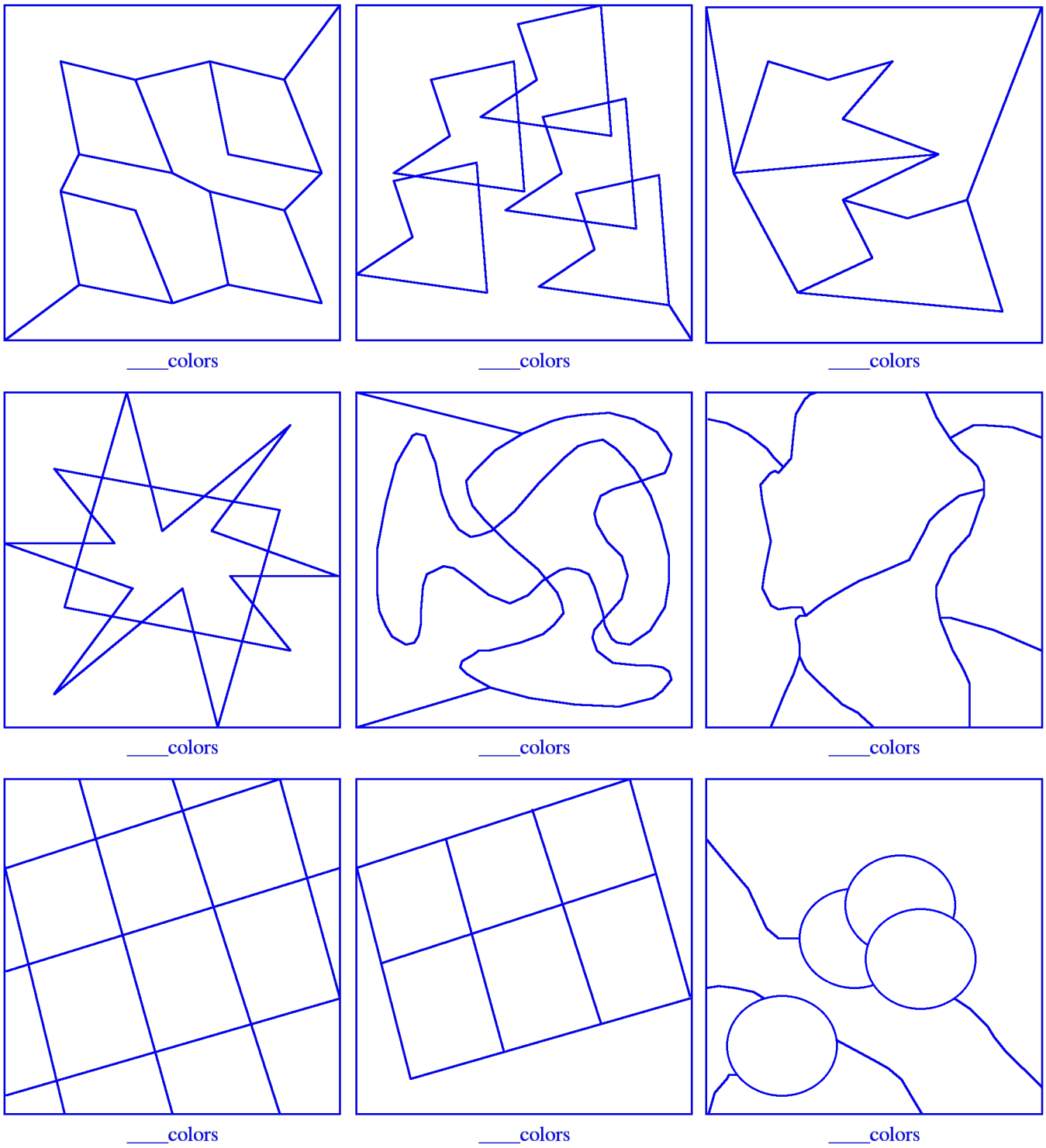
Map Coloring

1. Color the "maps" below, *using as few colors as possible*. (Start by using pencil and labeling the regions!) Write the number of colors you needed next to each map. Follow these rules:
   - ◊ Each region must be one color only
   - ◊ Adjacent regions cannot be the same color (regions touching "by corner" are not considered adjacent.)
2. On the back of the paper, create your own 2-color, 3-color, 4-color, and 5-color maps.



