CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Ben Ackerman

Project Number
J1301

Project Title
Thinking in Semicircles: The Area of an Arbelos

Abstract

Objectives/Goals
The purpose of this experiment was to prove that the area of an arbelos is equal to the area of a circle whose diameter is the altitude of a right triangle drawn to the hypotenuse, which is inscribed in a semicircle. The experiment involved creating a mathematical proof using the knowledge of various geometry theorems and postulates, and applying them to the diagram in order to create accurate formulas for both areas. The history of Geometry and the format for a mathematical proof are discussed.

Methods/Materials
The materials to construct the diagram used for this proof include a pencil, a ruler, and a compass. The area of the arbelos was found by subtracting the areas of the two smaller inner semicircle from the larger one. The diameter of the circle, which was also the altitude drawn to the hypotenuse of a right triangle inscribed in the larger semicircle, was found using the theorem, which states that the altitude drawn to the hypotenuse of a right triangle is the geometric mean of the two segments of the hypotenuse. By dividing the altitude, or the diameter, in two, the radius of the circle was found, thus making the area of the circle possible to calculate. Once the dust settled, the two formulas for the areas were equal.

Results
The proof held true. Once the areas of the arbelos and the circle were calculated they were equal.

Conclusions/Discussion
In conclusion, both areas when found were equal.

Summary Statement
A mathematical proof was constructed to determine whether the area of an arbelos is equal to the area of a circle, whose diameter is the altitude of a right triangle drawn to the hypotenuse inscribed in a semicircle.

Help Received
My mother helped me use spray mount to put my board together.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

Hristos S. Courellis

Project Number

J1302

Project Title

Artificial Neural Networks that Decode Commands Embedded in the Temporal Density of Neural Spike Sequences

Abstract

Objectives/Goals

The objective is to design Artificial Neural Units that decode commands encoded in the temporal density of neural spike sequences (each unit decodes one command) and to use them in an Artificial Neural Network to decode a multitude of such commands

Methods/Materials

The proposed solution involved: (1) Artificial Neural Units (ANUs), based on a very simple version of the integrate-and-fire model, designed to fire when the temporal spike density in their input exceeds a certain value; (2) Extended Artificial Neural Units (XANUs) made of ANUs and XOR operators, designed to fire when the temporal spike density of the input is bounded within a range of values; and (3) A network of command tuned XANUs that can decoded a number of different commands. A home PC was used running MS-Windows XP, MatLab for performing simulations, and the Minstorms NXT development platform to create a simple robotics application.

Results

Guidelines for choosing the various ANU and XANU parameters and the linear XANU network were introduced. Unit and network functionality were demonstrated with matlab simulations. Three spike sequences were considered for encoding a single command, and single and two command sequences were employed for simulations. Loss of spikes was also explored with simulations. Loss of the first or the third spike did not affect the performance of the XANUs. However, loss of the second spike did when it altered the spike density enough to be outside a XANU#s sensing range. The simple robot application was created, downloaded on the robot, and ran successfully.

Conclusions/Discussion

Decoding commands embedded in spike sequences could play an important role in the design and implementation of prosthetic limbs. Neural signals from the brain could be used to move artificial limbs, if they were decoded appropriately. The work in this project is only a proof of concept of such decoding devices. It illustrates how we can use ANNs to perform this type of temporal decoding reliably. ANUs are extremely simple and the XOR operator is a common component of minimal complexity. This makes the solution very attractive for hardware implementation. The potential for future work is tremendous. More complex ANUs with more inputs, more involved input path characteristics, and more complex network topologies could be used to enhance the operation of the ANUs, the XANUs, and the Artificial Neural Networks.

Summary Statement

Decoding commands embedded in spike sequences can play an important role in interfacing brain signals to artificial limbs and the presented artificial neural network illustrates one way to design and implement such an interface.

Help Received

I would like to thank my parents for their advisement throughout the project, their help with using matlab and developing matlab custom code, their help with the presentation of the different components, their editorial suggestions, for importing and placing the figures, and for their financial support.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Diego Crespo

Project Number
J1303

Project Title
Which Algorithm Is the Most Efficient in Solving Alexander's Star?

