CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Ish B. Bhanu

Project Number
S1201

Project Title
Face Recognition by the Computer

Abstract

Objectives/Goals
My first objective was to determine whether the correlation coefficient can be used to recognize and distinguish human faces from each other. The second was to learn image processing programs for computing correlation coefficients on the computer. The third and final was to collect data of ten human faces in six different poses (normal, looking up, looking down, looking left, looking right, and smiling) and then to quantify their performances.

Methods/Materials
The correlation computing program was used. It determines how similar 2 pictures are based on the matrices that make up these pictures in the computer. MATLAB Image Processing Toolbox was used to compute correlation coefficients and to obtain a grey scale image from a color image. Other materials include Sony VAIO Computer, Sony digital camera, Canon printer.

Results
Two experiments were performed. Experiment 1: Recognizing one face from a database of ten faces, where each face had up to six variations. On the average it resulted in an 89% accuracy in determining whether a random face of subjects in different poses matched one of those subjects looking straight at the camera. Experiment 2: Distinguishing between two pictures of ten subjects in 6 different poses. The experiment resulted in an 82% accuracy rate in determining whether two pictures were different.

Conclusions/Discussion
Experimental results suggest that the computer had more difficulty in distinguishing faces from each other than just identifying whether or not a random face matched a particular face. As the number of subjects increase i suspect that the recognition performance will decrease. Thus the correlation technique used here needs to be enhanced with facial features like eyes, nose, lips, and etc. Also another question that I plan on researching is the performance of face recognition by humans and understanding the human brain.

Summary Statement
Recognition of the face by the computer, using the correlation coefficient, makes sense but it is not sufficient.

Help Received
My father introduced me to Dr. Nadimi (Pst-Doc) and Ms. Zhou, graduate student, at VISLAB UC Riverside. They showed me the MATLAB program.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Mina R. Bionta

Project Number
S1202

Project Title
Environmental Changes and Species Diversity: A Numerical Simulation

Abstract

Objectives/Goals
The objective is to understand the statistical forces that drive population diversity in the fossil record. Diversity falls during the KT extinction, but rabidly speeds up afterwards until it reaches its pre-extinction rate.

Methods/Materials
I wrote a numerical simulation program in C++ that studies the diversity of families in different environmental conditions. This simulation involves a population of animals with 1 gene that interacts with the local environment to determine the number of offspring. The program runs many generations and calculates the mean gene value and diversity in each generation. Abrupt changes in climate are modeled by changing the environmental variable. In this program, I defined Goobers, virtual, single-gene animals inhabiting a virtual landscape. The statistics of their population and gene distribution provide information on their interaction with the environment.

Results
I studied 4 different cases. 1) The 1st case has no environmental change. I ran the program for 1000 generations. I found that after 150 generations the Goobers found their optimal condition and no diversity change was detected. 2) The 2nd case has one environmental change. The environmental change was enforced after 500 generations, which caused 99% of the Goobers to die. 3) The 3rd case has four different environmental regions. The diversity steadily rises in this situation. 4) Case 4 was started with the same parameters as Case 3. After 300 generations, the environments were changed suddenly. The effect of the dramatic climate change is apparent. The number goes down then quickly recovers as new families evolve. The diversity also shows a rapid decline followed by a rapid increase to previous levels. This case most closely matched the fossil record.

Conclusions/Discussion
Many features of evolution are due to purely statistical effects, which can be modeled by simple simulations. My climate change simulation shows how to interpret the plot of diversity in the fossil record. Rising diversity indicates that the population is expanding into new niches. Sudden climate changes show decrease in diversity followed by a very rapid increase.

Summary Statement
Using computer modeling, my projects shows that punctuated evolution is a statistical process and closely related to environmental changes.

Help Received
Father taught me basic computer programming; Mother proof-read report; Mrs. Edgar-Lee supported me in entering the Regional Fair

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Christopher L. Chiccone

Project Number
S1203

Project Title
Radical Obsession

Abstract

Objectives/Goals
The objective of this report is to explain and present a pattern of numbers that I found, involving radicals and Pascal's triangle. My goal is also to validate and interpret the meaning of my original convergence. I also hope to find other alternative patterns that relate to my theory through research.

Methods/Materials
While taking this convergent pattern for example: (1/1, 3/2, 7/5, 17/12, 41/29, 99/70, 239/169, 577/408, 1393/985, 3363/2378 . . . , you can see that the next numerator is made by multiplying the previous denominator by 2 and then adding that number to the previous numerator. The next denominator is made by simply adding the previous numerator and denominator together. This pattern converges to the square root of 2. I then developed a recursive formula that encompassed all numbers and variables. For a/b; (an-1+xbn-1)/(an-1+bn-1).
Materials:
TI-83 Plus Silver Edition Graphing Calculator
TI-83 Plus Computer Link and Program
Math CAD 2001i Professional

Results
As I continued my research I found that my pattern is closely related to Pascal#s triangle. Also while using this equation I can put any value I want in for x and receive the square root of that number without touching the radical symbol on my calculator. I discovered that my equation could be the basis of how square roots were developed.

Conclusions/Discussion
This convergent pattern is a simple formula and it#s just a matter of following the principles of Algebra that led me to discover all of the details. I later learned through recent research that my expression is related almost exactly to the commonly known way of finding square roots and that#s through continued fractions. My pattern also relates to a method discovered by Newton involving the derivatives of a parabola that eventually converge to the square roots of numbers.

