4. Describe the four types of attribute data by measurement scale.
5. Can you convert ordinal data into interval data? Why, or why not?
6. Define a relational database.
7. Explain the advantages of a relational database.
8. Sometimes it is difficult to tell a primary key from a foreign key. Take a look at the parcel table and the owner table in Figure 8.8. Which field in the parcel table is the primary key (i.e., an attribute that can uniquely identify a record in the table)? Which field in the owner table is the foreign key (i.e., an attribute designed for linking the owner table to the parcel table)?
9. Identify the primary key and the foreign key for linking the zone table to the parcel table in Figure 8.8.
10. A fully normalized database may slow down data access. To increase the performance in data access, for example, one may remove the address table in Figure 8.8. How would the database look if the address table were removed?
11. Provide a real-world example (other than those of Chapter 8) of a one-to-many relationship.
12. Explain the similarity, as well as the difference, between a join operation and a relate operation.
13. Suppose you have downloaded a GIS data set. The data set has the length measure in meters instead of feet. Describe the steps you will follow to add a length measure in feet to the data set.
14. Suppose you have downloaded a GIS data set. The feature attribute table has a field that contains values such as 12, 13, and so on. How can you find out if these values represent numbers or text strings using ArcGIS?
15. Describe two ways of creating new attributes from the existing attributes in a data set.

APPLICATIONS: ATTRIBUTE DATA MANAGEMENT

This applications section has seven tasks. Task 1 covers attribute data entry using a geodatabase feature class. Tasks 2 and 3 cover joining tables and relating tables, respectively. Tasks 4 and 5 create new attributes by data classification. Task 4 uses the conventional method of repeatedly selecting a data subset and assigning a class value. Task 5, on the other hand, uses a Visual Basic script to automate the procedure. Task 6 shows how to create new attributes through data computation. Task 7 lets you create and use relationship classes in a file geodatabase.

Task 1: Enter Attribute Data of a Geodatabase Feature Class

What you need: *landat.shp,* a polygon shapefile with 19 records.

In Task 1, you will learn how to enter attribute data using a geodatabase feature class and a domain. The domain and its coded values can restrict values to be entered, thus preventing data entry errors.

1. Start ArcCatalog, and connect to the Chapter 8 database. First, create a personal geodatabase. Right-click the Chapter 8 database in the Catalog tree, point to New, and select Personal Geodatabase. Rename the new personal geodatabase *land.mdb.*
2. This step adds *landat.shp* as a feature class to *land.mdb.* Right-click *land.mdb,* point to Import, and select Feature Class (single). Use the browse button or the drag-and-drop method to add *landat.shp* as the input features. Name the output feature class *landat.* Click OK to dismiss the dialog.

3. Now create a domain for the geodatabase. Select Properties from the context menu of *land.mdb*. The Domains tab of the Database Properties dialog shows Domain Name, Domain Properties, and Coded Values. You will work with all three frames. Click the first cell under Domain Name, and enter lucodevalue. Click the cell next to Field Type, and select Short Integer. Click the cell next to Domain Type, and select Coded Values. Click the first cell under Code and enter 100. Click the cell next to 100 under Description, and enter 100-urban. Enter 200, 300, 400, 500, 600, and 700 following 100 under Code and enter their respective descriptions of 200-agriculture, 300-brushland, 400-forestland, 500-water, 600-wetland, and 700-barren. Click Apply and OK to dismiss the Database Properties dialog.

4. This step is to add a new field to *landat* and to specify the field's domain. Right-click *landat* and select Properties. On the Fields tab, click the first empty cell under Field Name and enter lucode. Click the cell next to lucode and select Short Integer. Click the cell next to Domain in the Field Properties frame and select lucodevalue. Click Apply and OK to dismiss the Properties dialog.

Q1. List the data types available for a new field.

5. Launch ArcMap. Rename the data frame Task 1 and add *landat* to Task 1. Open the attribute table of *landat*. lucode appears with Null values in the last field of the table.

6. Click the Editor Toolbar button to open the toolbar. Click the Editor dropdown arrow and select Start Editing. Right-click the field of LANDAT-ID and select Sort Ascending. Now you are ready to enter the lucode values. Click the first cell under lucode and select forestland (400). Enter the rest of the lucode values according to the following table:

Landat-ID	Lucode	Landat-ID	Lucode
59	400	69	300
60	200	70	200
61	400	71	300
62	200	72	300
63	200	73	300
64	300	74	300
65	200	75	200
66	300	76	300
67	300	77	300
68	200		

Q2. Describe in your own words how the domain of coded values ensures the accuracy of the attribute data that you entered in Step 6.

7. When you finish entering the lucode values, select Stop Editing from the Editor dropdown list. Save the edits.

Task 2: Join Tables

What you need: *wp.shp*, a forest stand shapefile, and *wpdata.dbf*, an attribute data file that contains vegetation and land-type data.

Task 2 asks you to join a dBASE file to a feature attribute table. A join operation combines attribute data from different tables into a single table, making it possible to use all attribute data in query, classification, or computation.