Abstract

Objectives/Goals
To identify the most efficient algorithm in terms of time and number of moves (rotations of 72 degrees upon the puzzle's twelve axes of rotation) required to solve the twisty puzzle Alexander's Star (the ultimate configuration). This could ultimately be applied to handle configurations of software and data on computers.

Methods/Materials
Alexander's Star is manually subjected to two algorithms Optimal solution and God's Algorithm, with one trial for each algorithm consisting of 15 tests each. The puzzle's configuration is randomized before each test (in order to avoid the repitision of results).
Materials: written algoriths; stop watch; alexander's star puzzle; data log to record results.

Results
OPTIMAL (TRIAL 2) RAW DATA 1/18/2008
mental reasoning(control) 3 48.18 67
time moves
mean 4 08.89733333333333333 71.93333333
median 4 29.82 71
mode none 69
range 54.66 22
SUBJECTION OF ALEXANDER'S STAR TO GOD'S ALGORITHM RAW DATA
mental reasoning(control) 3 48.18 67
time moves
MEAN 3 26.096 55
MEDIAN 3 34.91 54
MODE NONE 57
RANGE 1 05.28 29

Conclusions/Discussion
Generally all of the ultimate configurations generated by God#s algorithm were the most efficient in terms of times to moves and the applicability. Then the traditional logical reasoning method (the control)and finally the optimal solution was the least efficient in terms of moves to time and was a bit more challenging or cumbersome to apply (hence generating ultimate configurations in a greater allotment of time) and generally the most frivolous. In short my hypothesis was supported through all examinations of

Summary Statement
To ultimately find the most efficient algorithm in terms of times and moves to solve the Rubik's puzzle Alexander's Star.

Help Received
For the generation, production, finalization, and construction of my display I have an immense number of people to thank many directly and indirectly. For the idea of my science fair project there is an immense number of people who I do no know or may never know who dedicated their time and effort writing

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Tracy A. Gallagher

Project Number
J1304

Project Title
Walk This Way: Is There a Correlation between Height and Stride Length?

Abstract

Objectives/Goals
This researcher was testing to see if there was a standard ratio between height and stride length. Originally it was hypothesized that the ratio for men would be 3:5 and for women 1:3

Methods/Materials
This researcher gained information from 45 different subjects. This information included age, weight, gender, height, foot type, and average length of one step. To measure foot type the subjects dampened the bottom of there foot and pressed it on paper. To measure the average stride length this reasearcher would measure the length of 10 steps and divide that by ten.

Results
The researcher was wrong in hypothesizing that the ratio would differ between men and women. In the end the the ratio differed between age groups and foot types.

Conclusions/Discussion
The standard ratio between all subjects was 1/2.75. As the age groups went to a higher age the ratio got closer to 1/3.10. Same with the foot type, the low arches had a ratio around 1/2.61 and as the arch increased so did the ratio.

Summary Statement
This project was to see if there was a common ratio between height and stride length.

Help Received
none

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Kira S.E. Ghandi

Project Number
J1305

Project Title
The Frog with the Fear of Water

Abstract

Objectives/Goals
The purpose of this project is to see how often a frog can make it across a particular pond without getting wet.

Methods/Materials
I used a digital frog and a digital pond because I did not have a frog to use (or a pond) and I could not make a frog behave like that unless he/she wanted to. I used the percent of the pond filled by lily pads as the independent variable, assuming that each of the lily pads are the same size. I measured the pond in lily pads (I used a 50 by 50 grid each time); the size of the lily pads does not matter to the results of my experiment.
The first thing that I did was set up my computer so that it would make a virtual lily pad-covered pond by having the computer randomly place green squares and white squares in the pond. I described the lily pad coverage of the pond as a percentage from 5% to 100% by increments of 5%. I generated results for each lily pad concentration twenty times.

Results
The first time the frog can make it across the pond is when 35% of the pond is covered by lily pads. After 50% of the pond was covered all of the tests showed that the frog could get across every single time (100%). There is a dramatic change after 35% of the pond is covered, as shown in my graph. I could take my work further to see if the size of the pond has any effect on the probability of the frog getting across.