Summary Statement
To show a method that I created which reveals the basis of how square roots could have been developed.

Help Received
Dr. Fletcher, the chairman of Civil Engineering at the University of the Pacific, helped with continued research, along with Steve Gallo, math professor at the University of the Pacific and San Joaquin Delta College.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Collin N. Cronkite-Ratcliff

Project Number
S1204

Project Title
A Computer Model of the SARS Epidemic

Abstract

Objectives/Goals
The purpose of this study is to simulate the SARS epidemic in a stochastic model.

Methods/Materials
The modeling uses a Monte Carlo approach. Monte Carlo simulation is a general technique that uses computer generated (pseudo) random numbers to directly simulate probabilistic occurrences in the real world. The model was programmed in C++ on Bloodshed DEV-C++ version 4. The results were compiled and graphed with Microsoft Excel 97.

Results
The simulated epidemics produced by the model are compared with outbreaks that occurred in several different countries during the 2003 outbreak. In general, the progress of typical model epidemics appears to be quite similar to that seen in the real world. Variation in the progression of epidemics in different countries can be understood in the model as resulting from differences in the effectiveness of the response of the public health system, as well as from stochastic variations. The model also allows one to explore the sensitivity of an epidemic's progression to factors such as transmissibility of SARS and the effectiveness of public health controls such a patient isolation.

Conclusions/Discussion
A stochastic computer model of the SARS epidemic has been developed that simulates some key features of the epidemic of 2003, and allows one to explore how epidemics might progress if some basic features of the disease, or the response of the public health system, were to change.
The simulated results show that SARS is sufficiently contagious to cause a very large epidemic if uncontrolled, but can also be contained and extinguished by basic public health control measures such as isolation.

Summary Statement
The purpose of this study is to simulate the SARS epidemic in a stochastic model.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Emily F. Eder

Project Number
S1205

Project Title
The Effect of Quantum Computing on Hash Functions

Abstract

Objectives/Goals
The purpose of this research project is to determine the effect quantum computing will have on current message authentication techniques. Attack algorithms using classical computers cannot defeat authentication methods because of space and time limitations. An efficient quantum hash function attack, based on the birthday attack, will be developed, dramatically reducing both space and time requirements for this birthday attack algorithm. This work will show that current message authentication methods must be significantly modified to defend against quantum attacks.

Methods/Materials
First, known quantum computing algorithms and hash function attack methods are analyzed. Hash values for multiple inputs are also tested, using the Sha-1 and MD5 hash algorithms. A detailed analysis of the birthday attack is performed, detecting weaknesses and postulating solutions to those weaknesses. The birthday attack then becomes the target algorithm for the remainder of the project. Next, appropriate quantum algorithms are explored in detail, and ideas that could transfer to the birthday attack are found. A quantum simulator is obtained, and known quantum algorithms are tested. Quantum algorithms are also adapted to produce different outputs. Finally, a new and original quantum birthday attack algorithm is proposed.

Results
An efficient quantum birthday attack algorithm has been created. The space requirement for this algorithm is 4n bits, where n is the size of the hash function output. The time requirements for the algorithm have also been greatly reduced. In addition, aspects of the algorithm have been simulated using a quantum simulator.

Conclusions/Discussion
The quantum birthday attack algorithm, developed in this project, gives dramatic improvements compared to the original classical algorithm. It provides a change in the space complexity from an exponential function, O(^(2n/2)), using a classical computer, to a polynomial function, O(n), using a quantum computer. This algorithm will have major implications for current message authentication procedures once quantum computing becomes a reality. Internet commerce, banking, and communication depend critically on having secure message/monetary transfers. This research has shown that message authentication techniques used for these procedures will need to be dramatically altered.

Summary Statement
An efficient quantum birthday attack algorithm has been created, which dramatically reduces space and time requirements, making current message authentication procedures vulnerable.

Help Received
Dr. V. E. Henson, Dr. E. Chow, and Mr. T. Brugger, all of LLNL, provided encouragement on my quantum research. Dr. Henson provided a linux-based laptop for quantum simulations. Prof. D. Meyer, UCSD, gave instruction on the Grover Search Algorithm.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Michael H. Fischer

Project Number
S1206

Project Title
Solitonland: A Complete Mathematical and Physical Relativistic Soliton Universe

Abstract

Objectives/Goals
One of the fundamental principles of modern science is that the speed of light is constant in every inertial frame of reference. In this science project we do not postulate this principle but instead show why this principle is true. To do so, we construct a scale-model universe, both mathematically and physically, which we call Solitonland. In this model universe, all laws of physics are controlled by the Sine-Gordon equation, a single nonlinear partial differential equation that has soliton solutions. Solitons have many distinguishing characteristics that make them ideal for this project and also for optical communications. Our goal is to understand the relativistic structure of our own physical universe by building and studying a simplified relativistic model.

Methods/Materials
We engineered and constructed a new type of nonlinear discrete model of the Sine-Gordon equation using 50 nonlinear oscillators coupled together elastically. We study this model both physically and numerically using optical and computer aided digital photographic measuring systems. We focus on the behavior of moving kinks and breathers as they collide and interact. Our results are presented graphically and three-dimensionally when viewed through suitable anaglyph glasses.

