Non-local Hidden Variables

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December 3, 2024

Abstract

This paper documents an independent investigation into the intersection of quantum mechanics and classical computation through the lens of non-local hidden variable theories. I propose and implement a novel computational framework that explores the boundaries between deterministic computing and quantum behavior. By engineering a system that deliberately exploits race conditions and quantum effects present in modern computer architecture, I explore the possibility of manifesting quantum-like behavior at a macroscopic scale.

The foundation of this approach rests on Bell's Inequality, which definitively shows that no local hidden variable theory can fully reproduce quantum mechanical predictions. Rather than attempting to circumvent this fundamental constraint, I leverage it to design a non-local hidden variable framework implemented through distributed computing architecture. The system utilizes quantum wells inherent in transistor design, coupled with carefully controlled race conditions, to create what I term a "qubyte" - an abstract object exhibiting quantum-like properties.

Contents

1 Introduction

Building practical quantum computers presents significant engineering challenges in maintaining quantum coherence and controlling quantum states at the microscopic level. Current approaches require extreme conditions - near-absolute zero temperatures and careful isolation from environmental interference - to preserve delicate quantum states. These requirements create substantial barriers that limit the scalability and practical implementation of quantum computing systems. However, the fundamental principles of quantum mechanics suggest an alternative approach: rather than fighting against decoherence, quantum-like behavior could potentially be engineered at a macroscopic scale.

Modern classical computers already operate at the boundary between quantum and classical realms. As transistor sizes approach fundamental physical limits, quantum effects such as electron tunneling become increasingly significant. While these effects are typically viewed as limitations to be minimized, they reveal an intriguing possibility: the quantum nature of the underlying hardware might be deliberately exploited to manifest quantum behavior at a higher level of abstraction.

This intersection between classical and quantum domains was first explored in the Einstein-Podolsky-Rosen (EPR) paradox of 1935. The thought experiment considered two particles that interact and then separate to arbitrary distances. Quantum mechanics predicts that measuring one particle instantaneously determines the state of the other - a phenomenon Einstein famously called "spooky action at a distance." This apparent violation of locality troubled Einstein, who believed it indicated quantum mechanics must be incomplete, suggesting the existence of hidden variables that would restore classical causality.

The resolution to this paradox came through Bell's Inequality, which provides a mathematical framework to distinguish quantum behavior from classical hidden variable theories. Bell showed that any local hidden variable theory must satisfy certain statistical bounds that quantum mechanics violates. Subsequent experimental violations of Bell's Inequality have definitively demonstrated the reality of quantum entanglement and non-locality.

This paper proposes a novel computational framework that deliberately exploits race conditions and quantum effects present in modern computer architecture to create what we term a "qubyte" - an abstract object exhibiting quantum-like properties. By engineering a system of non-local hidden variables implemented through distributed computing architecture, we demonstrate the possibility of manifesting quantum behavior at a macroscopic scale. The framework utilizes quantum wells inherent in transistor design, coupled with carefully controlled race conditions, to create a system that violates Bell's Inequality while operating entirely within classical computing hardware.

Through a series of experiments testing the boundaries between classical and quantum probability, we explore whether this system can implement a full quantum mechanical system of probability inside a classical computer. The results reveal insights into the nature of information, computation, and the quantum world, with potential applications ranging from quantum simulation to novel approaches to randomness and encryption. Most significantly, this work suggests a new pathway toward quantum computation that bypasses many of the engineering challenges facing current approaches.

The paper begins by establishing the necessary background in both computer science and quantum mechanics before introducing the qubyte construct and its theoretical foundations. We then present experimental results demonstrating quantum-like behavior, including violations of Bell's Inequality, and explore practical applications in quantum algorithms and random number generation. Finally, we discuss the implications of this work for our understanding of the classical-quantum boundary and its potential impact on the future of quantum computation.

2 Background and methods

The famous thought experiment of Schrodinger's cat has stood as a paradoxical representation of the counter-intuitive implications of quantum mechanics. A cat is most definitely a classical object, and an atom undergoing random radioactive decay is definitely a quantum object. However, if we put both of them in a box, and have the fate of the cat tied to the wavefunction of the atom, it creates a superposition of the cat being both alive and dead until the box is opened and the state is observed. The future of the cat is entangled to the atom, and our knowledge breaks down at the wall of the box. It is only a matter of probability.

