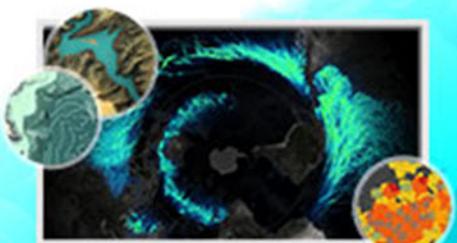


Exercise

Labels as Symbols

Section 4 Exercise 2

05/2018



Labels as Symbols

Instructions

Use this guide and ArcGIS Pro to reproduce the results of the exercise on your own.

Note: The version of ArcGIS Pro that you are using for this course may produce slightly different results from the screenshots you see in the course materials.

Time to complete

Approximately 30-40 minutes.

Software requirements

ArcGIS Pro 2.1

Introduction

On a map, labels serve many purposes. Although labels can give cartographers headaches when map space is scarce, they designate features, names, and other characteristics.

In thematic mapping, you use symbols to show differences in amount or type. You might use proportional symbols to show differences in the quantity of something as it differs from one place to another. You might use a color scheme ranging from light to dark to show changes in magnitude between areas or use different hues to show differences in categorical information.

What if you combine all of these approaches?

Labels can operate as literal symbols. For instance, you could position a label over an area to show the data value for that area. Then, there's no need to symbolize the map, as the label indicates data values and spares people from trying to interpret the data values through symbols. But maybe you could go further. You could give the labels different colors to signify certain characteristics and size them differently to show other information.

What will you learn?

In this exercise, you will create a map of proportional labels that have some additional meaning encoded through the use of color. You've previously created a series of different thematic maps in Section 3 Exercise 2 and used attribute-driven symbology, so you already have a good understanding of creating thematic maps. You've also explored labeling options in the first exercise in Section 4. Now you will put these two ideas together.

In addition, you will be introduced to the use of Arcade Expressions in ArcGIS Pro, which allows you to control many aspects of symbology by creating scripted expressions.

Step 1: Download the exercise files

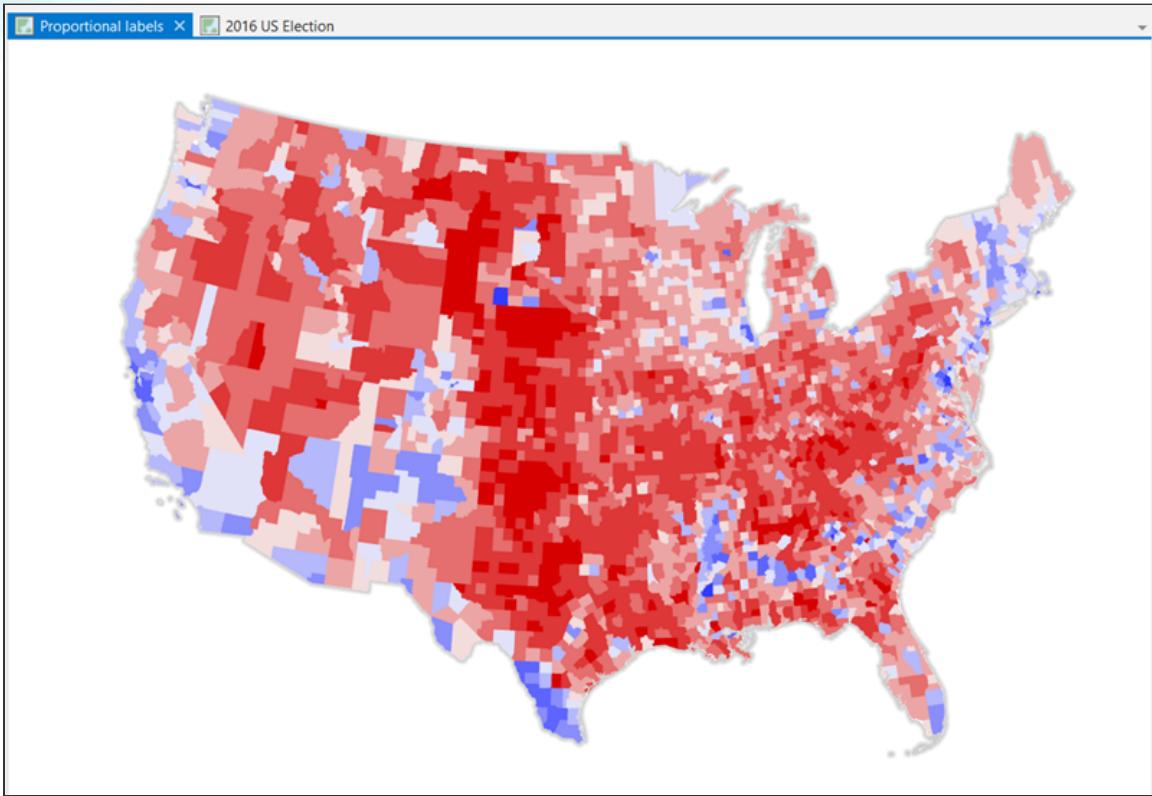
In this step, you will download the exercise files.

- a Open a new web browser tab or window.
- b Go to <https://bit.ly/2EAValg>, and download the exercise ZIP file.
- c Extract the files to a folder on your local computer, saving them in a location that you will remember.

Step 2: Open the ArcGIS Pro project

- a From the main ArcGIS Pro start page, click Open Another Project, and browse to the Sec4Ex2_LabelsAsSymbols.ppkx project package file that you saved on your computer.

This project opens with a simple polygon layer of the counties of the United States active. The Contents pane displays two views of the data: one in the Diverging Hue layer, which is currently turned on, and another in the Blended Hue layer. Although the layers are symbolized differently, they depict the same data. This is just to give you some context for what you are mapping: the share of vote for Republicans and Democrats in the 2016 presidential election. The diverging and blended hue maps are just two different ways to look at the same dataset. They show you where greater and lesser shares of votes occurred for the two parties. You won't use these maps for the final proportional labels, but they can help you understand the underlying pattern of the data.



Note: If you would like to check your work as you go through this exercise, result layers are provided in the 2016 US Election map.

- b Save your project with a name such as **Sec4Ex2_LabelsAsSymbols_<yourfirstandlastname>.aprxF** in the folder on your computer where you are saving your work.

Step 3: Explore the data

For this exercise, you will work with United States election data from 2016.

- a For the Proportional Labels map, if necessary, open the Contents pane.

Hint: On the ribbon, click View, and in the Windows group, click Contents.

- b In the Contents pane, open the attribute table for either the Diverging Hue or Blended Hue layers (both point to the same data).

Hint: In the Contents pane, right-click the layer name and choose Attribute Table.

| Diverging Hue | | | | | | | | | | | |
|---------------|---------|----------|------------|------------|------------|---------|-----------|-----------|-------------|-------------|-------------|
| | Field: | Add | Delete | Calculate | Selection: | Zoom To | Switch | Clear | Delete | | |
| # | Shape | NAME | STATE_NAME | STATE_FIPS | CNTY_FIPS | FIPS | DEM_votes | REP_votes | DEM_percent | REP_percent | Total_votes |
| 1 | Polygon | Autauga | Alabama | 01 | 001 | 01001 | 5908 | 18110 | 23.956855 | 73.435789 | 24661 |
| 2 | Polygon | Baldwin | Alabama | 01 | 003 | 01003 | 18409 | 72780 | 19.56531 | 77.351472 | 94090 |
| 3 | Polygon | Barbour | Alabama | 01 | 005 | 01005 | 4848 | 5431 | 46.66025 | 52.271415 | 10390 |
| 4 | Polygon | Bibb | Alabama | 01 | 007 | 01007 | 1874 | 6733 | 21.422039 | 76.966164 | 8748 |
| 5 | Polygon | Blount | Alabama | 01 | 009 | 01009 | 2150 | 22808 | 8.469902 | 89.851875 | 25384 |
| 6 | Polygon | Bullock | Alabama | 01 | 011 | 01011 | 3530 | 1139 | 75.090406 | 24.228887 | 4701 |
| 7 | Polygon | Butler | Alabama | 01 | 013 | 01013 | 3716 | 4891 | 42.786413 | 56.315486 | 8685 |
| 8 | Polygon | Calhoun | Alabama | 01 | 015 | 01015 | 13197 | 32803 | 27.855876 | 69.239699 | 47376 |
| 9 | Polygon | Chambers | Alabama | 01 | 017 | 01017 | 5763 | 7803 | 41.827551 | 56.633764 | 13778 |
| 10 | Polygon | Cherokee | Alabama | 01 | 019 | 01019 | 1528 | 8490 | 14.51014 | 83.87127% | 10412 |

The layer attribute table contains a number of fields, which are described below:

| Field name | Description |
|--------------------|--|
| ID | Alphanumeric code used to identify individual constituencies |
| NAME | County name |
| STATE_NAME | State name |
| STATE_FIPS | Administrative boundary ID |
| CNTY_FIPS | Administrative boundary ID |
| FIPS | Administrative boundary ID |
| DEM_votes | Number of votes cast for the Democratic party |
| REP_votes | Number of votes cast for the Republican party |
| DEM_percent | Percentage share of votes cast for Democratic party |
| REP_percent | Percentage share of votes cast for Republican party |
| Total_votes | Total number of votes cast |
| Vote_difference | Difference between votes for the two candidates |
| Winner | Surname of the winning candidate |
| Win_percent | Percentage share of vote for winning candidate |
| Continuous_percent | Percentage share recoded so Republicans are positive values and Democrats are negative values. Used to create the two maps in the Contents pane. |
| Win_votes | Number of votes for the winning candidate |
| Win_code | Numeric code that can be used for definition queries |

You can examine the values in the different fields to familiarize yourself with the data you will be working with.

- c When you are finished, close the attribute table.

Step 4: Prepare the map

First, in the Contents pane, you will make a copy of one of the mapped layers, which will form the basis of the new map layer.

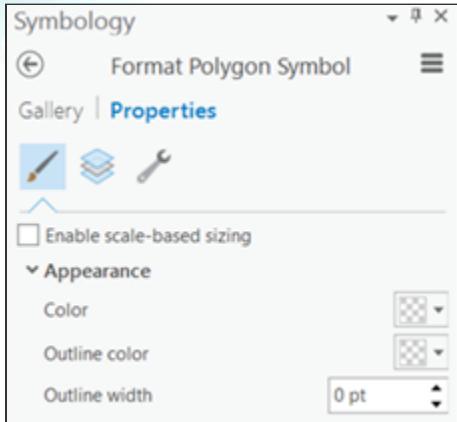
- a In the Contents pane, right-click the Diverging Hue layer and choose Copy.
- b At the top of the Contents pane, pause the mouse pointer over the Proportional Labels map, right-click, and then choose Paste.

The copied layer is added at the top of the Contents pane, and you now have two Diverging Hue layers.

- c Turn off the lower Diverging Hue layer.
- d Rename the new layer **Labels > 60%**.

Because you'll be adding many labels and do not want a conflicting background, you will create a completely neutral background for the map by symbolizing the layer with a single symbol.