Results
We construct measuring rods and clocks in Solitonland called kinks and breathers using special soliton solutions. We show theoretically and experimentally that when boosted, these kink measuring rods undergo Lorentz contractions and these breather clocks undergo time dilations, exactly as in our own physical universe. We show precisely both mathematically and physically that as measured by the Solitonlanders using their measuring rods and clocks, these two effects exactly cancel each other out. Thus the resulting speed of Solitonland light is constant in every inertial system, exactly as it is in our own physical universe.

Conclusions/Discussion
We extrapolate these results to our own real physical universe, or in fact to any universe, either real or imagined. In any such universe, we show that the speed of light, as measured by the rods and clocks of that universe, is constant in every inertial system. From this conclusion we can explain why the speed of light in our own real physical universe is independent of the inertial system. Our results have applications to the use of optical systems and to the teaching of fundamental aspects of physics.

Summary Statement
A scale model relativistic universe is constructed mathematically and physically in order to understand the structure of our own real physical universe.

Help Received
My techer Mr. Steely helped me organize the presentation of my work.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Eric A. Ford

Project Number
S1207

Project Title
Can You Hear Me Now? A Mathematical Model for the Optimal Arrangement of Cell Phone Towers

Abstract

Objectives/Goals
The objective of my project was to determine the optimal arrangement of cell phone transmission towers for the best service coverage in Kern County using a mathematical model.

Methods/Materials
I placed a coordinate plane over a map of Kern County and established a set of nodes within the county boundaries as coordinate pairs in an Excel spreadsheet. I assigned a population density value to each node based on a population density map. A list of nodes that represent the major highways was created using linear equalities. Areas of unusable land, such as Department of Defense property, were marked by a set of linear inequalities and were not included in the experiment. I created Visual Basic macros to find the total population density and the total number of highway nodes to which service would be provided. The results of the macros were combined to create an optimization value that was used to determine which nodes would be feasible tower locations. A minimum optimization value was selected to exclude locations that were not feasible. The model was executed with minimum optimization values of 6.5 and 40.5 because they represented the optimization values of towers with no significant population or highway coverage for two different tower ranges. The model was also executed with 40, 60, 80, and 100 total towers.

Results
When the model was run with different minimum optimization values and total numbers of towers, different arrangements of towers resulted. The towers generally were arranged in the same basic pattern, clustered around the population density centers and spread along the major highways.

Conclusions/Discussion
The different arrangements of towers have unique strengths and weaknesses. Different models may be suitable for different conditions in the region. Different models may also be suitable for different service providers. A company that is not concerned with immediate profits may wish to implement the arrangement of towers that was produced by the 100-tower model or the model with the minimum optimization value of 6.5. While the network would provide coverage to almost every possible area where a person might use a cell phone, it would be very expensive to build and maintain so many towers, especially in remote locations.

Summary Statement
My project is a mathematical model that utilizes linear programming to determine the optimal arrangement of cell phone transmission towers in Kern County.

Help Received
Maps were obtained from ESRI#s Geography Network ArcExplorer program. My father explained how to create the macros and my mother edited my writing. Both parents assisted in the assembly of my display. Mr. Bob Tranter of the Bureau of Land Management provided information regarding regulations

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Evan M. Gates

Project Number
S1208

Project Title
Software and Hardware Implementation of Rubik's Cube Solving Algorithms

Abstract

Objectives/Goals
The goal was to write the software and create the hardware required to autonomously solve a Rubik's cube.

Methods/Materials
The physical Rubik's cube solver was made primarily out of Plexiglas. A stepper motor is mounted on each of the six sides with a shaft that goes into the center of one face of the cube. In this manner all faces of the cube can be turned. All of the required code was written in C. An implementation of the Thistlethwaite algorithm was written to solve the Rubik's cube. This algorithm uses an iterative deepening search as well as pruning trees to search for moves to solve the cube. It works through four nested subgroups of the cube, restricting moves and solving certain aspects along the way. The state of the cube was originally kept in a file after having a scrambling program scramble it. The use of cameras has recently been implemented to read in the state of the cube. A color recognition scheme was devised, discerning the different colors by comparing RGB values. After a string of moves is produced, either by the solver, the scrambler, or by manual input, it is passed to a program which creates stepper motor commands. The face turns of the cube are translated into turns of the stepper motors, and output through the COM port at a given pace.

Results
There was some trouble stopping the solver from jamming. This was fixed by making all turns clockwise and slightly overshooting the goal so that the cube would self correct if slightly misaligned. Creating consistent lighting for the color recognition to get consistent results was difficult. Lights were added in an attempt to light each face consistently. The solving algorithm solved the cube efficiently and executed quickly.

Conclusions/Discussion
Although the goal was reached, the project can still be improved upon. The main area that could use improvement is the color recognition algorithm. The implementation of neural networks would produce more accurate results. Neural networks could also be used to determine the sampling areas as opposed to manually inputting where the center of the cube is. Another possible extension would be the use of a more efficient solving algorithm. The current algorithm is known as the Thistlethwaite algorithm. Another popular algorithm is the Kociemba algorithm. This algorithm solves the cube on average in ten less moves than the Thistlethwaite algorithm.

Summary Statement
Creation of both the software and hardware needed to autonomously solve a Rubik's cube.

