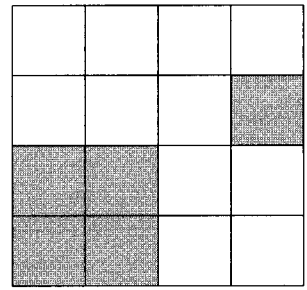
- UTM coordinates in meters at the upper-right corner: 570595, 4830380

How many rows does the DEM have? How many columns does the DEM have? What are the UTM coordinates at the center of the (row 1, column 1) cell?

6. Go to either the GeoEye website **(http://www.geoeye.com/)** or the DigitalGlobe website **(http://www.digitalglobe.com/),** and take a look at their high-resolution sample imagery.
7. How many 7.5-minute DEMs are covered by one 30-minute DEM?
8. You can find the status graphics for USGS DEMs, DRGs, and DOQs at the following website: **http://statgraph.cr.usgs.gov/viewer.htm.** How much of your state is covered for each of these USGS digital data products?
9. Find the GIS data clearinghouse for your state at the Geospatial One-Stop website **(http://www.geodata.gov/).** Go to the clearinghouse website. Does the website offer USGS DEMs, DRGs, and DOQs online? Does the website offer both 30-meter and 10-meter USGS DEMs?
10. Use a diagram to explain how the run-length encoding method works.
11. Refer to the following figure, draw a quad tree, and code the spatial index of the shaded (spatial) feature.



12. A number of government agencies have used MrSID to store digital images such as DOQs and DRGs. When these images are made available online, we can see them at different resolutions by zooming in or out. Go to the Massachusetts GIS website **(http://www.state.ma.us/mgis/mrsid.htm)** and view the DOQs and DRGs at different resolutions.
13. Explain the difference between lossless and lossy compression methods.
14. What is vectorization?
15. Use an example from your discipline and explain the usefulness of integrating vector and raster data.

APPLICATIONS: RASTER DATA MODEL

This applications section has three tasks. The first two tasks let you view two types of raster data: DEM and Landsat TM imagery. Task 3 covers the conversion of two shapefiles, one line and one polygon, to raster data.

Task 1: View USGS DEM Data

What you need: *Task1,* a folder that contains data files for a USGS 7.5-minute DEM in SDTS (spatial data transfer standard) format.

There are two options for importing USGS DEMs in SDTS format in ArcCatalog. The first option uses the Import From SDTS tool in the Coverage Tools/Conversion/To Coverage toolset. This option, however, requires an ArcInfo license and the installation of ArcInfo Workstation. The second option is to use ArcView 8x Tools, available in ArcCatalog's View menu. ArcView 8x Tools, called Conversion Tools, has the SDTS Raster to Grid tool. In Task 1, you will use the second option.

1. Start ArcCatalog and connect to the Chapter 4 database. Click the View menu, point to Toolbars, and select ArcView 8x Tools. Click

the dropdown arrow of Conversion Tools, and select SDTS Raster to Grid.

2. In the SDTS Raster to Grid dialog, click the button for the input prefix. In the Open dialog, use the browse button to navigate to the *Task1* folder. When the 8146 prefix appears, highlight it, and click OK. Save the output grid as *menanbuttes* in the Chapter 4 database, and click OK to dismiss the SDTS Raster to Grid dialog. The conversion creates an elevation grid and 10 tables associated with the grid.
3. This step examines *menanbuttes,* an elevation raster created in Step 2. Right-click *menanbuttes* in the Catalog tree and select Properties. The General tab shows information about *menanbuttes* in five categories: data source, raster information, extent, spatial reference, and statistics. An integer grid with a cell size of 30 (meters), *menanbuttes* is projected onto the NAD_1927_UTM_Zone_12N coordinate system. *menanbuttes* has a minimum elevation of 4771 (feet) and a maximum elevation of 5619.

Q1. How many rows and columns does *menanbuttes* have?

Q2. What are the *x*- and *y*-coordinates at the upper-left corner of *menanbuttes*?

4. Launch ArcMap. Rename the data frame Task 1, and add *menanbuttes* to Task 1. Right-click *menanbuttes* and select Properties. On the Symbology tab, right-click on the Color Ramp box and uncheck Graphic View. Then select Elevation #1 from the Color Ramp's dropdown menu. Dismiss the Properties dialog. ArcMap now displays the dramatic landscape of the twin buttes.

Task 2: View a Satellite Image in ArcMap

What you need: *tmrect.bil,* a Landsat TM image comprised of the first five bands.

Task 2 lets you view a Landsat TM image with five bands. By changing the color assignments of the bands, you can alter the view of the image.

1. Right-click *tmrect.bil* in ArcCatalog and select Properties. The General tab shows that *tmrect.bil* has 366 rows, 651 columns, and 5 bands.

Q3. Can you verify that *tmrect.bil* is stored in the band interleaved by line format?