Interestingly, a similar concept can be observed in the virtualized environments of modern computer architectures. Just as Schrodinger's cat exists in a state of quantum superposition within the sealed box, a container can be created within a computer to run an application within an isolated memory space. In this dedicated memory space, only the application and the operating system can access that data. Relative to other applications, this is an information barrier that cannot be crossed.

Figure 1: Schrödinger's App, created by Gemini

In this project, docker containers are used to create isolated environments to put hidden variables inside[CITATION]. Imagine Schrodinger's App, that hides random information inside it's container. It can only be measured by opening the app and looking inside the box. Servers run on these containers to allow the variables to be created and measured, as well as acting as detectors to measure other servers. There could be multiple servers defining a network, each with their own local hidden variables, to which the servers relative to each other could be considered non-local. Variables within these networks are then tested to satisfy the probability rules of quantum mechanics. An extension of Bell's Inequality, called the CHSH test is used to show non-local correlations between measurement results.

2.1 Computer Science

We consider our computers to be deterministic classical machines, but don't recognize the quantum effects that are essential to make it work. Moore's law is the exponential increase in chip sizes that was first observed by leader of intel [CITATION]. The challenge was that individual transistors could be made smaller and smaller, and eventually we ran into issues of quantum tunneling. This is where the probability wave of the electron distribution stretches outside the quantum region, into the classically forbidden region, and the charge leaves the transistor. We can engineer transistors to work at extremely high probabilities, but there is always a chance of interference. The certain nature of classical computing comes from redundancy. Hamming codes are used to turn an approximation into exact calculations.[CITATION].

Race conditions violate the deterministic nature of a computer. A race condition occurs when two or more simultaneous processes try to access the same information. Imagine one person deletes a post on instagram right next to another person trying to view their profile. The behavior depends on which request arrived first, and the results are undefined. There are hundreds of processes accessing information within a computer to coordinate the keyboard, screen, and microsoft word. Each process is given a small amount of time called a quanta to run on the CPU. Then the process is switched out until the next available quanta. You can see all the processes and threads running concurrently in the Task Manager.

Each program run on a computer is it's own turing machine with completely deterministic behavior. Every application is given a piece of memory space to hold it's variables, and time on the CPU to evolve. The memory space is a range of addresses that define the physical location of those transistors inside the chip. Transistors with neighboring addresses are next to each other on the physical board. The time coordinate is defined as the program counter, that steps through line by line and executes the program. This defines a 4 dimensional coordinate system for the information to flow through.

It has been shown that a turing machine can be described by a microscopic quantum mechanical Hamiltonian model [CITATION]. This describes the evolution of program according to Schrodinger's equation where the interaction Hamiltonian has components to read bits, act, and shift the tape. This result is surprising because of the distinction between classical computing and quantum computing, but it shows that classical is merely an approximation of the underlying quantum mechanical system.

2.2 Physics

The intersection of classical and quantum mechanics has historically been marked by apparent paradoxes that challenge our intuitive understanding of reality. One of the most fundamental is wave-particle duality, first observed in Young's double-slit experiment, where individual particles somehow exhibit wave-like behavior, passing through both slits simultaneously and creating interference patterns. This duality extends beyond light to all matter, as demonstrated by de Broglie's matter waves, suggesting that quantum objects exist in a superposition of states until measured.

In the context of classical computing systems, the most prominent quantum effect that manifests itself is quantum tunneling in transistors. A transistor can be modeled as a finite square well containing electrons, as shown in the figure above. The electron's wavefunction $\psi(x)$ has a finite probability of penetrating the classical barrier - a phenomenon with no classical analog. The tails of the wavefunction extending into the classically forbidden regions represent the probability of tunneling. As transistor dimensions shrink following Moore's Law, this tunneling probability increases exponentially, creating a fundamental limit to classical computation.

This probabilistic nature of quantum mechanics deeply troubled Einstein, leading to the famous Einstein-Podolsky-Rosen (EPR) paradox in 1935. The thought experiment involved two particles that interact and then separate. According to quantum mechanics, measuring one particle instantaneously affects the state of the other, regardless of their separation - what Einstein called "spooky action at a distance." The EPR argument suggested that quantum mechanics must be incomplete, and there must be some "hidden variables" that determine the outcomes of measurements but are simply unknown to us.

