REVIEW QUESTIONS

1. Describe the two required inputs for address geocoding.
2. List attributes in the TIGER/Line files that are important for geocoding.
3. Go to the MapQuest website (**http://www.mapquest.com/**). Type the street address of your bank for search. Does it work correctly?
4. Try a street intersection at the MapQuest website. Does it work correctly?
5. Describe the three phases of the address geocoding process.
6. What address matching options are usually available in a GIS package?
7. What geocoding output options are usually available in a GIS package?
8. Explain the difference between the side offset and end offset options in geocoding.
9. What is ZIP code geocoding?
10. Geocoding is one of the most commercialized GIS-related activities. Can you think of a commercial application example of geocoding besides those that have already been mentioned in Chapter 16?
11. Explain in your own words how events are located along a route using dynamic segmentation.
12. Go to ESRI's geodatabase Web page (**http://support.esri.com/datamodels**). Download the custom template of the transportation data model. Use the search function in Adobe Reader to look for the keyword "route." How many route feature classes are included in the data model?
13. Explain the difference between the coverage and the geodatabase in storing a route's linear measure system.
14. Describe methods for creating routes from existing linear features.
15. How can you tell a point event table from a line event table?
16. Suppose you are asked to prepare an event table that shows portions of Interstate 5 in California crossing earthquake-prone zones (polygon features). How can you complete the task?
17. Check whether the transportation department in your state maintains a website for distributing GIS data. If it does, what kinds of data are available for dynamic segmentation applications?

APPLICATIONS: GEOCODING AND DYNAMIC SEGMENTATION

This applications section covers five tasks. Task 1 asks you to geocode ten street addresses by using a reference database derived from the 2000 TIGER/Line files. Task 2 lets you display and query highway routes and events downloaded from the Washington State Department of Transportation website. Again using data from the same website, you will analyze the spatial relationship between two event layers in Task 3. In Tasks 4 and 5, you will build routes from existing line features and locate features along routes. Task 4 locates slope classes along a stream route, and Task 5 locates cities along Interstate 5.

Task 1: Geocode Street Addresses

What you need: *Streets,* a street feature class of Kootenai County, Idaho, derived from the 2000 TIGER/Line files; and *cda_add,* a table containing street addresses of 5 restaurants and 5 government offices in Coeur d'Alene, the largest city in Kootenai County.

In Task 1, you will learn how to create point features from street addresses. Address geocoding requires an address table and a reference dataset. The address table contains a list of street addresses to be located. The reference dataset has the address information for locating street addresses. Task 1 includes the following four steps: view the input data; create an address locator; run geocoding; and rerun geocoding for unmatched addresses.

1. Start ArcCatalog, and connect to the Chapter 16 database. Launch ArcMap. Add *streets* and *cda_add* to Layers and rename Layers Task 1. Right-click *streets* and open its attribute table. Because *streets* is derived from the TIGER/Line files, it has all the attributes from the original data. Figure 16.2 has the descriptions of some of these attributes. Right-click *cda_add,* and open the table. The table contains the fields Name, Address, and Zip. Close both tables.
2. Right-click the Chaper 16 database in ArcCatalog, point to New, and select Address Locator. In the Create New Address Locator dialog, select US Streets with Zone and click OK.
3. Start with the left side of the New US Streets with Zone Address Locator dialog. Enter Task 1 for the name. Then select *streets* in *kootenai.gdb* for the reference data. Select FRADDL for the field of House From Left, TOADDL for House To Left, FRADDR for House From Right, and TOADDR for House To Right. Move to the right side of the dialog. In the Input Address Fields frame, first match Street with Address and delete others. To delete Addr, highlight it and click the Delete button. Delete Street. Next match Zone with Zip. Use the same procedure to delete Zipcode, City, and Zone. Keep the default values for spelling sensitivity, minimum candidate score, and minimum match score in the Matching Options frame. Click OK to dismiss the dialog. The address locator Task 1 is now added to *kootenai.gdb*

Q1. The default spelling sensitivity value is 80. If you were to change it to 60, how would the change affect the geocoding process?

