International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 05 Issue: 04 | April - 2021 ISSN: 2582-3930

# Quantum computation, quantum theory and AI

Shital Gopal Shetkar

Department of Science and

Information Technology

Patkar-Varde College

Mumbai 4000062, India

***Abstract:***

***The main purpose of this paper is to explore different (possible) quantum applicationsAI calculation and reviewing the interaction between scientific theory and AI. we tend to students unacquainted with quantum calculation, a short introduction thereto provided, and introduced a preferred however easy quantum rule for them they appreciate the facility of quantum computation.This paper is a review paper for this Mingsheng Ying paper on the Artificial Intelligence track.***

***Key Words:***

***Quantum mechanics, Quantum circuits, Qubits and quantum registers, Quantum algorithms***

## I. INTRODUCTION

**Quantum mechanics**is a basic concept in physics that provides a description of the physical structures on the atomic scale and subatomic particles. It is the foundation of all quantum physics including quantum chemistry, quantum field theory, quantum technology, and quantum information science. Quantum theory is undoubtedly one of the great scientific achievements of the 20th century. It offers the same framework for the construction of various modern body ideas. More than 50 years after its invention, the quantum theory married to computer science, gave birth to another great 20th-century intellectual revolution and the new story of quantum arithmetic. no old computer could mimic certain quantum events without a decrease in clarity, and saw thatthe results of the machines should give something really new to the calculation.

## II. WHAT IS QUANTUM COMPUTING

Quantum computers process information in a fundamentally different way than classical computers. Traditional computers operate on binary bits — information processed in the form of ones or zeroes. But quantum computers transmit information via quantum bits, or qubits, which can exist either as one or zero or both simultaneously. That's a simplification, and we'll explore some nuances below, but that capacity known as superposition lies at the heart of quantum's potential for exponentially greater computational power.Quantum computing promises to completely transform the computing as we know it.Moderncompter computes the information in very basic formate as an 0 and 1.In Modern computers the data can be represent by only 1 or 0 bit.In Quantum computing the memory units which help you to compute this bits is an size of an atom.In quantum we have the quantum bits or qubits which can represent the multiple states at a same time.It can represent the state as an 0,1 or 0 and 1 at a time which increases the power of quantum computer of working million times more efficient and fast than the supercomputer.

1. ***Qubits and quantum registers***

Mathematically, a qubit is represented by a unit vector in the two-dimensional complex Hilbert space, and it can be writtenin the Dirac notation as follows:

$|\psi\_ = \alpha 0|0\_ + \alpha 1|1\_$, (1)

where $|0\_$ and $|1\_$ are two basis states, and $\alpha 0$ and $\alpha 1$ are complex numbers with $|\alpha 0|2 + |\alpha 1|2 = 1$.

2. ***Quantum gates***

Typically, quantum computation is realized by quantum circuits consisting of quantum gates. A quantum gate describesa discrete time step of evolution of a closed quantum system.

3. ***Quantum measurements***

The outcome of quantum computation can only be obtained by measuring certain quantum registers. We only considerquantum measurement in the computational basis. It is well known that quantum measurements in other bases can becarried out by combining unitary transformation and measurement in the computational basis.

## III. MODELS OF QUANTUM COMPUTATION

***1. Quantum Turing machine and quantum automata***

*The Quantum Turing machine is the first definition of a quantum computer, but it is not a real quantum computer because the machine may be in a quantum state within the calculation steps, but at the end of each calculation machine the machine always goes back to one of its* *classics. The first quantum Turing machine was described by Deutsch in 1985. On his machine, the tape can also be present in quantum regions.*

***2. Quantum circuits***

The regional model of quantum calculation was also proposed by Deutsch. Specifically, the quantum region consists of a series of quantum gates connected by quantum wires that carry qubits. Yao has shown that the quantum regional model is equal to the quantum Turing machine in the sense that they can mimic another during polynomial. Since then, quantum circuits have become the most popular model of quantum calculations in which most of the existing quantum algorithms are displayed.

***3. Adiabatic quantum computation***

Quantum Turing machine, quantum automata and quantum circuits are quantum integration of its classmates. Recently, several models of quantum computer novels are pregnant and have no obvious analogues, one such model is adiabatic quantum computation proposed by Farhi, Goldstone, Gutmann and Sipser. Unlike all other models considered in this section, which are indirect time periods, adiabatic quantum computation is a continuous calculation model. Based on adiabatic perspective in quantum physics. In quantum adiabatic integration, the emergence of the quantum register is dominated by the slightly different Hamiltonian.

## IV. LOGICAL FOUNDATIONS OF QUANTUM COMPUTATION

***1. Categorical quantum logic***

Currently, quantum algorithms and communication processes are presented mainly at the lowest level of quantum circuits. We have learned from old calculations that high definition is very useful in the development and analysis of algorithms and processes because it enables us to think of a problem that we intend to solve in a logical way, rather than details to get started. However, high-definition definition techniques lack quantum calculation In response to high-level needsdescription in quantum information science, Abramsky and Coecke proposed a phase-theoretic axiomatization of quantum machines using the most advanced legal tools in computer science,
especially Abramsky’s previous work on concurrency semantics and geometry of interaction.

