Instructional Days: 11-14

Topic Description: In this lesson, students learn how computers can be used as a tool for visualizing and understanding data. Sonification, the transformation of data into sound, is explored in particular.

**Objectives**:

The student will be able to:

* Explain how computers can be used as tools for visualizing data and interpreting data
* Explore relationships between different statistics and geographical location.
* Create their own hypotheses and test them using data.

**Outline of the Lesson:**

* Journal: In what ways can data be stored? In what ways can it be transmitted? (5 minutes)
* Discussion: Have students share their answers. Some examples are tables, journals, databases, graphs, text (like a stock exchange), voice, sonification… Guide them toward the idea that data can also be represented as sound in a way deeper than just saying numbers. (20 minutes)
* Examples of sonification?
* Introduction to iSonic and geographical sonification (15 minutes)
* Students follow tutorial below (??? Minutes)

**Student Activities**:

* Discuss methods of storing and transmitting data.
* Listen to examples of sonification.
* Learn to use iSonic
* Create and investigate their own hypotheses on geographical data using iSonic.

**Resources:**

This activity makes use of iSonic (<http://www.cs.umd.edu/hcil/audiomap/>), a program that uses sonification to display geographic data to blind users. It can be used by both sighted and visually impaired users. It is designed from the ground up to be completely accessible.

Before being run, it requires some installation and setup. It will only work on Windows. The instructions are available on the website above, but they are briefly summarized below.

1. Download and install the Java JRE *if* you do not already have it. It is likely that you already do. Any version at or above 5.0 will work.
2. Download and install the Microsoft Speech SDK 5.1 (this has not been tested with other versions.) Go to <http://www.microsoft.com/en-us/download/details.aspx?id=10121>, click Download, and select “SpeechSDK51.exe”. Run the executable to install the program.
3. Once Microsoft Speech SDK 5.1 has been installed, download and run the “SpeechServer” program from (<http://www.cs.umd.edu/hcil/audiomap/demo/SpeechServer.exe>). It should open an empty black terminal window. This must be running in the background before you run the iSonic program.
4. Download the 2003 Disability and Census Data with scatterplot, table, and map iSonic version from (<http://www.cs.umd.edu/hcil/audiomap/demo/us_states_withscatterplot.jnlp>) and run it, bypassing any warnings that may show up. If it runs correctly, it will make a chiming sound and play an introductory message.

The following is a guided tutorial for students to familiarize themselves with the tool, learn how sonification can display data, and at the end use the tool to find information about the United States. Advise the students to not use the help menu on F1 (it doesn’t seem to work correctly), but to feel free to use F10 to browse the menu and check out the different commands and shortcuts.

**Student Tutorial**

1. Once iSonic has started up, you will be on a page showing a scattergraph of some of the data. For now we will ignore this. Try using the tab key to cycle through the different displays. You should hear it announce what each page is when you change to it. There is a scatterplot, a graph, and a table, all showing census information on the United States. Listen to each page’s description and then cycle back to the map page using tab.
2. Once you are on the map page (which is now displaying “Population 21-64 years with a disability”), use the arrow keys to move between different states. You will only hear various beeps as you move around. By pressing the space bar, you can hear complete information about the state you are on.
3. Press F10 to access the menu, which contains all of the different commands and their keyboard shortcuts. Using the arrow keys, navigate left to “Information Level”, then down to “Decrease Level.” Repeat this process until it says “Information Level 0.” Try navigating the map now.
4. After you are finished with trying out information level 0, go back to “Information Level” and select “Increase Level”. Again, try navigating the map. Note what sounds it makes and what information it gives you. Increase the information level again and try information levels 2 and 3.
   1. Activity: Can you find your home state?
   2. Reflection: What seems to be the relationship between the beeping sound it makes and the number said by the program?
5. Now that you are on information level 3, you should hear a beep, the name of the state, and a number for “Population 21-64 years with a disability”. As you continue the lesson, feel free to change the information level to whichever is the most helpful for you and what you are trying to do.
   1. Activity: What state have you found that has the highest number for the current statistic?
6. Switch to the table using the tab key. It is arranged as a spreadsheet with a list of states in the leftmost column and different columns of statistics to the right. Switch to information level two or three to hear the column names every time you move into a new column.
7. Try using the arrow keys to navigate the table. If at any point you are lost, press the home key to move to the leftmost column with the state name, or spacebar to make the program announce the state name and its statistics.
   1. Activity: Find North Dakota’s number of people 65 and older without a disability, and then compare it to California’s number of people 65 and older without a disability.
   2. Activity: Once you are in the column of people 65 and older without a disability, use tab to return to the map.
8. This visual table is useful, but there’s much more that we can do with it than just moving around it with an arrow key and looking at individual cells. We’re going to try sorting some of the information now.  
     
   By pressing the ‘O’ key we can order the information in any column. By pressing it multiple times, we can cycle through unsorted (default), ascending, and descending order. At any time, you can press CTRL-O to return all columns to their default unsorted ordering.  
     
   Move to the “Population 21 to 64 years” column. Use the ‘O’ key to sort the data in ascending order, then move to the top of the spreadsheet. Find out what the 5 most populated states are.
9. A common use of geographical data is to identify relationships between geographic information and other trends. These trends are often difficult to see when you’re analyzing a spreadsheet, but are apparent once you are analyzing the data on a map. iSonic’s sonification abilities will let us listen to the geography instead of seeing it. We will use these features to analyze which area of the United States has the highest employment rate for 21 to 64 year olds with disabilities.   
     
   First, we will use the “filter” tool to select only the states we are interested in. Press the ‘F’ key to open the filter dialog (use the exit bar in the menu to close the dialog). This is arranged as a list of sliders that “filter out” certain states. Every statistic such as “Population 21 to 64 years” has its own slider that defines a minimum and maximum value for that statistic. If a state falls below the minimum or over the maximum, then it will be “unselected”. The minimum and maximum bars for every statistic default to the lowest and highest state for that statistic, so every state is included by default.   
     
   We will investigate which states have the highest employment rates for disabled people between 21 and 64 and what region those states are in. First, use the left and right arrow keys to find “Percent employed population 21 to 64 years with a disability”. Like the map and the table, we can use the space bar to get more information, including the current and maximum range. Use the up arrow key to increase the minimum bar to about 44.9%. Now only states with employment rates for the disabled above 44.9% will be selected. Close the filter dialog (F10 and arrow keys), go to the table page, move into the “Percent employed population 21 to 64 years with a disability” column, and return to the map page.  
     
   Now, using the touchscreen??? Drawing pad??? try dragging over the map (with the left mouse button down if necessary). The states that have been unselected will make soft piano-like notes when you drag over them, but those that are still selected will continue to make high pitched trilling sounds. By dragging over the map and listening to where the selected states are, you should be able to identify a large region with high employment rates for people with disabilities. Which region is it?
   1. Challenge: You can use more than one filter at a time for more complicated analysis of the map. Use the options in the filter menu and two or more filter sliders to investigate a question of your own choosing.