CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Rohan Chakicherla

Project Number
J1201

Project Title
Environmental Impact of Manipulation of Traffic Controller Algorithms

Abstract

Objectives/Goals
My goal is to reduce the total number of stopped/idling vehicles at intersections, which should significantly reduce emissions. I propose that factoring in the ratio of the number of vehicles on an arterial street to the number of vehicles on secondary streets in existing traffic controller algorithm will reduce total number of idling vehicles at an intersection and therefore reduce emissions.

Methods/Materials
This project describes the design procedures of a real life application of a smart Traffic Light Controller. The changes that this design proposes allow the maximum usage of the existing controllers being used in the Tri-Valley with minimum capital investment. Numbers of primary and secondary cars per traffic-light change were counted at different intersections. Fuel consumption at intersection was computed using modified formula. Emissions of the CO, NOx, Voc for primary and secondary cars were calculated (Excel). Ratios of Primary/Secondary cars were calculated and graphed and threshold for optimal P/S ratio was computed. Hypothetical benefits of using the threshold were computed. Several scenarios were simulated using Visual Basic Programming. Threshold was applied in simulation.

Results
Real-life traffic measurements, and calculations using these measurements, show in this study that CO emissions per signal light change at suitable arterial-versus-side intersection in the Tri-Valley area is approximately 5.55 grams. Simulation of the implementation of my traffic algorithm reduced the ratio of P/S cars at suitable intersection from 6.05 to 1.4. This also reduced the CO emissions per signal light change at suitable intersections in the Tri-Valley area to approximately 1.51 grams.

Conclusions/Discussion
I conclude from these results that there is a potential of reducing up to 7% of CO emissions caused by idling of cars at all suitable intersections in the State of California by implementing my proposed algorithm. Implementation of my proposed Traffic Light Controller could have a significant economic and environmental impact on the Tri-Valley area.

Summary Statement
Factoring in the ratio of number of vehicles on an arterial street to number of vehicles on secondary streets in existing traffic controller algorithm reduced total number of idling vehicles at suitable intersections, reducing emissions.

Help Received
Dad drove me, taught me Excel. Dad's friend gave pointers on Visual Basic, Mentor gave industry formulas.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Eric J. Christensen

Project Number
J1202

Project Title
TKO: Total Kid Organizer

Abstract

Objectives/Goals
The Objective of my project is to develop an easy to use multi-task software program for the Palm Pilot hand held unit (PDA) for use by elementary through high school aged students. It will organize a student's school and home tasks, as well as scheduled activities and classes. It will also allow students to create and take quizzes,grade and store quiz scores and calculate real-time grades/progress using a relatively inexpensive device.

Methods/Materials
I used a standard Windows PC along with Satellite Form Mobile APP Designer software (a PC software development tool) to create my program. I learned many aspects of programming in the process. I used a Palm OS Emulator to test the program. I downloaded the program onto my Palm Pilot PDA for further testing and use at school. I am beginning to use a Microsoft Access Database for storing information and reports.

Results
Creating this program took longer than I thought it would. Learning basic programming was confusing at first. The program had more 'bugs' that needed to be fixed than I thought it would, and some were not that easy to fix. Testing also took a long time, and still continues. Nonetheless, I think it could be a great tool for students to help them stay organized and do better in school. Plus, I learned a lot about computer programming while doing it!

Conclusions/Discussion
The program turned out to be able to do most of the things I wanted it to do. It is simple to use for even elementary aged students. Other quiz and scheduling programs available are not as easy as mine to use. Other scheduling programs do not link student information together like TKO does. It also stores assigment details for all subjects and keeps track of ongoing grades.

Summary Statement
My project created an easy to use multi-task software program for students to use for school/home organization and learning.

Help Received
Integrated Advantage Inc. provided equipment, software, and instruction in programming. Mother helped with board and typing.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Alexander M. Craig

Project Number
J1203

Project Title
Let's Triangulate!

Abstract

Objectives/Goals
The goal of my project is to see if the mathematical formula of triangulation can be accurately used in conjunction with the laser rangefinder, and if they stay accurate at different distances.

Methods/Materials
My materials were a laser pointer, ruler, protractor, 50/50 beamsplitter (microscope slide), mirror, and calculator/trig table. In order to carry out my experiments, I first had to set up my laser rangefinder device. I placed a 50/50 beamsplitter so that the beam is reflected at exactly ninety degrees. Above the beamsplitter I set any object (or a wall), and position it so that the laser hits this object. Next, I put a mirror a few inches away from the other beam which passed directly through the beamsplitter. Then I adjusted this mirror so that the laser was being reflected in such a way that it hit the aforementioned object on the exact same spot that the other beam did. Now we have a right triangle. After doing all of the math-the tan(x) = a/b- I came to the predicted conclusion that triangulation is accurate when used in conjunction with the laser rangefinder, and it may be used at different distances to accurately calculate them.