However, in 1964, John Stewart Bell proposed a mathematical framework to test whether any local hidden variable theory could reproduce the predictions of quantum mechanics. Bell's Inequality establishes clear statistical bounds that any local, realistic theory must satisfy. The profound implication is that no theory of local hidden variables can ever reproduce all the predictions of quantum mechanics. Subsequent experiments have consistently violated Bell's Inequality, confirming the non-local nature of quantum mechanics and demonstrating that Einstein's intuition about locality was incorrect.

The type of Bell Inequality test examined is the CHSH inequality. The spin 1/2 source creates two entangled photons traveling with equal and opposite momentum, and polarization in the same direction. Each photon is then put through a beam splitter that separates vertical and horizontal photons detected at D. The beam splitters at a and b can be independently rotated, and the detectors are put into a cross correlator to find probabilities for each of the following.

The heart of the paradox is that a photon travelling right is affected by the angle of the polarizer that the left travels through. This breaks causality, and was Einstein's objection to quantum mechanics. The solution is that the two photons are part of the same wavefunction spread non-locally. They cannot be considered as two independent particles, they are entangled in their correlations.

Also include in physics: Wave particle duality Measurement changes the state

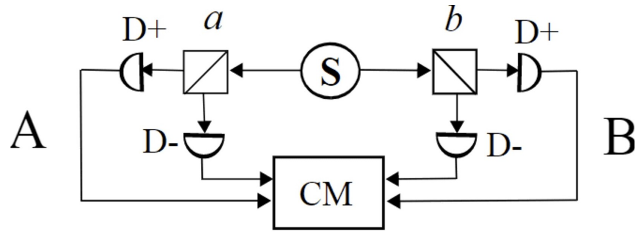

Figure 2: CHSH Test. The central S is a spin 1/2 source, a and b are beam splitters, D are detectors, and CM is a correlator.

2.3 Quantum Computing

Quantum computing leverages the principles of quantum mechanics to perform computations that are intractable on classical computers. At its core, quantum computing manipulates quantum states represented by wavefunctions - mathematical objects that encode the complete information about a quantum system. Unlike classical bits which must be either 0 or 1, a quantum bit (qubit) exists as a wavefunction that can represent a superposition of both states simultaneously:

$$|\phi\rangle = \alpha |0\rangle + \beta |1\rangle$$

where α and β are complex numbers satisfying $|\alpha|^2+|\beta|^2 = 1$. This superposition property enables quantum computers to process multiple states simultaneously. For example, Shor's algorithm exploits this quantum parallelism to factor large numbers exponentially faster than classical computers by placing the input number in a superposition of all possible factors and using quantum interference to identify the correct ones.

The power of quantum computing stems from the ability to perform unitary operations on these wavefunctions while maintaining their quantum nature. These operations are represented by quantum gates, which transform the wavefunction while preserving its quantum properties. A quantum algorithm can be viewed as a sequence of such transformations followed by a measurement that collapses the wavefunction to yield the desired result.

For a physical system to function as a quantum computer, it must satisfy the DiVincenzo criteria, established by David DiVincenzo in 2000:

1. A scalable physical system with well-characterized qubits
2. The ability to initialize qubits at a ground state such as $|000\rangle$
3. Long relevant decoherence times, much longer than the gate operation time
4. A "universal" set of quantum gates
5. A qubit-specific measurement capability

3 Theory of Non-local Hidden Variables

Transistors are designed to hold a static charge inside a finite potential barrier. A charge is a collection of electrons in a gas. The Schrodinger Equation within a finite square well tells us there could be states of different energy levels within the well. We can define a "classical" transistor to be a finite square well with depth equal to the voltage applied to contain the charge, and two allowed energy states, on and off.

The tails of the wavefunction approach 0, but there is a non-zero probability of the charge tunneling through the barrier and showing a false result. Transistors are designed to minimize this probability by balancing the energy of the charge to the size of the well. A static charge represents information which has energy below the potential threshold.

