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Research article

The Color of LLMs

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Abstract

In 1937, Jorge Luis Borges wrote a characteristically engimatic historical note and literary reflection on „Ramon Llull' s Thinking Machine.“ It was the year when the idea of „thinking machines“ picked up momentum with Harold Aiken's mechanical Mark I early computer that became the electronic Mark IV. 85 years ahead of ChatGPT (first released in 2022), Borges is looking back some 650 years at Ramon Llull's great arts which includes an *ars inveniendi* that inspired rational speculation ever since. This is one five essays that look though the lens of Borges at contemporary learning machines. It explores how Jorge Luis Borges' account illuminates the nature and limitations of contemporary large language models. The author recalls that Jonathan Swift's *Gulliver's Travels* already describes an engine that mechanically assembles books from broken sentences, and Borges associates it with the combinatorial tradition of thinking machines. This tradition, including Llull's disks, Raymond Queneau's cut-up book, and the Infinite Monkey Theorem, relies on generation by chance and recombination. It is contrasted with the algorithmic tradition, represented by the Antikythera mechanism, astronomical clocks, and the calculating machines by Schickard, Pascal, Leibniz, and Babbage, where problems are solved by rules. The author notes that astrology failed because it depended largely on correlation rather than computation, and that modern LLMs are also based on correlations learned from human artifacts. At the same time, LLMs contain a combinatorial element guided by prompting. A parallel is drawn with Oulipo: literary constraints, such as writing a novel without the letter "e," foster creativity, whereas LLM prompting directs and constrains searches. The analysis of Borges' color motifs – "red," "zenithal," the tiger, Blake – shows that Borges' text is a subtle critique of simplistic thinking machines and an affirmation of human creativity and intertextuality, which cannot be reduced to mechanical recombination and correlation.

Keywords: Ramon Llull; Jorge Luis Borges; LLMs; Thinking machines; Combinatorics; Algorithms; Prompting; Oulipo; Creativity; Intertextuality; Color

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Научная статья

Цвет больших языковых моделей

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Аннотация
В 1937 году Хорхе Луис Борхес написал характерную для него загадочную историческую заметку и литературное размышление под названием “Мыслящая машина Раймунда Луллия”. Это произошло в тот самый год, когда концепция “мыслящих машин” получила мощный импульс благодаря разработке Говардом Эйкеном механического компьютера Mark I, который впоследствии эволюционировал в электронный Mark IV. За 85 лет до появления ChatGPT (выпущенного в 2022 году) Борхес обращается к событиям 650-летней давности, анализируя великое искусство Раймунда Луллия, включающее в себя ars inveniendi (искусство изобретения) и ставшее с тех пор источником вдохновения для рационалистических спекуляций. Настоящая работа представляет собой одно из пяти эссе, в которых современные обучающиеся машины рассматриваются сквозь призму творчества Борхеса. В статье исследуется, каким образом анализ Хорхе Луиса Борхеса проясняет природу и ограничения современных больших языковых моделей. Автор напоминает, что в “Путешествиях Гулливера” Джонатана Свифта уже описывалось устройство, механически собиравшее книги из обрывков фраз, и Борхес связывает его с комбинаторной традицией проектирования мыслящих машин. Данная традиция, охватывающая диски Луллия, комбинаторную книгу Раймона Кено и теорию о бесконечной обезьяне, опирается на случайную генерацию и рекомбинацию. Она противопоставляется алгоритмической традиции, представленной Антикитерским механизмом, астрономическими часами и вычислительными машинами Шиккарда, Паскаля, Лейбница и Бэббиджа, в которых задачи решаются на основе жестких правил. Автор отмечает, что астрология потерпела крах, поскольку в значительной степени полагалась на корреляцию, а не на исчисление, и что современные большие языковые модели (LLM) также базируются на корреляциях, извлеченных из артефактов человеческой культуры. В то же время большие языковые модели содержат комбинаторный элемент, управляемый посредством промптинга. Проводится параллель с УЛИПО (Oulipo): литературные ограничения, такие как написание романа без буквы “e,” стимулируют творчество, тогда как промптинг в больших языковых моделях направляет и сужает пространство поиска. Анализ цветовых мотивов у Борхеса — “красного,” “зенитального,” образов тигра и Уильяма Блейка — показывает, что борхесовский текст представляет собой утонченную критику упрощенных “мыслящих машин” и утверждение человеческой креативности и интертекстуальности, которые не могут быть сведены к механической рекомбинации и корреляции.