Results
After all of my hard data-gathering and analysis, I came to the conclusion which my hypothesis supported. Triangulation is accurate at all distances, and although I was only able to test a very limited number of distances (due to the restrictions of space in a town as crowded as Palo Alto), I am confident that triangulation and the laser rangefinder are accurate at all distances. My data supports this.

Conclusions/Discussion
Once I had finished all of my data-analysis and conclusion-gathering, I have concluded that my hypothesis is correct. Triangulation is accurate, and it works correctly with the laser rangefinder. My data supports this by having a margin of error at .67 inches at the maximum, minimum .05 inches. This proves that when triangulation and the laser rangefinder are used together, some very accurate results will be achieved. I have proven, through my data, that triangulation and the laser rangefinder are very accurate when used together.

Summary Statement
My project is about using the formula of triangulation and the laser rangefinder and seeing if they can accurately measure distances of varying sizes.

Help Received
My mother helped me to tape/glue down materials onto my display board. A math teacher at my school helped me learn how to do this basic trigonometry, but all the work in my project was done by me.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Krista C. Drechsler

Project Number
J1204

Project Title
Accuracy of Voice Recognition Software

Abstract

Objectives/Goals
The purpose of this project was to study the accuracy learning curve using Dragon Naturally Speaking 6 voice recognition software and from the information learned develop a training plan to optimize training time so that voice recognition accuracy is obtained in the least amount of time.

Methods/Materials
Users dictated to Dragon Naturally Speaking 6 Voice Recognition Software into Microsoft Word, using a microphone, which came with the software, to find the accuracy of the program. Procedurally, equipment settings and speech characteristics were optimized first followed by Dragon initial mandatory training for all users. Then, 100 words from a phonetically balanced passage were read ten times with subsequent training focusing on most commonly missed vocabulary. The number of words correctly recorded out of 100 determined the accuracy percentage.

Results
Test data showed that initial accuracy percentages were in the mid 70's to mid 80's, increasing to peak accuracies in the mid 90's, with overall averages in the high 80's to low 90's.

Conclusions/Discussion
According to the data, accuracy generally increased with training time, however, some users improved more quickly and consistently than others. Accuracy can be accelerated by immediately correcting and training the words voice recognition misses. One can expect to experience accuracy percentages in the low 90's after about 10 minutes using this method of training. A lesson learned from this experiment is that it is very important to pronounce words and phrases clearly, consistently, and at an even rate. With this kind of program, many jobs can be accomplished at once. For example, a surgeon in an operating room can use voice recognition to direct surgical tables, cameras, light sources, and pumps. In the future, I envision our world where business meetings are recorded in detail using voice recognition; and when it gets hot, someone can just shout, "Open! Window!"

Summary Statement
I studied the accuracy of Dragon Naturally Speaking 6 voice recognition software.

Help Received
My teacher (Ms. Garza) helped me stay on track and complete the project in an organized way on time. My dad helped me understand the more difficult concepts.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Connor S. Ferguson

Project Number
J1205

Project Title
Programming a Video Game in Scheme

Abstract

Objectives/Goals
I designed and programmed a video game using the language Scheme.
The object of the game is to move the AUP (Anti-UFO Platform, a blue rectangle at the bottom of the screen) using the arrow keys and stop the oncoming UFO (a green rectangle) before it hits the ground. The AUP is able to fire once using the up arrow key to shoot down the UFO. If the UFO is not hit by the shot, the player can position the AUP so the UFO lands on it to win the game. If the UFO hits the ground without landing on the AUP or being hit by the shot, the player loses.

Methods/Materials
Although the game's premise is very simple, the process of translating it all into Scheme is more complicated.
I had to define functions that governed the AUP, UFO, and the shot. The AUP's function makes it move left or right ten pixels at a time with the arrow keys. The UFO's function makes it descend and move side to side a certain number of pixels depending on the level of difficulty. It also speeds up as it descends to create the illusion of the earth's gravitational pull. The shot ascends fifteen pixels at a time from the center of the AUP when the up arrow is pressed.
I then put the programs I designed for each the AUP, the UFO and the shot into one big function that controls them all. This function produces true if the player wins and false if they lose. I can then use this in the big program that takes in the player#s name and the level of difficulty they wish to play at and executes the whole game. It displays a personalized message with the outcome of the game.

Results
The game worked as it should.

