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Quantum Computing

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ABSTRACT:-

Quantum computing has recently been the focus of much research in the computer field due to its potential to form calculations faster and more efficiently than traditional computing methods. In this journal, we discussed about quantum computing, history, usage and its types.

Keywords: Quantum computing, Quantum parallelism, Programming, Information, Annealing, Operations, Quantum theory

1. INTRODUCTION

A computer is a physical device that helps us process information by executing algorithms. When designing complex algorithms and protocols for various information processing tasks, it's truly helpful, perhaps essential, to work with some idealized computing model. Real computing bias are embodied in a larger and constantly richer physical reality than is represented by the idealized computing model.

INTRODUCTION OF QUANTUM COMPUTING

Quantum information processing is the result of using the physical reality that amount proposition tells us about for the purposes of performing tasks that were preliminarily allowed insolvable or infeasible. At small scales, physical matter exhibits parcels of both patches and swells, and amount computing leverages this geste using technical tackle.

1.1 What is Quantum Computing ?

Bias that perform quantum information processing are known as amount computers. A amount computer is a computer that exploits amount mechanical marvels. The introductory unit of information in amount computing is the qubit. When measuring a qubit, the result is a probabilistic affair of a classicalbit. However, surge hindrance goods can amplify the asked dimension results, If a amount computer manipulates the qubit in a particular way. The design of amount algorithms involves creating procedures that allow a amount computer to perform computations efficiently.

Fig 1.1: Quantum Computing

1.2 History of Quantum Computing

For numerous times, the fields of amount mechanics and computer wisdom formed distinct academic communities. Programming a amount computer is also a matter of composing operations in such a way that the performing program computes a useful result in proposition and is implementable in practice. ultramodern amount proposition developed in the 1920s to explain the surge – flyspeck duality observed at infinitesimal scales, and digital computers surfaced in the following decades to replace mortal computers for tedious computations. during World War II; computers played a major part in wartime cryptography, and amount drugs was essential for the nuclear drugs used in the Manhattan Project. In 1980, Paul Benioff introduced the amount Turing machine, which uses amount proposition to describe a simplified computer. In a 1984 paper, Charles Bennett and Gilles Brassard applied amount proposition to cryptography protocols and demonstrated that amount crucial distribution could enhance information security. According to some experimenters, noisy intermediate- scale amount(NISQ) machines may have specialized uses in the near future, but noise in amount gates limits their trustability. In recent times, investment in amount computing exploration has increased in the public and private sectors.

Fig 1.1: History of Quantum Computing

2. USAGE OF QUANTUM COMPUTING

Quantum computing is a rapidly-emerging technology that harnesses the laws of quantum mechanics to solve problems too complex for classical computers. Today, IBM Quantum makes real quantum hardware -- a tool scientists only began to imagine three decades ago -- available to hundreds of thousands of developers.

2.1 Quantum Information Processing

Computer masterminds generally describe a ultramodern computer's operation in terms of classical electrodynamics. The qubit serves as the introductory unit of amount information. It represents a two- state system, just like a classical bit, except that it can live in a superposition of its two countries. In one sense, a superposition is like a probability distribution over the two values. still, a amount calculation can be told by both values at formerly, inexplainable by either state collectively. In this sense, a" superposed" qubit stores both values contemporaneously.

2.2 Quantum parallelism

Quantum community refers to the capability of amount computers to estimate a function for multiple input values contemporaneously. This can be achieved by preparing a amount system in a superposition of input countries, and applying a unitary metamorphosis that encodes the function to be estimated. The performing state encodes the function's affair values for all input values in the superposition, allowing for the calculation of multiple labors contemporaneously. This property is crucial to the speedup of numerous amount algorithms.

2.3 Quantum Programming

There are a number of models of calculation for amount computing, distinguished by the introductory rudiments in which the calculation is perished . A amount gate array decomposes calculation into a sequence of many- qubit amount gates. A amount calculation can be described as a network of amount sense gates and measures. still, any dimension can be remitted to the end of amount calculation, though this promptness may come at a computational cost, so most quantum circuits depict a network conforming only of amount sense gates and no measures. Any amount calculation can be represented as a network of amount sense gates from a fairly small family of gates. A choice of gate family that enables this construction is known as a universal gate set.

2.4 Quantum Annealing

Quantum annealing relies on the adiabatic theorem to take over computations. A system is placed in the ground state for a simple Hamiltonian, which sluggishly evolves to a more complicated Hamiltonian whose ground state represents the result to the problem in question. The adiabatic theorem countries that if the elaboration is slow enough the system will stay in its ground state at all times through the process. Adiabatic optimization may be helpful for working computational biology problems

3. TYPES OF QUANTUM COMPUTING

• Measurement-Based quantum computing

A measurement-based quantum computer decomposes computation into a sequence of Bell state measurements and single-qubit quantum gates applied to a highly entangled initial state (a cluster state), using a technique called quantum gate teleportation.

• Adiabatic quantum computing

An adiabatic quantum computer, based on quantum annealing, decomposes computation into a slow continuous transformation of an initial Hamiltonian into a final Hamiltonian, whose ground states contain the solution.

• Topological quantum computing

A topological quantum computer decomposes computation into the braiding of anyons in a 2D lattice.

3.1 Components of Quantum computing

1. Quantum hardware designed to be stable and auto-calibrated to give repeatable and predictable high-quality qubits;
2. Cryogenic engineering that delivers a continuous cold and isolated quantum environment;
3. High precision electronics in compact form factors to tightly control large numbers of qubits;
4. Quantum firmware to manage the system health and enable system upgrades without downtime for users; and
5. Classical computation to provide secure cloud access and hybrid execution of quantum algorithms.

CONCULSION

Any computational problem solvable by a classical computer is also solvable by a quantum computer. Intuitively, this is because it is believed that all physical phenomena, including the operation of classical computers, can be described using quantum mechanics, which underlies the operation of quantum computers. Quantum computers have the potential to revolutionize computation by making certain types of classically intractable problems solvable. While no quantum computer is yet sophisticated enough to carry out calculations that a classical computer can't, great progress is under way.

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