____colors ____colors ____colors

____colors ____colors ____colors

____colors ____colors ____colors

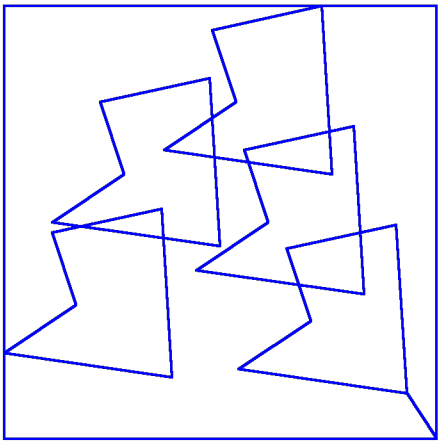
Color Theorems

Mapmakers have known for a long time that any map whatsoever can be colored in four colors. This is known among mathematicians as the *four-color theorem*, which was stated in the early 1850's, but only proved in 1976, by Kenneth Appel and Wolfgang Haken at the University of Illinois. They used hundreds of pages of reasoning and 1,000 hours of computer searching to guarantee the validity of the theorem to their colleagues in the mathematics community.

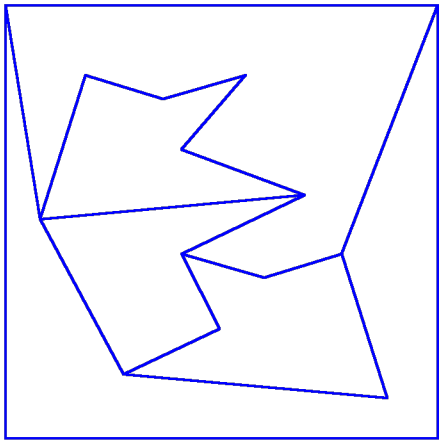
1. If you thought any of the maps on the previous page required more than four colors, try again to color them in only four colors. (The question asking you for a five-color map was, ahem, a trick question.)

As you probably noticed on the previous page, some maps can be colored in just two colors. How can one recognize such a map?

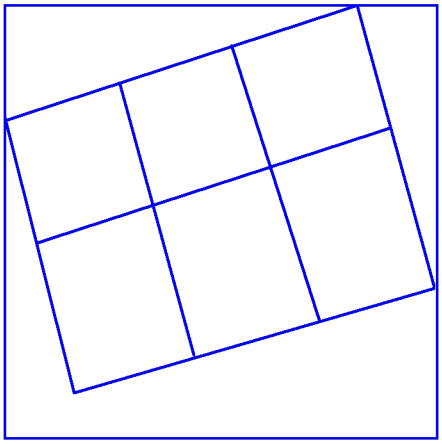
2. Change the following maps into two-color maps, by adding *as few lines as possible*.



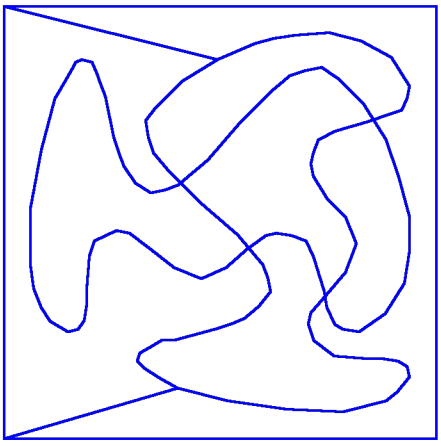
____lines



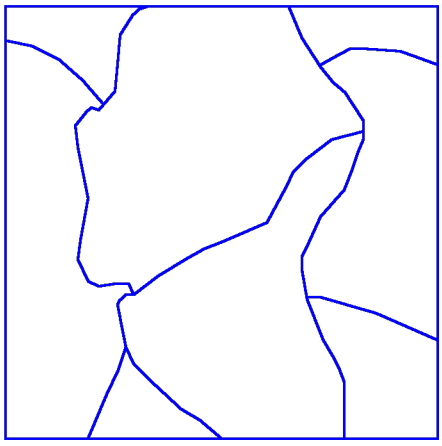
____lines



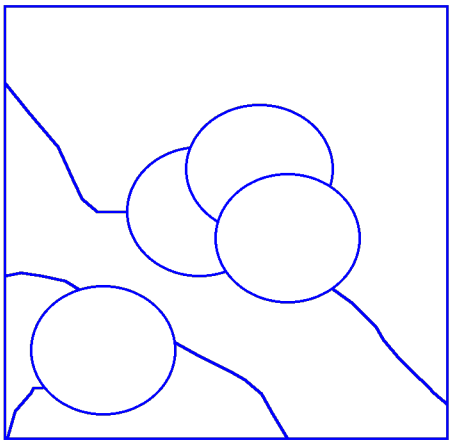
____lines



____lines



____lines



____lines

3. What condition guarantees that a map is a two-color map? Discover and state a *two-color theorem*, and prove it with a logical, illustrated argument.