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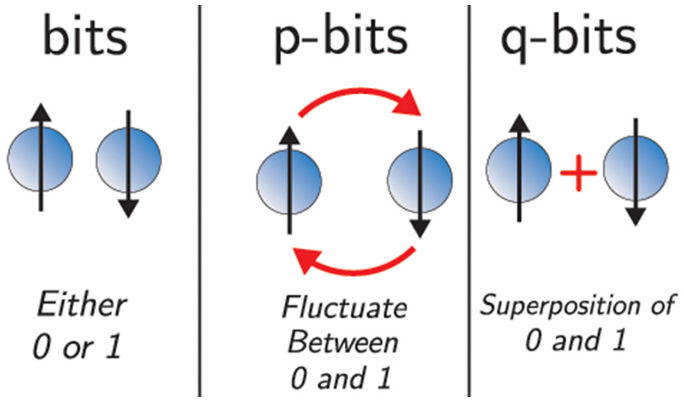
Researchers introduce probabilistic bits, which have the potential to advance quantum computing and machine learning using existing technology.



Digital electronics use standard bits that are stored using well-developed technology. In comparison, quantum computing uses quantum bits, or q-bits, that need to be stored in quantum storage devices where physical implementations remain a major obstacle preventing the technology's success.

Camsari et al. introduce the concept of probabilistic bits, or p-bits, to bridge the gap and act as an intermediate between standard bits and q-bits. p-bits are classical entities that fluctuate rapidly between 0 and 1—they can be physically represented by unstable low barrier magnets.

Lead author Kerem Camsari said that p-bits can be considered "the poor man's q-bit" because they can be stored and processed using existing electronics and can emulate certain properties of q-bits. For example, the researchers used the circuit simulator SPICE to test p-circuits they designed. The results of their simulations of quantum annealing—a type of quantum computing—were similar to those obtained with quantum annealers, which suggests that a network of p-bits can approximate a network of q-bits.

In addition to quantum computing, p-bits may have applications in machine learning, which is another active field that could benefit from using highly tailored hardware for performing probabilistic calculations. p-bits are similar to the binary stochastic neurons used in machine learning, which could make them effective hardware accelerators.

The authors also argue that one way to implement p-bits in existing CMOS technologies can be through the spin-Hall effect or magneto-electric effect present in modern RAM technology. Next, they plan to further explore the extent to which a p-bit can function as "a poor man's q-bit."

Source: "p-bits for probabilistic spin logic," by Kerem Y. Camsari, Brian M. Sutton, and Supriyo Datta, *Applied Physics Reviews* (2019). The article can be accessed at https://doi.org/10.1063/1.5055860.