Summary Statement
My project studies the connections of randomly placed objects to each other at different density levels.

Help Received
Mother and father helped with project idea, father taught some Excel tricks to set up the experiment.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Sana Hadyeh

Project Number
J1306

Project Title
Transect Sampling: A Statistical Model Demonstration of Accuracy in Forestry Management

Abstract

Objectives/Goals
This project considers a mathematical model that examines whether transect sampling of small forest areas statistically represents larger populations.

Methods/Materials
A model of 24 scale hectares with "tree" samples was created to represent a large population. Random transect lines were drawn and smaller hectare samples were derived and t-tested for reliability. Later stages of the project examined real data to examine whether the model duplicated actual field data.

Results
All of the smaller model samples failed the t-test at a 95% confidence level. An examination of comparative real field data also indicated similar results in that most samples failed t-test reliability.

Conclusions/Discussion
Transect sampling may not adequately represent a medium size larger mother population.

Summary Statement
This project considers a mathematical model that examines whether transect sampling of small forest areas statistically represents larger populations.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Shaleena Jeeawoody

Project Number
J1307

Project Title
Voice Analysis and Recognition as a Car Theft Deterrent

Abstract

Objectives/Goals
According to the National Insurance Crime Bureau, a car is stolen every 26 seconds in the United States. In this project, I wanted to find out whether I could develop a more efficient car security system using the technology voice recognition. The function of this voice recognition car security system is to unlock only when it recognizes a password spoken by the password holder.

Methods/Materials
In my project, I used a mathematical technique, the Fourier Transform. The Fourier Transform breaks down time signals into frequencies, which can then be analyzed.
The code I have written in Matlab converts the word spoken in the microphone from the time domain into frequency, overlaps the frequency spectra of the same word spoken by two people, and calculates the area under the curve. The difference between two voices is expressed as an area under the curve, which ranges from a low value to a high value depending on the participants# voice characteristics. When this value is small, this means that the two voices analyzed are somewhat close to each other and so the word is not a good password. The bigger the value is, the less correlation exists between the two voices and so a better choice for a password.

Results
My results show that among the fifteen words tested, no two voices overlapped. For a given word, the voice spectrum differs from one person to another. The highest value of area is observed with the words #godzilla# and the least value is observed with the word #weather.#

Conclusions/Discussion
For each word spoken by two different people, the security code is able to differentiate between them and thus, can be used for voice analysis and recognition. I also find that calculating the area under the curve is not the best mathematical method to use, as a time lag exists between the voice recordings and many unwanted frequencies interfere in the calculations. More research needs to be done, but voice recognition technology can definitely be used as a car security system.

Summary Statement
The purpose of my project was to find out if voice recognition technology can be used as a more efficient car security system.

Help Received
Mr. Amar Gill helped me with the software Matlab. My 14 participants helped me by providing their voices. My parents helped me with support and advice.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Abraham P. Karplus

Project Number
J1308

Project Title
Self-Similar Sierpinski Fractals

Abstract

Objectives/Goals
The goal of my science fair project is to better understand self-similar objects and their fractal dimension. A self-similar object is one that is created out of multiple smaller copies of itself. A part of studying these fractals is understanding how to create them. Fractals do not have integer dimensions like a square or cube do. For instance, the dimension of a fractal triangle (known as a Sierpinski Triangle after its discoverer) is approximately 1.58. My investigative question is #How does fractal dimension vary in regular Sierpinski polygons as the number of sides of these polygons increases? Also, what is the limit of fractal dimension as the number of sides goes to infinity?# Based on the results for fractal triangles and squares, my hypothesis was: #The fractal dimension will increase as the number of sides increases.#

Methods/Materials
I wrote multiple programs that generate fractals. Some of these used recursive code, others random code (known as the Chaos Game). The programs were written in Scratch, a graphical programming language available free from MIT. In order to understand fractal dimension, I had to understand scaling factor, namely how many times bigger a given copy is than the next size smaller. I used trigonometry to derive a summation formula for the largest possible scaling factor such that the copies do not overlap for regular polygons. I also derived a closed-form version. The scaling factor is one of the two essential numbers (along with number of sides) needed to compute fractal dimension. I derived the formula for fractal dimension. I used my closed-form formula in Gnuplot to show my results. I used Maple to determine the limit of the closed-form equation.