Help Received
Father helped format report; Mother helped with display board.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Aruna O. Gnanasekaran

Project Number
S1209

Project Title
Seeking the Center: Centripetally Accelerating Pi

Abstract

Objectives/Goals
There are three objectives in this project. The first is to derive an expression for Pi using the concept of centripetal acceleration. Knowing that the Pi Associates are all the other roots, beside Pi, of an infinite polynomial, the second goal is to investigate the nature of the Pi Associates. And the last objective is to derive expressions for Pi by approximating the areas of definite integrals.

Methods/Materials
If a body is acted upon by centripetal acceleration, you can visualize that the body is constantly falling toward the center, but never reaches it. Since it can be shown that the fall distance is proportional to Pi, we can equate this to a value found for the fall distance through geometric means. This allows me to derive a recursive d expression using the concept of centripetal acceleration. To find the nature of the Pi Associates, one must find all of the finite Pi Associates. All of the other Pi Associates would be unbounded. To approximate the areas of definite integrals is to approximate the area under the curve of a function. We can do this by fitting rectangles under the curve and finding their areas. The smaller the rectangles are, the more accurate the approximation will be. This is represented as an infinite process.

Results
I was able to derive an expression for Pi from the concept of centripetal acceleration. When I investigated the Pi Associates, I found that the only finite Pi Associate is #d, and all the rest are unbounded. I did derive some expressions for Pi by approximating the areas of definite integrals.

Conclusions/Discussion
Although I have derived an expression for Pi from the concept of centripetal acceleration, I still believe there is so much more to be investigated in that area. I was hoping that there would be more finite Pi Associates, but the only Pi Associate is - d. In the future I plan to investigate more definite integrals. I also plan to continue my investigation of Pi and also derive expressions for Pi by approximating the surface area and volume of a sphere.

Summary Statement
This project was done to derive an expression for Pi from the concept of centripetal acceleration, investigate the Pi Associates, and derive expressions for Pi by approximating the areas of definite integrals.

Help Received
My father has been by me through many sleepless nights, helping me with tedious cutting and pasting that is involved with making a board. He made sure I was equipped with supplies I needed, and took me to the library for research. My brother helped with computer simulations. He also helped remove a virus from

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Ariana G. Haro

Project Number
S1210

Project Title
A Statistical Comparison of Radial and Transect Sampling Methods in a Hypothetical 2-Dimensional Model

Abstract

Objectives/Goals
This experiment attempts to determine which method of bioassay, radial sampling or transect-line sampling, will prove to be a more accurate representation of the whole population sampled.

Methods/Materials
A 2-dimensional model of 28 scale hectares was made and the test units were randomly thrown on it from different angles towards the center to establish a base population. The data was collected from where those units fell. The standard error, standard deviation, and mean were then calculated. Using that information, graphs and spread sheets were generated. These were used to compare data. Three separate trials of comparative sample sets of radial and transect-line sampling were examined to confirm results.

Results
After analysis of the graphs and spread sheets the radial sample methodology clearly represents the whole population better than transect sampling, with some qualification. Two of the three trials of radial sample sets worked better. However, in all cases the means were outside of the standard error.

Conclusions/Discussion
The original hypothesis was, in a 2-dimensional environment radial sampling methods will more accurately represent the whole population. This hypothesis is a true statement based upon the results of the testing. When tested the radial samples proved to be more accurate two out of three times. Although, the radial samples were closer than the transect samples they were still inaccurate when compared to the standard error.

Summary Statement
Using a 2-dimensional model, along with generated spread sheets and graphs, I was able to statistically analyze sample populations and determine whether radial or transect-line sampling methods best represent a larger population sample

Help Received

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Scott S. Hsieh

Project Number
S1211

Project Title
The Molecular Model: A Computer Simulation of the Kinetic-Molecular Theory

Abstract

Objectives/Goals
How does a computer simulation of a gas, following kinetic-molecular theory, stack up against the ideal gas law? How do real gas conditions (molecular collisions and intermolecular attractions) change the situation?

Methods/Materials
The basic premise of the project is to create the computer model. In theory, the following steps are taken, although in practice, the lines are very much blurred. The foundation code was obtained from http://nehe.gamedev.net. From that, a "Molecule" object was added which could move around in an imaginary box and could draw itself, along with the environment, which could in turn contain several Molecules. The variables of pressure, volume, and number of molecules were introduced, and the real gas concepts of collisions and attractions were added. Finally, a script system was written which would churn out data points systematically for detailed analysis of the results.

Results
Under ideal conditions, the simulation came very close to the ideal gas law, generally with a correlation exceeding .99, and under real conditions, the model correctly deviates at very high pressures. There are a few noteworthy observations to be drawn: a "solid" state can be induced, and without collisions, intermolecular attractions can destabilize the model.

Conclusions/Discussion
The molecular model I built correctly (although not perfectly) mimics ideal and real gas behavior. It provides a useful visual for understanding how all the assorted variables come together to result in the equations for the gas.

Summary Statement
Using the kinetic-molecular theory, a computer model was built that would simulate gas molecules, allowing both intuitive grasp of the concepts used as well as detailed analysis of the results.

Help Received
Mother helped in cutting and pasting paper and in the placement of construction paper; other family members gave some assorted ideas and suggestions

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Swetha Kambhampati

Project Number
S1212

Project Title
Adaptive Routing for Road Traffic: Developing a System to Find the Fastest Route Considering Traffic Congestion

Abstract

Objectives/Goals
The goal of this project was to develop a system to distinguish the optimal and fastest route between two points, with respect to time, considering traffic congestion.

