13. Suppose you are asked to convert a paper map to a digital data set. What methods can you use for the task? What are the advantages and disadvantages of each method?
14. Explain the difference between point mode and stream mode for digitizing.
15. The scanning method for digitizing involves both rasterization and vectorization. Why?
16. The source map can greatly influence the quality of a digitized map. Provide an example that supports the statement.

APPLICATIONS: GIS DATA ACQUISITION

This applications section covers four methods for data acquisition. In Task 1, you will download USGS DEM and DLG, both in SDTS format from the Internet and import them into ArcGIS. Because the import operations require the use of Coverage Tools, Task 1 is limited to users who have an ArcInfo license and ArcInfo Workstation on their computer. Other users will skip Task 1. Task 2 covers on-screen digitizing. Task 3 uses a table with *x*-, *y*-coordinates. Task 4 uses online connection. There are other methods for data acquisition: Chapter 6 covers the use of a scanned file for digitizing, and Chapter 16 covers address geocoding.

Task 1: Download and Process DEM and DLG from the Internet

What you need: access to the Internet, an unzip tool, ArcInfo license, and ArcInfo Workstation.

To complete Task 1, you must have an ArcInfo license and ArcInfo Workstation on your computer. Because the SDTS files for both the DEM and the DLG are in the TAR.GZ zipped format, you must have access to a utility tool such as WinZip or RAR for unzipping the files. If you cannot unzip the TAR.GZ files, you can skip Steps 1 to 6 and, instead, use the following folders in the Chapter 5 database to complete the task: *elevation_cp*, *hydrography_cp*, and *masterdd_cp*. Before using them, rename the folders *elevation*, *hydrography*, and *masterdd*, respectively.

1. Go to the GIS Data Depot website **http://data.geocomm.com/.** (GIS Data Depot is one of the three websites for downloading USGS data.)
2. Use the following links to download Menan Buttes, ID DEM 24K: USGS DEMs > Download DEM Data Here > Click Idaho on the map > Select Madison > Click DEM 24K > Select Menan Buttes, ID > Set up an account with GeoCommunity > Click 1704439.DEM.SDTS.TAR.GZ (10 meter) to download > Save the file to the Chapter 5 database. This DEM has a 10-meter resolution.
3. Use the utility tool to unzip the downloaded file and save the extracted files in a folder named *elevation* in the Chapter 5 database.
4. Now you will download a DLG and a master data dictionary for the same area. Go to the USGS Geographic Data Download website **(http://edc.usgs.gov/geodata/).** Click on 1:24,000 Scale Digital Line Graphs (DLG) SDTS Format Only, and select State. Click Idaho, then Menan Buttes. Click on hydrography and then 1573016.HY.sdts.tar.gz. Save the file in the Chapter 5 database. Go back to the USGS Geographic Data Download Web page. Click on 1:24,000 Scale Digital Line Graphs (DLG) SDTS Format Only, and then Alphabetical List. Click on 00MASTERDD_LRG.SDTS.tar.gz and save the file in the Chapter 5 database.
5. Use the utility tool to unzip 1573016.HY.sdts.tar.gz and save the extracted files in a folder named *hydrography* in the Chapter 5 database. Next, unzip 00MASTERDD_LRG.SDTS.tar.gz and save

the extracted files in a folder named *masterdd*. (For WinZip users: before unzipping the files, select Configuration from WinZip's Options menu and on the Miscellaneous tab uncheck the box next to TAR file smart CR/LF Conversion.)

6. Click Show/Hide ArcToolbox Windows to open the ArcToolbox window in ArcCatalog. Right-click ArcToolbox, and select Add Toolbox. In the Add Toolbox dialog, use the browser to navigate to Catalog, Toolboxes, and System Toolboxes. Select Coverage Tools to add to ArcToolbox.
7. Double-click the Import From SDTS tool in the Coverage Tools/Conversion/To Coverage toolset. In the Import From SDTS dialog, use the browse button to navigate to the data files in the *elevation* folder. The data files all have the 1102 prefix. Double-click any of the files. The Input SDTS Transfer File Prefix in the dialog should list 1102. Change the output grid name to *menandem* and save it in the Chapter 5 folder (not the *elevation* folder). Click OK to execute the conversion.
8. Double-click the Import From SDTS tool in the Coverage Tools/Conversion/To Coverage toolset. Use the browse button to navigate to the data files in the *hydrography* folder. The data files all have the HY01 prefix. Double-click any of the files. Save the coverage as *menanhydro* in the Chapter 5 database.
9. Launch ArcMap. Change the data frame name to Task 1. Add *menandem* and the arc layer *menanhydro* to Task 1. Change the color of *menanhydro.arc* to blue and the color ramp of *menandem* to Elevation #1. The two data sets should register spatially.