Conclusions/Discussion
One of the biggest problems was getting the UFO to register as hit at the right time. First, when the shot hit the UFO it would work correctly. But if the shot did not hit and the UFO moved back over the path that the shot traveled, it saw it as hit. Then, in trying to fix that problem I changed the function that determines whether the UFO has been hit by the shot so that nothing registers as hit. I went back and forth between these results for a while before I finally realized what my problem was. I had been saying that the shot just had to be higher than the UFO to be hit. That was why when it had gone past, it would still register as hit when the UFO came back: because it was higher. So I changed the function to include that the shot had to be higher than the bottom of the UFO but lower than the top of the UFO.

Summary Statement
I designed and programmed a simple video game using the programming language Scheme.

Help Received
Dan Anderson, computer teacher at school, helped tutor me in Scheme; Matthias Felleison, author of the book "How to Design Programs", answered some questions via email; Father helped put together display board

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Brenna A.W. Fitzpatrick

Project Number
J1206

Project Title
Is It Worth Your Money? Is There a Way to Make Blackjack Insurance Worth It?

Abstract

Objectives/Goals
The objective of this project was to find out if making an insurance bet in blackjack was worth your money and if different deck sizes effected insurance bets.

Methods/Materials
When writing the porgram I made it so that a game of blackjack would be repeated 1 million times. When an option to get insurance came up four different stratagies would be used: Betting when you had no tens/face cards in your hand, betting with one ten/face card in your hand, betting with 2 tens/face cards in your hand and counting cards. Counting cards is when you count the total amount of cards and the amount of tens/face cards played. If the amount of facecards remaining is over 33% of the total cards left, you buy insurance. I did this in four different deck sizes: Normal(52 cards) Doubled(104 cards) Tripled(156 cards) and Quadrupled(208 cards)

Results
In the 52 card deck the no tens strategy lost you about 3 cents per bet. One ten lost you 9 cents, two tens lost you 14 cents and counting cards earned you about 13 cents.
In a 104 card deck the no tens strategy lost you about 6 cents per bet. One ten lost you 9 cents, two tens lost you 11 cents and counting cards earned you about 11 cents.
In a 156 card deck the no tens strategy lost you about 6 cents per bet. One ten lost you 9 cents, two tens lost you 7 cents and counting cards earned you about 11 cents.
In a 208 card deck the no tens strategy lost you about 7 cents per bet. One ten lost you 8 cents, two tens lost you 10 cents and counting cards earned you about 10 cents.

Conclusions/Discussion
Using simple strategies(no tens, one ten, two tens strategies) were no good and lost you money. However, counting cards earned you about 10-13 cents a bet. Different deck sizes do make a difference. When counting cards or betting with no tens, its best to do with a 52 card deck. The one ten and two ten strategy works best with larger decks.

Summary Statement
I wrote a computer program to find out if buying insurance in blackjack is worth your money.

Help Received
My dad taught me how to program and helped me out when I got confused.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Aaron P. Gallagher

Project Number
J1207

Project Title
Encryption: The Effect of Algorithm Type and Plaintext Length on Encryption, Decryption, and Force-Cracking Times

Abstract

Objectives/Goals
The objective of this project was to find, with a method of scoring, which encryption algorithm was the "best."

Methods/Materials
Using REALbasic and C++, I wrote an implementation of each algorithm (RSA, Blowfish, and IDEA) and timed the number of milliseconds that it took to encrypt and decrypt a varying amount of data. I calculated the estimated time to force-crack, and awarded points to the quickest and strongest algorithms, where the best algorithm was the one with the most points.

Results
IDEA, which was the slowest algorithm, accumulated the most points, probably because it was strongest. RSA, second most seure and second quickest, almost beat IDEA because of speed, but did not win because of the weight of not being strongest. Blowfish, which was the least secure, but most likely the quickest algorithm, got the least amount of points.

Conclusions/Discussion
There was a lot of differentiation among the speeds of each algorithm. IDEA had times of over 600ms, while Blowfish had times around 4ms. Each algorithm was very secure and relatively speedy. I doubt that IDEA, the most secure out of the algorithms I tested with over 2.4· 10^40 years to force crack, is even the most secure algorithm that has been developed. If I were to design an encryption algorithm, I would combine the speed of Blowfish with the strength of IDEA.

Summary Statement
To see which encryption algorithm compared the best, where the best algorithm is the quickest and strongest, isolating factors such as length of plaintext.

Help Received
George Feineman helped with mathematical assistance and background information; Kathy Spoto helped type.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Jarred D. Garcia

Project Number
J1208

Project Title
A Comparison of Transect and Radial Sampling Methods

Abstract

Objectives/Goals
I attempted to determine if radial sampling methodology is more accurate than transect line sampling from a larger population sample.

Methods/Materials
I constructed a scale model forest population of twenty-five (25) scale hectares. On this flat board I randomly drew three radial samples of a scale hectare in size, and three transect line samples of the same scale size to establish comparative sample sets. I randomly threw pieces of kibble on the model board to establish the individual base population. I then collected the data for the whole population and calculated means and standard deviations for the large population, then for each of the radial and transect sample sets for comparison.