Q2. What output options are available?

4. Go back to ArcMap. Click the Tools menu, point to Geocoding, and select Geocoding Addresses. Click Add in the next dialog, and add the address locator Task 1. Click OK.
5. In the next dialog, make sure that *cda_add* is the address table and the address input fields (Address and Zip) are correct. Provide the path and save the output feature class *cda_geocode.shp* in *kootenai.gdb*. Click OK to geocode the addresses.
6. The Geocoding Addresses dialog shows that 9 out of 10 addresses in *cda_add* are matched and 1 is unmatched. Click the Rematch button. In the Interactive Rematch-cda_geocode dialog, select Unmatched Addresses from the Show results dropdown list. The unmatched record is that of 2750 W KATHLEEN AVE. The address shows that the ZIP code is 83814. Enter the new ZIP code of 83815 in the Zone window. The Candidate window shows 21 candidates. Highlight the top candidate with a score of 100 and click Match. Click Close to dismiss the dialog.
7. Geocoding Result: cda_geocode is added to the map. You need to zoom into the city of Coeur d'Alene to see the 10 geocoded point features.

Task 2: Display and Query Routes and Events

What you need: *decrease24k.shp,* a shapefile showing Washington State highways; and *SpeedLimitsDecAll.dbf,* a dBASE file showing legal speed limits on the highways.

Originally in geographic coordinates, *decrease 24k.shp* has been projected onto the Washington State Plane, South Zone, NAD83, and Units feet. The linear measurement system is in miles. You will learn how to display and query routes and events in Task 2.

1. Insert a new data frame in ArcMap and rename it Task 2. Add *decrease24k.shp* and *SpeedLimitsDecAll.dbf* to Task 2. Open the attribute table of *decrease24k.shp.* The table shows state route identifiers (SR) and route measure attributes (Polyline M). Close the table.
2. This step adds the Identify Route Locations tool. The tool does not appear on any toolbar by default. You need to add it. Select Customize from the Tools menu. On the Commands tab, select the category of Linear Referencing. The Commands frame shows five commands. Drag and drop the Identify Route Locations command to a toolbar. Close the Customize dialog.
3. Open the attribute table of *decrease24k,* and use the Select By Attribute tool to select "SR" = '026'. Highway 26 should now be highlighted in the map. Zoom in on Highway 26. Click the Identify Route Locations tool, and then click a point along Highway 26. This opens the Identify Route Location Results dialog and shows the measure value of the point you clicked as well as other information.

Q3. What is the total length of Highway 26 in miles?

Q4. In which direction is the route mileage accumulated?

4. Clear the selected features. Now you will work with the speed limits event table. Select Add Route Events from the Tools menu. In the next dialog, from top to bottom, select *decrease24k* for the route reference, SR for the route identifier, *SpeedLimitsDecAll* for the event table, SR for the route identifier, line events, B_ARM (beginning accumulated route mileage) for the from-measure, and E_ARM (end accumulated route mileage) for the to-measure. Click OK to dismiss the dialog. A new layer, *SpeedLimitsDecAll Events,* is added to Task 2.
5. Right-click *SpeedLimitsDecAll Events* and select Properties. On the Symbology tab, choose Quantities/Graduate colors in the Show frame and LEGSPDDEC (legal speed description) for the value in the Fields frame. Choose a color ramp that can better distinguish the speed limits classes. Click OK to dismiss the dialog. Task 2 now shows the speed limits data on top of the state highway routes.

Q5. How many records of *SpeedLimitsDecAll Events* have speed limits > 60?

Task 3: Analyze Two Event Layers

What you need: *decrease24k.shp,* same as Task 2; *RoadsideAll.dbf,* a dBASE file showing classification of roadside landscape along highways; and *RestAreasAll.dbf,* a dBASE file showing rest areas.

In Task 3, you will use ArcToolbox to overlay the event tables of rest areas and the roadside landscape classes. The output event table can then be added to ArcMap as an event layer.