The reason transistors are used to contain the quantum information is that they are resilient to external noise. This is normally a problem for quantum systems implemented using atoms, because a single photon from the environment can come in and destroy the quantum state. Computers are resistent to this noise, and unless there was a Carrington event, it wouldn't feel interference from the environment. However, since it is on a computer, there could be interference from other computer processes.

We can take a chain of transistors and a singular charge, and confine the movement of that charge within the chain. Using bit shift operators, in each time step we can move the charge by a distance, creating an effective velocity for the charge within the chain. This effective velocity increases the overall energy of the charge greater than that of a static charge what the transistor is designed for. This increases the probability of tunneling, and makes it possible to describe the charge within the chain as one wavefunction.

The dynamic charge inside a chain can be considered a variable for it's changing position. Instead of a line, create a loop of transistors for the charge to travel around in. This induces a microscopic magnetic moment, analogous to spin-1/2 electrons.

Next we need to define a filter to separate the chain into two orthogonal regions. To do this, we cut the loop into two separate chains, and the charge will only be located in one of them. The selection of transistors to cut is arbitrary, as you can separate odd and even, every two, every four and so on, each defining unique transformations of the original information. We define each unique cut as a basis. This is analogous to a polarizer grating.

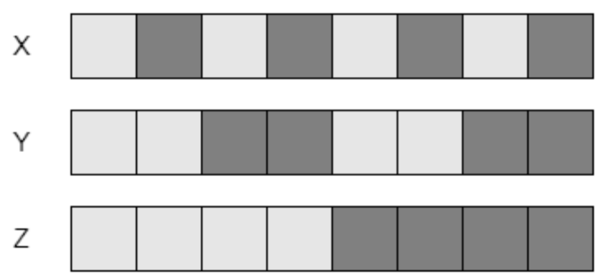

Figure 3: Polarizer gratings for n=8 qubytes.

Measurement can be taken with a polarizer grating to find the probability of the charge being located within the light or dark regions. This is expected to be 50%-50% for each basis, and can be used as a random number generator. If you measure the same basis multiple times, it will stay the same result, because it stays within the loop. Polarizers can also be rotated.

On it's own, the above describes a local hidden variable theory, that will not violate Bell's Inequality. It exists inside a program with it's own local spacetime coordinates and

Hamiltonian. The information is hidden by the dynamics of the system. You can't say where the charge is unless a measurement is taken.

To take this theory non-local, we must zoom out and put the local hidden variables in a box. Then take two more boxes and use them as detectors that can take measurements by interacting with the box with the variables. We label these as A, B, and C.

From the perspective of A, it considers the variable inside B to be non-local relative to itself. The same is true for C relative to the non-local variable inside B. If the polarizers in A and C are aligned, they will both measure the variable in B to be the same result. Due to the changing of state that measurement causes, if the polarizers in A and C are offset by an angle, the result will be dependent on which non-local measurement occured first.

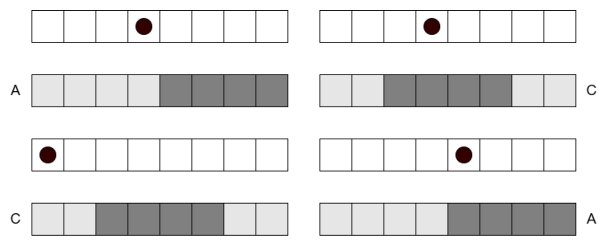

Figure 4: Different measurement results for a race condition.

Given an equal amount of time between measurements, for the same initial condition, the results can be different. If A measures first, the result is light-light. If C measures first, the result is dark-dark. While the results are different, the two cases are measured to be in the same state, which is a representation of entanglement.

4 Qubyte

The model of a chain of transistors fits naturally into computer architecture as an n bit integer. This object is called the qubyte, and is designed to create the closest match to a real quantum mechanical object. The methodology I followed in development was to create theory to inspire engineering, engineering to push experiments, and experiments to refine theory. The end goal is a system to satisfy the DiVincenzo criteria.

To satisfy the first criteria, the qubyte object was created. It is a dynamically measured, perpetual race condition that can be measured along $\log_2 n$ axes, for n bits. It scales linearly because each qubyte is a single integer, and lives in both bitspace and software space, similar to quantum mechanical objects in real space and hilbert space.