Results
I found neither the radial nor the transect samples to be within an acceptable area of representation for the population examined.

Conclusions/Discussion
A population sample set size of three hectares based upon a large population of twenty-five hectares may not be adequate to represent the larger population base for radial or transect sampling.

Summary Statement
In this project I attempted to determine statistically if radial sampling would more adequately represent a larger population base population than transect sampling methods.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Kevin C. Gietzel

Project Number
J1209

Project Title
Have Popular Books Changed to Use Simpler Language over the Past Century?

Abstract

Objectives/Goals
I had a hypothesis that older books were more complex than more modern ones. My goal was to learn whether the length of a book's sentences, words, and paragraphs had decreased over the years. I believed that if sentences, words and paragraphs had decreased, then books had become easier to read.

Methods/Materials
I used a computer and ten library books. I typed in an excerpt from each of these books and then used a program to collect my data.

Results
I found that the word lengths of books had not really changed over the past century. Paragraph length also changed little. Sentence length had no dicernible pattern.

Conclusions/Discussion
I decided that my research was flawed either by the limited sample or that best selling books had not changed over the past century while regular books had. It was also a possibility that old books used words of similar length even though these words were more complex.

Summary Statement
My project is about how and whether books have become more complex in writing style over the past century.

Help Received
My mother and father drove me to the library; they each typed an exerpt; received input on how to revise report.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Robert Hays; Chandan Lodha

Project Number
J1210

Project Title
Tiling with Shapes and Tessellations in Nature

Abstract

Objectives/Goals
The overall objective of this project was to explore which shapes can (or cannot) tile a rectangular grid or infinite plane (in one or multiple ways) and understand why.

Methods/Materials
We discovered many different types of amazing shapes that have been used in tiling in man-made objects such as puzzles, art, and architecture, and tessellations in nature such as crystals and honeycombs. We decided to experiment with the following shapes: Pentominoes, Heptiamonds, Wheelbarrow, Kite #n# Dart Pair, and Regular Convex Polygons (including Triangles, Squares, and Hexagons).

We built pentominoes from legos, heptiamonds from pattern blocks; wheelbarrow and kite #n# dart from tagboard, and different types of (triangular, square, and hexagonal) honeycombs with manipulatives. We experimented tiling appropriate rectangular grids and planes using these shapes.

We used a symmetry principal to reduce the number of tiling problems for pentominoes.
We counted the number of sides used in building honeycombs and noticed patterns for which we derived formulas for the amount of wax used.

Results
We found that we can tile some rectangular grids (8x8 with a square removed anywhere, 3x20, 4x15, 5x12, and 6x10) with twelve pentominoes. Additionally, we discovered that all but one of the 24 heptiamonds could tile a plane individually. We invented interesting, non-trivial ways of tiling a plane using both wheelbarrow and kite #n#dart pairs. Finally, we used manipulatives, algebra, and geometry to prove that hexagons are the most efficient shape (consume the least wax to create the same amount of area) from all regular convex shapes to build a honeycomb.

Conclusions/Discussion
We discovered that although many different types of convex and non-convex shapes (e.g. pentominoes, wheelbarrow) and several interesting combinations of them (e.g. kite n#dart) can be used to tile a plane in interesting ways, there are many simple shapes that cannot be used to tile the plane (e.g. a V-shaped heptiamond or a pentagon). Although we proved that hexagons use the least amount of wax in comparison to squares or triangles, we did not prove that they are better than irregular or multiple shapes to hold honey (we discovered that the general proof was given only five years ago in 1999!).

Summary Statement
In this project we explored which shapes can or cannot tile an infinite plane or rectangular grid, explained why, and applied our findings to nature and society.

Help Received
Parents - Provided overall guidance, helped develop project, and gave overall tips on display; Math Teacher - Helped on background research; Science Teacher - Gave project and display tips; Neighbor - Gave project and display tips; Science Fair Coordinator - Gave display tips

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Si-Si Hensley

Project Number
J1211

Project Title
Shape to the Max

Abstract

Objectives/Goals
The objective of this experiment is to find out which shape of a fixed perimeter encloses the largest area.

Methods/Materials
Since I only know how to compute the areas for simple shapes I needed a method to compute areas for more general shapes. If shapes are cut out of the same material that has the same thickness then there is a simple way to convert mass to area. My basic procedure for the experiment is to cut out different shapes of the same perimeter and weigh them to determine their area. As there are an infinite number of shapes I chose 23 for my experiment. Five of my shapes were rectangles, eight of my shapes were triangles, four of my shapes were ovals, three of my shapes were regular polygons (5, 6 and 8 sided), and three of my shapes were irregular shapes. I used poster board to cut out my shapes, a ruler and protractor, an accurate scale (.01 g) and a digital thermometer/barometer.