1. Insert a new data frame in ArcMap and rename it Task 2. Add *wp.shp* and *wpdata.dbf* to Task 2.

2. Open the attribute table of *wp* and *wpdata*. The field ID is in both tables will be used as the field in joining the tables.

3. Now join *wpdata* to the attribute table of *wp*. Right-click *wp*, point to Joins and Relates, and select Join. (Another option, new in ArcGIS 9.3, is to select Join from the Options dropdown menu in the *wp* attribute table.) At the top of the Join Data dialog, opt to join attributes from a table. Then, select ID in the first dropdown list, *wpdata* in the second list, and ID in the third list. Click OK

to join the tables. Open the attribute table of *wp* to see the expanded table.

Task 3: Relate Tables

What you need: *wp.shp, wpdata.dbf,* and *wpact.dbf.* The first two are the same as in Task 2. *wpact.dbf* contains additional activity records.

In Task 3, you will establish two relates among three tables.

1. Select Data Frame from the Insert menu in ArcMap. Rename the new data frame Tasks 3–6. Add *wp.shp, wpdata.dbf,* and *wpact.dbf* to Tasks 3–6.
2. Check the fields for relating tables. The field ID should appear in *wp*'s attribute table, *wpact,* and *wpdata.* Close the tables.
3. The first relate is between *wp* and *wpdata.* Right-click *wp,* point to Joins and Relates, and select Relate. In the Relate dialog, select ID in the first dropdown list, *wpdata* in the second list, and ID in the third list, and accept Relate1 as the relate name.
4. The second relate is between *wpdata* and *wpact.* Right-click *wpdata,* point to Joins and Relates, and select Relate. In the Relate dialog, select ID in the first dropdown list, *wpact* in the second list, and ID in the third list, and enter Relate2 as the relate name.
5. The three tables are now related. Right-click *wpdata* and select Open. Click the Options dropdown arrow and choose Select By Attributes. In the next dialog, create a new selection by entering the following SQL statement in the expression box: "ORIGIN" > 0 AND "ORIGIN" <= 1900. Click Apply. Click Selected at the bottom of the table so that only selected records are shown.
6. To see which records in the *wp* attribute table are related to the selected records in *wpdata,* go through the following steps: Click the Options dropdown arrow in the *wpdata* table, point to Related Tables, and click Relate1: wp. The *wp* attribute table shows the related records. And the *wp* layer shows where those selected records are located.
7. You can follow the same procedure as in Step 6 to see which records in *wpact* are related to those selected polygons in *wp.*

Q3. How many records in *wpact* are selected in Step 7?

Task 4: Create New Attribute by Data Classification

What you need: *wpdata.dbf.*

Task 4 demonstrates how the existing attribute data can be used for data classification and the creation of a new attribute.

1. First click Clear Selected Features in the Selection menu in ArcMap to clear the selection. Click Show/Hide ArcToolbox Window to open ArcToolbox. Double-click the Add Field tool in the Data Management Tools/Fields toolset. Select *wpdata* for the input table, enter ELEVZONE for the field name, select SHORT for the type, and click OK.
2. Open *wpdata* in Tasks 3–6. ELEVZONE appears in *wpdata* with 0s. Click the Options dropdown arrow and choose Select By Attributes. Make sure that the selection method is to create a new selection. Enter the following SQL statement in the expression box: "ELEV" > 0 AND "ELEV" <= 40. Click Apply. Click Selected at the bottom of the table so that only selected records are shown. These selected records fall within the first class of ELEVZONE. Right-click the field ELEVZONE and select Field Calculator. Click Yes to proceed in the message box. Enter 1 in the expression box of the Field Calculator dialog, and click OK. The selected records in *wpdata* are now populated with the value of 1, meaning that they all fall within class 1.
3. Go back to the Select By Attributes dialog. Make sure that the method is to create a new selection. Enter the SQL statement: "ELEV"

> 40 AND "ELEV" <= 45. Click Apply. Follow the same procedure to calculate the ELEVZONE value of 2 for the selected records.

4. Repeat the same procedure to select the remaining two classes of 46–50 and > 50, and to calculate their ELEVZONE values of 3 and 4, respectively.

Q4. How many records have the ELEVZONE value of 4?

Task 5: Use Advanced Method for Attribute Data Classification

What you need: *wpdata.dbf.*

In Task 4 you have classified ELEVZONE in *wpdata.dbf* by repeating the procedure of selecting a data subset and calculating the class value. This task shows how to use a Visual Basic code and the advanced option to calculate the ELEVZONE values all at once. If Task 5 fails to run in ArcGIS 9.3, ESRI recommends that a repair is run on the ArcGIS Desktop install (http://support.esri.com/index.cfm?fa=knowledgebase.techarticles.articleShow&d=25207). To run a repair: Navigate to Start > Settings > Control Panel > Add or Remove Programs. Select ArcGIS Desktop and click the Change button. When prompted, select the Repair option.

1. Open *wpdata* in Tasks 3–6. ELEVZONE should appear in the table with values calculated in Task 4. If necessary, clear selected records in *wpdata* by selecting Clear Selection from Options' dropdown menu and show all records. Right-click ELEVZONE and select Field Calculator. Click Yes to proceed in the message box.

