

**Example 2.1.** Let  $X$  be the set of all countries in the world, and  $Y$  be the set of all cities in the world. Define a map  $f: X \rightarrow Y$  by letting  $f(x)$  be the capital of the country  $x$ . Then  $f$  is injective (no city can be the capital of two countries), but not surjective (some cities are not capitals). Define a map  $g: Y \rightarrow X$  by letting  $g(y)$  be the country in which the city  $y$  lies. Then  $g$  is surjective (in every country there is at least one city), but not injective (some countries have more than one city).

It is also interesting to look at the compositions  $f \circ g$  and  $g \circ f$ ...