The following is a rough outline of the subjects we covered in the workshop and some of the examples we used. Based on my perception of interest levels and needs I was able to expand, shorten or leave out certain topics.

Day 1
On the first day we reviewed basic concepts of the ArcMap user interface: the Main and Standard menu bars, table of contents, map display window, the Tools bar, Selection functions under the Main menu bar, the Overview and Magnifier tools and attribute tables. I illustrated these functions using the Digital Chart of the World (polygon layer), a shapefile of major cities of the world (point layer), and a shapefile of major rivers of the world (polyline layer). We discussed the differences between an ArcView 3.3 project and ArcGIS map documents and looked briefly at ArcCatalog and ArcToolbox.

Day 2
We briefly reviewed Day 1 and introduced data symbolization using the Layer Properties windows and the layer patches in the table of contents. We explored simple feature symbolization, and then category and quantity symbolization. Using the DCW, we symbolized countries and major cities by population. Finally I introduced the concept of adding a new field to an attribute table and calculating population density using the Field Calculator.

Day 3
We reviewed Day 2 and introduced the creation of layouts, with an explanation of the difference between Data and Layout Views and the difference between the Data View Tools bar and the Layout Tool bar. We created a layout of countries of the world showing countries with populations greater than 100,000,000 people with a simple color fill symbolization. Trainees asked for an explanation of symbols (i.e., >, <, =>, =<, etc) on the Select by Attributes dialog, as these were totally unknown to them. To complete the layout we learned how to insert a title, scale bar, legend, north arrow, a graticule or grid, text items and labels and annotations.

Day 4
We created more layouts to crystallize the previous day’s work. We produced several layouts of population of all countries of the world symbolized by graduated colors and graduated symbols.

In the afternoon we discussed how to hyperlink images to features in a shapefile. This was a topic of particular interest, as the group wants to give GIS-based presentations that show the abuses that the Burmese military has perpetrated on specific villages in the country.

Day 5
We discussed coordinate reference systems (CRS’s) and map projections. I demonstrated how to define the coordinate reference system for shapefiles and why this is critical to proper alignment of datasets. I also showed some pitfalls that can occur when a CRS is not defined or is improperly defined. I demonstrated how to change the projection of a Data or Layout View and showed some basics on how to choose a map projection for specific projects. This day’s discussion was critical as the
group had some misconceptions about how to transform data from one CRS to another and had no idea of how to change projections.

**Day 6**

We began by going online (each trainee had an internet connection) and exploring sites from which existing GIS datasets can be downloaded. We found the website of the US National Geospatial-Intelligence Agency and their GEOnet Name Server, which lists the names and locations of populated places and geographic features of countries of the world. The group downloaded the listing of these entities for Burma and I demonstrated how to process the data in Excel to segregate the names and locations of populated places from those of geographic features, so that we ended up with just a list of cities, towns and villages in the country. We then converted these locations to a shapefile using the Add XY Event functionality and displayed the places in ArcMap with a vector file of Burma states and districts.

In the afternoon I introduced georeferencing. The group georeferenced a topographic map of Burma and then transformed the map from its original geographic CRS to WGS84, the standard datum used in their work. We then displayed the populated places shapefile on the georeferenced map to see how well the GEOnet locations correlate to the same places on the georeferenced map. The group then assessed the accuracy of the GEOnet locations to the locations on the georeferenced map. This exercise was of great interest, as each trainee was interested in finding specific places that he knew in Burma.

At the end of the day I gave the group two simple exercises to illustrate how to produce a manually-contoured topographic map. This was in preparation for a field trip we were to take the next day to a local farm, where we would take GPS measurements of the property boundaries and features on the property, including elevations.

**Day 7**

We began the day by reviewing the contouring exercises from the previous day and I gave some instructions for the field survey work that would be undertaken at the local farm.

We traveled by trucks to the farm and spent about three hours there taking GPS measurements. In addition to measuring the perimeter boundaries of the farm, we measured the locations of a house under construction, two newly-dug wells, a proposed pond site, a proposed pig pen, the locations of jackfruit and mango trees and elevations of topographic features.

On return to the classroom each trainee converted his GPS data to shapefiles and I displayed them all in one map view for comparison. We discussed the differences and discrepancies between the file, why such differences can occur, and devised a set of rules for more consistent survey work in the future.