- e In the Contents pane, click the Labels > 60% layer to select it.
- f From the Feature Layer contextual tab, from the Appearance tab, in the Drawing group, click the Symbology down arrow, and then choose Single Symbol.
- g In the Symbology pane, click the symbol to open the Format Polygon Symbol pane.
- h Click the Properties tab.
- i In the Appearance section, change Color to No Color, the Outline Color to No Color, the Outline Width to 0 pt, and then click Apply.



- j Close the Symbology pane.

You now have a completely blank canvas on which to make your labeled map with just the Geography and Coastal Vignette layers visible below the transparent Labels > 60% layer.

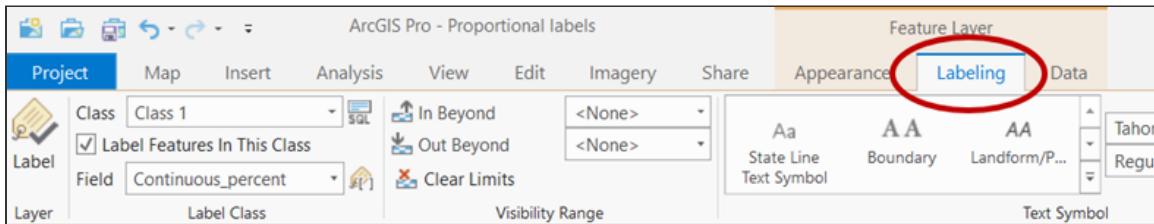
Note: If you are zoomed in, you will see the state outlines. For context, you may want to zoom out so that you see the entire United States.



Step 5: Use a query expression to filter labels on a map

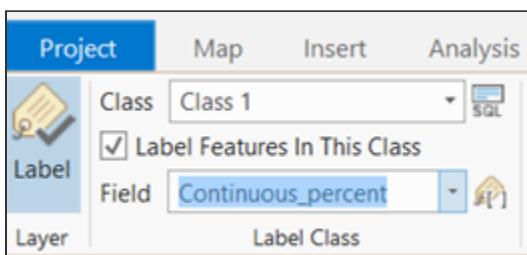
Now you can begin to add labels to your map. Then, you will use a query expression to filter the labels to display only those that meet certain criteria. This is referred to as a definition query.

- a In the Contents pane, with the Labels > 60% layer selected, click the Labeling tab.

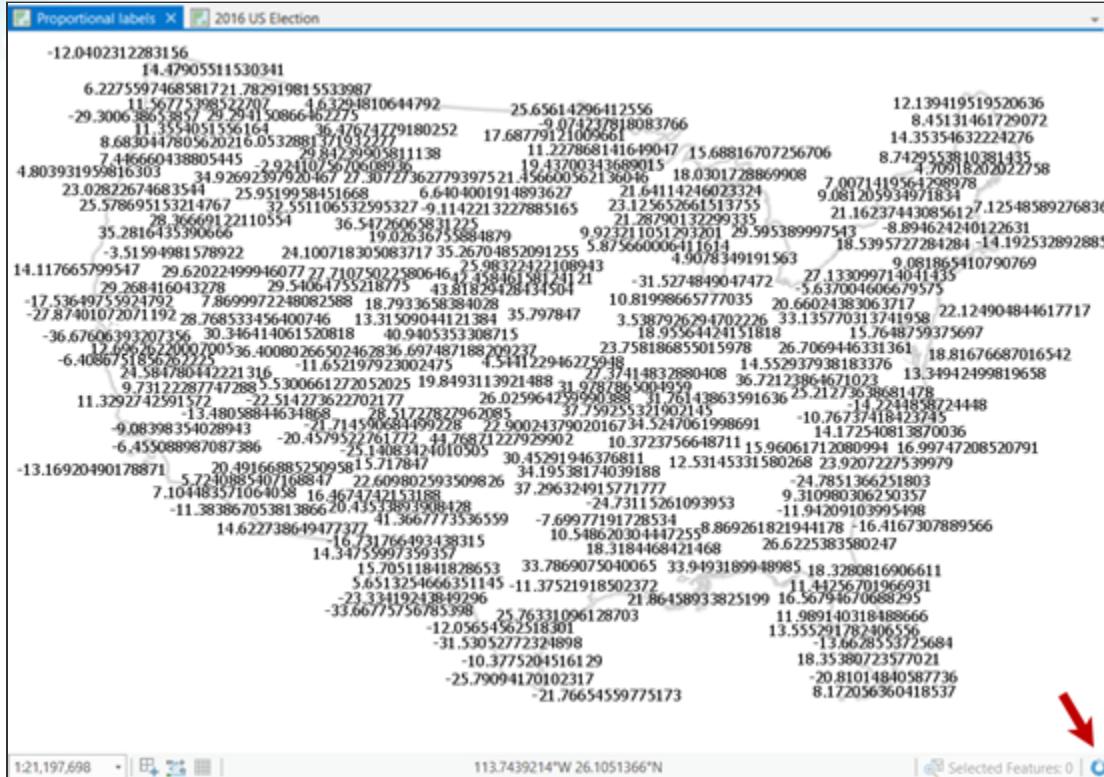


This tab provides access to the core labeling properties of your layer.

- b In the Label Class group, for Field, choose Continuous_percent from the drop-down list.
- c From the Labeling tab, in the Layer group, click Label to activate dynamic labeling on the layer.



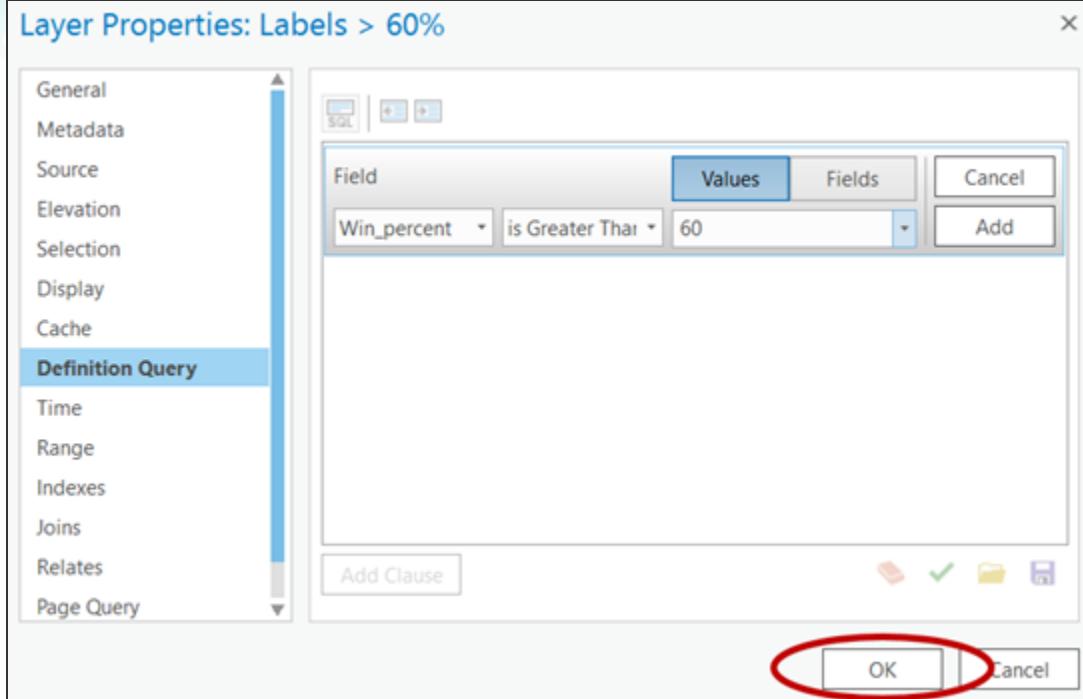
If you wait a short while (you can see the spinning Drawing icon in the bottom right of the map window that tells you ArcGIS Pro is busy drawing), your labels appear, although they're far from impressive yet.



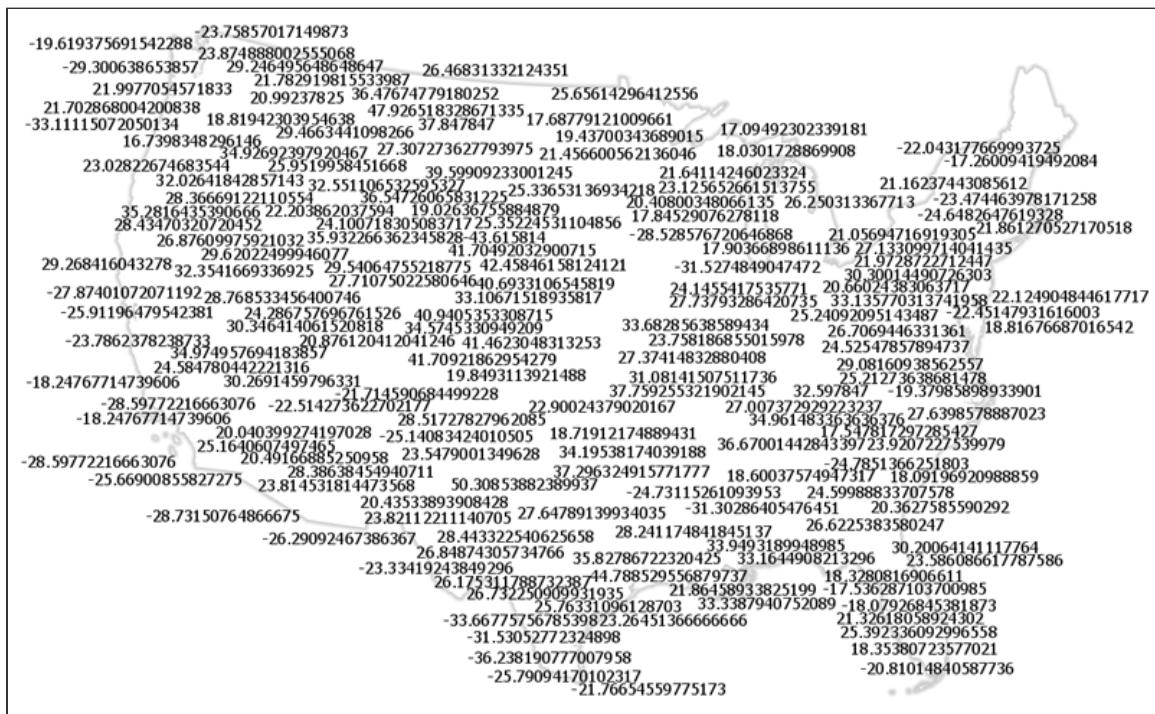
Because the drawing of many labels takes time, you can apply a definition query to work just on a subset of labels.

- d Right-click the Labels > 60% layer and choose Properties.
- e In the Layer Properties dialog box, on the Definition Query tab, click Add Clause.
- f Create a query expression to specify Win_percent Is Greater Than Or Equal To 60, click Add, and then click OK.

Note: Delete any extra numbers to the right of the decimal place so you're left with the integer 60.



Your map will now show labels only for areas that meet the criteria.



You've just used an expression to apply a filter to how the map behaves. This is a simple form of specifying an expression using the dialog box.

Using the Labeling pane, you can change the color of your labels and adjust the number of significant figures shown, using Arcade Expressions to modify the properties of the labels. This introduces you to the idea that you can build complex symbology based on different aspects of the data that cannot be implemented through the default renderers. It provides the possibility of effectively modifying symbology in any way you want over and above the out-of-the-box options.