Q1. What is the elevation range (in meters) in *menandem*?

Q2. What is the coordinate system that both *menandem* and *menanhydro* are based on?

Q3. What other layers besides *arc* are contained in the *menanhydro* coverage?

Task 2: Digitize On-Screen in ArcMap

What you need: *land_dig.shp*, a background map for digitizing. *land_dig.shp* is based on UTM coordinates and is measured in meters.

On-screen digitizing is technically similar to manual digitizing. The differences are as follows: you use the mouse pointer rather than the digitizer's cursor for digitizing; you use a feature or image layer as the background for digitizing; and you must zoom in and out repeatedly while digitizing. Task 2 lets you digitize several polygons off *land_dig.shp* to make a new shapefile. You will digitize the new shapefile in a freehand style using the image as the background.

1. Make sure that ArcCatalog is connected to the Chapter 5 folder. First create a new shapefile for digitizing. Right-click the Chapter 5 folder, point to New, and select Shapefile. In the next dialog, enter *trial1* for the name, select Polygon for the feature type, and click the Edit button for the spatial reference. Import the coordinate system of *land_dig.shp* for *trial1*.
2. Insert a data frame in ArcMap and rename it Task 2. Add *trial1* and *land_dig.shp* to Task 2. Make sure that *trial1* is on top of *land_dig* in the table of contents. Before digitizing, you need to change the symbol of the two shapefiles, define the selection layer, and set up the digitizing environment. To facilitate digitizing, you want to draw *land_dig* in red with labels and *trial1* in black. Select Properties from the context menu of *land_dig*. On the Symbology tab, click Symbol and change it to a Hollow symbol with the Outline Color in red. On the Labels tab, check the box to label features in this layer and select LAND_DIG_I from the dropdown list for the label field. Click OK to dismiss the Layer Properties dialog. (You may need to right-click *land_dig* and select Zoom to Layer to see the layer.) Click the symbol of *trial1* in the table of contents. Select the Hollow symbol and the Outline Color of black.
3. Click the Selection tab in the table of contents. Uncheck *land_dig*. This ensures

that *trial1* is the only selectable layer during digitizing. Switch back to the Display tab.

4. Click the Tools menu and make sure that the Editor Toolbar is checked. (The alternative is to click the Editor Toolbar button.) Select Start Editing from the Editor dropdown list. Make sure that the task is to Create New Feature, and the target is *trial1*. Select Options from the Editor dropdown list. On the General tab, enter 10 and select map units for the snapping tolerance. (The snapping tolerance is set to 10 meters because the map units of *trial1* are in meters.) Click OK. Click the Editor dropdown arrow again and select Snapping. Check the Vertex, Edge, and End boxes for *trial1* only. Close the Snapping dialog. You can use the Measure tool to see how large a snapping tolerance of 10 meters is.
5. You are ready to digitize. Zoom to the area around polygon 72. Notice that polygon 72 in *land_dig* is made of a series of lines (edges), which are connected by points (vertices). Click the Sketch tool on the Editor toolbar. Digitize a starting point of polygon 72 by left-clicking the mouse. Use *land_dig* as a guide to digitize the other vertices. When you come back to the starting point, right-click the mouse and select Finish Sketch. The completed polygon 72 appears in cyan with an x inside it. A feature appearing in cyan is an active feature. To unselect polygon 72, click the Edit tool and click a point outside the polygon. If you need to delete a polygon in *trial1* later, use the Edit tool to first select and activate the polygon and then press the Delete key.
6. Digitize polygon 73. You can zoom in and out, or use other tools, any time during digitizing. Click the Sketch tool whenever you are ready to resume digitizing.
7. Digitize polygons 74 and 75 next. The two polygons have a shared border. The strategy is to digitize the outline of both polygons first and then to cut the polygon in two. Use one end of the shared border as the starting point and digitize the outline, including a vertex at the other end of the shared border. Change the task to Cut Polygon Features. Make sure that the digitized outline is still active; if not, use the Edit tool to select it. Click the Sketch tool. Left-click the starting point used in digitizing the outline. Digitize the other vertices that make up the shared border. Double-click the other end of the shared border.
8. Auto-Complete Polygon is an alternative to Cut Polygon Features in the previous step. To use this alternative method, you will digitize one of the two polygons first, switch the task to Auto-Complete Polygon, and then digitize the other polygon without going over the shared border again.
9. You are done with digitizing. Right-click *trial1* in the table of contents, and select Open Attribute Table. Click the first cell under Id and enter 72. Enter 73, 74, and 75 in the next three cells. (You can click the box to the left of a record and see the polygon that corresponds to the record.) Close the table.
10. Select Stop Editing from the Editor dropdown list. Save the edits.

