique values to display. Then click OK.

Edit your map so that the countries are drawn in different colours. Choose a colour scheme you like the most.

Now your map looks better, but there is still something missing - the labels. Generally, **labelling** is the process of placing descriptive text onto or next to features on your map. In ArcMap, labeling refers specifically to the process of automatically generating and placing descriptive text for map features. A label is a piece of text on the map that is dynamically placed and whose text string is derived from one or more feature attributes. In ArcMap, label positions are generated automatically, labels are not selectable and you cannot edit the display properties of individual labels.

To display labels for a layer, you simply specify the attribute or attributes of the feature you want to base your labels on - for example, a street name or soil type - and then turn labelling on. ArcMap then automatically places labels on or near the features they describe. You can also control the font, size, and color of the text to help differentiate labels for different types of features. A map of Europe, for example, could have both country and major city labels, each displayed with a different text symbol. When you turn on dynamic labelling, ArcMap places as many labels on the map as possible without any overlap. In areas where features are tightly clustered together, some features may not be labelled. As you zoom in on your map, more labels will dynamically appear.

Labelling all features in a layer:

In the table of contents, right-click the layer you want to label and click *Properties*. Click the *Labels* tab. Check *Label Features*. Click the *Label Field* dropdown arrow and click the field you want to use as a label. Click OK. You can turn the labelling off by right-clicking on the layer in the table of contents and unchecking the *Label Features*.

In the Labels tab you can also select the style for your labels. You can specify the colour, font and size of your labels by editing the Text Symbol or using the Pre-defined Label Style. Try this.

Edit your map so that you choose different labelling for each of the four features, i.e., countries, lakes, rivers, cities. Do not label streets and railroads. Play with styles until you find your favourite combination.

Changing the coordinate system of your map

You may have noticed that the shape of Sweden is rather different from the one you knew. The reason is that this map was a subset of a world map which uses GCS_WGS_1984, a coordinate system that is suitable for world maps. Now you will change it to a coordinate system that is suitable for a map of Sweden.

In the table of contents, right click on the *'layers'* (or *Map of Sweden if you renamed it*) data frame and choose *Properties*. The data frame's current coordinate system is GCS_WGS_1984. In the *Select a coordinate system* box, click on the plus sign next to *Predefined*. Click on the plus sign next to the *Projected Coordinate Systems*, the plus sign next to *Continental*, then the plus sign next to *Europe*.

The projected coordinate systems for Europe are listed. You will select an equal-distance projection. Click *Europe Equidistant Conic*. The details of the projection appear in the Current coordinate system box. Examine the details and click *OK*.

Compare this map with the one in GCS_WGS_1984 coordinate system and write down your observations.

Adding map elements to your map

Adding **map elements** is the final step of making your map. North arrows, scale bars, scale text, title and legend are examples of such elements.

North arrows indicate the orientation of the map. Scale bars provide a visual indication of the sizes of features and distances between features on the map. You can use a scale bar to represent the scale of your map. A scale bar is a line or bar divided into parts and labelled with its ground length, usually in multiples of map units such as tens of kilometers or hundreds of miles. If the map is enlarged or reduced, the scale bar remains correct. You can also represent the scale of your map with scale text. Scale text indicates the scale of the map and of features on the map. Scale text tells a map reader how many ground units are represented by a map unit, for example, "one centimeter equals 100,000 meters."

A legend tells a map reader which symbol is used to represent which feature on a map. Legends consist of examples of the symbols on the map with labels containing explanatory text. When you use a single symbol for the features in a layer, the layer is labelled with the layer's name in the legend. When you use multiple symbols to represent features in a single layer, the field you used to classify the features becomes a heading in the legend, and each category is labelled with its value. Legends have patches that show examples of the map symbols. By default, the legend patches are points, straight lines, or rectangles that match the map symbols.

To add any of the map elements, you have to be in the **layout view** (not the data view!).

Adding a North arrow:

- Click the *Insert* menu and click *North Arrow*.
- Choose a North arrow that you like.
- Click OK.
- Click and drag the North arrow into place on your map.
- Optionally, resize the North arrow by clicking and dragging a selection handle.

Adding a scale bar:

- Click the *Insert* menu and click *Scale Bar*.
- Choose a scale bar that you like.
- Click OK.
- Click and drag the scale bar into place on your map.
- Optionally, resize the text on the scale bar by clicking and dragging a selection handle.
- You can change the units on the scale bar by right-clicking it and editing the units in its *Properties*.

The scale text can be added in a similar way as the scale bar. Try it.

Adding a legend:

- Click the *Insert* menu and click *Legend*. The *Legend Wizard* appears. If this wizard doesn't appear, wizards have been turned off. When wizards have been turned off, a default legend will be immediately added to your layout. You can double-click this legend to change its

properties. If you would prefer to use the Legend Wizard when you insert a legend, you need to turn wizards back on again. Choose *Options* from the *Tools* menu and in the dialog that appears choose the *Application* tab and check the 'Show wizards when available' box.

- By default, all the layers on the map will appear as legend items in the legend. To remove a legend item, click it, then click the left arrow button.
- Use the up and down arrow buttons to order the legend items.
- Click *Next*.
- Type a title for the legend.
- Set the text color, font, and size as desired.
- Click *Next*.
- Click the *Border* dropdown arrow and click a border.
- Click the *Background* dropdown arrow and click a background.
- Click the *Drop Shadow* dropdown arrow and click a drop shadow.
- Click *Next*.
- Click a *Legend Item* in the list to modify the symbol patch.
- Set the *Patch* properties as desired.
- Click *Next*.
- Set the spacing between legend elements by typing a value into the appropriate box.
- Click *Finish*.

Adding a title to a map:

- Click the *Insert* menu and click *Title*.
- Type a title for the map.
- Click and drag the title into place on your map.
- Modify the appearance of the title text by right-clicking on the title and editing its *Properties*.

Adding text to a map:

- Click the *Insert* menu and click *Text*. A text box will appear in the centre of your screen.
- Type the text.
- Click and drag the text into place on your map.
- Modify the appearance of the text by right-clicking on the text and editing its *Properties*.

Add the north arrow, scale, legend and title to your map. Edit their appearance and layout until you like the finished map. Add your name and the date of production to the map.

Exporting the finished map

Now you can export the map in a variety of formats. To export the map as an image file (a .jpg or .tiff) you should choose *File -> Export Map* from the menu.

If you want to create a pdf, do not try to export it with ArcMap. Pdfs created with ArcMap do not have all the information embedded. What you can do instead is that you print the map choosing *PDFcreator* as your printer and follow the instructions that appear on the screen. This will not actually print your map, but create a pdf of it in your disk space.

3. Report

You don't have to write any report for this exercise. Export your map as a pdf file and show the map and the answers to the three questions in the text to the teacher before the end of the lab.