Step 6: Use Arcade Expressions to modify the properties of labels

There are several plain text files in the folder where you extracted your exercise files. You will use the contents of these text files to help you build some Arcade Expressions to modify the properties of the labels in your map.

- a In a text editor, such as Notepad (Windows) orTextEdit (Mac), open the Sec4Ex2_Expressions1.txt file from the location on your computer where you downloaded the exercise files.

Take a deep breath...because the file contains code.

Arcade Expressions is a lightweight expression language. Like other expression languages, it can perform mathematical calculations and evaluate logical statements. It was designed specifically for creating custom visualizations and labeling expressions in the ArcGIS platform, and it provides a powerful way to customize your maps.

This isn't a course about how to code, but coding can be useful in cartography to extend out-of-the-box functionality. One of the best ways to learn is to look at some code and follow along.

Here's the code:

```
function FindText(continuousValue) {  
    if (continuousValue >= 0){  
        return Text(50 + continuousValue, '#');}  
    else {  
        return Text(50 - continuousValue, '#');}  
}  
  
"<CLR " + ">" + FindText($feature.Continuous_percent) + "</CLR>"
```

Remember that the Continuous_percent field in the attribute table of the data you're using to generate labels had both positive and negative values. The column includes the percentage

Democrats won with a negative sign in front of the value, if Democrats won the county. The column includes the percentage Republicans won, with no sign in front, if Republicans won the county.

The Continuous_percent field therefore holds the winning percentage for each county and provides a way to determine whether it was Republican or Democratic.

This is the field that you are using to make your labels and show the winning percentage by county across the map.

However, you don't want to display the negative sign on the finished map. Using logic and calculation, the code writes a short function to return values that are all in the positive range.

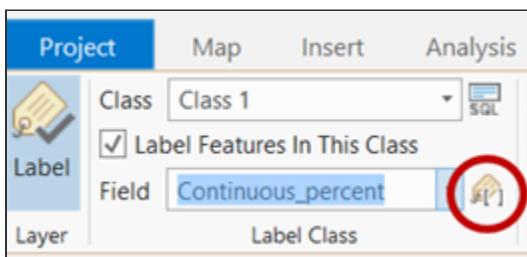
The first part of the code states that if the value in the field is assessed as positive based on the calculation `50 + continuousValue` (the Continuous_percent value), return the value and return only the numeric values before the decimal point by using a single #.

If you specify '#.#', a single decimal place would be returned, and so on. The next part of the code states that if this is false, the value must be negative.

The calculation `50 - continuousValue` (the Continuous_percent value) checks for this and returns just the integer portion of the value.

The final line of code draws the labels.

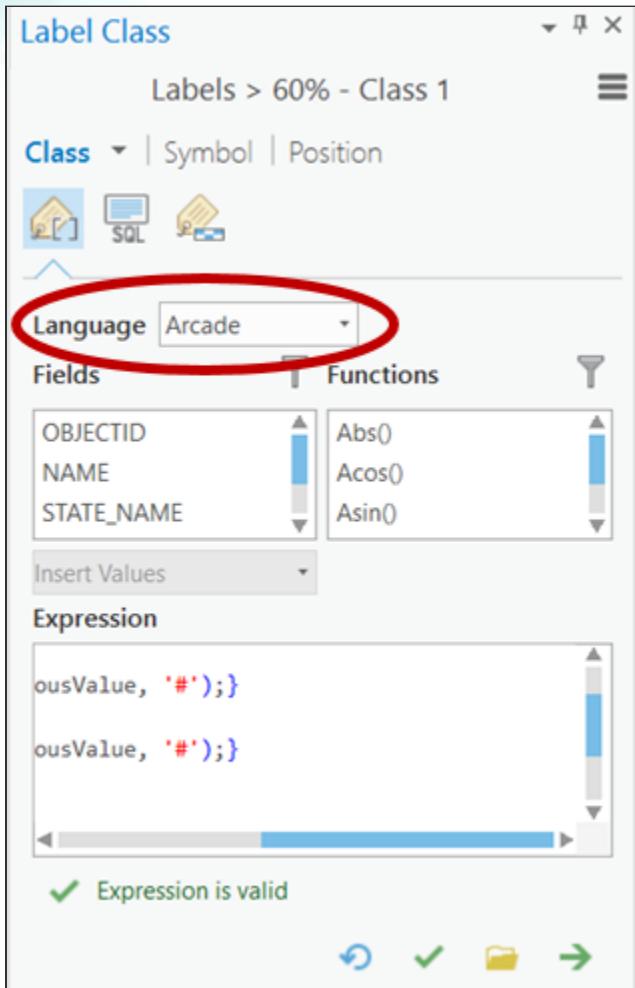
- b In the Contents pane, ensure that the Layers > 60% layer is highlighted.
- c In the Label Class group, next to the Field drop-down list, click the Expression button.



The Label Class pane opens. You can dock it so that it stays open.

Hint: Right-click the top of the pane and choose Dock.

- d From the Class tab, ensure that Language is set to Arcade.
- e In your text editor, copy the code from the Sec4Ex2_Expressions1.txt file.
- f In the Label Class pane, in the Expression code block area, paste the code, overwriting any existing content.

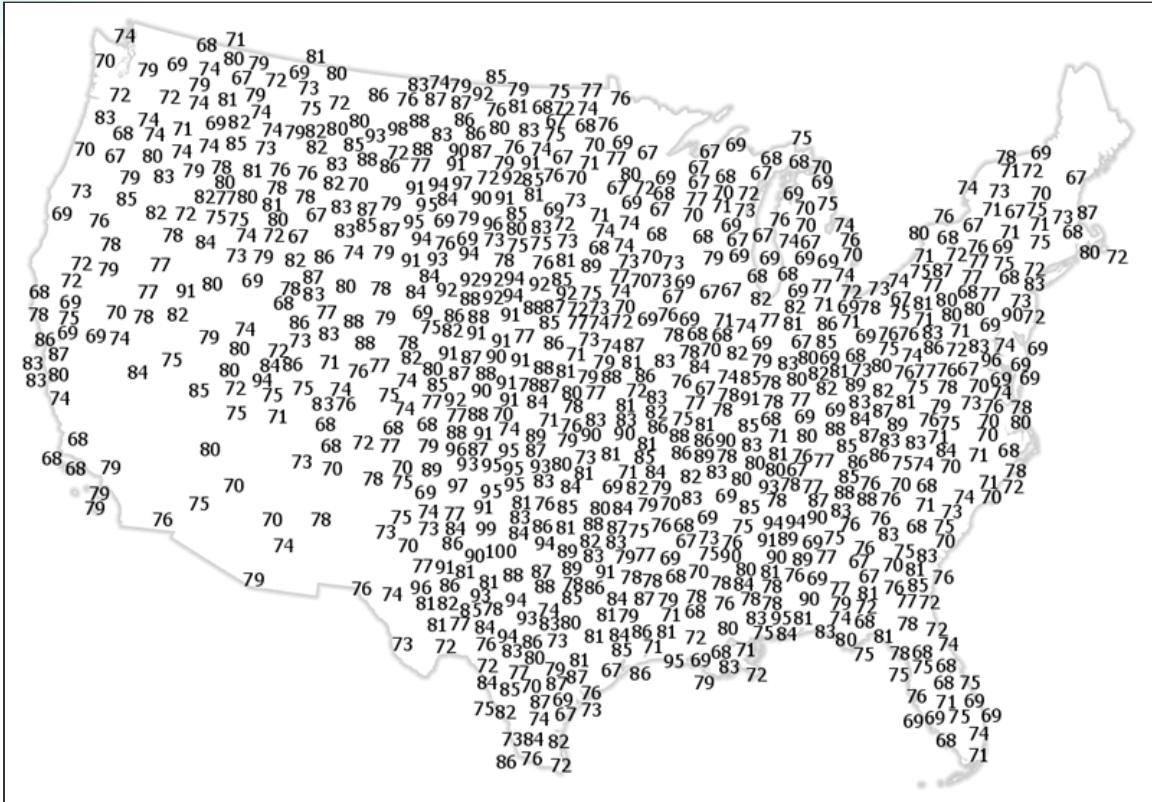


- g Underneath the code block area, click the green check (tick) symbol.

This verifies that the syntax of the code is acceptable. The expression should return as valid.

- h Click Apply.

After a few seconds, integer labels replace the previous labels and you're on your way to making a map that's useful.



- i Save your work.

Step 7: Add color to the labels

You have now used a piece of code to handle some of the rendering of the labels, but you need a way to distinguish Democratic-winning counties from Republican-winning counties. You will add a function to the code to make this distinction using color.

- a In your text editor, open the Sec4Ex2_Expressions2.txt file.

Here is the code:

```

function FindDEMColor(votePercentage)
{
if (votePercentage >= 50){
    return "red = '18' green = '15' blue='224'";
}
else{
    return "red = '0' green = '0' blue='0'";
}

function FindGOPColor(votePercentage)
{
if (votePercentage >= 50){
    return "red = '237' green = '28' blue='36'";
}
else{
    return "red = '0' green = '0' blue='0'";
}

function FindColor(continuousValue){
if (continuousValue >= 0){
    return FindGOPColor(50 + continuousValue);
}
else {
    return FindDEMColor(50 - continuousValue);
}

function FindText(continuousValue){
if (continuousValue >= 0){
    return Text(50 + continuousValue, '#');
}
else {
    return Text(50 - continuousValue, '#');
}

"<CLR " + FindColor($feature.Continuous_percent) + ">" +
FindText($feature.Continuous_percent) + "</CLR>"

```

This version of the code extends the previous one (new code is seen in a darker color). It includes the function that assesses whether the value in the Continuous_percent field is positive or negative, but there are additional lines of code and three additional functions.

- `FindDEMColor` specifies a mix of colors using the RGB scheme for values of data that are eventually returned as Democratic, blue.
- `FindREPCColor` specifies a mix of colors using the RGB scheme for values of data that are eventually returned as Republican, red.
- `FindColor` uses the same logic as `FindText` in the original code to apply the `FindREPCColor` function to positive values and the `FindDEMColor` function to negative values.

An additional command is inserted in the last line to draw the text using the specified colors.