To take inspiration from Schrodinger's Cat in the box, the program is run inside multiple docker containers. This creates local spacetime for the program to live inside memory, and it has it's own clock. The spacetime of one program must satisfy all laws of physics, as well as causality.

Take 32 bits set to 0, and one bit set to 1 that defines the initial position. It is also given an initial momentum, which can be negative or positive to move left or right respectively. The qubit travels freely in this space until it reaches the end, and the momentum is set to -31, sending it back to the beginning. It travels around this loop at a high frequency, depending on the hardware the program is run on. The frequency is in the mesoscopic range, between the 10^9 Hz of the CPU, and the refresh rate of the screen, about 60Hz. It continues in this loop, and can be generalized as a spinner.

Time	Qubyte Position
0	00000000000000000000000000000001
1	00000000000000000000000000000010
2	00000000000000000000000000000100
3	00000000000000000000000000001000
4	00000000000000000000000000010000
5	00000000000000000000000000100000
6	00000000000000000000000001000000
7	00000000000000000000000010000000

The qubyte is designed this way because it exemplifies the wave-particle duality of quantum mechanics. If you take a screenshot of the position at one moment, it looks like a particle. Alternatively, if you graph the motion of the particle over time, it satisfies the wave equation.

4.1 Measurement

A polarizer is a mask to put the object through. There are several bases that sets the width of the slits as powers of 2^{b-1}. For a qubit in motion, each polarizer has a 50-50 probability to show up in the 0 or the 1, and we can label these as white and black.

Basis	Measurement Mask
0	00000000000000000000000000000000
1	01010101010101010101010101010101
2	00110011001100110011001100110011
3	00001111000011110000111100001111
4	00000000111111110000000011111111
5	00000000000000001111111111111111
6	00000000000000000000000000000000

If the instantaneous position of the qubyte aligns with the 1's, we label it as up, and the opposite for down. This satisfies the qubit specific measurement capability. Once a qubit is measured, it stays within the boundaries set by the polarizer. This lets the qubyte "remember" the state that it was observed in.

The polarizer can be rotated an angle in increments of $\frac{180}{2^b}$. This action is basis specific, as rotating the first basis by 2 is identical to a non-rotation. A larger basis has more resolution to make measurements at angles.

Three of these polarizers can be taken to define three orthonormal bases on a bloch sphere. A qubyte can either be created as a free particle within the whole set of bits, or it can be created in one of these states. This satisfies the criteria to initialize a qubit in a ground state, as well as allowing 5 more fundamental states to start in. These states are up/down, left/right, and forward/backward.

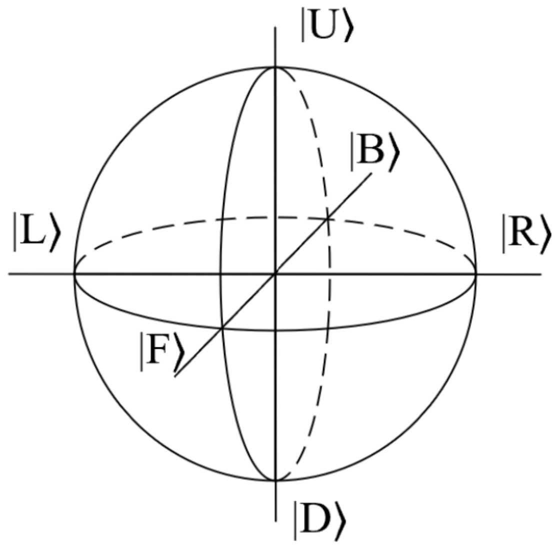

Figure 5: Bloch Sphere. A qubit is a vector that points from the origin to one of 6 basis states.

4.2 Gates

Designing gates to interact with qubytes is finding ways to transform from one state to another. The first gate to consider is the not gate. It takes a state and flips it to the other side of the sphere. This can be done with a bitshift over half the wavelength in a polarizer, or in terms of bases the shift is 2^{b-1}. Given that a polarizer creates two orthonormal states, it is identical to a 90 degree rotation. The NOT gate is reversible, so applying the gate again results in the original state.