Q4. Define the snapping tolerance. (Tip: Use the Index tab in ArcGIS Desktop Help.)

Q5. Will a smaller snapping tolerance give you a more accurate digitized map? Why?

Q6. The Task dropdown menu on the Editor Toolbar lists four categories of tasks. Which category does Auto Complete Polygon belong to?

Task 3: Add XY Data in ArcMap

What you need: *events.txt,* a text file containing GPS readings.

In Task 3, you will use ArcMap to create a new shapefile from *events.txt,* a text file that contains *x*-, *y*-coordinates of a series of points collected by GPS readings.

1. Insert a data frame in ArcMap and rename it Task 3. Add *events.txt* to Task 3. Select Add

XY Data from the Tools menu. Make sure that *events.txt* is the table to be added as a layer. Use the dropdown list to select EASTING for the X Field and NORTHING for the Y Field. Click the Edit button for the spatial reference of input coordinates. Select projected coordinate systems, UTM, NAD1927, and NAD 1927 UTM Zone 11N.prj. Click OK to dismiss the dialogs. Ignore the warning message that the table does not have object-ID field. *events.txt Events* is added to the table of contents.

2. *events.txt Events* can be saved as a shapefile. Right-click *events.txt Events,* point to Data, and select Export Data. Opt to export all features and save the output as *events.shp* in the Chapter 5 database.
3. You can also convert *events.txt* into a shapefile directly in ArcCatalog. Right-click *events.txt* in the Catalog tree, point to Create Feature Class, and select From XY Table. The Create Feature Class From XY Table dialog allows you to specify the X Field, the Y Field, and the output shapefile.

Task 4: Access California Watersheds on the Geography Network Map Server

What you need: Broadband connection to the Internet.

This task lets you connect to the Geography Network map server, select California watershed data sets, and display them in ArcMap.

1. Launch ArcCatalog, if necessary. Expand GIS Servers in the Catalog tree. Double-click Add ArcIMS Server to open its dialog. Enter **http://www.geographynetwork.com** for the URL of the server, and click OK. After it is connected, expand the server to see its available data.
2. Launch ArcMap, if necessary. Rename the data frame Task 4. Drag Calif_Watershed from the server in the Catalog tree to Task 4. A map of California should now appear. Right-click Calif_Watershed, and select Expand All Sub-Layers. These sub-layers are designed to be visible at different map scales.
3. Zoom into a watershed and view other sub-layers at the scale. A change in view may take some time to complete; watch the message in the status bar. To minimize visual clutter, you can turn off some sub-layers. You can also use the Identify tool to identify, for example, lakes and reservoirs.
4. One of the uses of a map server is to make maps. (To continue, you must remove all data frames except Task 4.) Suppose you want to map hydrologic features in the Bay Area. Zoom into the area, select appropriate sub-layers to be visible, switch to the Layout view, click the Insert menu to add map elements such as a legend and a scale bar, and click the File menu to either print or export the map.

Challenge Task

What you need: *quake.txt.*

quake.txt in the Chapter 5 database contains earthquake data in northern California from January 2002 to August 2003. The quakes recorded in the file all had a magnitude of 4.0 or higher. The Northern California Earthquake Data Center maintains and catalogs the quake data (**http://quake.geo.berkeley.edu/**).

This challenge task asks you to perform two related tasks: (1) use the longitude (Lon) and latitude (Lat) readings in *quake.txt* to create a shapefile called *quake* and define its coordinate system as NAD27, and (2) download a shapefile of California counties. To download the shapefile of California counties, go to **http://casil-mirror1.ceres.ca.gov/casil/.** Select geopolitical/counties.

Q1. How many records are in *quake*?

Q2. What is the maximum magnitude recorded in *quake*?

Q3. What coordinate system is *co_calif* based on?

Q4. What are the parameter values of the coordinate system for *co_calif?*

Q5. Were the quakes recorded in *quake* all on land?

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