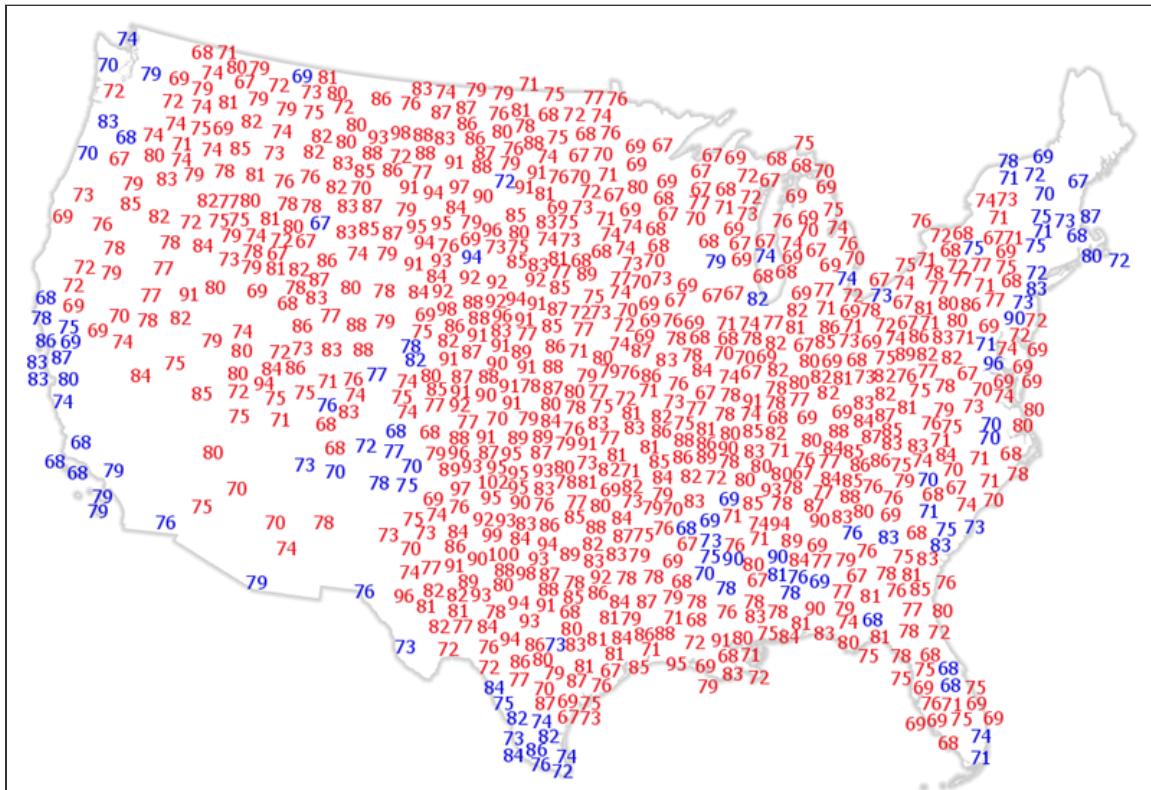
- b** In the Label Class pane, in the Expression code block area, press Ctrl + A to select the code, and then press Delete to delete it.
- c** In your text editor, copy the code from the Sec4Ex2_Expressions2.txt file.
- d** In the Label Class pane, paste the code into the Expression code block area.
- e** Validate the syntax of the code.

Hint: Click the green check (tick) symbol underneath the code block area.

The expression should return as valid.

- f** Click Apply.

The same labels appear, but they are red or blue depending on whether the Democratic or Republican candidate won the county.



Step 8: Vary label color

Strength of vote is also an important variable. The original diverging hue choropleth map used different shades of red or blue to emphasize the strength of voting for each party in the

county. You can also use Arcade Expressions to define this for the labels. Rather than specify a single blue or red for the label color, you can specify multiple colors to be used when criteria in the expression are met.

- a In your text editor, open the Sec4Ex2_Expressions3.txt file.

Here is the code:

```

function FindDEMColor(votePercentage)
{
if (votePercentage < 50){
    return "red = '185' green = '82' blue='159'";
}
if (votePercentage >= 50 && votePercentage < 55){
    return "red = '178' green = '82' blue='159'";
}
if (votePercentage >= 55 && votePercentage < 60){
    return "red = '169' green = '83' blue='160'";
}
if (votePercentage >= 60 && votePercentage < 65){
    return "red = '161' green = '83' blue='160'";
}
if (votePercentage >= 65 && votePercentage < 70){
    return "red = '151' green = '83' blue='161'";
}
if (votePercentage >= 70 && votePercentage < 75){
    return "red = '140' green = '83' blue='161'";
}
if (votePercentage >= 75 && votePercentage < 80){
    return "red = '131' green = '83' blue='162'";
}
if (votePercentage >= 80 && votePercentage < 85){
    return "red = '117' green = '83' blue='162'";
}
if (votePercentage >= 85 && votePercentage < 90){
    return "red = '100' green = '83' blue='163'";
}
if (votePercentage >= 90 && votePercentage < 95){
    return "red = '88' green = '83' blue='163'";
}
if (votePercentage >= 95){
    return "red = '18' green = '15' blue='224'";
}
else{
    return "red = '0' green = '0' blue='0'";
}

function FindGOPColor(votePercentage)
{
if (votePercentage < 50){
    return "red = '185' green = '82' blue='159'";
}
if (votePercentage >= 50 && votePercentage < 55){
    return "red = '191' green = '79' blue='146'";
}
if (votePercentage >= 55 && votePercentage < 60){
    return "red = '196' green = '76' blue='136'";
}
if (votePercentage >= 60 && votePercentage < 65){
    return "red = '200' green = '72' blue='126'";
}
if (votePercentage >= 65 && votePercentage < 70){
    return "red = '205' green = '69' blue='115'";
}
if (votePercentage >= 70 && votePercentage < 75){
    return "red = '209' green = '65' blue='105'";
}
if (votePercentage >= 75 && votePercentage < 80){
    return "red = '214' green = '61' blue='94'";
}
if (votePercentage >= 80 && votePercentage < 85){
    return "red = '220' green = '54' blue='80'";
}
if (votePercentage >= 85 && votePercentage < 90){
    return "red = '222' green = '51' blue='73'";
}
if (votePercentage >= 90 && votePercentage < 95){
    return "red = '225' green = '48' blue='67'";
}
if (votePercentage >= 95){
    return "red = '237' green = '28' blue='36'";
}
else{
    return "red = '0' green = '0' blue='0'";
}

function FindColor(continuousValue){
if (continuousValue >= 0){
    return FindGOPColor(50 + continuousValue);
}
else {
    return FindDEMColor(50 - continuousValue);
}

function FindText(continuousValue){
if (continuousValue >= 0){
    return Text(50 + continuousValue, '#');
}
else {
    return Text(50 - continuousValue, '#');
}

"<CLR " + FindColor($feature.Continuous_percent) + ">" +
FindText($feature.Continuous_percent) + "</CLR>"

```

The difference between the code in Sec4Ex2_Expressions2.txt and this code is that FindDEMColor and FindGOPColor have expanded if-then-else statements to specify different colors for values that fall within different bands. This is effectively applying a choropleth style shading scheme to the labels.

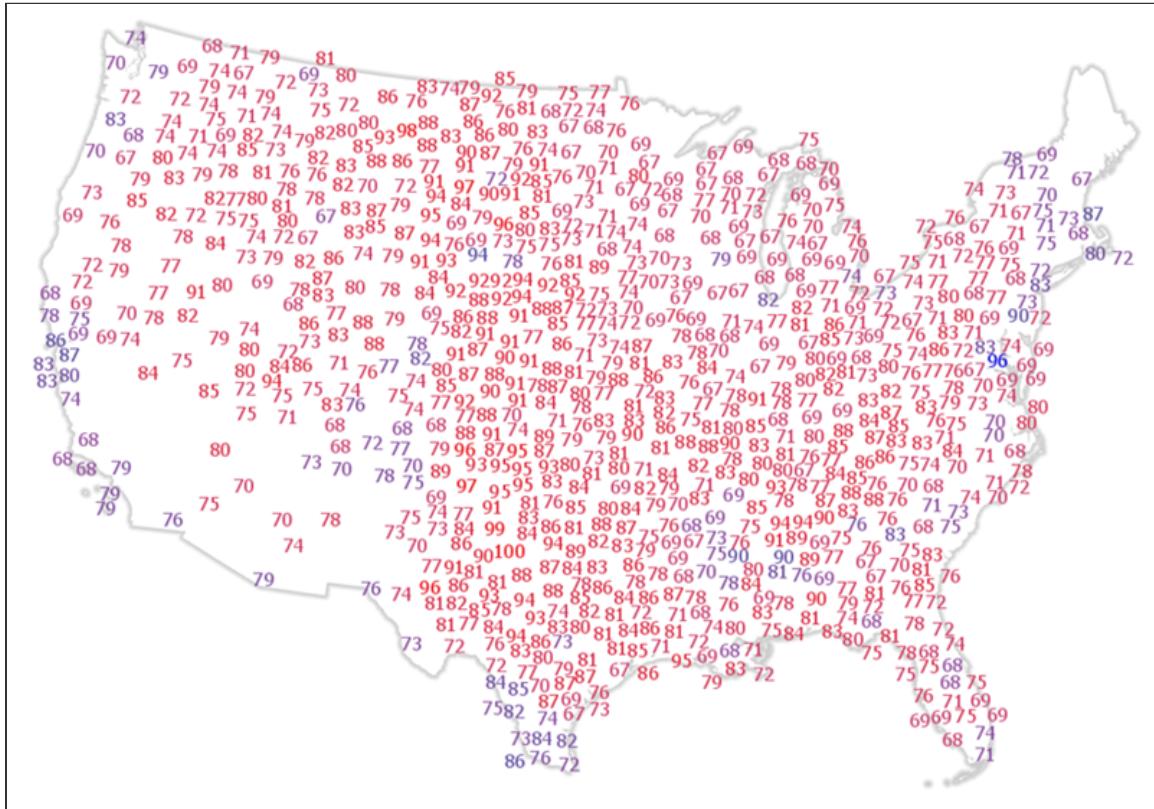
- b** In the Label Class pane, in the Expression code block area, delete the existing code.

Hint: Press Ctrl + A to select all of the code, and then delete it by pressing Delete.

- c** In your text editor, copy the code from the Sec4Ex2_Expressions3.txt file.
- d** In the Label Class pane, paste the code into the Expression code block area, and validate the syntax of the code.

Like the other expressions, this expression should be valid.

- e** Click Apply.



Your labels should now have a different value of blue or red to emphasize the strength of vote using a blended hue color scheme, where light colors represent low data values and dark colors represent high data values. For now, the labels appear only for counties with values

above 60% (because the definition query you originally set up still applies) but not for those in the mid-range.

Next, you will apply some transparency to the labels to give some more emphasis than others.

- f In your text editor, open the Sec4Ex2_Expressions4.txt file.