The next gate is the hadamard gate. The hadamard swaps up and left, as well as down and right. It acts as an intermediary between the two bases, and is used for computing multiple function simultaneously. The operator measurs both bases, and if they aren't equal, perform a NOT operation. The Hadamard gate is also reversible.

The next is the CNOT gate. This measures one qubit, the control, and will conditionally perform the NOT on the second qubit, the target. CNOT is effectively a measurement of the control, and in order to make an entangled pair of qubits, the Hadamard is used on the first, and then the CNOT gate is used with the first as the control. These two gates together are called the Bell Circuit, because it takes two qubits and entangles them.

The final gate to consider is the Toffoli gate. This is the same as the CNOT, but with multiple control qubits.

The Toffoli gate and the Hadamard gate make up a strict universal set of gates [CITATION]. This satisfies the final criteria, as is enough to do basic quantum computations. However, in order to represent entanglement, the non-local step is required.

5 Entnet

The qubyte is a description of a local hidden variable theory that can be implemented on any classical computer. To make this theory non-local, we separate the object from the measurement. This is done by implementing the qubyte on an http server, and using a separate program to make requests to the server for starting qubytes, applying gates, and measurement.

The server the qubytes are contained by is called Entnet, which stand for entanglment network. Entnet is the container for local hidden qubytes, and all interaction with these qubytes is mediated through the server. Requests can be made to start qubytes in a particular state, apply gates to qubytes, and make measurements of qubytes. There is one additional route, called a forward request. This is used together with another request to forward from one entnet to all the nodes in the network.

Entnet can be configured to many different network layouts, where some servers act to contain hidden variables and other servers act as detectors. The last piece of the network is the observer, to run tests from and collect results.

The simplest network is one Entnet and one observer. This configuration is used for the single qubit testing performed below.

The next network is two Entnet and two observers. On this configuration, it can be used to create a quantum teleportation protocol for transfering data from one observer to another.

The network used to test CHSH experiment was three Entnet and one observer. One entnet is used to store hidden variables, and the other two entnets are used as detectors to forward measurement requests through.

6 Experimental Results

The first set of experiments establishes the uncertain nature of the qubyte, but does not differentiate yet between classical results and quantum results. The first tests to consider are the distribution tests. If a qubyte is split in half by a polarizer, it will randomly fall into one of the boxes at an equal probability. This is the Law of Equal A Priori Probability [CITATION]. It is also true for a photon traveling through a measurement device such as a beam splitter. To perform more complicated experiments, a different network configuration is required.

6.1 Single qubit probability

potential well non-local hidden variables represented by computers separated non-locally Time evolving hidden variables oscillate from 1 to -1 Macroscopic quantum systems

6.2 Entanglement

Bell's Inequality differentiates the limit between entangled correlations and classical coincidences. It is tested using the CHSH experiment, where we would expect a classical result of $|S| = 2$, and quantum mechanical correlations of $|S| = 2\sqrt{2}$. These two lines are on each of the graphs below. The time elapsed is the relaxation time between the creation of a qubyte and measurement.

The first graph was created using a primitive version of Entnet implemented on a network of arduinos. This was in May 2023. This was the first result in which the S-values went outside of the classical range. This was taken with a sample size of 10. At the time this was an exciting result, as previous iterations were entirely within the classical range, but it wasn't enough for evidence of non-local correlations. The experiment worked by creating two qubytes on non-local frames, using gates to entangle them, and then measuring them.

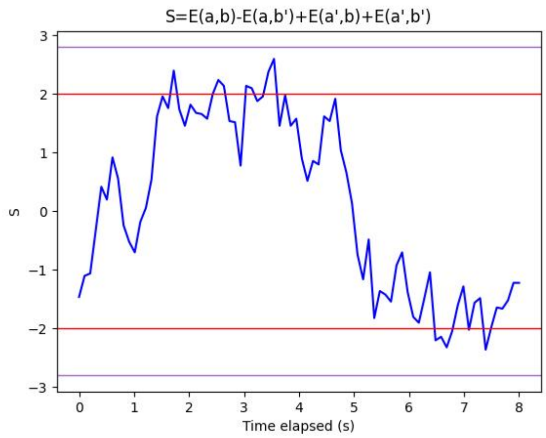

Figure 6: S values from model C

The next graphs were created on the next iteration of entnet, and they show the problem with previous results. For the same experiment, what looks like violations at low sample sizes converge to the classical result with larger sample sizes.