I wanted to collate all the elevation readings and have the trainees produce a hand-contoured topographic map that could then be digitized and used for a final map of the farm, but there was too much variation in the elevation readings due to poor survey techniques.
The GPS survey work and subsequent conversion to GIS map proved to be a very popular exercise, as it linked practical field work to GIS applications. I would use this exercise again in future training work with better instructions on how to avoid the survey pitfalls and produce a more consistent set of measurements.

Finally we downloaded and installed Google Earth on each computer and explored how to locate and view specific areas. We converted the farm shapefiles to KML format and displayed them on Google Earth views of the farm area. The trainees were able to see how the boundaries of the farm looked in the Google imagery and how well their GPS points outlined the boundaries - or did not, depending on the accuracy of their measurements.

**Day 8**

Following on our introduction to scanned topographic maps on Day 6, we continued with other types of raster data. I provided a set of 10 Landsat images of an area of northern Venezuela and demonstrated how to add them to a map view. We discussed basic differences between vector and raster data and defined what a pixel is. We then explored the Effects tool bar and demonstrated with the Venezuela data how the brightness and contrast functions can be used to enhanced imagery data and how to display satellite imagery bands in different color scales. We opened a set of ASTER images on top of the Landsat imagery and compared the two datasets using the transparency function and the swipe and flicker tools (Effects tool bar). The trainees could thus see the good alignment of the two datasets by comparing roads and other features in the two datasets. We learned the meaning of resolution in satellite imagery and how to determine the resolution of imagery using the Measure tool. Finally we added four scanned and georeferenced topographic maps that cover the same area as the satellite imagery and compared them to the Landsat and ASTER data. We discussed the advantages and disadvantages of each data set. I demonstrated that the topographic sheets do not align well with the satellite data, and we did a coordinate system transformation to effect better alignment.

Next I provided a series of six scenes downloaded from the Google Earth view of the farm area we visited on Day 7. Each trainee georeferenced these scenes and created a mosaic that showed the location of the farm relative to Mae Sot and the road route to the farm.

We then downloaded and installed the Hawths Tool extension on each trainee’s computer and did a series of exercises with some of the functions. For example, using the raster Gridded Population of the World we extracted the population of Burma cities, towns and villages to the shapefile of populated places we created on Day 6. We also used Hawths to add a field of area and perimeter to a shapefile of Burma states and districts.

We then created a grid raster from an ASCII file of the harvested areas of rice of the world using the excellent world crops dataset from Monfreda et al (2008), available for download at [http://www.geog.mcgill.ca/~nramankutty/Datasets/Datasets.html](http://www.geog.mcgill.ca/~nramankutty/Datasets/Datasets.html). We examined the relative rice harvest of the various Burmese states and districts compared to other areas of the world.
Day 9
We began this day with one final example of raster data - LIDAR. I explained the concept of the Digital Elevation Model (DEM) and how LIDAR is collected from aircraft using laser beams. I provided a LIDAR mosaic of the city of New Orleans and we explored the scene using the Identify tool to show elevations of various features in the city. By identifying elevations on the surface of the Mississippi River trainees were able to determine the direction of flow of the river through New Orleans. We used the Select by Attributes and symbolization functions to color code areas above and below sea level in the city. To my surprise I learned that the city of Bangkok, like New Orleans, is also below sea level and is actively subsiding.

We examined a second example of LIDAR data from the city of Houston, Texas. Trainees were asked to identify visually identify various features on the scene, such as highways, streets, flood control reservoirs, buildings, outdoor soccer stadium, etc., and to determine the slope of the land surface in various locations. It was in this exercise that the Trainees had trouble identifying the regular pattern of city streets and blocks.

Day 10
Our final day was devoted to a special project. Each trainee was to create a polygon shapefile that shows the area to be flooded by a proposed dam on the Salween River of Burma. The area of the reservoir will extend up several rivers in Thailand and will be used to sell water and hydroelectricity to Thailand. Each trainee georeferenced two topographic maps of Burma that cover the areas to be flooded by the dam, and I demonstrated how to identify and digitize the level of the reservoir. Each trainee then created a polygon to show the extent of the reservoir. The exercise was a good one to demonstrate digitizing complex features and how to avoid pitfalls in doing so.

At the end of the day we had a period for final questions and answers and for comments on the workshop. Finally we presented certificates of completion to each trainee and celebrated with ice cream and traditional Thai pastries.

Days 11 and 12
Following the formal group training I worked for two additional days with the convener of the workshop on some long-range projects he wants to accomplish. I volunteered to continue my work with the group from the US and to make myself available for follow-up and future projects if appropriate. Specifically, I will be researching several cartographic problem issues concerning the group’s various base maps, which are a major area of concern for the group’s future work.