Results
During the experiment I noticed many patterns. First I noticed the square has the largest area of the rectangles with a fixed perimeter and the equilateral triangle has the largest area for triangles with a fixed perimeter. After measuring the area of the regular polygons of a fixed perimeter I found out that my hypothesis that the square enclosed the maximal area was wrong. As the number of sides of the regular polygons of a fixed perimeter increased the bigger the area became. As the number of sides of a regular polygon increased the more and more it look like a circle. At this time I made a new hypothesis stating that the curve of fixed perimeter of the largest area is the circle. The remainder of my data supported this hypothesis.

Conclusions/Discussion
At the beginning of the experiment I hypothesized that the square had the largest area for a curve of fixed perimeter. I thought this because it is the widest on all sides. In fact my hypothesis was wrong and the shape of a fixed perimeter enclosing the most area is the circle. Based on my research I know that Steiner and Hurwitz were able to prove in the 1830s that the circle encloses the largest area for a fixed perimeter.

Summary Statement
My project determined experimentally the shape of fixed perimeter that encloses the maximal area is the circle.

Help Received
Father helped explain some equations, Mother helped cut out shapes, Father and Mother showed me how to plot charts using Excel.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)

Rebecca E. Jacobs

Project Number

J1212

Project Title

The Sequel of Nim: Symmetries and Transformations of n-Cubes and the Nimber-Simplex Graph

Abstract

Objectives/Goals

This project is a continuation of last year's project which mapped finite groups under Nim addition to n-dimensional Simplexes, creating the Nimber-Simplex graph. The goals of this year's project are first, to apply finite group theory to regular convex polytopes, second, to determine the symmetry group of an n-cube using the Nimber-Simplex graph, and third, to illustrate a reversible transformation between the Nimber-Simplex graph and an n-cube.

Methods/Materials

In this project, two isomorphisms are defined: one between the Nimsum group 2^n-1 and the Cartesian product C(2)^n, the other between the symmetry group of a Simplex-(n-1) and the permutation group S(n). The symmetry group of an n-dimensional hypercube is determined by mapping the group C(2)^n to the vertices of the n-cube as well as to diagonal matrices representing reflection operations. Permutations of coordinate axes, P(n), are shown to be isomorphic to S(n). The group of symmetries of the n-cube, G(n), is then a semidirect product of the normal subgroup N(n), representing the reflection symmetries, and the subgroup P(n). That is, G(n)=N(n)xP(n). A reversible transformation between the Nimber-Simplex graph in (n-1) dimensions and an n-dimensional hypercube is demonstrated. Materials used in this project include Zometool, an hp Deskjet printer, and a Dell PC running Microsoft Windows 98 and Word 97.

Results

The original ideas developed in this project include the definition of the Nimber-Simplex graph, the isomorphism between the Nimsum group 2^n-1 and C(2)^n, and mapping C(2)^n to vertices of an n-cube as well as the reflection matrices of the n-cube. These two results were used to prove that the Nimber-Simplex graph in (n-1) dimensions determines the symmetry group of an n-cube and that the Nimber-Simplex graph unfolds into an n-cube. Finally, it was discovered that this year's project connects all regular convex polytopes in n>4 dimensions!

Conclusions/Discussion

The first hypothesis that the symmetry group of an n-cube is a semidirect product of the symmetry group of a Simplex-(n-1) and the Nimsum group 2^n-1 was proven. The second hypothesis that there is a reversible transformation between the Nimber-Simplex graph in (n-1) dimensions and an n-cube was also proven. Since n-cubes and n-dimensional cross-polytopes are dual, the Nimber-Simplex graph relates all regular convex polytopes in n>4 dimensions.

Summary Statement

This project determines the symmetry group of an n-cube using the Nimber-Simplex graph, demonstrates a reversible transformation between the Nimber-Simplex Graph and an n-cube, and relates all regular convex polytopes in >4 dimensions.

Help Received

My father helped teach me group theory and guided my research of symmetries and regular polytopes. My parents assisted with backboard construction and reviewed the report for readability and technical accuracy. My math teacher acted as an advisor.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Elliot R. Kroo

Project Number
J1213

Project Title
Learning From the Birds: Using Atmospheric Energy to Improve Airplane Performance

Abstract

Objectives/Goals
The purpose of this project is to find to what extent it is possible to increase an airplane#s performance by using the energy in atmospheric turbulence. I hypothesized that since there is energy in turbulence, there should be a way to use this energy to stay flying without any thrust. If my hypothesis is correct, some kinds of planes could fly for a long time on low power in places where charging batteries is very difficult or impossible.