1. Insert a new data frame in ArcMap and rename it Task 3. Add *decrease24k.shp, RoadsideAll.dbf,* and *RestAreasAll.dbf* to Task 3. Open *RoadsideAll.* The CLASSIFICA field stores five landscape classes: forested, open, rural, semi-urban, and urban. (Ignore the coincident features.) Open *RestAreasAll.* The table has a large number of attributes including the name of the rest area (FEATDESCR) and the county (COUNTY). Close the tables.
2. Click Show/Hide ArcToolbox Window to open ArcToolbox. Set the Chapter 16 database for the current workspace. Double-click the Overlay Route Events tool in the Linear Reference Tools toolset. The Overlay Route Events dialog consists of three parts: the input event table, the overlay event table, and the output event table. Select *RestAreasAll* for the input event table, SR for the route identifier field (ignore the warning

message), POINT for the event type, and ARM for the measure field. Select *RoadsideAll* for the overlay event table, SR for the route identifier field, LINE for the event type, BEGIN_ARM for the from-measure field, and END_ARM for the to-measure field. Select INTERSECT for the type of overlay. Enter *Rest_Roadside.dbf* for the output event table, SR for the route identifier field, and ARM for the measure field. Click OK to perform the overlay operation.

3. Open *Rest_Roadside*. The table combines attributes from *RestAreasAll* and *RoadsideAll*.

Q6. How many rest areas are located in forested areas?

Q7. Are any rest areas located in urban areas?

4. Similar to Task 2, you can use the Add Route Events tool to add *Rest_Roadside* as an event layer. The event layer can display the rest areas and their attributes such as the landscape classification.

Task 4: Create a Stream Route and Analyze Slope along the Route

What you need: *plne*, an elevation raster; and *streams.shp*, a stream shapefile.

Task 4 lets you analyze slope classes along a stream. Task 4 consists of several subtasks: (1) use Spatial Analyst to create a slope polygon shapefile from *plne*; (2) import a select stream from *streams.shp* as a feature class to a new geodatabase; (3) use ArcToolbox to create a route from the stream feature class; and (4) run an overlay operation to locate slope classes along the stream route.

1. Insert a new data frame in ArcMap and rename the data frame Task 4. Add *plne* to Task 4. Use the Slope tool in the Spatial Analyst Tools/Surface toolset to create a percent slope raster from *plne* and name it *plne_slp*. Use the Reclassify tool in the Spatial Analyst Tools/Reclass toolset to reclassify the percent slope raster into the following five classes: <10%, 10–20%, 20–30%, 30–40%, and >40%. Name the reclassified raster *reclass_slp*. Then use the Raster to Polygon tool in the Conversion Tools/From Raster toolset to convert the reclassified slope raster to a polygon shapefile. Name the shapefile *slope*. The field GRIDCODE in *slope* shows the five slope classes.
2. Right-click the Chapter 16 database in ArcCatalog, point to New, and select Personal Geodatabase. Name the geodatabase *stream.mdb*.
3. Next import one of the streams in *streams.shp* as a feature class in *stream.mdb*. Right-click *stream.mdb*, point to Import, and select Feature Class (single). Select *streams.shp* for the input features, enter *stream165* for the output feature class name, and click on the SQL button for the expression. In the Query Builder dialog, enter the following expression: "USGH_ID" = 165 and click OK. Click OK in the Feature Class to Feature Class dialog to run the import operation. Expand *stream.mdb*, and *stream165* should appear as a feature class in the database.
4. Double-click the Create Routes tool in the Linear Referencing Tools toolset in ArcMap. Select *stream165* for the input line features, select USGH_ID for the route identifier field, enter *StreamRoute* for the output route feature class in *stream.mdb*, and click OK. Add *StreamRoute* to the map.
5. Now you will run an operation to locate slope classes along *StreamRoute*. Double-click the Locate Features Along Routes tool in the Linear Referencing Tools toolset. Select *slope* for the input features, select *StreamRoute* for the input route features, enter USGH_ID for the route identifier field, enter *Stream_Slope.dbf* for the output event table in the Chapter 16 database, uncheck the box for keeping zero length line events, and click OK to run the overlay operation.
6. Select Add Route Events tool from the Tools menu. In the next dialog, make sure that *StreamRoute* is the route reference, USGH_ID

is the route identifier, *Stream_Slope* is the event table, and RID is the route identifier for the event table. Click Line Events. Then click OK to add the event layer.

