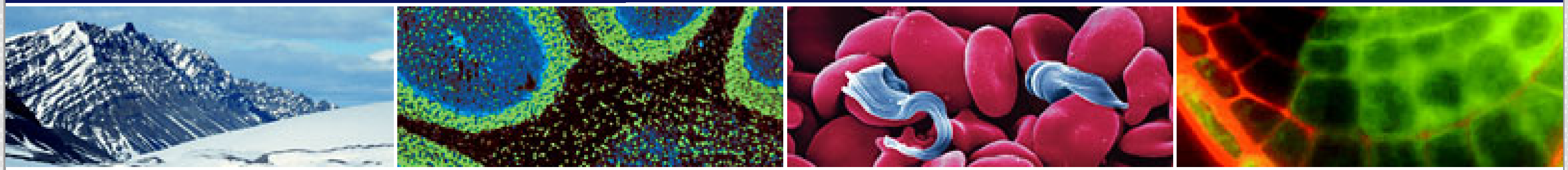

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Quantum Computing -Presentation
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The clearest indicator of the deep relationship between information theory and quantum physics is entanglement. The degree of entanglement is now identified with the quantum entropy in the fundamental case of a pair of two-level quantum systems. Fundamentally, the quantum entropy is responsible for differences between quantum and classical information. At the same time, quantum entanglement is increasingly recognized as pervasive in the microphysical world, the cutting-edge realm of nanotechnology. Quantum entanglement has in recent years been shown in various ways to serve as an information-theoretic resource. The maintenance of coherence is vital to the preservation of entanglement in quantum states. Thus real-world quantum computing will require preserving entangled states in a quantum mechanical processors (registers) and memory devices at the nanoscale.

The number of parameters describing the quantum computational states grows exponentially in the number of two-level systems, whereas in the analogous classical system it grows only linearly in the number of two-state systems (``qubits''). The size of the space of information-encoding states available to the composites of two-level systems (``multi-qubit states'') therefore grows far faster than that available to analogous classical systems. Moreover, di erent computational states are typically simultaneously available and processed during the operation of a quantum computational algorithm.

Quantum computers are, in essence, complex interferometric devices involving states described by large state spaces and relying on quantum coherence for their operation. Quantum computing is of particular interest because its extraordinary degree of parallelism makes tractable some computational tasks that have been viewed as intractable in traditional computing theory. The increase in computational e ciency that can appear in a quantum computational algorithm is known as quantum speedup. There is now a great push toward realizing quantum computing in various ways, including with atoms in optical cavities and in solid state matter, to realize this computational speedup.

References:

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