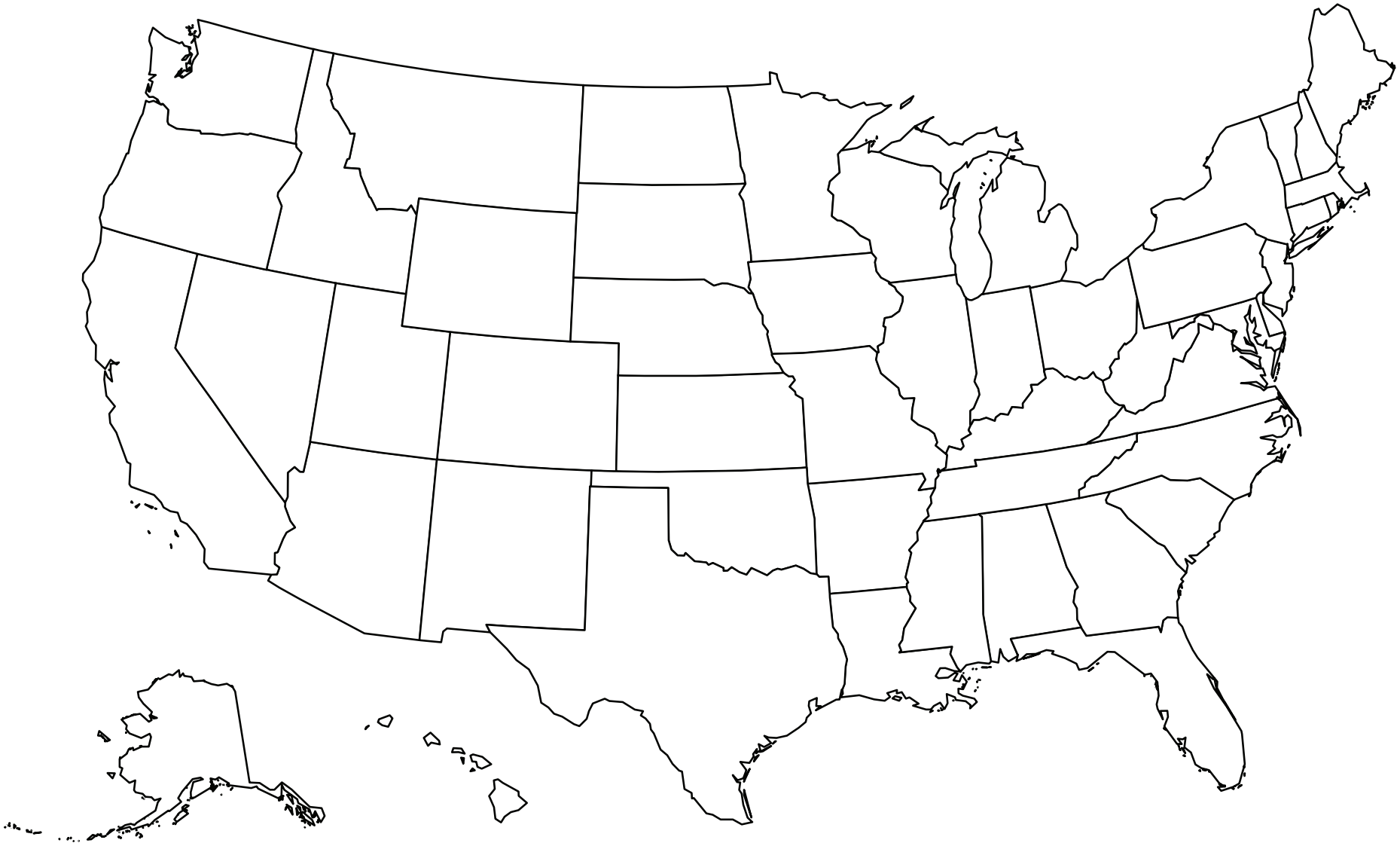
Coloring Maps, Creative Math, and Computers

Color in the map so that states that touch each other don't have the same color.
Try to use as few colors as possible. How many colors do you need?

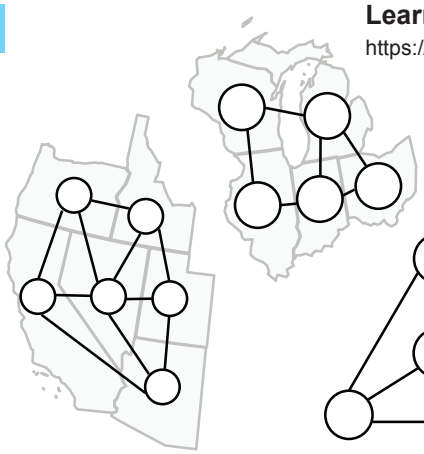


Flip the page to learn more!

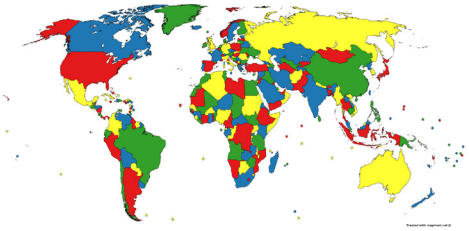
Graph theory

Learn more with interative maps!
https://michaelpro.dev/projects/coloringmaps

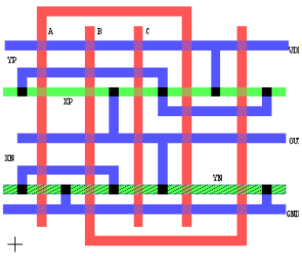
Even though each state looks different, we can see how they are connected to each other using a type of math called **graph theory**! Each state gets a circle (a vertex) and a line when it's connected to another state (an edge).



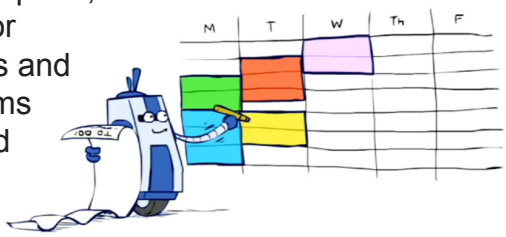
You may not have realized it, but you were just doing math! Trying to color a map with different colors is a type of **constraint satisfaction problem** called **graph coloring**.

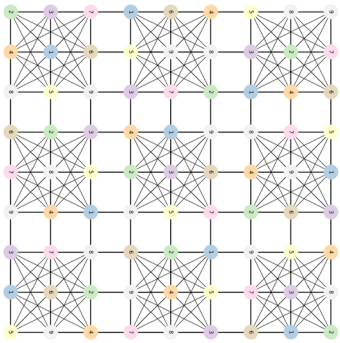


In 1976, mathematicians used a computer to prove that any map you can draw on a flat piece of paper (a planar map) can be colored with just 4 colors. You can even color in a map of every country in the world with just 4 colors!



People need to solve these types of problems to schedule planes at airports, figure out classroom schedules for teachers and students, let phones and computers to run multiple programs at once, create circuit boards, and to create and solve puzzles like sudoku.





If you like coloring in graphs, you're solving similar issues as computer scientists and programmers, mathematicians, and engineers!

Algorithmic thinking

How does a computer solve this problem? By simply following a list of steps, like a recipe in a cookbook. This is called an **algorithm**.
Here are some steps taken from real algorithms to help you think like a computer:

- Start with a state that touch lots of other states first. They are tricky to color in if other nearby states have already been colored in first.
- Don't add another color unless you have to. Reuse colors as often as possible.
- Color in states that have fewer color options left to choose from before coloring in states that have more colors left to choose from.