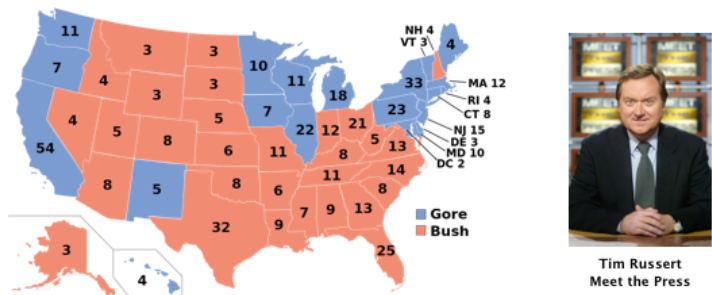


Purple America

Write a program to visualize U.S. presidential election results.

Historical context. During coverage of the 2000 presidential election, Tim Russert coined the political terms *red states* and *blue states* to refer to states that predominantly vote for the Republican presidential candidate (red) or the Democratic presidential candidate (blue). The news media use red-state blue-state maps, such as the one below, to display election results.



The problem. On this assignment, you will create more refined (and less polarizing) *choropleth maps* by mashing up two sources of data: geographic boundary data and election return data.

Geographic data. We supply geographic data (sourced from the [U.S. Census](#)) that describes the boundary of each state and county in the United States.

- The first line consists of four real numbers, representing the bounding box of the region. The first two numbers are the minimum longitude and latitude values; the second two numbers are the maximum longitude and latitude values.
- The next line is an integer that specifies the number of subregions.
- There is one block for each subregion (with a blank line separates blocks):
 - The first line of a block is an integer *N* that specifies the number of points in the polygon describing the subregion.
 - The second line of a block is a string that is the name of the subregion.
 - The third line of a block is a string that is the name of the region.
 - The remaining *N* lines of the block describe the polygonal boundary, given as *N* pairs of real numbers, representing the longitude and latitude coordinates.

% more USA.txt	% more NJ.txt	% more USA-county.txt
-124.731216 24.544102	-75.560143 38.928589	-124.731216 24.544102
-66.980385 49.384365	-73.894402 41.357330	-66.980385 49.384365
104	21	3206
Alabama	Atlantic	Autauga
USA	NJ	AL
498	127	118
-88.200027 34.995548	-74.877563 39.608414	-86.916969 32.664028
-88.202919 35.007942	-74.736694 39.729721	-86.816589 32.659988
-87.984886 35.005848	-74.676102 39.691162	-86.713409 32.661602
...
-88.153519 34.921185	-74.857353 39.420528	-86.916809 32.649662
-88.176064 34.962433	-74.856087 39.424465	-86.917458 32.653877
-88.187088 34.974182	-74.985443 39.514725	-86.921387 32.655415
...
Wyoming	Warren	Weston
USA	NJ	WY
68	121	11
-111.048203 44.474144	-75.120819 40.968208	-105.078743 44.176205
-111.054558 44.666336	-75.122986 40.970055	-104.375000 44.181641
-111.054420 45.001392	-75.131744 40.969185	-104.054001 44.180401
...
-111.043846 43.315800	-75.095901 40.924057	-105.081238 43.592144
-111.044724 43.501213	-75.112061 40.948017	-105.078255 43.827049
-111.046272 43.983456	-75.118141 40.952927	-105.080872 43.826954

We note that the number of subregions in [USA.txt](#) is not 50 for two reasons: first, we do not include either Alaska or Hawaii; second, we include an entry for each polygonal subregion—some states (such as Michigan, Florida, and California) comprise several polygonal subregions.

Election return data. We supply election return data (sourced from [Dave Leip's Atlas of U.S. Presidential Elections](#)) that describes the results for each presidential election, by state and county. Each row consists of four fields, separated by commas: the name of a subregion, the number of votes for the Republican candidate, the number of votes for the Democratic candidate, and the number of votes for the Independent (or third party) candidate.