Methods/Materials
1. A WEB based simulated city was built by defining the nodes and the roads connecting theses nodes. Different traffic congestions on different roads were specified.
2. A Java Class was written to implement an enhanced Dijkstra's algorithm for finding the fastest path between two points, considering traffic congestion. The Java Class was compiled using Java compiler from JDK.
3. Developed a Java Server Page (JSP) using the above Java Class to display the map and the optimal route on the Web Browser.
4. All the components were tested to ensure the absense of bugs.
5. Used the system to find an optimal and fastest route for the given starting and ending points.

Results
After executing the system with various starting and destination points, the resulting routes demonstrated the success of this system in finding the most time-efficient path considering traffic congestion, with 100% accuracy.

Conclusions/Discussion
A system with full accuracy, precision, and effectiveness, that calculates the fastest route between two specified points while taking into considering road congestion, can be developed through writing a program in Java that employs Dijkstra's algorithm. This is notable in people's everday lives by making a considerable impact on the time and resources expended when undertaking a route through maximally reducing the duration of travel and its inconveniencies.

This experiment can be expanded in the future, with improved technology like GPS, to facilitate real-time routing through developing a system with a database dynamically changing in correspondance to the changing of road traffic. Also the system can be made to be accessable from PDA or Cell Phone so that people can use the system from anywhere.

Summary Statement
The experiment is about fabricating a simulated system to find the optimal route between two points with considering traffic.

Help Received
I would like to thank my science teacher Mr. Ferazzi for valuable guidance. My father also helped me test the system to elimate all bugs.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Nimi P. Katragadda

Project Number
S1213

Project Title
Are You Making Money in the Stock Market? Juxtapositional Analysis of Money Flow vs. Momentum Indicator

Abstract

Objectives/Goals
Several different market indicators are often used to predict trends or patterns in stocks. Two of the most common tools used by stock analysts are money flow and momentum. The Money Flow Index ("MFI") is a momentum indicator that measures the strength of money flowing in and out of a security. It is related to the Relative Strength Index, but the Money Flow Index accounts for volume. The Momentum indicator measures the amount that a security's price has changed over a given time span. In this project, these two different indicators were used as tools for deducing patterns. The purpose of this project was to, first, discover if both the Money Flow Index and the Momentum indicator produced credible predictions; and second, to deduce, in terms of percentage, whether the Money Flow Index or the Momentum indicator was more beneficial.

Methods/Materials
The Money Flow Index can be interpreted by finding a divergence between the indicator and the price action. If the price trends higher and the MFI trends lower (or vice versa), a reversal may be imminent. The Momentum indicator can often be used as a leading indicator. As a market peaks, the Momentum indicator will climb sharply and then fall off-- diverging from the continued upward or sideways movement of the price. Similarly, at a market bottom, Momentum will drop sharply and then begin to climb well ahead of prices. Both of these situations result in divergences between the indicator and prices. With these techniques, I used the software program eSignal 7.5 to analyze the graphs of over 60 stocks.

Conclusions/Discussion
After analyzing numerous stocks, there were definitely certain conclusions that could be drawn. Through the course of the experiment, 65 stocks were analyzed. The data table that was created clearly showed the open price, close price, money flow change, and momentum change for a particular stock. This made it easier to analyze the data and draw conclusions. The resulting percentage of occurrence for money flow was 38 out of 53, approximately 72%. For momentum, the result was 15 out of 53, approximately 28%. These percentages show that the money flow index played a predominant role in the charts that were analyzed. In the end, Money Flow was determined to be a more beneficial technique for predicting patterns in charts.

Summary Statement
This project is about comparing two widely used stock market techniques to determine which is more beneficial.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Joshua A. Kroll

Project Number
S1214

Project Title
Security Through Chaos: Encryption as a Source for Information Entropy

Abstract

Objectives/Goals
The need for a reliable method of encryption has persisted throughout history; encryption applications range from military and intelligence uses to daily commercial activities. As technology has improved to allow for easier and better encryption and transmission, so has it allowed improvements in interception and message processing. Codes have become more advanced, progressing from simple character-replacement ciphers to today's algorithms of large pseudoprimes, exponents, and modular congruences. But the concept has remained simple; it is desirable to be able to send information from one point to another without anyone being able to understand it in the middle. Ideally, the encrypted information should contain no shadows of the original message, which could be identified by careful observation. That is, the ideal code would encrypt a message so that it would be indistinguishable from random noise during transmission. The aim of this project is to determine just how random the messages encrypted by various algorithms really are by comparing large empirical tests to an ideal, random set.

Methods/Materials
The internal complexity, or randomness, of each message was tested using Shannon's measure of information entropy. A Chi-square test was then used to determine how close to the ideal of random noise the encrypted form comes. Data were encrypted using the DES, 3DES, and AES strong encryption methods.

Results
While all three encryption algorithms effectively randomized the set with respect to one-character strings, only AES performed well at higher orders of entropy and approximated the random condition well in all tests. 3DES outperformed DES on all tests.

Conclusions/Discussion
The results strongly indicate that AES is more secure than other algorithms tested. It is highly unlikely that any cryptanalytic attack could be developed for use against AES-encrypted messages which takes advantage of internal patterning. Also, though no such attack has yet been developed, it is likely that one exists in DES and 3DES systems. Additionally, results demonstrate that it is possible to develop a secure communication system using AES in which it would be impossible for an adversary eavesdropping on the communication channel to determine whether a message was being transmitted or simply random data.