Here is the code:

```
function FindDEMColor(votePercentage){
var baseColor = "red = '0' green = '0' blue='255'"
if (votePercentage < 50){
    return baseColor + " alpha='0'";
}
if (votePercentage >= 50 && votePercentage < 55){
    return baseColor + " alpha='10'";
}
if (votePercentage >= 55 && votePercentage < 60){
    return baseColor + " alpha='20'";
}
if (votePercentage >= 60 && votePercentage < 65){
    return baseColor + " alpha='30'";
}
if (votePercentage >= 65 && votePercentage < 70){
    return baseColor + " alpha='40'";
}
if (votePercentage >= 70 && votePercentage < 75){
    return baseColor + " alpha='50'";
}
if (votePercentage >= 75 && votePercentage < 80){
    return baseColor + " alpha='60'";
}
if (votePercentage >= 80 && votePercentage < 85){
    return baseColor + " alpha='70'";
}
if (votePercentage >= 85 && votePercentage < 90){
    return baseColor + " alpha='80'";
}
if (votePercentage >= 90 && votePercentage < 95){
    return baseColor + " alpha='90'";
}
if (votePercentage >= 95 && votePercentage < 100){
    return baseColor + " alpha='100'";
}
else{
    return baseColor + " alpha='0'";
}

function FindGOPColor(votePercentage){
var baseColor = "red = '255' green = '0' blue='0'"
if (votePercentage < 50){
    return baseColor + " alpha='0'";
}
if (votePercentage >= 50 && votePercentage < 55){
    return baseColor + " alpha='10'";
}
if (votePercentage >= 55 && votePercentage < 60){
    return baseColor + " alpha='20'";
}
if (votePercentage >= 60 && votePercentage < 65){
    return baseColor + " alpha='30'";
}
if (votePercentage >= 65 && votePercentage < 70){
    return baseColor + " alpha='40'";
}
if (votePercentage >= 70 && votePercentage < 75){
    return baseColor + " alpha='50'";
}
if (votePercentage >= 75 && votePercentage < 80){
    return baseColor + " alpha='60'";
}
if (votePercentage >= 80 && votePercentage < 85){
    return baseColor + " alpha='70'";
}
if (votePercentage >= 85 && votePercentage < 90){
    return baseColor + " alpha='80'";
}
if (votePercentage >= 90 && votePercentage < 95){
    return baseColor + " alpha='90'";
}
if (votePercentage >= 95 && votePercentage < 100){
    return baseColor + " alpha='100'";
}
else{
    return baseColor + " alpha='0'";
}

function FindColor(continuousValue){
if (continuousValue >= 0){
    return FindGOPColor(50 + continuousValue);
}
else {
    return FindDEMColor(50 - continuousValue);
}

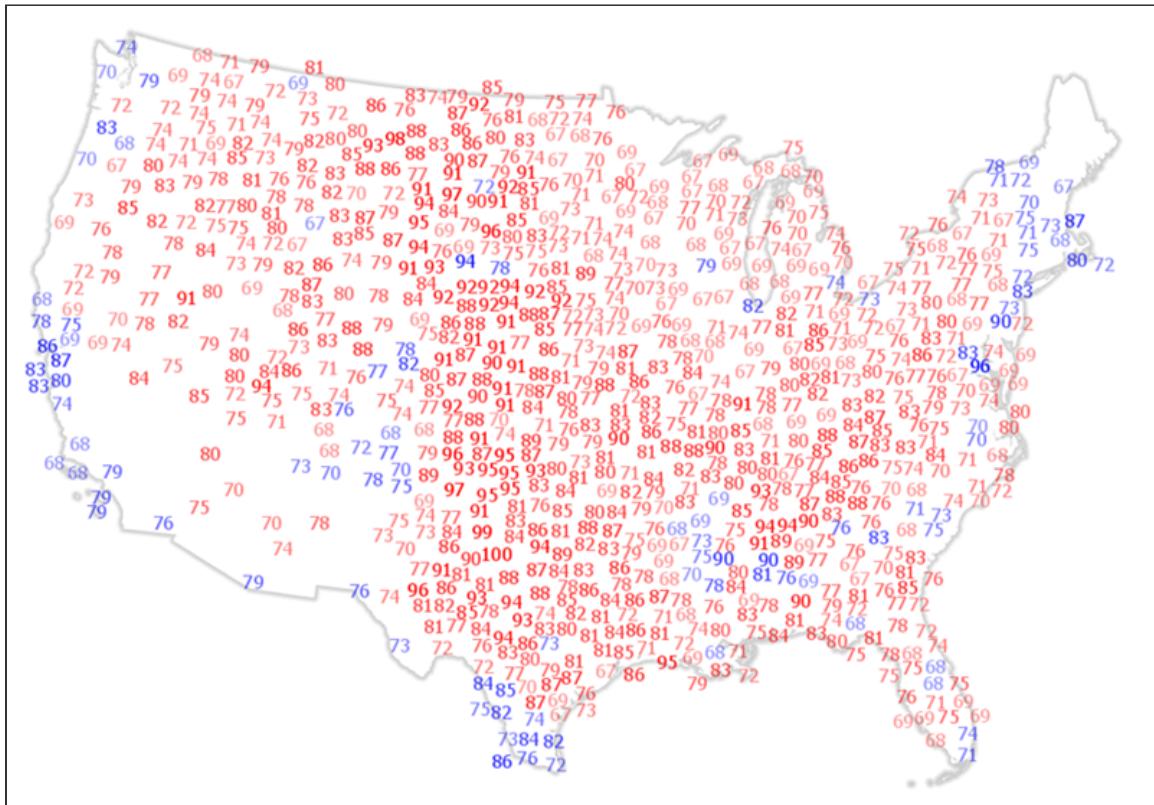
function FindText(continuousValue){
if (continuousValue >= 0){
    return Text(50 + continuousValue, '#');
}
else {
    return Text(50 - continuousValue, '#');
}

"<CLR " + FindColor($feature.Continuous_percent) + ">" +
FindText($feature.Continuous_percent) + "</CLR>"
```

- g In the Label Class pane, remove any existing code from the Expression code block.
- h In your text editor, copy the code from the Sec4Ex2_Expressions4.txt file, paste it into the Expression code block area, and validate the syntax of the code.

Like the other expressions, this expression should be valid.

- i Click Apply.



The code is virtually the same except for how color is specified. In Sec4Ex2_Expressions3.txt, a different set of RGB values was specified for each label class. A variable, baseColor, is used to set a solid red and a solid blue within each function. In this updated code, the colors are additionally modified by varying the alpha channel for each label class. This controls the amount of transparency applied to each color, which has the effect of emphasizing and de-emphasizing different label colors. Each symbol has the same red or blue, but the lower values have increased transparency applied, blending them into the background. This is applying the same technique as the value-by-alpha choropleth mapping technique you created in Section 3 Exercise 2 - Thematic Maps, except applied to labels instead of the map itself.

Step 9: Vary label size

Finally, you will change the font size using Arcade Expressions to use proportional symbol scaling to modify the labels.

- a In your text editor, open the Sec4Ex2_Expressions5.txt file.

Here is the code:

```

function FindDEMColor(votePercentage){
var baseColor = "red = '0' green = '0' blue='255'";
if (votePercentage < 50){
    return baseColor + " alpha='0'";
}
if (votePercentage >= 50 && votePercentage < 55){
    return baseColor + " alpha='10'";
}
if (votePercentage >= 55 && votePercentage < 60){
    return baseColor + " alpha='20'";
}
if (votePercentage >= 60 && votePercentage < 65){
    return baseColor + " alpha='30'";
}
if (votePercentage >= 65 && votePercentage < 70){
    return baseColor + " alpha='40'";
}
if (votePercentage >= 70 && votePercentage < 75){
    return baseColor + " alpha='50'";
}
if (votePercentage >= 75 && votePercentage < 80){
    return baseColor + " alpha='60'";
}
if (votePercentage >= 80 && votePercentage < 85){
    return baseColor + " alpha='70'";
}
if (votePercentage >= 85 && votePercentage < 90){
    return baseColor + " alpha='80'";
}
if (votePercentage >= 90 && votePercentage < 95){
    return baseColor + " alpha='90'";
}
if (votePercentage >= 95){
    return baseColor + " alpha='100'";
}
else{
    return baseColor + " alpha='0'";
}
}

function FindGOPColor(votePercentage){
var baseColor = "red = '255' green = '0' blue='0'";
if (votePercentage < 50){
    return baseColor + " alpha='0'";
}
if (votePercentage >= 50 && votePercentage < 55){
    return baseColor + " alpha='10'";
}
if (votePercentage >= 55 && votePercentage < 60){
    return baseColor + " alpha='20'";
}
if (votePercentage >= 60 && votePercentage < 65){
    return baseColor + " alpha='30'";
}
if (votePercentage >= 65 && votePercentage < 70){
    return baseColor + " alpha='40'";
}
if (votePercentage >= 70 && votePercentage < 75){
    return baseColor + " alpha='50'";
}
if (votePercentage >= 75 && votePercentage < 80){
    return baseColor + " alpha='60'";
}
if (votePercentage >= 80 && votePercentage < 85){
    return baseColor + " alpha='70'";
}
if (votePercentage >= 85 && votePercentage < 90){
    return baseColor + " alpha='80'";
}
if (votePercentage >= 90 && votePercentage < 95){
    return baseColor + " alpha='90'";
}
if (votePercentage >= 95){
    return baseColor + " alpha='100'";
}
else{
    return baseColor + " alpha='0'";
}
}

function FindSize(totalVotes)
{
if (totalVotes < 16187){
    return "7";
}
if (totalVotes >= 16187 && totalVotes < 43656.999999){
    return "9";
}
if (totalVotes >= 43657 && totalVotes < 85764.999999){
    return "10";
}
if (totalVotes >= 85765 && totalVotes < 143827.999999){
    return "11";
}
if (totalVotes >= 143828 && totalVotes < 219676.999999){
    return "12";
}
if (totalVotes >= 219677 && totalVotes < 325219.999999){
    return "13";
}
if (totalVotes >= 325220 && totalVotes < 464183){
    return "15";
}
if (totalVotes >= 464183 && totalVotes < 716852.999999){
    return "17";
}
if (totalVotes >= 716853 && totalVotes < 1185477.999999){
    return "20";
}
if (totalVotes >= 1185478 && totalVotes < 2330793){
    return "24";
}
}

function FindColor(continuousValue){
if (continuousValue >= 0){
    return FindGOPColor(50 + continuousValue);
}
else {
    return FindDEMColor(50 - continuousValue);
}
}

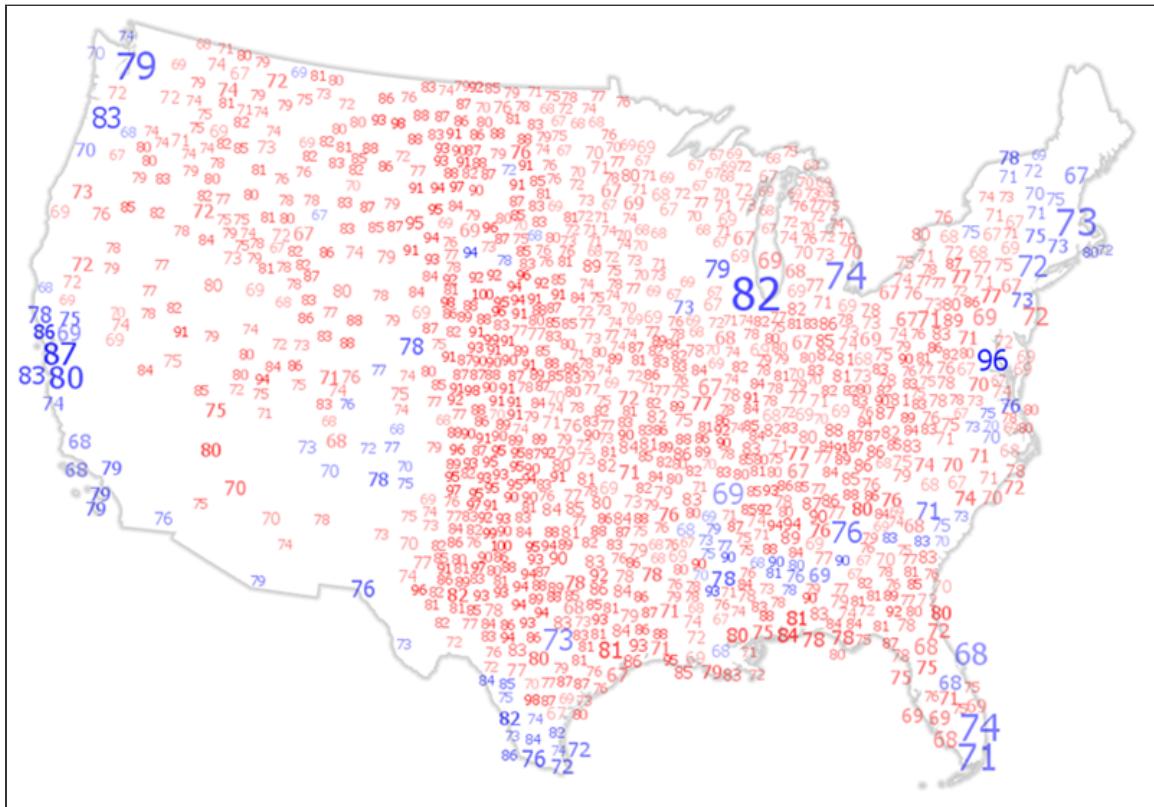
function FindText(continuousValue){
if (continuousValue >= 0){
    return Text(50 + continuousValue, '#');
}
else {
    return Text(50 - continuousValue, '#');
}
}

"<FNT size = '" + FindSize($feature.Total_votes) + ">" + "<CLR " +
FindColor($feature.Continuous_percent) + ">" +
FindText($feature.Continuous_percent) + "</CLR></FNT>"

```

This version of the code has an added function that applies different font sizes to different labels depending on how they are specified in the `FindSize` function. The 10 specified classes return font sizes between 7 and 24 points.

