More chess games than ATOMS IN THE UNIVERSE?

Read and complete the text with the correct form of the verbs

Everything around us is made of atoms. Scientists 1 _____ (estimate) that there are about 10^{80} atoms in the observable universe. Although this number is almost impossible to imagine, there is something even more surprising: the number of possible chess games 2 _____ (be) much larger.

This idea is connected to the work of Claude Shannon, the inventor of Information Theory. In 1948, Shannon 3 _____ (develop) a mathematical way to understand how information 4 _____ (travel) through communication systems, including speech, music, computer code, and many other forms of communication.

While studying information and logic, Shannon 5_____ (become) interested in another question: could a computer ever beat a human at chess? In 1950, he 6 _____ (argue) that it was possible, even though computers at the time 7_____ (be) far less powerful than they are today.

Over the following decades, computers gradually 8_____ (improve). By the 1970s, they could defeat weak players, but the world's best chess players were still far stronger. That 9_____ (change) in 1996 when the computer Deep Blue defeated world chess champion Gary Kasparov in a game. One year later, an improved version of Deep Blue won an entire match against him.

Shannon's work also led to another fascinating idea known as the Shannon Number. This number estimates how many different chess games can be played. The result is enormous: there 10_____ (be) roughly 10^{120} possible game sequences in chess.

To understand how large this number is, compare it to the number of atoms in the observable universe. Scientists 11_____ (think) there are about 10^{80} atoms, meaning that the number of possible chess games is vastly greater.

How is this possible? The answer 12_____ (lie) in the way chess works. In a typical position, a player 13_____ (have) around 35 legal moves. Each move 14_____ (create) many new possibilities, and those possibilities continue to grow with every turn. After dozens of moves, the number of possible game sequences becomes unimaginably large.

The most interesting lesson is that complexity does not always come from having more material. A chessboard 15_____ (contain) only 64 squares and 32 pieces, yet it can 16_____ (produce) more possibilities than there are atoms in the observable universe. Just as atoms combine to create everything we see around us, a small set of rules can create an extraordinary amount of complexity.

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