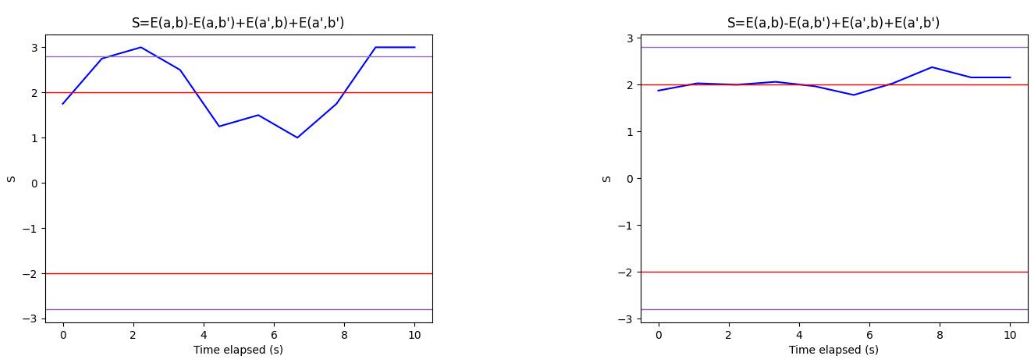

Figure 7: S values from the same test with higher sample

This is indicative of a local hidden variable theory, and despite occasional violations, it will ultimately fail to recreate quantum mechanics. The way that this approach was overcome was through using double forward requests to make measurements. In a network configuration with three entnet and one observer, there is one node with a single qubyte. To measure the qubyte, a double forward request to measure is sent to the node with the hidden variable, which then sends a single forward request to the other nodes, which then measure the single qubyte from two different perspectives. Using this network configuration, we found strong violations of Bell's Inequality that converge to the quantum mechanical result at high sample sizes.

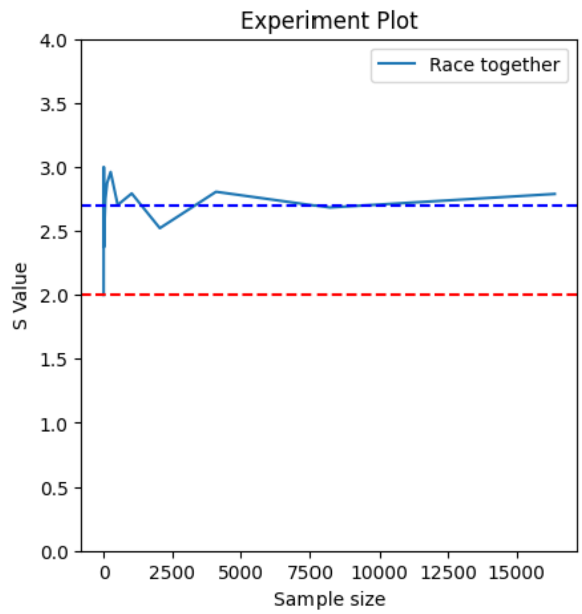

Figure 8: S values from double forward measurement

One consideration with this result is the exponential increase that comes with the forwarding process. A single measurement request takes 1 request. A forward measure request takes three requests, the initial, and then the forward to two. A double measure request takes seven requests, once to the initial, twice for the first forward, and each forward takes another two.

7 Applications

The basic computational framework described above has been tested for applications, and has come up with less than certain feasability. Each of the applications "work", but they open loopholes that may destroy the efficiency.

7.1 Deutsch-Jozsa Algorithm

The simplest algorithm to implement on a quantum computer is the Deutsch-Jozsa algorithm, introduced in the seminal 1992 paper by Deutsch and Jozsa. It demonstrates the first deterministic quantum algorithm achieving an exponential speedup over classical computers. The algorithm solves the following problem: given a black-box (oracle) function f: Z2N $\rightarrow$ Z2, determine whether f is constant (returns all 0s or all 1s) or balanced (returns an equal number of 0s and 1s). While a classical computer would need O(2N-1 + 1) queries in the worst case to determine this with certainty, the quantum algorithm solves it with just one query to the oracle.