Methods/Materials
To make the programming aspects of this project easier to work on, I developed them one piece at a time. Using some of the software I developed for my science fair project last year (Artificial Intelligence: Can a computer program learn how to play connect four?), I quickly implemented a Genetic Algorithm, an optimization algorithm that uses natural selection to single out the best answer to a problem. I then combined several laws of physics: Newtons second law of motion, the forces on the plane (in both the upward/downward directions and the forward/backward directions), and some laws of aerodynamics including the relationships governing the values of lift, drag, and air velocity of a moving plane. My simulation integrated these equations in very small time steps, and by controlling the lift coefficient over time with a basic control law, controlled the plane through the simulated air.

Results
When I optimized the control law with my genetic algorithm, it was able to gain ten meters in altitude in 450 meters in a time period of 60 seconds with a maximum gust of 0.7 meters per second. With a gust even greater than 0.7 meters per second, the plane was able to gain even more altitude. This control law was able to turn moving air into energy that the plane could use, and to the point where it could fly without a motor.

Conclusions/Discussion
The data I collected from my simulations show that my hypothesis is correct. The optimizer found that if the optimized airplane surfed the turbulent air, it could gain altitude or speed. If I were to add to this project in the future, I would try different types of gust patterns, or send up a model plane gather data to develop a more accurate representation of the atmospheric turbulence.

Summary Statement
It is possible to get all the energy necessary for a model plane to gain altitude from turbulence the plane encounters in flight.

Help Received
My father helped me to formulate the problem, to understand the aerodynamic concepts, and led me to interesting and useful references.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Daiwei Li

Project Number
J1214

Project Title
The Debruijn Sequence Taken to Higher Powers

Abstract

Objectives/Goals
My intention with this project was to see what would happen if I allowed the use of different base numers in a Debruijn Sequence. The original Debruijn Sequence only includes binary digits (base two numbers) and includes all the possible subsequences (0,0), (0,1), (1,0), and (1,1). An example of a Debruijn sequence of width two might be this: (0,0,1,1,0)(the number of digits in the Debruijn sequence is called the length, so in our example the length would be five). The formula to obtain the width of a Debruijn sequence (the width is how many digits are in the subsequences) is w+2w-1. My hypothesis was that when I changed it so you could use base 3 numbers (0,1,2), you#d end up with a width to length formula of w+3w-1, the base 4 width to length to length formula would be w+4w-1....

Results
Through experimenting with these sequences and sets, I found that the formulas to get from width to length actually are w+3w-1, w+4w-1... Many interesting patterns emerged from my study of in the Debruijn sequence. One thing I noticed that in all the sets, there was either all the same number of each number, (e.g., in the base 2 set of width 2 (0,1,1,0,0) there are 2 ones and 3 zeros and it is impossible for you to get a set of 4 ones and 1 zero or vice versa), or one more of some of the numbers. This basically means that the amounts of each element in a set are as close as possible.

Conclusions/Discussion
According to the data, my hypothesis was correct and from it many patterns. Another pattern I noticed involves difference between the number of sequence elements. [#of elements in set of width x and base (y+1) - # of elements in a set of width (x-1) and base (y+1)] - [#of elements in set of width x with base y - #of elements in set of width (x-1) and base y]= [#of elements in set of width x and base (y+2)- # of elements in a set of width (x-1) and base (y+2)] - [#of elements in set of width x with base (y+1) - #of elements in set of width (x-1) and base (y+1)]+2. (Note, - stands for subtract) Doing this project helped me find out many new things about the Debruijn Sequence and hopefully will for you too.

Summary Statement
This project is about what would happen if you changed a variable in a set called the Debruijn Sequnece.

Help Received
Dad helped with setting up the board.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Deanna Lynn McKinstry

Project Number
J1215

Project Title
Goldbach's Conjecture: True or False?

Abstract

Objectives/Goals
To find out if there is a number that will disprove Goldbachs Conjecture, which states that every even number greater than 2 is the sum of two primes, by writing a computer program to test numbers from 4 x 10 to the 14th power through 4 x 10 to the 15th power.

Methods/Materials
· Microsoft Qbasic
· Microsoft Visual Basic
· Dell 1.9 GHZ Pentium 4 Computer with 256 MB of RAM
· Floppy Disk
· Elementary Basic: Learning to Program Your Computer in Basic with Sherlock Holmes by Henry Ledgard and Andrew Singer, 1982

1. Learn how to program with help from Elementary Basic and computer scientist
2. Find out what numbers have already been tested to see if they are the sum of two prime numbers
3. Write the program
4. Test, revise, and fix the program
5. Run the program for 29 days

Results
The program took 29 days to search from 4 x 10 to the 14th power through 400000001068266 and the program did not find a number that disproves Goldbachs Conjuncture.