Summary Statement
This project is designed to determine the effectiveness of various encryption algorithms at increasing the entropy of, or randomizing, sets of several internal complexities.

Help Received
Dr. Rose Rey assisted in reviewing the project idea and developing the Chi-squared test.; Hans and Eric Nielson assisted in coding the entropy computation program; Mr. Eric Fink reviewed some written material related to the project.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Jordan S.E. Liew

Project Number
S1215

Project Title
Benford's Law

Abstract

Objectives/Goals
To test the validity of Benford's Law and how it can be applied in real life situations.

Methods/Materials
Materials List
1. Microsoft Excel
2. Various statistics from The World Almanac
3. Vital Statistics of the United States Volume II-Mortality
4. Random Number Table
5. Various articles on the internet

Procedures
1. Collect various data from World Almanac
2. Put this data into an Excel spreadsheet.
3. Using various formulas, isolate the left most digit.
4. Then count the number of times, each digit appears.
5. Graph the data.
6. See if the data follows the Benford#s Law distribution.
7. Test whether or not truly random numbers from a random number table and data, which is bounded fit the distribution. Repeat procedures 2-6.
8. Test whether or not things such as land area still fit the distribution even after being converted to another unit. Repeat procedures 2-6.

Results
Benford's Law does in fact apply. However, certain sets of data does not conform to Benford's Law namly, data which is bounded by a maximum and minimum, numbers randomly generated by a person, assigned numbers, and numbers taken from a random number table.

Conclusions/Discussion
The data collected from this experiment supports the hypothesis given to a certain extent. Various data such as World Wheat Production and US Air Quality of certain cities all shows a conformation to Benford's Law. However, data such as SAT scores and human generated numbers showed that it does not conform to data which is bounded or generated in such a manner.

Summary Statement
This project is a validation of a peculiar mathematical phenomenon known as Benford's Law and a look into its applications in real life.

Help Received
Mother and Father helped with cutting and pasting of board. Dr. Gross helped with some background information and ideas.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Christina K. Llanes

Project Number
S1216

Project Title
Neurotic About Hidden Neurons

Abstract

Objectives/Goals
The purpose of this project is to determine whether adding more hidden units to a neural network increases its accuracy. It was hypothesized that if more hidden units are added, then the performance of the neural network will increase, but the time it takes for the network to learn will also increase.

Methods/Materials
First, six neural networks were designed on Excel Spreadsheets, each containing a different amount of hidden units (8, 16, 32, 48, 64, 96 hidden units). These networks will be performing pattern recognition to recognize decimal digits. Digits are inserted in the neural network through an array of 8 cells by 4 cells on the User Interface worksheet. A digit can be drawn into the array by putting color into the cells, making the pattern look like a digit. All the networks were trained using the back propagation algorithm, which was coded in Visual Basic. The neural network was trained with training data. Then experiment data was propagated through all six networks, and the results were recorded on the Experiment Data worksheet.

Results
All of the neural networks performed approximately the same, except the neural network with 8 hidden units which was about 40% less accurate. However, the time that the networks took to learn the training data does increase drastically as the number of hidden units increases, even if the pattern recognition performance only improves slightly.

Conclusions/Discussion
The results of the neural networks support the hypothesis. The neural network with 96 hidden units performed with the greatest accuracy, but it took the longest time to learn out of all the neural networks because of the additional computations it had to calculate. Therefore, if one wanted to create a neural network with high accuracy and the time to learn was not important, then the network should contain a large amount of hidden units. On the other hand, if one wanted to create a neural network that learned quickly and performed with lower accuracy, then a network with less hidden units should be used.

Summary Statement
I tested if the amount of hidden units in a neural network would effect its accuracy and its learning time.

Help Received
Mother and sister typed up experiment data. Professor Crowley gave me neural network advise. Mr. Wellman helped me with the topic. My father taught me basic calculus.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Tarang Luthra

Project Number
S1217

Project Title
Adaptive Interference Rejection in Wireless Networking

Abstract

Objectives/Goals
Wireless networking is fast becoming ubiquitous. With the crowding of airwaves, the interference from unwanted sources is increasingly impacting how fast and far one can communicate. The focus of this project was on developing and simulating an adaptive algorithm in which an antennae array in a receiver can automatically adjust itself to provide the optimum rejection of interference without knowing which direction it is coming from. A new scheme was developed which further helped in rejecting the interference that comes from a direction closer to the source. A computer simulation using Java programming language was then completed.

Methods/Materials
In my project, I used the mathematical models of antennae array, electromagnetic waves captured by the array, radiation from an unwanted source and the signal processing to be done by the array in wireless home networking environment.
In my simulated experiment, I applied programmable weights to the signals received at each element. I studied how different amount of weighting allowed me to change the antennae gain and interference rejection. I then wrote the program that picked the weighting that provided me the best signal reception.

Results
Graph 1 shows the plot of three different weighting schemes # Raised Cosine, Equal and new one called Tarang # which I used in my adaptive processing algorithm. Graph 2 shows beam patterns of the array when these weightings are applied. It can be seen that the gain obtained at each angle location is different for various antennae weighting schemes. Graph 3 shows for which interference directions my adaptive processing algorithm picked different weightings as the optimum ones for a 5-element array. We see that if the interference is near the source, the Tarang weighting comes out to be the best.