Ключевые слова: Раймунд Луллий; Хорхе Луис Борхес; Большие языковые модели; Мыслящие машины; Комбинаторика; Алгоритмы; Промптинг; УЛИПО (Oulipo); Креативность; Интертекстуальность; Цвет

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It is nearly impossible, from a contemporary perspective, to not associate Borges' story with LLM-based text generation. Consider, for example, the passage on page 158, where Jonathan Swift's mocking account of a thinking machine (called “The Engine”) is related: “The professor shewed me several Volumes [...] of broken sentences, which he intended to piece together” (Swift, 1726/2008, Pt. III, Ch. 5, as cited in Borges, 1999, p. 158). A slightly earlier passage from Gulliver's Travels, not cited by Borges, is even more stunning in how precisely it anticipates criticism of the effects of LLMs: “Every one knew how laborious the usual method is of attaining to arts and sciences; whereas, by his contrivance, the most ignorant person, at a reasonable charge, and with a little bodily labor, might write books in philosophy, poetry, politics, laws, mathematics, and theology, without the least assistance from genius or study” (Swift, 1726/2008, Pt. III, Ch. 5).

At a second glance, it is possible – and instructive – to distinguish two different traditions of “thinking machines.” I call them “combinatorial” versus “algorithmic.” Borges' text is concerned with the first: “the methodical application of chance to the resolution of a problem” (Borges, 1999, p. 157). Indeed, Llull's disks and Swift's Engine rely on combinatorial generation to reveal the answer to a question (Borges, 1999). Other approaches in this vein include Raymond Queneau's cut up book to generate 100,000,000,000,000 poems (Queneau, 1961) or the Infinite Monkey Theorem.

In contrast, already since antiquity, algorithmic machines have been considered and, in fact, were successfully built: The antikythera device, astronomical clocks, the computing machines of Schickard, Pascal, Leibniz, Babbage stand in this tradition (Freeth et al., 2006; Ifrah, 2000). But also: systems of astrology. Common to all is the assumption that problems can be solved algorithmically. At first, this was inspired by the movement of the planets and stars that follow God's will which can be revealed by studying celestial laws associated with earthly events. In the scientific age, it was recognized that the laws of physics and of algebra permit to reliably predict the movements of bodies and to make numeric computations. These laws were mapped to mechanical structures such as cogwheels, gears, tabs, holes, etc.

Incidentally, astrology failed because it relied not merely on computation but largely on correlation. And the latter, such as the association of astronomical constellations with auspicious (victory, affluence, etc.) or ominous (loss, death, etc.) events, turned out to be spurious. In this context, it is interesting to note that modern LLMs are also based on correlation. A decisive difference is that, in the latter case, correlation is the result of learning from human artifacts (though not necessarily from facts): the ambition of the companies that sell AI-based products is to consume and to correlate the whole existing body of human knowledge.

Importantly, the combinatorial element is present in LLMs as well, but – and this goes beyond what is envisaged in Borges' text – it can be guided by “prompting,” a technique to constrain the replies of an LLM within user-defined boundaries. This observation leads directly back to Raymond Queneau. The Oulipo movement that he co-founded holds the belief that willful imposition of constraints on the composition of texts fosters unexpected (literary) discoveries (Motte, 1986). Indeed, the decision to write a whole novel without a single occurrence of the letter “e” certainly spurred Georges Perec (1969) to come up with solutions he would not have considered otherwise. From this

point of view, a book such as the "Oulipo Compendium" can be seen as a massive collection of literary prompts (Mathews & Brotchie, 2005). Yet, there is an important difference between LLM-style and Oulipo-style prompting. Whereas the latter is intended to steer creativity, the goal of the former is to direct and constrain searches. Or, phrased in a different manner, the latter is productive, the former subtractive.