% more USA2012.txt	% more NJ2012.txt
Alabama,1255925,795696,22717,	Atlantic,46522,65600,1222,
Alaska,164676,122640,13179,	Bergen,169070,212754,4166,
Arizona,1233654,1025232,47673,	Burlington,87401,126377,2561,
Arkansas,647744,394409,27315,	Camden,69476,153682,2791,
California,4839958,7854285,360745,	Cape May,25781,21657,655,

...
Virginia,1822522,1971820,60147,
Washington,1290670,1755396,99892,
West Virginia,417655,238269,14743,
Wisconsin,1407966,1620985,39483,
Wyoming,170962,69286,8813,
...
Salem,14334,14719,570,
Somerset,66603,74592,1985,
Sussex,40625,26104,1465,
Union,68314,139752,2022,
Warren,25744,18745,926,

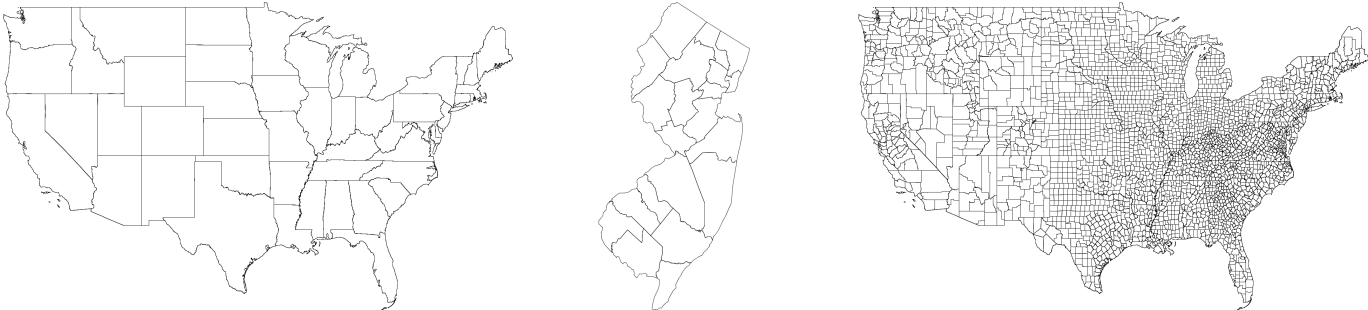
You can download all of the geometric and election return data files collectively as [purple-america-data.zip](#).

Part 1. Write a program `White.java` that takes the name of a region as the command-line argument and produces an outline map, as in the examples below:

% java White USA

% java White NJ

% java White USA-county



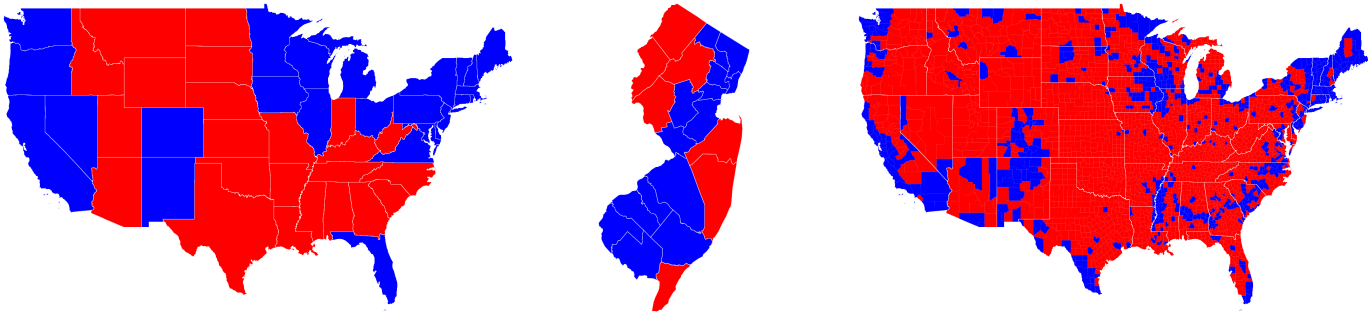
For simplicity, draw the point with longitude x and latitude y at location (x, y) in the plane. Use the bounding box of the region to determine the part of the plane to display in the drawing window and rescale the coordinates accordingly.

