Computer & Information Science

Burkina's Promise

Joston W Chan, Matthew S Coates, & Rebecca C Merendino

We helped build a website application that is meant to store and track information concerning users, sponsors, and children for ease of looking up information. The Burkina's Promise organization started when several short-term mission trips to the country of Burkina Faso revealed a need for helping the children of pastors become educated. The need for the site itself arose when the Burkina's Promise organization outgrew its use of Microsoft Excel to handle all of its data and information. During our time developing the site, we added features such as a User Messaging feature, more visitor pages, and other features. Lastly, we tested the entire site and fixed various bugs such as getting the Frontend Translator API to work throughout the user pages and being able to delete children in the database on the frontend via a button.

Behavv

Bryce Doane, Eddie Daniel, Matthew C Laven, & Gage L Sappenfield

Our application was built to aid special education teachers in the monitoring and tracking of students' behavior. Every day, these teachers are asked to record student's performance of specific tasks to track their progression over time. Teachers will then use this data to generate reports to share with teachers, parents, or counselors of that student. Currently, teachers are using complex and unmanageable spreadsheets to record student's ratings on specific tasks within specific classes. Behavv serves to make reporting this data easier and more user-friendly by simplifying data entry and presenting clear visual representations of that information. Our application allows teachers to focus less on stressful spreadsheets and more on students' success.

ISeek

Nik m Mourelatos, Sam J Gulinello, Joseph M King, & Luke A Meads

The iSeek team has built an application to aid people that are visually impaired. If you are visually impaired and have misplaced something you own then you could spend an unwanted amount of time trying to find your object. iSeek intends to solve this problem. Through the use of your phone's camera, alongside a trained chatbot, helps users find misplaced or new objects in their surroundings. iSeek is built with the user in mind, all actions inside the app are voice-activated alongside the classic touch controls. We hope to have created an app that is unique to the market and that has.d5tithaea

Mathematics

Applications of Options Greeks and the Black-Scholes Equation

Ryan B Althoff

Options Greeks are embedded in the definition of the Black-Scholes equation and have direct applications to

Ordering Polynomial Rings

Abigail Mitchell

Polynomial rings are a foundational concept in understanding the characteristics of number systems. Through the examination of specific polynomial rings and their properties, it is possible to develop methods of ordering the polynomials within these rings. In this presentation, a broad introduction to polynomial rings will be provided in addition to an in-depth exploration of ordered polynomial rings and their properties. An understanding of ordered polynomial rings is useful for further development in both number theory and calculus.

Proof and Application of The Central Limit Theorem

Ian Parzyszek

The broad applications of the Central Limit Theorem cannot be understated. It allows one to approximate other distributions with that of a normal distribution, which is crucial in hypotheses testing and modern day statistical analysis. The properties of this theorem have been observed for hundreds of years but its actual discovery and proof did not happen until 1810. The elegance of this mathematical proof is shown in this paper, along with its applicability to modern day hypotheses testing using real world data.

The Tower of Hanoi and Recursive Sequences

Sunny Shao

The Tower of Hanoi is a famous puzzle invented by a French mathematician Edouard Lucas in 1883. The task that is we are given a tower of eight disks, initially stacked in decreasing size on one of three pegs. The objective is to transfer the entire tower to one of the other pegs, moving only one disk at a time and never moving a large one onto a smaller. How do we solve this problem? This problem may not appear to be related to mathematics, but we can actually use a recursive sequence to solve it. Sequences are mathematical objects discussed in Calculus II and the Tower of Hanoi is just one example of how sequences can be applied in the real world.

The Black Scholes Model

Katie R Stottlemyer

In this presentation, I will discuss the Black-Scholes Model which is an important mathematical model in financial theory for pricing options. I will discuss the background of this model and an example of how it is used. I also will discuss some contradictions that have been found when using the model and how it is being used.

Mathematical Approaches to Political Gerrymandering

Morgan Zimmerman

With the speculation that electoral maps are divided into boundaries that favor one election outcome over another,

Development of a Detector System for Dark Photon Dark Matter

Ryan J Thurber, Abaz Kryemadhi†, & Niklas Hellgren†

Dark Matter is assumed to exist because of the gravitational effects on stars as they move around galaxies. Efforts have been made to discover its properties in ways such as studying possible inelastic collisions in particles, but they have not yielded conclusive results. Dark photons have been motivated from theory as dark matter candidates. They can convert to regular photons at a small rate. Therefore, my study will strive to discover the regular photons emitted by the dark photons. This can be done by setting up an experimental area shielded from all light sources where the existence of a dark photon would be manifested by the appearance of regular photons in a completely dark area. To increase the chance of detection, a spherical mirror will be used to reflect the photons towards our detector, which increases our effective surface area. So far, I have worked with the photodetector and the data acquisition system in order to understand detector performance in a vacuum, which allows for photons of a shorter wavelength to last longer before they are absorbed, and how to determine the background noise from actual signals.

Development of a Detector for High Energy Gamma Ray Studies

Brandon J Weindorf, Aeowyn Kendall, Al W Mokris, Abaz Kryemadhi†, & Matthew J Farrar†

Despite the rapid progression of knowledge present in the field of particle physics, many mysteries still abound that have yet to be fully solved and understood; one such example is that of dark matter as there is relatively little known about it and many experiments today endeavor to detect it. This project focuses on the use of a relatively new technology, Silicon Photomultipliers (SiPMs), to detect high energy particles incident from space. It is currently hypothesized that dark matter serves as the source of high energy particles that are particularly more energetic than those incident from the sun and supernovae. The Silicon Photomultipliers are coupled with deionized water and scintillating materials to generate and absorb Cherenkov Radiation. While classic photomultipliers (PMTs) can solely be used for this experiment, they cost more and require significantly more power than that of SiPMs. While SiPMs are significantly smaller than PMTs, use of a large volume of water can increase the effective detection range of the SiPM. We detail the design, construction and overall development of multiple Cherenkov Radiation detectors. Moreover, we report on the performance of each design and discuss comparisons among each combination of models. Finally, we present the new data programming tool that has been developed to aid in the analysis and visualization of all collected data.

Acridine Orange as a Novel Tool for Identifying Partially Double-Stranded DNA

Eli Whitehead Zimmers & Matthew J Farrar†

One of the distinguishing features of hepadnaviruses is the presence of partially double-stranded DNA. Hepatitis B is one of the well-known examples of this virus family, yet there remains a paucity of effective methods for probing this nucleic acid structure. This study investigates the use of the dye Acridine Orange (AO) as a possible probe for understanding these genomes. AO is of interest for identifying partially double-stranded DNA because of its unique spectral properties. Specifically, AO fluoresces red (~650 nm) if bonded to single-stranded DNA (ssDNA), or green (~525 nm) if bonded to double-stranded DNA (dsDNA) by intercalation. To test this system, confocal optics and single-photon counting modules were used to probe dsDNA or ssDNA at the single-molecule level. The ratios of green/red fluorescence by AO-stained DNA in varying concentrations of AO were assessed.

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