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Schrodinger's Bits: Information in a Quantum World

In a landmark 1948 paper, Claude Shannon shattered conventional wisdom by showing that a stream of data could be sent reliably through even the noisiest communications channel. His legacy ranges from the recent Huygens probe photos of Titan to modern cellular phone infrastructure. Despite its phenomenal success, however, Shannon's theory failed to address an extremely important feature of physical reality—that it is quantum mechanical. Anyone who has heard of Schrodinger's famous cat which could be dead and alive at the same time has some feel for the slippery nature of information in quantum theory. Shannon's bits are supplemented by ebits of entanglement and qubits of quantum communication, while simple data transmission is supplemented by exotic sounding primitives like teleportation and superdense coding. The theory of these qubits and ebits is full of surprising insights governing what is and is not possible in our quantum mechanical world. It even hints that instead of trapping information forever, black holes might mix it up and spit it out unimaginably quickly. I'll give a tour of some of these developments, starting with some basic Shannon theory before moving on to quantum information theory and why it is new, interesting, and definitely different.