Operation of Deutsch-Jozsa Algorithm:

Step	Operation	State Evolution
1	Initialize	$\|01\rangle$
2	Apply Hadamard	$\|01\rangle$
3	Query Oracle	Uf transformation
4	Apply Hadamard	H n to first n qubits
5	Measure	if all 0's, f is constant
		else, f is balanced

The algorithm works by exploiting quantum parallelism and interference. After applying Hadamard gates to create a superposition of all possible inputs, the oracle is queried once, encoding all function values simultaneously. A final Hadamard transform causes destructive interference that reveals the global property of whether f is constant or balanced through a single measurement. The key insight is that the CNOT gate acts as an internal measurement device, correlating the auxiliary qubit with the input state - for constant functions, this correlation preserves the input superposition, while for balanced functions it creates entanglement that can be detected after the final Hadamard transform.

7.2 Quantum Teleportation

Quantum teleportation serves as a fundamental protocol in quantum computing, enabling the transfer of quantum states between different parts of a quantum computer or between s eparate quantum computers in a network. Unlike classical communication which can transmit only binary data (0s and 1s), quantum teleportation can transfer the complete quantum state of a particle, including superpositions and entanglement properties, while requiring both a quantum channel (through entangled particles) and a classical communication channel to complete the transfer. The algorithm works through the following key steps:

1. Preparation of an entangled pair of particles shared between sender and receiver
2. Measure the bell state of the particle to be teleported and one of the two in the pair
3. Transmit measurement results through classical channel
4. Apply gates based on measurement results to recover the original teleported state.

This protocol is essential for quantum computing networks as it provides a way to reliably transfer quantum information between quantum processors while preserving the delicate quantum states that make quantum computing powerful.

The difficulty with a quantum computer implemented on a classical computer is that there is no quantum line. If there was one network to send those types of messages securely, it would, but the quantum line is the same as the classical line, so it is vulnerable to attacks or reverse engineering the answers.

7.3 Random Number Generation

This can also be used to generate random numbers. A qubit within n bits can extract $\log n$ bits of classical information at each measurement. This information describes the position, and is an integer number between 0 and n, which takes $\log n$ bits to describe. It can also be viewed as a combination of measurements along each of the basis polarizers. The first basis determines even or odd in the same way as the first bit in an integer.

The generator must be non-local to entnet, in order to take measurements.

8 Limitations

There are several limitations when testing this model of computation. It's not exactly classical, but it's also not exactly quantum. A lot of the results were found through trial and error, but once they were established they have remained strong.

One major limitation is that there is no concrete way to represent negative probability amplitude. This is due to there only being objects and measurement probability. An interference test has not been performed, except with the CHSH inequality, so more research is necessary for that.

Each of the applications described above "work" but do it in a way that isn't exactly quantum. The Deutsche Jozsa algorithm only takes one pass through, but there is a "width" to the qubyte, which means it's not only one passing through.

The quantum teleportation protocol reliably sends data from one observer to another, however it does so in a way that could easily be thwarted by a hacker listening on the line. This is because communication between entnet nodes is done through classical methods, there is no "quantum line" to keep the data secure.

9 Conclusion

This project started as an idea for a random number generator, and has now demonstrated violations of Bell's Inequality at a scale that hasn't been seen before. This is an entirely new playground for physical experimentation and has widespread applicability, that it could be implemented on anyone's computer, and used to scale quantum algorithms beyond the limitations of classical simulators or noisy quantum computing systems.

The limitations of the system are to be carefully considered when furthering development. It doesn't act entirely classical or quantum, it exists somewhere in the middle as a probability computer, that is able to implement quantum gates.

The future of this work is to develop a new framework for encryption based on quantum teleportation, and this application is possible to implement on every device.

In conclusion, while this work does not precisely emulate quantum computing, it provides a novel framework that is flexible to explore quantum-like behavior in a classical system that does not have the scaling problem that other simulators have.

10 Acknowledgements

I would like to say thank you to Professor Daniel Ou-Yang for always believing in the idea. I would like to acknowledge Claude for assistance with the introduction and background, as well as ChatGPT being the original tool used for development of Entnet. I want to thank the unofficial members of qutron labs, my family, and Erin. Thank you all for your support through this.

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