- b** In the Label Class pane, in the Expression code block area, select the existing code and delete it.
- c** In your text editor, copy the code from the Sec4Ex2_Expressions5.txt file.
- d** In the Label Class pane, paste the code into the Expression code block area, validate the syntax of the code, and click Apply.



Your labels should now take on a different value of blue or red to emphasize the strength of vote using a diverging hue color scheme. They should also now differ in size based on the total number of votes cast for the candidate.

- e** Close the Label Class pane and save your map.

You've now created a multivariate proportional symbol map using labels. Hue represents the political party. Value represents the strength of the vote. Size represents actual numbers of

votes. A lot of information is encoded into the symbol, and the symbol itself is literal—placing the data on the map.

Step 10: Manage visibility of labels based on scale

You have mapped labels for counties with values above 60%. Part of the reason for this was to assist with the speed of drawing, but there is another important cartographic reason. At small map scales, it will be impossible to show all labels on the same map because there are more than 3,000 counties and associated labels.

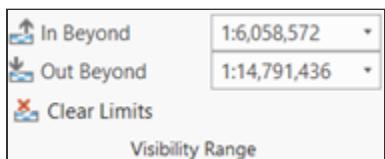
There are many approaches to reduce clutter, such as allowing the automated placement engine in ArcGIS Pro (Maplex) to declutter through selective positioning. However, this will omit labels due to their proximity with other nearby labels. Such a computational approach ignores the relative importance of a label cartographically. You would rather see more important labels consistently appearing at smaller scales and the rest progressively appearing as you zoom in to larger scales.

You will achieve that by using multiple layers of data, definition queries, and visibility range settings.

- a In the Contents pane, with the Labels > 60% layer highlighted, click the Appearance tab.
- b In the Visibility Range group, in the In Beyond field, type **1:6,058,572**, and then press Enter to set the scale.

This sets a value roughly midway between two of the standard web map zoom scales (which you used in Section 3 Exercise 2 - Thematic Maps). It ensures that when the map is published as a web map, the map will be visible as a user settles on a particular zoom scale. It will turn off at the point when another scale-based rendering becomes visible.

- c In the Out Beyond field, type **1:14,791,436**, and then press Enter to set the scale.



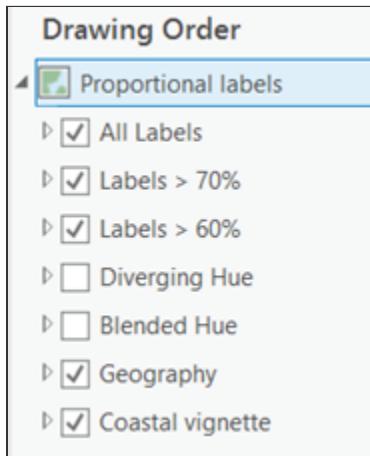
This layer will now appear only between those two zoom scales. You can zoom in and out of the map beyond the two scale extremities to see this.

Note: It may take a moment for the labels to draw.

You will now create another layer to manage visibility at even smaller scales.

- d In the Contents pane, right-click the Labels > 60% layer and choose Copy.

- e At the top of the Contents pane, right-click the Proportional Labels map item and choose Paste.
- f Rename the top layer **Labels > 70%**.
- g In the Contents pane, paste another copy of the layer and rename it **All Labels**.



- h Highlight the Labels > 70% layer, and then click the Appearance tab.

Again, you will set a zoom scale to manage visibility.

- i In the Visibility Range group, for In Beyond, type **1:14,791,437**, and then press Enter to set the scale.
- j For Out Beyond, use the drop-down list to set the scale to <None>.
- k Right-click the Labels > 70% layer and open the Layer Properties dialog box.

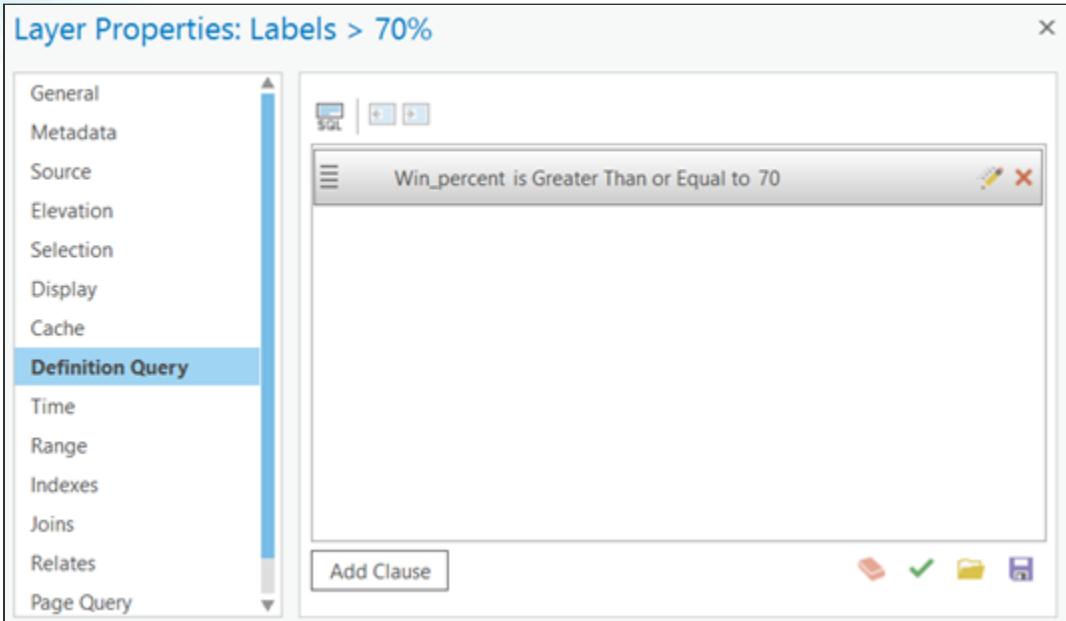
Next, you will edit the definition query to define which labels are visible.

- l From the Definition Query tab, click the pencil icon  to the right of the existing clause to edit it.

Hint: The pencil icon appears when you hover your pointer over the existing clause.

- m Modify the expression query to specify Win_percent Is Greater Than Or Equal To 70, click Update, and then click OK.

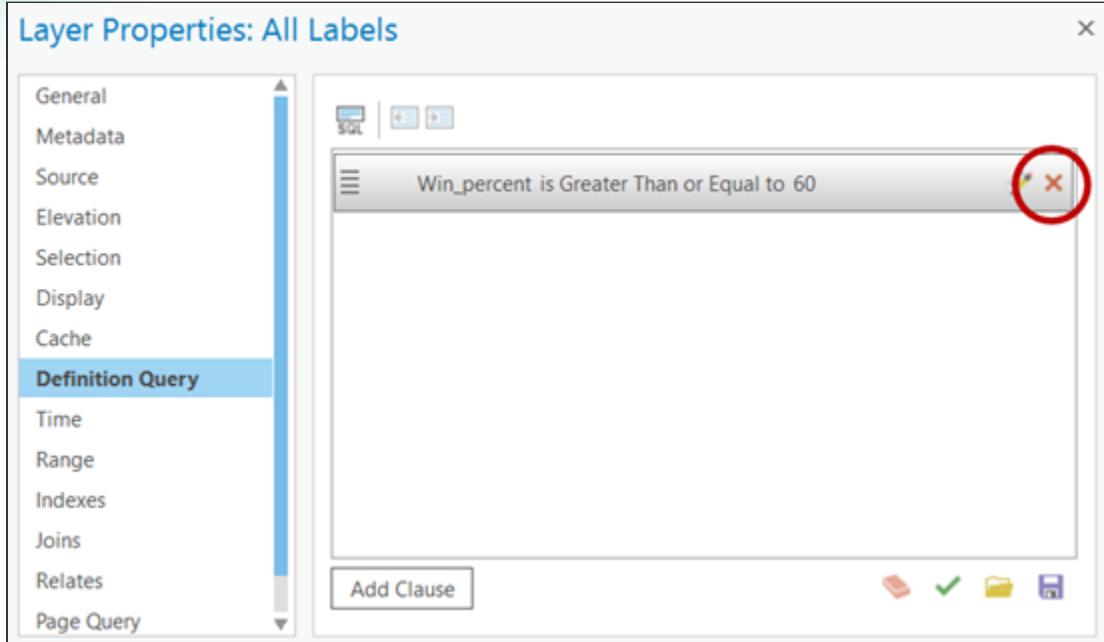
Note: Delete any extra numbers to the right of the decimal place so you're left with the integer 70.



The Labels > 70% layer now draws only when the scale is 1:14,791,437 or smaller and draws labels only for values of the percentage share of votes greater than 70%. Now you will set visibility for the All Labels layer.