Conclusions/Discussion
The results did support my hypothesis which stated that there is not a number (in the numbers searched) that will disprove Goldbachs Conjecture. The information gained in this subject expanded our knowledge about mathmatics by using modern technology to test an old theory.

Summary Statement
My project tries to disprove Goldbach's Conjecture using a computer program.

Help Received
Father taught me how to program.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Leonard L. Pinto

Project Number
J1216

Project Title
Comparing Methods of Biostatistical Sampling

Abstract

Objectives/Goals
My objective was to determine which is the most accurate method of bioassay sampling statistically in a 2-dimensional format; radial sampling of hectares or transect line sampling of the same dimension.

Methods/Materials
A scale model board of 50 cm X 50 cm with washers randomly scattered on it represent the base statistical population area to be surveyed. Five radial hectares and five transect lines (encompassing an area of one hectare) were randomly plotted within the base population model and a comparative study was done using standard deviation and means.

Results
The calculations indicated that the transect line population samples produced a much smaller standard deviation, and when compared to the radial hectare population samples taken, were the most accurate.

Conclusions/Discussion
The comparative study and calculations prove that the transect lines are the most accurate method bioassay sampling method within this 2-dimensional model.

Summary Statement
I statistically determined the most accurate method of bioassay sampling through calculations and comparison of radial sampling and transect line sampling in a 2-dimensional hypothetical model.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Indigo Prizm

Project Number
J1217

Project Title
What Is the Estimated Digital Visual Bandwidth of a Human Being?

Abstract

Objectives/Goals
My goal was to find a estimated digital visual bandwidth for a person. My investigative question was: what is the estimated digital visual bandwidth of a human being? Having had no experience in this kind of science prior to my project, I did not have a hypothesis for the total bandwidth. I did however, have a hypothesis for the second part of my field of vision test. I predicted that the shape for someone's field of vision would be the shape of half of a penut shell.

Methods/Materials
For my project, I used the folloing items: a laptop computer, twenty-two pieces of wood, and about forty screws. First I found out the field of vision. Then I wrote down that number. Next I found out the color depth, and wrote down that number too. After that I found out the video frame rate, and multiplied all my numbers together.

Results
My result for the field of vision test contradicted, because the shape for the field of vision was actually an ellipsoid, not a peanut.

Conclusions/Discussion
This helps because you can make a completely blind person see, if you directley stimulate the visual cortex by programming a machine to take in a certain amount of bits/second.

Summary Statement
My project is about finding what the estimated digital visual band width of the average person is, so that someone could build a machine to make a completely blind person see.

Help Received
My father bought the supplies, helped me find the area of an ellipsoid, and helped with my general display at the science fair at school.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Philip Q. Shao

Project Number
J1218

Project Title
Practical Uses of Sampling Theorem

Abstract

Objectives/Goals
The purpose of this experiment is to find the most efficient number of frames to capture key elements of a motion, and if the theoretical sampling rate works for the motion of a human being.

Methods/Materials
Using the plotting features of excel, I simulated human motion with a sinusoidal function. In parallel I took a movie of my brother doing a directed set of repetitive motions. I picked out frames of this movie based upon the excel simulation and ranked each sequence in order of how well it represents the true motion.

Conclusions/Discussion
I concluded that the theoretical minimum sampling rate is a fantastic guideline but is not entirely accurate on specimens like human beings whose motion is not a true sinusoidal function no matter how well they are trained. With this experiment, I was able to reduce the number of frames needed to capture the motion by 96% from 400 to 16 frames.

Summary Statement
My project sets out to find the minimum number of frames needed to accurately describe a repetitive motion.

Help Received
Mother helped proofread report and board layout.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Veronica S. Soto

Project Number
J1219

Project Title
You Get the Point?

Abstract

Objectives/Goals
The purpose of my project was to examine the mathematics of computational origami.

Methods/Materials
I used different traditional origami patterns and shapes to relate the geometry of design to the pattern of the origami.

Results
I found that algorithms, Huzita#s axioms, and Kawasaki#s theorem could predict where points and creases would successively go in the origami pattern.

Conclusions/Discussion
I found that any figure, such as an animal or inanimate object could be made through computation, but that geometric shapes required additional manipulations of cutting and extra paper to obtain the desired pattern.

Summary Statement
I examined predictable mathematical relationships with a variety of traditional origami shapes and patterns.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Alexandra E. Stone

Project Number
J1220

Project Title
Do Odds-Makers Make Accurate Predictions?

Abstract

Objectives/Goals
The objective of my project was to determine if odds-makers# predictions about sporting events were accurate and if they improved throughout the season.