Conclusions/Discussion
Fig. 1 shows the plot of the signal gain obtained at each angle location for different antennae weighting schemes. We see that the Raised Cosine weighting provides the best interference rejection at the angles farthest to the source but as interference comes closer to the source, in terms of the look angle, it provides the least interference rejection. Tarang weighting provides maximum rejection of the interference at the angles close to the source, compared to the other two kinds of weightings. The Rectangular weighting provides the best rejection of interference at the mid range of angles.

Summary Statement
The focus of this project was on developing and simulating an adaptive algorithm in which an antennae array in a receiver can automatically adjust itself to provide the optimum rejection of interference without knowing which direction it is

Help Received
Mother helped with poster board; Dad helped with getting computer.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Ian R. McFarlane

Project Number
S1218

Project Title
Dynamics of Acid within a Magnetic Field

Abstract

Objectives/Goals
Lorentz# Force Law states that a charged particle moving through a magnetic field is subject to a force. I propose this force can be used to concentrate ions in an acid by moving the acid through a magnetic field.

Methods/Materials
To test this I will attempt to write a computer simulation program in Java and solve for mathematical equations to predict the results of this yet to be preformed physical experiment.

Conclusions/Discussion
I succeeded in finding a mathematical formula to describe and predict the distribution of ions, however part of the equation requires one to solve for a limit of an integral. This results in the equation having a variable "l" that I am unable to solve for. I would need to consult with an expert to allow me to finish solving the formula.
The computer simulation is based on using the force formulas independent of each other. The program computes the forces on every ion for every other ion, and exerts this force for a tenth of a second. This is less accurate than a solving the integrated formula mentioned above. This program is still being de-bugged.

Summary Statement
I propose Lorentz# Force Law can be used to concentrate ions in an acid by moving the acid through a magnetic field.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)

Garrett M. Nada

Project Number

S1219

Project Title

The Effects of Encoding and Compressing Video File Types Using Various Codecs

Abstract

Objectives/Goals

The purpose of this experiment was to determine which compressed video file type is the best quality, quality being highest mux rate in bits per second, by converting three source files into numerous new compressed ones.

Methods/Materials

Three different source files were collected, one recorded off the television, one recorded on a digital camera and one from a DVD. Using the programs TMPGEnc Beta 12, TMPGEnc 2.52, DVD2AVI, Smart Ripper v2.34, Roxio Video Pack 5 and Flask Mpeg the source files were converted into numerous types of MPEGs, WMVs and AVIs and were then checked for qualitative and quantitative characteristics. The compression ratio, quality in bits per second, and visual quality of each file were compared with each other and the source files.

Results

The highest quality file converted from the Internet MPEG was the dragon720.wmv (Windows Media Video WMV) 720x480 with mux rate 1576000 bits/second. The highest quality file from the DVD source Vob files was the MSV1.avi (AVI using Microsoft MPEG-4 3688 V1 codec) 720x480 with mux rate 2419369 bits/second. The highest quality file from the source MPEG recorded on the digital camera was the CAM352m1.mpg (MPEG-1) 352x240 with mux rate with 1411200 bits/second. The best out of the three in quality and compression was the MSV1.avi.

Conclusions/Discussion

After comparing the three highest quality files from the original three source (control) files, the CAM352m1.mpg (MPEG-1) 352x240, the MSV1.avi (AVI using Microsoft MPEG-4 3688 V1 codec) 720x480, and the dragon720.wmv (Windows Media Video WMV) 720x480, the MSV1.avi had the bigger mux rate of 2419369 bits/second, outscoring the other two mux rates of the CAM352m1.mpg (1411200 bits/second) and the dragon720.wmv (1576000 bits/second). The other important element of compression is size, and the MSV1.avi also outperformed the other files in compression level. The MSV1.avi was only 36.4% the size of its control/source file, while the other two were more than 36.4% the size of their respective controls. The data shows that the MSV1.avi with resolution 720x480 is the highest quality compressed file therefore the hypothesis of the MPEG-2 with resolution 720x480 from the source DVD data was proved incorrect. The data suggests that the later versions of the Microsoft MPEG-4 codec are not any better than their predecessor and that the WMA, MPEG-1 and MPEG-2 are not as efficient.

Summary Statement

This project was about finding out which type of video file has the best overall quality (mux rate) along with the highest level of compression by testing three source files and converting them to numerous new files.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Timothy L. Uy

Project Number
S1220

Project Title
Algorithm Performance on the Satisfiability Problem

Abstract

Objectives/Goals
The objective was the find an effective method to solve the Satisfiability problem.

Methods/Materials
Methods
1. Write the Clause Check subprogram
2. Write a program to generate random problems with the ability to regenerate problems
3. Write the Genetic algorithm
4. Write the GSAT algorithm
5. Write the Simulated Annealing algorithm
6. Write the Exhaustive algorithm
7. Make sure the algorithms run properly
8. Run a 100 clauses 10 variables problem with the Genetic algorithm, GSAT, and Simulated Annealing. Do this 10 times for each algorithm
9. Repeat step 8 for 200 clauses and 20 variables, 300 clauses and 30 variables, 400 clauses 40 variables, 500 clauses and 50 variables, 10 clauses and 10 variables, 30 clauses and 30 variables, 50 clauses and 50 variables, 42 clauses and 10 variables, 127 clauses and 30 variables, 212 clauses and 50 variables.
10. Record data and analyze which algorithm had a higher performance level in terms of states taken to achieve a solution, and number of clauses satisfied

Materials
1 Computer
Software:
Microsoft Visual C++ Introductory Edition Compiler
Microsoft Word
Microsoft Excel

Results
The Hillclimbing algorithm performed worse, in terms of the number of clauses satisfied. The Genetic algorithm performed the worse, in terms of number of states taken to find a candidate.