Q4. What is the pixel size (in meters) of *tmrect.bil*?

2. Launch ArcMap, if necessary. Insert a new data frame and rename it Task 2. Add *tmrect.bil* to Task 2. The table of contents shows *tmrect.bil* as an RGB Composite with Red for Band_1, Green for Band_2, and Blue for Band_3.
3. Select Properties from the context menu of *tmrect.bil.* On the Symbology tab, use the dropdown menus to change the RGB composite: Red for Band_3, Green for Band_2, and Blue for Band_1. Click OK. You should see the image as a color photograph.
4. Next, use the following RGB composite: Red for Band_4, Green for Band_3, and Blue for Band_2. You should see the image as a color infrared photograph.

Task 3: Convert Vector Data to Raster Data

What you need: *nwroads.shp* and *nwcounties.shp,* shapefiles showing major highways and counties in the Pacific Northwest, respectively.

In Task 3, you will convert a line shapefile (*nwroads.shp*) and a polygon shapefile (*nwcounties.shp*) to rasters. Covering Idaho, Washington, and Oregon, both shapefiles are projected onto a Lambert conformal conic projection and are measured in meters.

1. Insert a new data frame in ArcMap and rename it Task 3. Add *nwroads.shp* and *nwcounties.shp* to Task 3. Open ArcToolbox.
2. Double-click the Feature to Raster tool in the Conversion Tools/To Raster toolset. Select *nwroads* for the input features, select RTE_NUM1 for the field, save the output raster as *nwroads_gd,* enter 5000 for the output cell size, and click OK to run the conversion. *nwroads_gd* appears in the map in different

colors. Each color represents a numbered highway. The highways look blocky because of the large cell size (5000 meters).

3. Double-click the Feature to Raster tool. Select *nwcounties* for the input features, select FIPS for the field, save the output raster as *nwcounties_gd,* enter 5000 for the output cell size, and click OK. *nwcounties_gd* appears in the map with symbols representing the classified values of 1 to 119 (119 is the total number of counties). Double-click *nwcounties_gd* in the table of contents. On the Symbology tab, select Unique Values in the Show frame and click OK. Now the map shows *nwcounties_gd* with a unique symbol for each county.

Q5. *nwcounties_gd* has 157 rows and 223 columns. If you had used 2500 for the Output cell size, how many rows would the output grid have?

Challenge Task

What you need: *emidalat,* an elevation raster; and *idtm.shp,* a polygon shapefile.

A USGS DEM, *emidalat* is projected onto the UTM coordinate system. *idtm.shp,* on the other hand, is based on the Idaho Transverse Mercator (IDTM) coordinate system. This challenge task asks you to project *emidalat* onto the IDTM coordinate system. It also asks you for the layer information about *emidalat.*

1. Use the Metadata tab in ArcCatalog to read the spatial reference information about *emidalat* and *idtm.shp,* including the datum.
2. Use the Project Raster tool in the Data Management Tools/Projections and Transformations/Raster toolset to project *emidalat* onto the IDTM coordinate system. Use the default resampling technique and a cell size of 30 (meters). Rename the output raster *emidatm.*
3. Launch ArcMap. Rename the new data frame Challenge, and add *idtm.shp* and *emidatm* to Challenge. *emidatm* should appear as a very small rectangle in northern Idaho.

Q1. What is the maximum elevation in *emidatm*?

Q2. Is *emidatm* a floating-point grid or an integer grid?

Q3. How many rows and columns does *emidatm* have?

REFERENCES

Acharya, T., and P. Tsai. 2005. *JPEG2000 Standard for Image Compression: Concepts, Algorithms and VLSI Architectures.* Hoboken, NJ: Wiley-Interscience.

Addison, P. S. 2002. *The Illustrated Wavelet Transform Handbook.* Bristol, UK: Institute of Physics Publishing.

Bourgine, B., and N. Baghdadi. 2005. Assessment of C-Band SRTM DEM in a Dense Equatorial Forest Zone. *Comptes Rendus Geoscience* 337: 1225–34.

Bregt, A. K., J. Denneboom, H. J. Gesink, and Y. Van Randen. 1991. Determination of Rasterizing Error: A Case Study with the Soil Map of the Netherlands. *International Journal of Geographical Information Systems* 5: 361–67.

Brovelli, M. A., U. M. Longoni, and M. Cannata. 2004. LIDAR Data Filtering and DTM Interpolation Within GRASS. *Transactions in GIS* 8: 155–74.

Chrisman, N. 2001. *Exploring Geographic Information Systems,* 2d ed. New York: Wiley.

Clarke, K. C. 1995. *Analytical and Computer Cartography,* 2d ed. Englewood Cliffs, NJ: Prentice Hall.

Congalton, R. G. 1997. Exploring and Evaluating the Consequences of Vector-to-Raster and Raster-to-Vector Conversion. *Photogrammetric Engineering and Remote Sensing* 63: 425–34.

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