These days, not only programmers but also leading mathematicians find LLMs guided by prompting to be eminently useful in their work (Knuth, 2025; Tao, 2025). Nevertheless, the jury is out on whether LLMs can be "creative," "intentional," "understanding" or whether they just regurgitate (or, to be fair: correlate and combine) what they have learned. Thought experiments, such as Searle's Chinese Room argument gained fresh significance in the context of LLMs (Searle, 1980). Reportedly, the richly endowed software company builder.ai that sought to use AI for producing code, has in fact created a modern-day Mechanical Turk – or has it? A useful discussion reporting the mixture of fact, fake and fiction in this particular case is available (Orosz, n.d.).

More generally: Who guides and who is the guided? This trope, the reversal of the roles, their occasional conflation, is close or even central to Borges' writing. For instance, consider this excerpt from his well-known poem "Chess" that can be associated with both the Mechanical Turk and with LLMs:

> They [the chess pieces] do not know it is the players' hand that dominates and guides their destiny (Borges, 1960/1964a).

Yet, for deciphering the message of "Ramon Llull's Thinking Machine," this is a red herring. As always, Borges writing is a lot more subtle than the surface (here: an account of Llull's Thinking Machine and related devices) suggests and his work demands close reading.

It always pays off to watch how Borges uses colors, which, in his poetics, often play a significant role, as a clue and as a motif. For example, figure on page 158 is originally rendered in color (fig. 1). Hence, the colors do not just appear as examples in the text, they are actually a part of Llull's machine. Or consider the phrase "Ramón Llull on his red and zenithal island of Mallorca" (Borges, 1999, p. 157). I admit I had to look up "zenithal": to draw shadows on a figure as if the light came directly from above (the "zenith") to give it depth and plasticity. The "red" alludes to Mallorca's famous "terra rossa" soil. "Red" and "zenithal": Borges uses color and shadows to give plasticity to Llull's flat disks. It is a beautifully expressed attribution.

Since color is an important aspect of Llull and his machine, let us assume that color is an essential aspect of Borges' text as well. If we follow the lead, we are directed to the other main occurrence of color in the text, to the "running example": the question what constitutes a tiger's true color (Borges, 1999, p. 157). The question reappears in the ultimate paragraph on page 159, a pronounced text position. Borges quotes, seemingly with approval, Fritz Mauthner who proposes a rhyming dictionary as a "kind of thinking machine" (Borges, 1999, p. 159). He proceeds to reinvoke the tiger who requires a striking adjective in a poem, and comes up with "black" (associated with the night) and "red" (associated with blood). But this is pure mockery, because the dictionary is

completely unable to suggest a convincing poetic solution. Here is the beginning of William Blake's famous poem:

> Tyger! Tyger! burning bright
> In the forests of the night. (Blake, 1794/1988)