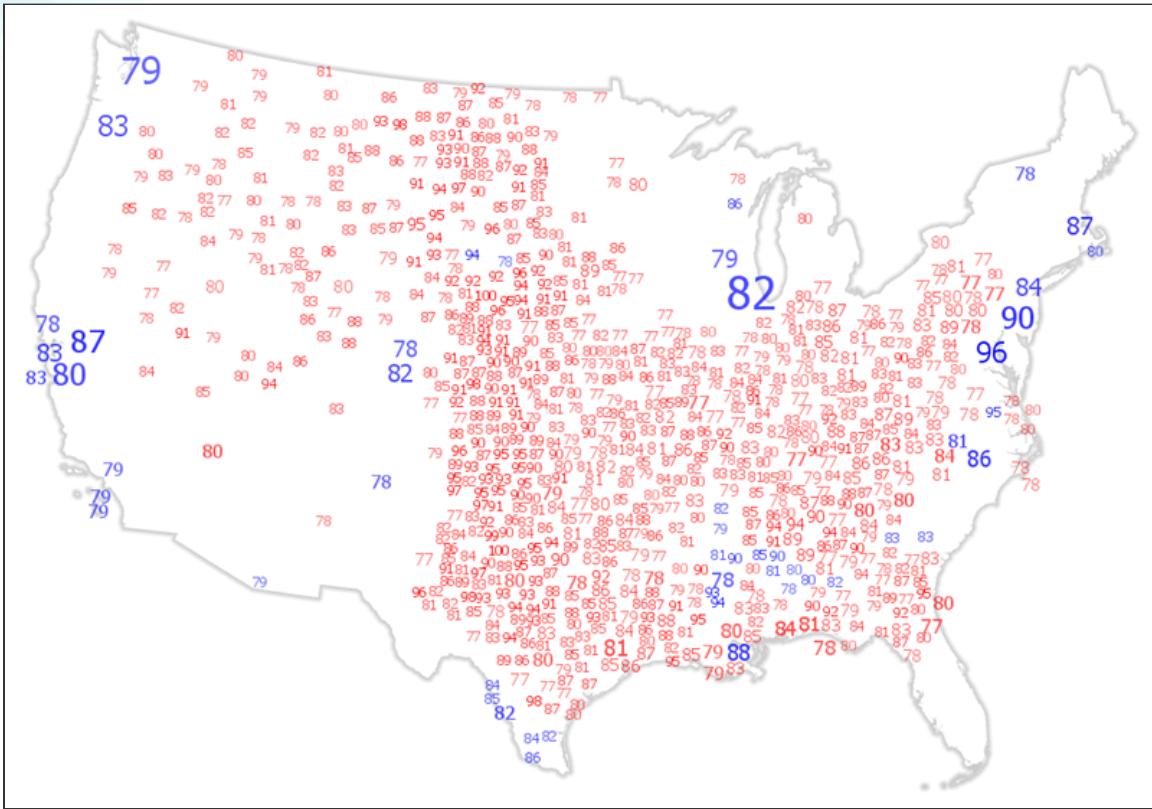
- n In the Contents pane, highlight the All Labels layer, and then click the Appearance tab.
- o For In Beyond, set the scale to <None>.
- p For Out Beyond, type **1:6,058,573**, and then press Enter to set the scale.
- q In the Contents pane, double-click the All Labels layer to open the Layer Properties dialog box.
- r From the Definition Query tab, pause your mouse pointer over the existing clause and click the red X icon to remove the existing Win_percent is Greater Than or Equal to 60 clause.

Hint: The red X icon appears when you hover your pointer over the existing clause.



- s Click OK to close the Layer Properties dialog box.

The All Labels layer now draws only when the scale is 1:6,058,573 or larger. Because the map is at a scale sufficient enough to allow enough space for all labels, all labels are drawn.



You are using visibility ranges to change the amount of detail on the map and to make the data legible at different scales. You can use this approach whenever you need to have some control over the scales at which information appears on the map.

- t** Zoom in and out of the map to see how the layers turn on and off at different times.
- u** When you are finished, save your map.

Step 11: Publish a tile layer

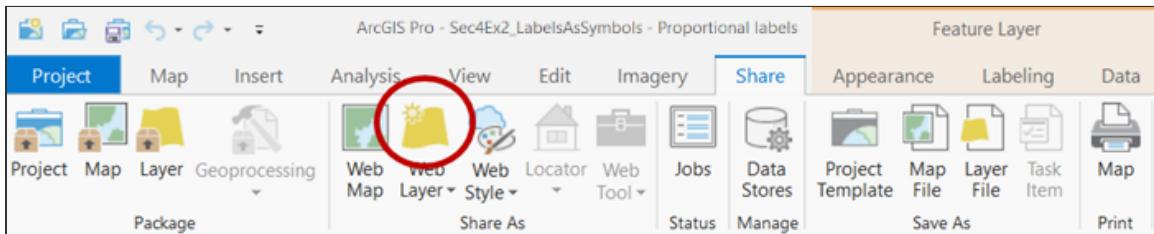
From the many ways to publish a map, you may prefer to make a layout and print it. You can use any of the techniques that you learned in Section 1 Exercise 3 - Make a Map to create a layout.

Here, you will explore a way to publish the map to your ArcGIS Online account as a web map using the technique you may have tried as a stretch goal in Section 3 Exercise 2 - Thematic Maps.

When you have a lot of complex detail in the map, a very efficient way to publish is to create cached raster tiles. This works well for this kind of map, which has a lot of complex symbology

set up using Arcade Expressions. You're effectively going to make a picture of your map and publish the resulting tiles. It will draw far more rapidly as a web map than alternative options.

- a From the Share tab, in the Share As group, click the Web Layer button (not the drop-down arrow) to open the Share As Web Layer pane.



- b In the Share As Web Layer pane, from the General tab, confirm that the Name field is set to Proportional_labels.
- c Add your first and last name to the end of the file name so that it is unique.

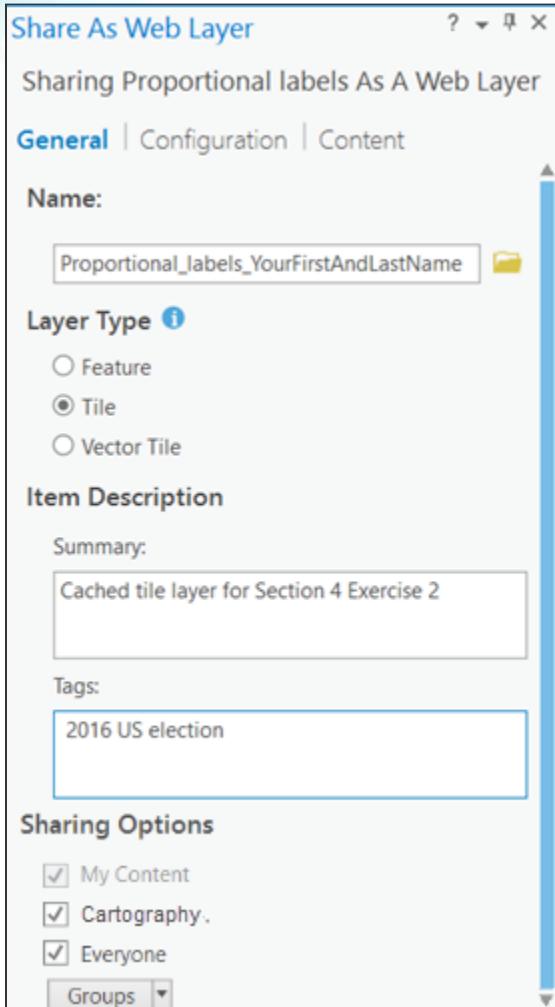
Note: Because all students in this class are creating a web layer for this exercise, the name of your web layer must be unique to avoid overwriting other people's work. Make a note of the name you typed, as you will need it to find the layer in ArcGIS Online.



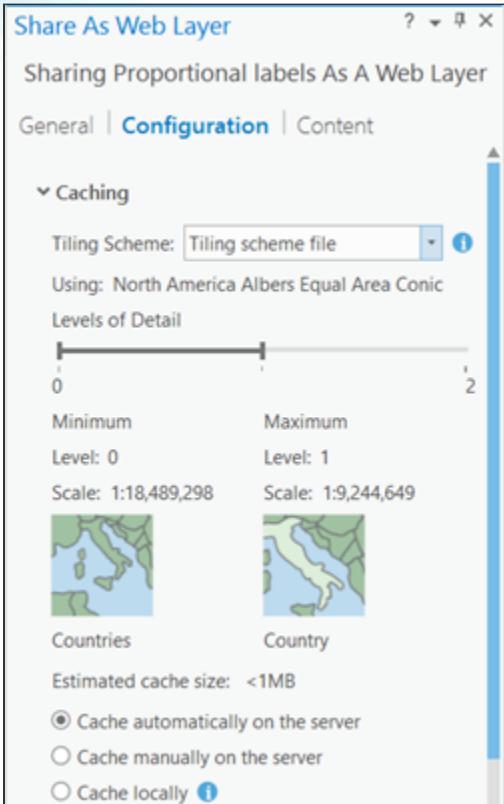
- d For Layer Type, choose Tile.

Next, you will add a summary item description and tags to help you and others find this layer, either in your organization or the general public, depending on how you want it shared. Tags also help group different types of items together, such as maps, map layers, or applications, so they can easily be searched.

- e For Summary, type **Cached tile layer for Section 4 Exercise 2**, and for Tags, type **2016 US election** and then press Enter. You can also add additional tags, if you want.
- f For Sharing Options, select Everyone.

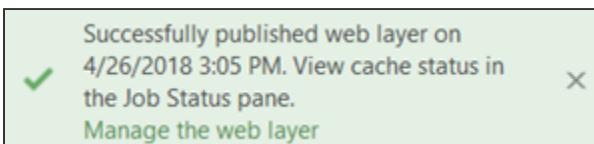


- g At the top of the pane, click the Configuration tab.
- h For Tiling Scheme, choose Tiling Scheme File from the drop-down list.
- i Browse to the location of the Sec4Ex2_Proportional_Text_Tiling_Scheme.xml file in your exercise folder.
- j Select the file, and then click OK.



- k In the Share As Web Layer pane, leave all other settings as they are, and then click Publish.

The process may take a few minutes. When the layer is successfully published, you will see a green message at the bottom of the Share As Web Layer pane.

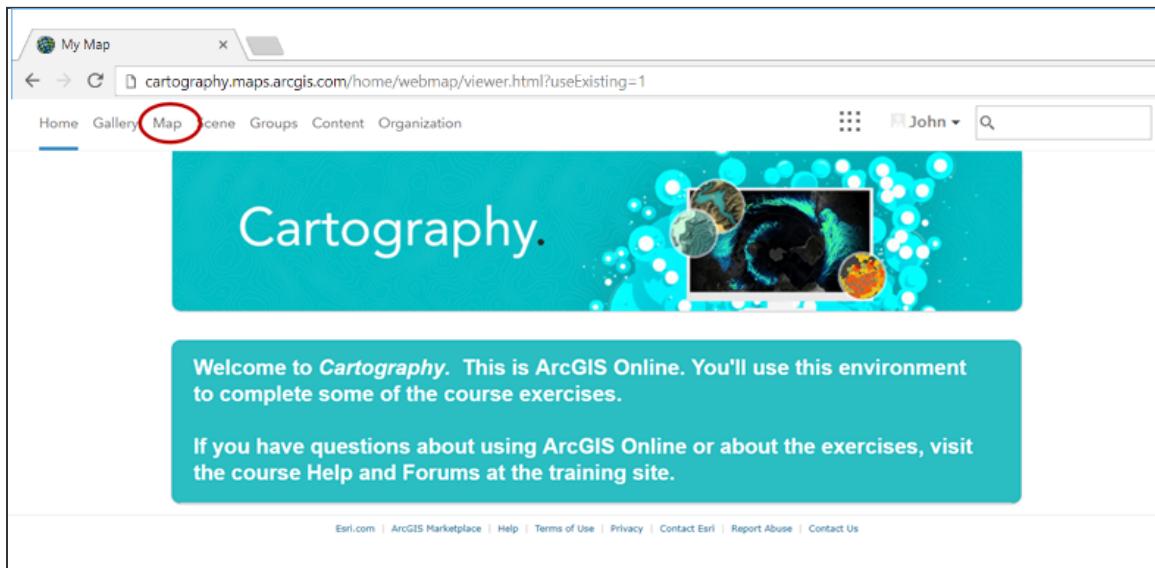


This publishes a cached raster map at three scales (in the Albers Equal Area Conic projection) to your ArcGIS Online account. We don't want to use Web Mercator because it's inappropriate for a thematic map of a large area like the United States (where equal area is important for interpretation). These projection and scale settings are specified in the XML file that ArcGIS Pro uses to publish. In the Section 3 Exercise 2 - Thematic Maps stretch goal, you may have made one of these XML files yourself, but here, it's provided for you. If you wanted to modify the parameters, you could go back to Section 3 Exercise 2 - Thematic Maps and recall how you made one of these XML specifications files.

