

A MILLION SONNETS

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A sonnet is a poem of fourteen lines with the rhyme pattern *aba'b'cdc'd'efe'f'gg'*; here, each letter refers to a line, rhyming lines are denoted by the same letter, and a prime on a letter serves to distinguish a line from its rhyming counterpart. By suitably transposing the lines of a sonnet, one can generate another sonnet. Thus, *aba'b'cdc'd'efe'f'gg'* can be made to yield *c'aca'gbg'b'dfd'f'e'e*. Most sonnets will not survive this kind of mangling but be reduced to sheer nonsense. However, some sonnets will prove robust under such transformations. Here is an example of such a robust specimen.

I am a most peculiar rhyme	<i>a</i>
I'd rather have been penned in prose	<i>b</i>
I haven't any sense of time	<i>a'</i>
For my content I'm too verbose	<i>b'</i>
My lines are seldom out of place	<i>c</i>
I twist and turn just as you please	<i>d</i>
I constantly can change my face	<i>c'</i>
I suffer from a strange disease	<i>d'</i>
I tell no tale, I have no plot	<i>e</i>
I specialize in metamorphosis	<i>f</i>
Some may like me but others not	<i>e'</i>
I don't invite deep diagnosis	<i>f'</i>
I was invented as a game	<i>g</i>
For me my author takes all blame	<i>g'</i>

By transposing the lines of this sonnet in all the allowed ways, one can generate a total of $2^7 \cdot 7! = 645,120$ different sonnets. In his verse novel *Eugene Onegin*, Pushkin employs a different type of sonnet with the rhyme pattern *aba'b'cc'dd'eff'e'gg'* (and an octosyllabic metre, like the above poem). It is clear that any Shakespearean sonnet can be transformed into a unique Pushkinian one, and vice-versa, simply by transposing lines within the second and third quatrains. If we allow ourselves Pushkinian sonnets as well, the total number of sonnets that can be generated from the above specimen is $2 \times 645,120$ or somewhat over the figure of a million promised in the title.

The number $2^7 \cdot 7!$ occurring above has an interesting geometrical interpretation. Consider a cartesian coordinate system in a 7-dimensional Euclidean space and associate a pair of rhyming lines with the points at unit distance from the origin along each coordinate axis (thus line 1 is associated with the point at +1 unit along the 1-axis, line 2 with the point at +1 unit along the 2-axis, line 3 with the point at -1 unit along the 1-axis, line 4 with the point at -1 unit along the 2-axis, etc.). Then the symmetry operations of a 7-dimensional hypercube (numbering $2^7 \cdot 7!$ in all) acting on these points produce the rearrangements that correspond to all the different versions of a given (Shakespearean or Pushkinian) sonnet.

I admit my sonnets get pretty boring after a while, but at least they proliferate. Perhaps someone more inventive than me can come up with a better specimen in this genre.

I cannot close without mentioning the most (mathematically) ingenious sonnet ever written. Entitled *Cent mille milliards de poemes* and written by Raymond Queneau, it consists of ten alternatives for each of the fourteen lines. Each line is printed on a thin strip of wood, with ten such strips stacked one on top of another and bound together at the spine of the book. The reader can flip the strips back and forth until he chooses one he likes for the first line, then he can do the same for the second line, and so on. The total number of sonnets he can generate in this way is 10^{14} . Even if he reads the sonnets at the rate of one a minute, he can get through only a small fraction of them in his lifetime.