Abstract: Science and Engineering Fair of Houston

1264

The Light Game

Category:

Mathematics

Roqaia Kamel

Harmony Public Schools - South District/Harmony School of Innovation Katy

In this project I tested a micro: bit's randomization program for any biases in the algorithm. The driving question is, under what circumstances does micro:bit have an algorithmic bias. In other words, how random is random. To determine the answer for this question I held a series of tests taking in to account probability. After documenting my data and cross examining each test I can conclude that the randomization program is indeed random and unbiased.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

[ ] Human participants [ ] potentially hazardous biological agents

[ ] Vertebrate animals [ ] microorganisms [ ] rDNA [ ] tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

[X] yes [ ] no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

[X] yes [ ] no

4. This project is a continuation of previous research.

[ ] yes [X] no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

[ ] yes [X] no

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[X] yes [ ] no

Abstract: Science and Engineering Fair of Houston

1265

Making Music with Markov Chains

Alexandra Noyes

Clear Creek ISD /Westbrook Intermediate School

Category:

Mathematics

Can mathematics be used to discover patterns in music from various genres, and help create new music? Yes! The math of Markov chains can help a musician, composer, or songwriter understand patterns in music and figure out what makes a song go viral. This understanding will help them create new music and their career will take off. I hypothesized that a song created by a Markov chain may not be the same as the original, but the tone and mood of the music would match the original. The new song would feel like the original song's genre. I started by selecting nine songs from three music genres: Country, K-Pop, and R&B. For each song, I created a table listing notes (Markov states) for both the rows and columns. I counted the number of times a transition occurred from a certain note to another certain note and marked that in the table. I converted the number of occurrences to a percentage and made a corresponding range of values to represent that percentage. I randomly selected the first note and used the table of transition percentages to pick additional notes in the Markov chain with the help of a random number generator. The random number determined the next note to use based on the note's range of values. I compared the original with the new song and noticed they had the same tone, mood, and even the entire measure almost perfectly matched. The results supported my hypothesis better than I expected.

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Abstract: Science and Engineering Fair of Houston

1266

Twisting Braids with Group Theory: Cryptography Future beyond Primes

Ansh Gupta

Conroe ISD /McCullough Junior High

Category:

Mathematics

As quantum computers approach reality, the digital security of our global financial and private data faces a crisis. Current encryption relies on large integer factorization—a task normal computers cannot handle, but one that an algorithm can solve nearly instantaneously. This weakness necessitates a new standard of quantum-resistant cryptography. This project explores group theory-based cryptography—specifically, Braid Groups—as a versatile alternative. This system is complex even for quantum computers, as it involves strings representing information getting tangled in random, unpredictable ways. Two Python programs were written: a "Searcher" to simulate encryption and a "Hacker" to simulate a brute-force decryption attempt. Execution times were measured over various braid orderings (B4, B5, B7) and rising key lengths. Due to time constraints, testing very large keys was impossible; therefore, projections were made on a logarithmic scale to show where decryption becomes impossible for even the fastest computers. Results showed that brute-force decryption time increased dramatically while encryption time stayed consistently low. This produced a significant "complexity gap," proving that Braid Groups offer a strong barrier against unwanted access. Ultimately, the findings imply that non-abelian group theory provides a safe foundation for post-quantum cryptography, as it remains computationally infeasible for even high-speed processors to crack.

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Abstract: Science and Engineering Fair of Houston

1267

Cards Chairs and Chances: Investigating How Seat Location Affects Winning Chances in Texas Hold 'Em Poker

London Hart

Houston ISD/BCM Academy at James D Ryan - MS

Category:

Mathematics

Texas Hold Em poker is one of the most popular ways to play poker in the United States, and when playing, its normally understood that the riffle method is used to shuffle the cards. My data showed me that the riffle method (along with an automatic card shuffler and the pile method) is likely used because it gives no distinct advantage to any one character sitting at a rectangular table of 10. To complete my project, I put a deck of 52 cards in numerical order and then shuffled them using 3 different shuffling methods, playing 10 games with each method, and after testing the riffle method, pile method, and overhand method, I found out that the overhand method gives an unfair advantage to anyone sitting across the dealer. This is important because anybody who knows this can now incorporate a way that increases their chances of winning.

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