Conclusions/Discussion
The Simulated Annealing Performed the best out of all algorithms

Summary Statement
To find out which out of the three algorithms will solve the Satisfiability Problem most effectively

Help Received
I would first like to thank my mentor, Dr. Kibler. I would also like to thank SCAS for their support.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Ilya Valmianski

Project Number
S1221

Project Title
Improving Surface Reconstruction from an Inertial Fusion Target Spheremap

Abstract

Objectives/Goals
Objective of my work was to develop a program to process experimental data of sphericity achieved using Spheremapping at General Atomics as well as to develop and realize in code an algorithm to correct misestimations in the model created.

Methods/Materials
- Loading of the experimental data.
- Parsing of the data.
- Creating spherical and Cartesian coordinates of the data.
- Identifying intersections.
- Identifying average centers for traces.
- Adjusting average centers for traces.
- Identifying intersections again to find the new points of intersections.
- Identifying average radii.
- Adjusting average radii.
- Visualization of the results.

Results
I developed a program in C programming language to process experimental data of sphericity of a capsule for a DT target. For this cause I developed and realized in code a special algorithm that can determine and correct the estimation error in the radii and centers of the bands. The program also provides data as well as visualizes a 3D model of the surface of the target. This program was used to aid in development at General Atomics of a program for full surface characterization with 10nm height resolution. The developed program will help improve the production of the capsules of the DT targets for Inertial Fusion Technology.

Conclusions/Discussion
A numerical investigation was performed to analyze the possibility of correction of misestimations in spheremapping data. The developed program improved the errors due to misestimations from 852nm to 454nm. The results were used at General Atomics for full surface characterization of a target.
Possible improvements to the program include:
- Adjusting algorithm.
- Increasing the flexibility of the program.
- Better user-interface.

Summary Statement
A numerical invetigation was performed to analyze the possibility of correction of misestimations in spheremapping data that was used at General Atomics.

Help Received
Used equipment of Gnereal Atomics under supervision of Dr. Richard Stephens

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Felice L. Wei

Project Number
S1222

Project Title
Techniques for Signal Estimation

Abstract

Objectives/Goals
The point of my project is to find the most efficient techniques for fixed versus adaptive filtering of signals. The error in mean and variance of each technique assesses the overall performance of it. The need for adaptive filtering comes with a changing signal while fixed filtering applies for slowly changing signals. The goal is to find the best technique for estimating different classes of signals.

Methods/Materials
Each technique is computer simulated using MATLAB.

Results
The Mean and variance of the errors for each technqiue is generated for different classes of signals.

Conclusions/Discussion
The Leaky Least Mean Square (LMS) stabilizes the estimate and reduces the variance when compared to the standard Least Mean Squared technique. Overall, the Leaky integrator with the non-leaksy start is best for fixed filtering while the Leaky LMS is best for adaptive filtering.

Summary Statement
This project is about selecting the best technique for signal estimation.

Help Received
Father helped teach me how to use the MATLAB software.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Tony Wu

Project Number
S1223

Project Title
A Category Oriented Web Search Engine Based on Round Robin Learning and Ranking Algorithm

Abstract

Objectives/Goals
I hoped to construct a category oriented web search engine through Round Robin learning and ranking algorithm. Such a search engine was designed to classify and rank the Web pages efficiently and to produce more effective search results than existing search engines.

Methods/Materials
More than 40,000 Web pages were loaded into a group of databases and stored as the URLs and the hits of terms in these Web pages. 500 URLs of these Web pages were indexed by the aggregate measure of subject and related keywords as training and testing data, which were used for calculation of the optimal decision boundary and Euclidean distance. A program was developed based on the algorithms, which allows users to automatically classify and rank the stored Web pages according their search queries and their selection of category.

Results
The search engine has shown the effectiveness in categorizing search results and ranking the relevance of returned Web pages to a search query through sufficient experimental data. Experimental data also demonstrated that the data structure based on the new classification and ranking algorithm has resulted in satisfying system performance with little cost in terms of data storage space and search speed.

Conclusions/Discussion
Through Round Robin Learning, a category oriented search engine can be constructed technically and economically. The study has shown the effectiveness of the search engine at an inexpressive cost compared with existing commercial search using link-based algorithms. Such a category oriented search engine has potential in uses of hunting terrorists and academic research. I plan to expand this project by adding more categories and testing the search engine under other conditions such as varying the user groups and the volume of Web pages.

Summary Statement
The project presents new classification and ranking algorithms for building a category oriented search engine based on Round Robin Learning approach.

Help Received
First and foremost, I would like to thank Professor Jeffrey D. Ullman, Professor Gio Wiederhold, and Dr. Jan Jannink in Computer Science Department, Stanford University for their advice. Additional thanks to Mr. Tinh Tran and Mr. Robert Ferazzi for proof-reading my paper.