On the Other Hand …

Ramón Lull and the Infidels

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Many of the fundamental ideas in artificial intelligence have an ancient heritage. Some of the most fundamental, surely, are that thinking is a computational process, that computational processes involve combining symbols, that computation can be made mechanical, and that the mathematics of computation involves combinatorics. All of these ideas have their origin, so far as we know, in the work of an eccentric 13th century Spanish genius, Ramon Lull (1232-1316). Lull's sources were partly mystical, but the interesting part of his thought drew from—or against—an analytic tradition in logic and combinatorics. Logic as a formal theory of reasoning first appeared in the fourth century B.C. in Aristotle's Prior Analytics as the theory of the syllogism. Combinatorics first appeared in the West in the writings of Porphyry, in the third century A.D., who showed how to compute the number of distinct pairs in a set of five things. Lull had still another source: lust.

By his own account, while a courtier Lull made great efforts to seduce the wives of other courtiers. After considerable effort to seduce a particular lady, she finally let him into her chambers and revealed a withered breast. Taking this as a sign from God, Lull gave up the life of a courtier and joined the Franciscan order, determined that he would dedicate his life to converting Moslem civilization to Christianity.

Lull moved to Majorca and spent several years mastering the Arabic language, studying and writing tracts in Catalan and Arabic (of which he eventually authored hundreds) against Islam and for Christianity. About 1274, Lull had a vision of the means by which Moslems could be converted to Christianity, a method he decribed in his *Ars Magna.* Lull's idea was that Moslems (and others) may fail to convert to Christianity because of a cognitive defect. They simply were unable to appreciate the vast array of the combinations of God's or Christ's virtues. But Lull believed that infidels could be converted if they could be brought to see the combinations of God's attributes. Further, he thought that a representation of those combinations could be effectively presented by means of appropriate machines, and that was the key to his new method.

A typical Lullian machine consisted of two or more disks having a common spindle. Each disk could be rotated independently of the others. The rim of each disk was divided into sections or camerae, and each section bore a letter. According to the application for which the machine was intended, the letters would each have a special significance. They might denote, for example, an attribute of God. One Lullian machine, for example, has the letters "B" through "R" around the rims of an inner disk, and around the outer disk Latin words signifying attributes of God: Bonitas (B), Magnitudo (C), Eternitas (D) and so on. A Lullian machine was operated by rotating the two disks independently, much as we would a star finder or (some years ago) a circular slide rule. At any setting of the disks, pairs of God's attributes would be juxtaposed on the rims of the inner and outer disks. Rotating the disks would create different pairings. One would thus discover that God is Good and Great, Good and Eternal, Great and Eternal, and so forth. The heretic and the infidel were supposed to be brought to the True Faith by these revelations.

Lull lectured on several occasions at the University of Paris, sometimes complaining that his philosophy was not understood there (nowadays, things are reversed: the rest of the world complains that the philosophy coming out of Paris is incomprehensible.). He traveled throughout Europe attempting to raise money for missions to North Africa to convert Moslems to Christianity, of which he made three. Tradition has it that on his third trip, at the age of 83, he was stoned to death, but some biographers are so lacking in romantic sentiment that they dispute this account.

Lull's writings advanced the idea that non-mathematical reasoning can be done, or at least assisted, by a mechanical process, and that reasoning does not proceed by syllogism, but by combinatorics. Reasoning is the decomposition and recombination of representations. The decomposition and recombination of attributes can be represented by the decomposition and recombination of symbols, and that, as Lull's devices illustrate, is a process that can be made mechanical.

Lull wrote a novel, Blanquerna, which contains an interesting aside: the first contribution we know of to the theory of voting, a subject that is now a staple of economics and political theory. No surprise, voting is about combinatorics. Lull considered how nuns should select a new mother superior. He proposed that of nine candidates, the voters should vote their preference among each pair—36 votes altogether!—and the candidate who won the most of these pairwise comparisons should be selected. In the 18th century, the idea of voting for pairs among multiple candidates was rediscovered by Condorcet, who, however, thought that the winner should be the candidate who defeated all others in pairwise comparisons. Condorcet was bedeviled by the problem, which he never solved and which does not arise in Lull's scheme, that sometimes no candidate may be selected by his procedure. Given the state of politics, that doesn't seem such a bad outcome.

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