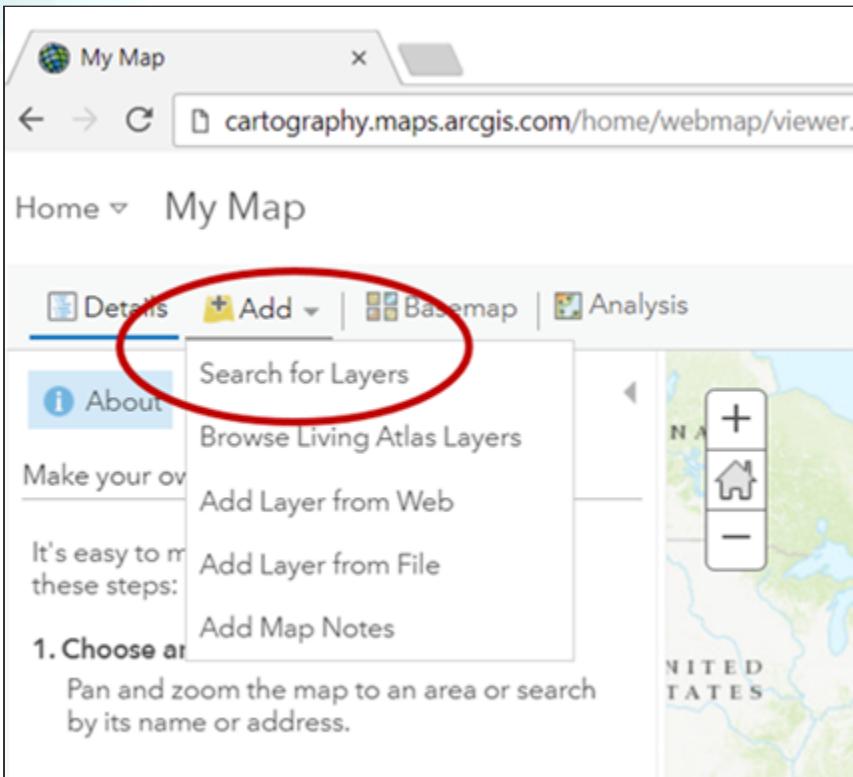
Next, you will sign in to your ArcGIS Online account and add the tile layer to a map.

Step 12: Add a tile layer to a web map

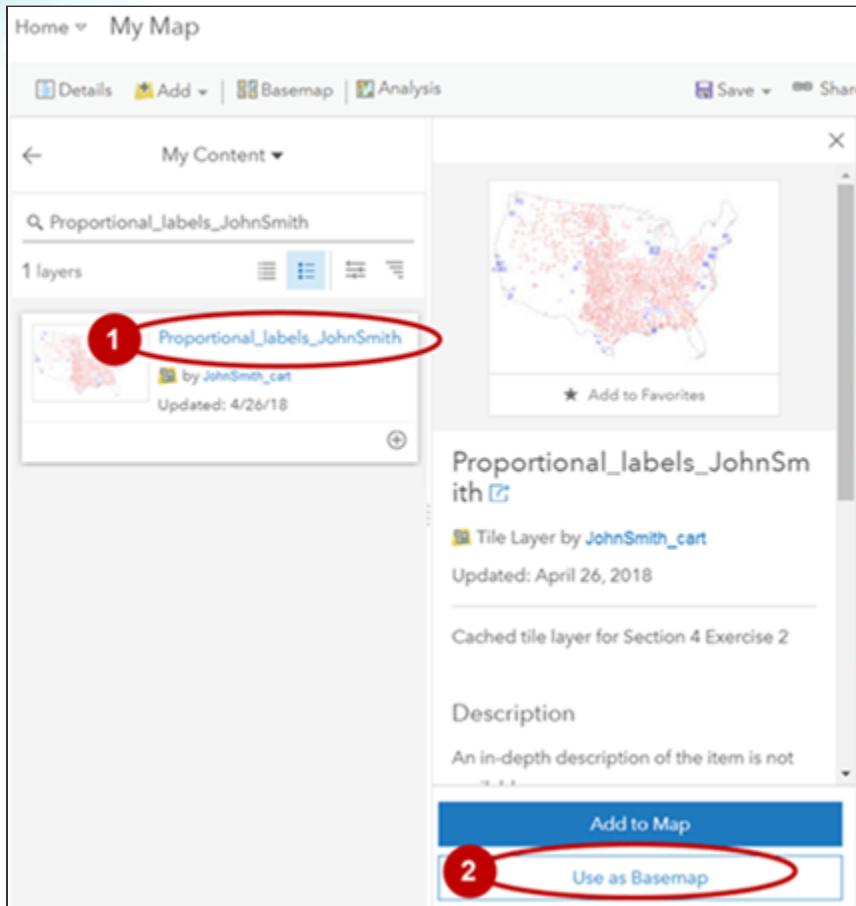
- a Open a new private or incognito web browser and go to www.arcgis.com.
 - b Sign in using your credentials for this course (username includes _cart), as explained in Section 1 Exercise 2 - Getting Started with ArcGIS Online.
- Hint: In ArcGIS Pro, you can find the ArcGIS username you are currently using by clicking on your name at the top right of the ArcGIS Pro window. You will use the same username to sign in to ArcGIS Online.*
- c At the top of the ArcGIS Online organization home page, click Map to open a new map.



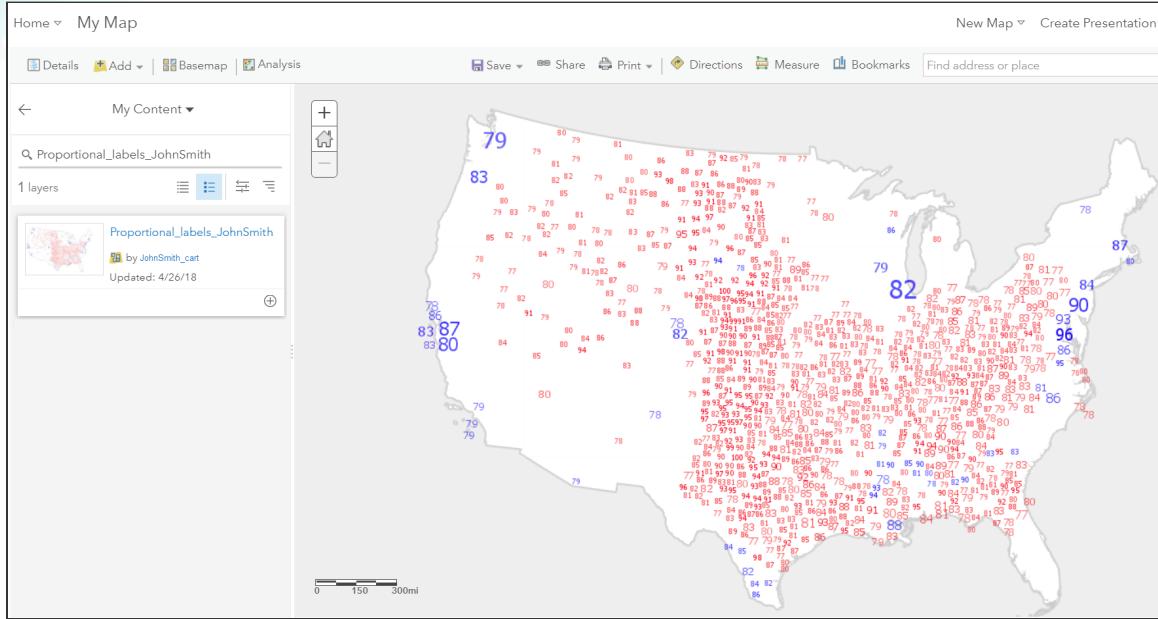
- d Click Add, and then click Search For Layers.



- e In the Search For Layers pane, type the name of your tile layer (for example, **Proportional_Layers_<YourFirstAndLastName>**), and then press Enter to search for your newly created cached tiles layer.
- f You should see one result.
- f Avoid just adding the layer to the map. Because it's in a different projection, you need to click the layer name, and then choose Use As Basemap.



- g Remember to save your web map in ArcGIS Online before exiting.



- h** At the top of the ArcGIS Online window, click Save, and then choose Save As from the drop-down list.
- i** Give your web map a title, tags, and a summary, and then click Save Map.

Save Map

| | |
|---|---|
| Title: | My Election Basemap |
| Tags: | election X basemap X MOOC X Add tag(s) |
| Summary: | A basemap for the Cartography. MOOC Sec4Ex2 |
| Save in folder: | JohnSmith_cart |
| <input type="button" value="SAVE MAP"/> <input type="button" value="CANCEL"/> | |

From here, you can create pop-ups and publish your web map in a web map app (see the stretch goal).

- j** When you are finished, sign out of ArcGIS Online, and close the incognito window.

Hint: In the upper right corner of the ArcGIS Online window, click your name and choose Sign Out.

- k** Back in ArcGIS Pro, save the project.
- I** If you are continuing to the stretch goals, leave ArcGIS Pro open; otherwise, exit ArcGIS Pro.

Conclusion

You've made a Proportional Labels map using some code built with Arcade Expressions. This introduces you to a powerful way to modify symbols and labels beyond the defaults and the options in the various symbology and labeling panes.

Although this course isn't about teaching you how to code, learning a little about how to create expressions can greatly expand your ability to modify the rendering of your map data. It allows you to go beyond the defaults of what is offered out-of-the-box.

Finally, you've published your map as a web map. If you follow the stretch goals, you will also make an app in ArcGIS Online that includes pop-ups to give people access to meaningful results.

Stretch Goals

- Create a pop-up in ArcGIS Pro that provides details about the election results when you click the map.
- Publish your web map as an app using [Web AppBuilder for ArcGIS](https://bit.ly/2GRoqdy) (<https://bit.ly/2GRoqdy>). This will create a cleaner version of your web map suitable for sharing with others. Remember that one of the key ideas behind cartography is to omit detail to clarify the message. So, see how minimal you can make the web map app's layout. Because the labels are actually on the map, you may simply need a small information box to explain what it is that people are seeing.

Hint: Review Section 3 Exercise 2 - Thematic Maps for some details.

Use the Lesson Forum to post your questions, observations, and map examples.