***2. Quantum lambda calculus***

The lambda figure is the formalism of high-order activities and is a sound basis for some important planning languages such as LISP, Scheme, ML and Haskell. The standard performance of λ-calculus was first introduced by Tonder. The non-cloning material of quantum data makes quantum lambda calculus closely related to linear lambda calculus created by the community of direct concept. In a series of papers, Selinger and Valiron systematically magnified quantum lambda calculus. Essentially, quantum lambda calculus was used by them to provide an unambiguous model of the corresponding piece of language of the functional quantum programming system, obtained by adding high-order functions in the Selinger language of quantum flowchart language QFC.

***3. Quantum computational logic***

The Quantum logum was proposed by Birkhoff and von Neumann as the concept of quantum machinery nearly 70 years ago. Quantum conceptual definitions are interpreted as closed space spaces (the Hilbert space) quantum system, or their algebraic extracts, orthomodular letice elements, and logical connectors are naturally translated asfunctions in the orthomodular thigh. The basic concept of quantum logic semantics is based on von Neumann's hypothetical estimation concept. Encouraged by the rapid development of quantum calculation, Catattaneo, Dalla Chiara, Giuntini and Leporini introduced the concept of quantum calculations where proposals are interpreted as quantum registers and logical links are interpreted as quantum gates or functions that are not defined in terms of quantum gates. This concept can be used to describe and consult quantum circuits. It seems that some interesting link between quantum computational logic and the algebraic function of quantum circuits exists and requires further studies.

***4. Theory of computation based on quantum logic***

***5. Quantum algorithms***

The study of quantum algorithms has been the driving force in the whole field of quantum calculation because some quantum algorithms show that quantum calculations can provide much faster than normal calculations. Unfortunately, I am not an expert on quantum algorithms and as a result I can only provide a brief survey of this area. Three classesof the quantum algorithms discovered, which show a profit over the older known algorithms:

a. **algorithms**

based on Quantum Fourier conversion, e.g. Deutsch - Jozsa algorithm and Shor's algorithm for re-installation and separate logarithm; quantum search algorithms, that is, Grover's algorithms and their extensions; quantum algorithms for simulating quantum systems, in the basic sense back to Feynman.

*b.* ***Quantum computer architectures***

Advances in quantum device technology have led people to believe that massive and efficient quantum computers will eventually be built. The design of the building will become more and more important as the computer size of quantum grows. Quantum computer construction is another area I don’t know. All I know is that research into the construction of quantum computers is still in its infancy and there are only a few papers provided in this article. Copsey et al proposed a removable structure, based on quantum computer silicon. A related work by Svore etal. introduced software design made with quantum computer design tools. Quantum programs are an integral part of the quantum computer core.

## V. POTENTIAL APPLICATIONS OF QUANTUM COMPUTATION IN AI

It would be great to have both quantum computation researchers and AI researchers use quantum calculation in AI. The AI community believes that quantum calculations show tangible potential for solutions to problems that are currently inaccessible.

### 1. *Quantum algorithms for learning*

Perhaps the only place where quantum calculation and AI have already merged in a fruitful way is machine learning. There are several papers devoted to the quantum extension of learning learning theory. Their goal is to discover quantum algorithms that work better than existing classical algorithms for studying archeology, such asBoolean activities.

### 2. *Quantum algorithms for decision problems*

Many decision-making problems can be made in terms of decision-making medicine. Farhi and Gutmann have shown that quantum-based quantum algorithms based on the evolution of Hamiltonian can solve the decision-making problems represented by the decision-making drug phase more quickly than random randomized controlled trials. But this does not mean any advantage of quantum calculation over the old calculation of this class of problems because they can also be solved very quickly by other old algorithms.

### 3. *Quantum search*

Most of the first AI research focused on search techniques. This is possible because on the other hand, many AI problems can be reduced to search; for example, editing, editing, theorem proof and data acquisition, on the other hand, computers can perform these types of tasks much faster than humans. Grover's algorithm shows that quantum computers can perform much faster than classical computers. Naturally, people expect that quantum calculation will be widely used in AI to solve various search-related problems. It is believed that quantum search will be one of the first computer technologies to play a key role in AI.

### 4. *Quantum game theory*

Game theory is being used in AI progressively more and more, especially in the many agent programs and distributed AI.Other opportunities to use quantum calculations in AI include:

• Representing knowledge in the form of quantum exaggeration, and accelerating knowledge of quantum similarity thinking.

• Quantum communication and distribution of quantum computing using multi-agent systems; mostly, using a catchlinking.

## VI. CONCLUSION

This paper identifies three categories of opportunities for AI researchers in the intersection of quantum calculation, quantum theory and AI:

• Develop quantum algorithms to solve problems in AI efficiently;

• Develop effective ways to create problems in AI by borrowing ideas from the quantum concept;

• Develop new AI strategies to deal with problems in the quantum world.

## VII. REFERENCES

[1] S. Abramsky, High-level methods for quantum computation and information, in: Proceedings of the 19th Annual IEEE Symposium on Logic in ComputerScience, pp. 410–414.

[2] S. Abramsky, B. Coecke, A categorical semantics of quantum protocols, in: Proceedings of the 19th Annual IEEE Symposium on Logic in ComputerScience, pp. 415–425.

[3] D. Aerts, M. Czachor, Quantum aspects of semantic analysis and symbolic artificial intelligence, Journal of Physics A: Mathematical and General 37(2004) L123–L132.

[4] M.A. Nielsen, I.L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, Cambridge, 2000

[5]https://www.sciencedirect.com/science/article/pii/S0004370209001398

[6] https://arxiv.org/pdf/1404.0074.pdf