7. Turn off all layers except *Stream_Slope Events* in the table of contents. Right-click *Stream_Slope Events* and select Properties. On the Symbology tab, select Categories and Unique Values for the Show option, select GRIDCODE for the value field, click on Add All Values, and click OK. Zoom in on *Stream_Slope Events* to view the changes of slope classes along the route.

Q8. How many records are in the *Stream_Slope Events* layer?

Q9. How many records in *Stream_Slope Events* have the GRIDCODE value of 5 (i.e., slope > 40%)?

Task 5: Locate Cities along U.S. Interstate 5

What you need: *interstates.shp,* a line shapefile containing interstate highways in the conterminous United States; and *uscities.shp,* a point shapefile containing cities in the conterminous United States. Both shapefiles are based on projected coordinates in meters.

In Task 5, you will locate cities along Interstate 5 that runs from Washington State to California. The task consists of three subtasks: extract Interstate 5 from *interstates.shp* to create a new shapefile; create a route from the Interstate 5 shapefile; and locate cities in *uscities.shp* that are within 10 miles of Interstate 5.

1. In ArcCatalog, click Show/Hide ArcToolbox Window to open ArcToolbox. Double-click the Select tool in the Analysis Tools/Extract toolset. Select *interstates.shp* for the input features, specify *I5.shp* for the output feature class, and click on the SQL button for the expression. Enter the following expression in the Query Builder: "RTE_NUM1" = ' 5'. (There are two spaces before 5.) Click OK to dismiss the dialogs. Next add a numeric field to *I5* for the route identifier. Double-click the Add Field tool in the Data Management Tools/Fields toolset. Select *I5.shp* for the input table, enter RouteNum for the field name, select DOUBLE for the field type, and click OK. Double-click the Calculate Field tool. Select *I5.shp* for the input table, RouteNum for the field name, enter 5 for the expression, and click OK.

2. Insert a new data frame in ArcMap and rename it Task 5. Add *I5.shp* and *uscities.shp* to Task 5. Open ArcToolbox in ArcMap. Double-click the Create Routes tool in the Linear Referencing Tools toolset. Select *I5* for the input line features, select RouteNum for the route identifier field, specify *Route5.shp* for the output route feature class, select LENGTH for the measure source, enter 0.00062137119 for the measure factor, and click OK. The measure factor converts the linear measure units from meters to miles.

3. This step locates cities within 10 miles of *Route5.* Double-click the Locate Features Along Routes tool in the Linear Referencing Tools toolset. Select *uscities* for the input features, select *Route5* for the input route features, select RouteNum for the route identifier field, enter 10 miles for the search radius, specify *Route5_cities.dbf* for the output event table, and click OK.

4. This step adds *Route5_cities.dbf* to Task 5. Click Add Route Events in the Tools menu. Make sure that *Route5* is the route reference, *Route5_cities* is the event table, and the type of events is point events. Click OK to add the event layer.

Q10. How many cities in Oregon are within 10 miles of *Route5*?

Challenge Task

What you need: *coeurdalene_streets.shp,* a street shapefile for Coeur d'Alene, Idaho; and *cda_add.txt,* a text file containing 10 street addresses in Coeur d'Alene.

This challenge question asks you to geocode the 10 addresses in *cda_add.txt,* similar to Task 1. The difference is the input data: you will use a shapefile (*coeurdalene_streets.shp*) for the reference data and a text file (*cda_add.txt*) for the address table. Save your geocoding results into a shapefile.

Q1. Do you get the same result as in Task 1?

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