Methods/Materials
The published scoreboard from the Union Tribune was used to develop a data table where I tracked fourteen through sixteen games per week the predicted point spread, and the predicted point total. After the games were played I recorded the actual point spread and the actual point total. With this information I computed the difference between predicted point spread and actual point spread and the difference between the predicted point total and actual point total. At the end of my experiment I analyzed the data so I could draw conclusions about the accuracy of the predictions.

Results
The winners were correctly predicted approximately 63% of the time. There was not a pattern with predicting total points throughout the season.

Conclusions/Discussion
The predictions improved slightly, though not significantly, over the course of the season.

Summary Statement
My porject is about the predicted odds and how it compares to what actually happens.

Help Received
My father helped me recieve all my information, and my science teacher guided me through the science fair project.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Moeka Takagi

Project Number
J1221

Project Title
Finding Hidden Sequences In Nature

Abstract

Objectives/Goals
My goals for this project were to find mathematical relationships in nature. I decided to conduct four experiments to find mathematical relationships: (1) in the number of flower petals and vegetable leaves, (2) in the leaf arrangement in plants, (3) in the number of spirals in plants, and (4) in shell shapes.

Methods/Materials
In (1), I counted the number of flower petals and vegetable leaves. In (2), I used iceberg lettuce, flowering kale, and succulents. Starting with the outermost leaf, I measured the angle of each successive leaf. I also cut the leaves of the flowering kale and I numbered each successive stalk. Then I looked for patterns and relationships in mathematics. For (3), I looked for spirals in cauliflowers, a pinecone, succulents, a sunflower, and a pineapple. In (4), I observed and analyzed four kinds of shells to find a Fibonacci spiral.

Results
I found in (1) and (2) that flower petals and vegetables with leaves had relationships with Fibonacci numbers. Also, I found in (2) that all the angles on my successive leaves were from 137~140 degrees. This was the Golden Angle. I used LOGO for spiral simulation and I confirmed when I applied Golden Angle to the simulation program, the result showed a well-observed spiral in nature. In the flowering kale, I discovered many relationships. I found that the stalk directly below stalk number 1 was stalk 14. That left a distance of 13, a Fibonacci number. I realized it took 5 right turns and 8 left turns to get from stalk 1 to 14, again, these are consecutive Fibonacci numbers. I also found spirals in the cut stalks in the flowering kale. I found 3 clockwise, and 5 counter clockwise spirals. Those are consecutive Fibonacci numbers. In (3), for all my experimental objects for this experiment, there were consecutive Fibonacci numbers in the spirals going clockwise and counter clockwise. In (4), I did not find any Fibonacci spirals, but I still could identify a mathematical relationship. All my shells were formed in an equiangular and similar manner. I learned that you could describe very different shells with the same mathematical term.

Conclusions/Discussion
I can conclude there is much mathematics combined into nature. Many flowers, plants, and others have survived in long-term natural selection because Fibonacci numbers make a good balance for living. That is why so many living things today have the Fibonacci sequence hidden behind them.

Summary Statement
My project was to search for various mathematical relationships existing inside nature.

Help Received
My dad helped me to make the presentation materials of my display board. He was the one to advice the programming language LOGO to me. He also taught me programming of LOGO.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Benjamin C. Wu

Project Number
J1222

Project Title
A Color Distinguishing Robot

Abstract

Objectives/Goals
The objective is to determine whether a robot constucted out of LEGO bricks can be made to distinguish between colors.

Methods/Materials
A LEGO MINDSTORMS Robotics Invention System 1.5 kit was purchased. Using these pieces, a robot was constructed and programmed. The robot was tested in different lighting conditions (dim, normal, bright) and with different materials (LEGO bricks, paper). The accuracy of the robot's color recognition was also tested.

Results
Since the robot was designed to perform optimally in normal lighting conditions with LEGO bricks, it performed best under those conditions. It did not perform well under other lighting conditions. The robot also had some slight problems with paper.

Conclusions/Discussion
It was found that in both very bright and very dim environments, the robot could not distinguish the colors accurately. The ambient lighting conditions affected the amount of light reflecting off the colored objects, which in turn caused the sensor to misrecognize the observed colors. This is because the program uses data gathered in normal lighting conditions, and was not designed for different environments. Different materials also caused minor problems with the color recognition. It is speculated that the lower opacity of the paper and the higher reflectivity of the LEGO bricks caused these problems. In addition, it was found that it was impossible to distinguish between similar colors, such as white and yellow, because they reflect roughly the same amount of light. It is also impossible to be able to distinguish between all colors with accuracies of 100%. An increase in accuracy with one color is often paired with a decrease in accuracy in another.

Summary Statement
A robot that could distinguish between colors was constructed out of LEGO bricks.

Help Received
Father helped with notebook