2. Check Advanced in the Field Calculator dialog. Next create a Visual Basic script to perform the classification. The first line of your script declares an integer variable called intclass, which stores the classification value. Enter the following statements in the first box under "Pre-Logic VBA Script Code":

```
Dim intclass as integer
If [ELEV] > 0 and [ELEV] <= 40 Then
intclass = 1
ElseIf [ELEV] > 40 and [ELEV] <= 45 Then
intclass = 2
ElseIf [ELEV] > 45 and [ELEV] <= 50 Then
intclass = 3
ElseIf [ELEV] > 50 Then
intclass = 4
End If
```

3. Enter intclass in the second box under "ELEVZONE =". In other words, ELEVZONE will be assigned the value from intclass. Click OK to dismiss the Field Calculator dialog. ELEVZONE is now populated with values calculated by the Visual Basic code. They should be the same as those in Task 4.

Task 6: Create New Attribute by Data Computation

What you need: *wp.shp* and *wpdata.dbf.*

You have created a new field from data classification in Tasks 4 and 5. Another common method for creating new fields is computation. Task 6 shows how a new field can be created and computed from existing attribute data.

1. Double-click the Add Field tool. Select *wp* for the input table, enter ACRES for the field name, select DOUBLE for the field type, enter 11 for the field precision, enter 4 for the field scale, and click OK.

2. Open the attribute table of *wp*. The new field ACRES appears in the table with 0s. Right-click ACRES to select Field Calculator. Click Yes in the message box. In the Field Calculator dialog, enter the following expression in the box below ACRES =: [AREA]/1000000 × 247.11. Click OK. The field ACRES now shows the polygons in acres.

Q5. How large is FID = 10 in acres?

Task 7: Create Relationship Class

What you need: *wp.shp*, *wpdata.dbf*, and *wpact.dbf*, same as in Task 3.

Instead of using on-the-fly relates as in Task 3, you will use the relationship classes in Task 7 by first defining and saving them in a file geodatabase.

1. First, create a new file geodatabase in ArcCatalog. Right-click the Chapter 8 database in the Catalog tree, point to New, and select File Geodatabase. Rename the new geodatabase *relclass.gdb*.

2. This step adds *wp.shp* as a feature class to *relclass.gdb*. Right-click *relclass.gdb*, point to Import, and select Feature Class (single). Use the browse button to add *wp.shp* as the input features. Name the output feature class *wp*. Click OK to dismiss the dialog.

3. This step imports *wpdata.dbf* and *wpact.dbf* as tables to *relclass.gdb*. Right-click *relclass.gdb*, point to Import, and select Table (multiple). Use the browse button to add *wpdata.dbf* and *wpact.dbf* as input tables. Click OK to dismiss the dialog. Make sure that *relclass.gdb* now contains *wp*, *wpact*, and *wpdata*.

4. Right-click *relclass.gdb*, point to New, and select Relationship Class. You will first create a relationship class between *wp* and *wpdata* in several steps. Name the relationship class *wp2data*, select *wp* for the origin table, *wpdata* for the destination table, and click Next. Next, take the default of a simple relationship. Then, specify wp as a label for the relationship as it is traversed from the origin to the destination, specify wpdata as a label for the relationship as it is traversed from the destination to the origin, and opt for no messages propagated. In the next dialog, choose the one-to-one cardinality. Then, choose not to add attributes to the relationship class. In the next dialog, select ID for the primary key as well as for the foreign key. Review the summary of the relationship class before clicking Finish.

5. Follow the same procedure as in Step 4 to create the relationship class *data2act* between *wpdata* and *wpact*. ID will again be the primary key as well as the foreign key.

6. This step shows how to use the relationship classes you have defined and stored in *relclass.gdb*. Insert a new data frame in ArcMap and rename it Task 7. Add *wp*, *wpact*, and *wpdata* from *relclass.gdb* to Task 7.

7. Right-click *wpdata* and select Open. Click the Options dropdown arrow and choose Select By Attributes. In the next dialog, create a new selection by entering the following SQL statement in the expression box: "ORIGIN" > 0 AND "ORIGIN" <= 1900. Click Apply. Click Selected at the bottom of the table so that only selected records are shown.

8. Click the Options dropdown arrow in the *wpdata* table, point to Related Tables, and click *wp2data*. The *wp* attribute table shows the related records, and the *wp* layer shows where those selected records are located.

Q6. How many records in the *wp* attribute table are selected in Step 8?

9. You can use the relationship class *data2act* to find the related records in *wpact*.

Challenge Task

What you need: *bailecor_id.shp*, a shapefile showing Bailey's ecoregions in Idaho. The data set is projected onto the Idaho Transverse Mercator coordinate system and measured in meters.

This challenge task asks you to add a field to *bailecor_id* that shows the number of acres for each ecoregion in Idaho.

Q1. How many acres does the Owyhee Uplands Section cover?

Q2. How many acres does the Snake River Basalts Section cover?