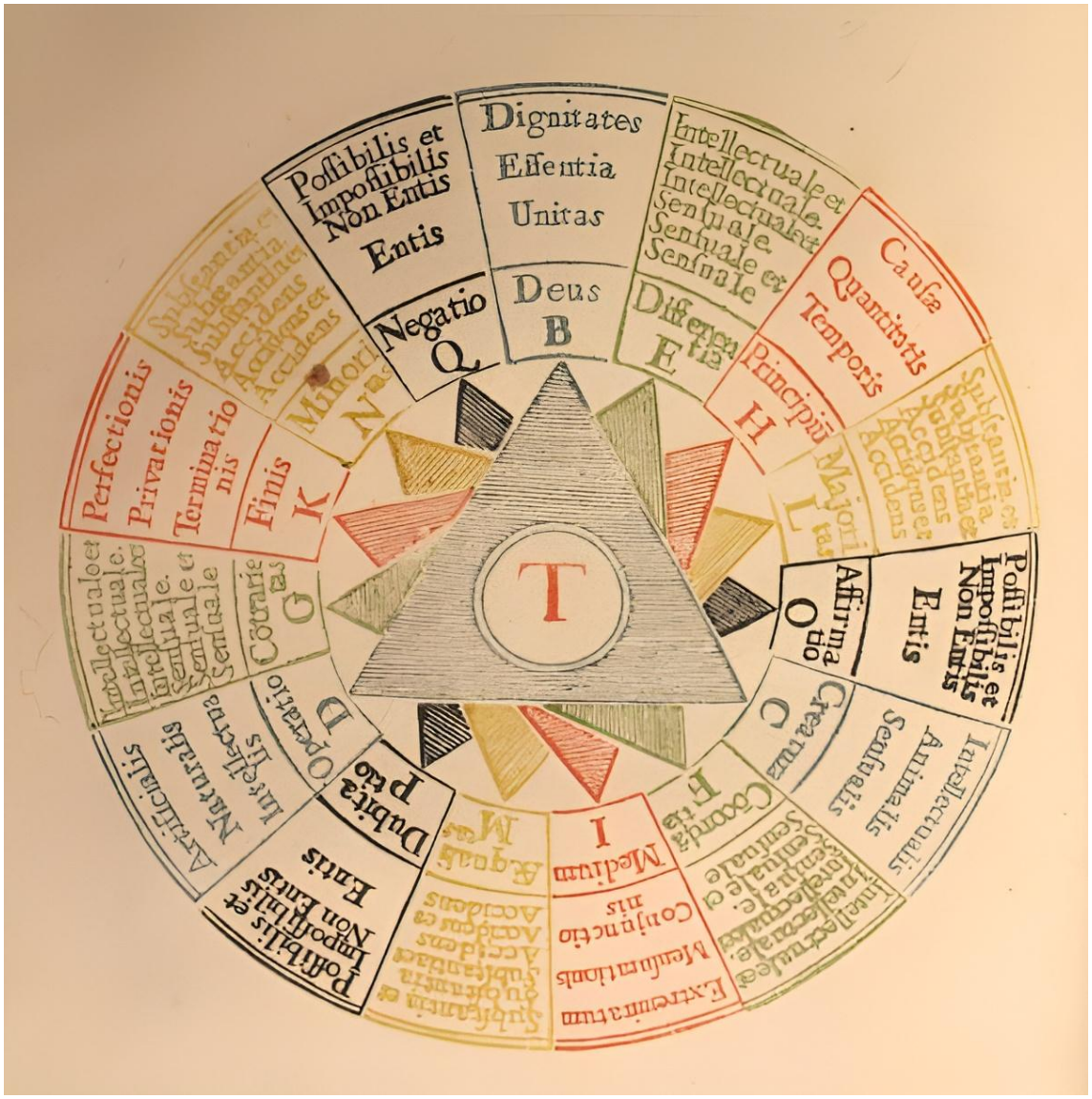

Figure 1. *Prima Figura T* from the Mainz deluxe edition of Ramon Llull's *Opera Omnia* (Llull, c. 1300/1721–1742). Image courtesy of the Martinus-Bibliothek, Mainz.

The color of Blake's tiger is the color of fire, he is a fiery creature, slinking noiselessly through the night. All color associations are present: black, red, orange, white, yellow, but without being named. How lame and unconvincing is the "dictionary" solution by comparison! The heading "A Final Defense" of the text's last paragraph means its exact opposite. Do we need to mention that Borges wrote a poem with the title "Blake,"

where color is dismissed as an inadequate way to characterize the essence of things (Borges, 1960/1964b)? Now we see the nature of Borges' text clearly: it is a searing critique of overly simplistic "Thinking Machines." On the other hand, Borges' subtle mastery of creativity and intertextuality is unsurpassed by machines, thinking or not.

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