Part 2. Write a program `RedBlue.java` that takes two command-line arguments (the name of the region and the year of the election) and produces a red-state blue-state map, as in the examples below:

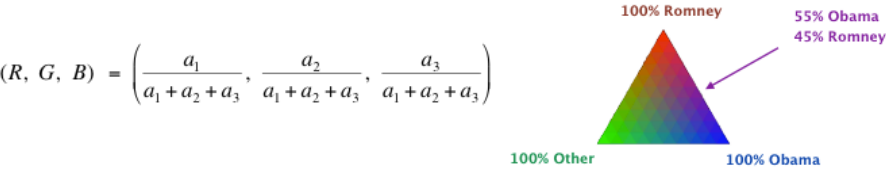
% java RedBlue USA 2012

% java RedBlue NJ 2012

% java RedBlue USA-county 2012



Part 3. A more refined visualization reveals that the United States is not as polarized by geography as suggested in the above visualizations. In 2000, Bob Vanderbei created a [Purple America](#) map, in which each region is colored in a shade of red, green, and blue, according to the proportion of votes received by each candidate. Specifically, if the Republican, Independent, and Democratic candidates receive a_1 , a_2 , and a_3 votes, respectively, then we draw the subregion using the following formula:

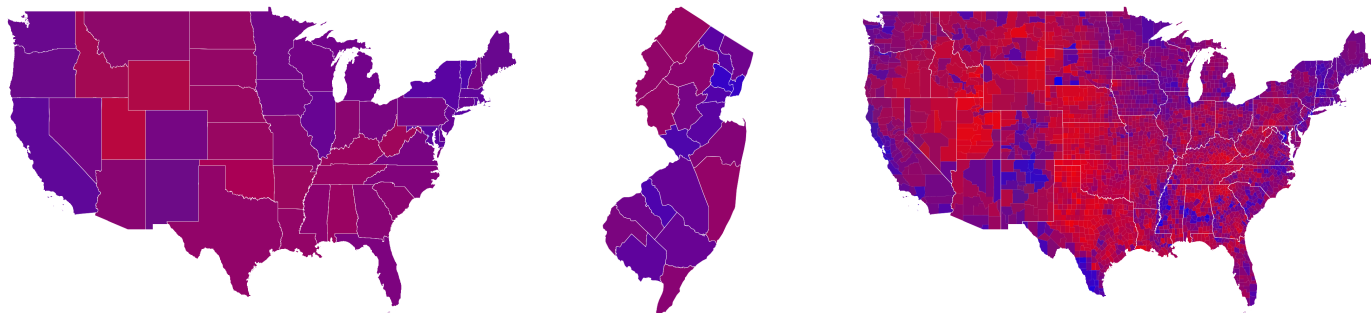


Write a program `Purple.java` that takes two command-line arguments (the name of the map and the year of the election) and produces a Purple-America map, as in the examples below:

% java Purple USA

% java Purple NJ

% java Purple USA-county



Extra credit. There are limitless opportunities for creativity, enrichment, and inspiration.

- Write a program to screen scrape the election return data from [Dave Leip's Atlas of U.S. Presidential Elections](#). Pay careful attention to name clashes between Dave Leip's site and the U.S. Census (e.g., LaSalle vs. La Salle, Kings County vs. Brooklyn).
- Modify your program to include Hawaii and Alaska.
- Use a [map projection](#) (such as Mercator, azimuthal, Albers, or Gall-Peters) to transform longitude and latitude coordinates into points in the plane.
- Explore a different color palette (with 5-7 color categories) for coloring the subregions. Here is one [example](#).
- Write the state name in the appropriate place. For large states, draw it in the *centroid* of the polygon describing the state.
- Create an interactive GUI which displays the election returns for a county as the user hovers over it. You will probably need to add a method to your polygon data type to determine whether a point is inside the polygon.
- Visualize the *gradient* or change in votes from one election to the next.
- Visualize a different data set by county, e.g., poverty rate, access to Internet, and average price of health care. Or collect data for elections in another country.

*This assignment was created by Kevin Wayne, with inspiration from Bob Vanderbei.
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