Results
My computational results were that fractal dimension has a downward trend as the number of sides increases, though it does increase occasionally. Here are some of the formulas I derived: (n is the number of sides)
Summation Scaling Factor: s=2(1+cos(360/n)+cos(720/n)+cos(1080/n)+...) while the cosine term is positive
Closed Form Scaling Factor: s= 1 + sin((180+360*floor((n-1)/4))/n) / sin(180/n)
Fractal Dimension: f=log(n)/log(s)

Conclusions/Discussion
I have found that fractal dimension goes up and down with the number of sides, though mainly down. It approaches 1 when the number of sides goes to infinity.

Summary Statement
My project is mainly deriving formulas for scaling factor and fractal dimension of self-similar polygonal fractals.

Help Received
Father taught me trigonometry and provided access to Maple and gnuplot. Both parents helped type report.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Meredith P. Lehmann

Project Number
J1309

Project Title
Accurate Simulation of Influenza Pandemics

Abstract

Objectives/Goals
The Great "Spanish Flu" Influenza Pandemic of 1918-19 was the worst in recent history and is viewed by epidemiologists as a "worst case" scenario. My objective was to learn if a simple Susceptible-Infected-Removed or SIR model could accurately track actual pandemic deaths in major American cities. An SIR model is governed by two parameters: the inverse of the average number of days a sick person is infectious and R(0), the average number of people infected by an infected person while contagious. My hypothesis is that an SIR model with R(0) = 2 can track actual deaths in the second wave of the Spanish Flu pandemic for each of 46 American cities.

Methods/Materials
This SIR model was simulated in the Mathematica programming language to predict the time path of infection. Actual pneumonia and influenza deaths were scaled in magnitude and shifted in time to make the number of deaths comparable to the number of infected people.

Results
The evolution of infected individuals in this SIR model was compared with the time path of scaled shifted pneumonia and influenza deaths in each city. It tracked deaths in 34 cities extremely well, closely matching the infected curve between week 4 and week 11 during which 98% of the infection occurs in the model. The evolution of pandemic deaths in 12 cities differed substantially from the model.

Conclusions/Discussion
Public health officials should fear a pandemic like the Spanish flu with R(0) = 2 because more than 1/2 of the susceptible population would need to be vaccinated or given appropriate antiviral treatment to stop an epidemic. They would have between 35 and 40 days to detect and identify the type of flu and produce and distribute the necessary medicine, which would be especially difficult if the flu was a new enough strain.

Summary Statement
Can a simple model of epidemics track actual deaths in 46 major American cities during the worst phase of the Great Spanish Flu Pandemic of 1918-19?

Help Received
Mom helped lay out the poster board. Dad helped with the formatting.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Nathan J. Manohar

Project Number
J1310

Project Title
Writing a Rubik's Cube Solver using Mathematica

Abstract

Objectives/Goals
I enjoy solving the Rubik's cube, and I have developed my own method for solving it. I am interested in mathematics and have written programs to solve Sudoku puzzles and magic squares. I decided to try to write a computer program that solves the Rubik's cube. I wrote the program using the Mathematica software package because Mathematica has built in graphics commands that allowed me to draw the Rubik's cube on a computer screen, and rotate the image using the mouse.

Methods/Materials
The program I wrote uses 56 simple steps that can be used to solve the cube. I used a recursive algorithm, which applies the 56 basic steps multiple times. This made the program powerful without having to write a large amount of computer code. I then generated a random cube by performing n number of random moves on a completely solved Rubik's cube. I then applied my computer program to solve this scrambled cube. I wrote a small program to repeat this process multiple times and save the number of moves needed to solve the cube. I then took the average and standard deviation of these values.

Results
I noticed that after the cube had been mixed up by twenty or more moves, the average number of moves needed to solve the cube remained constant at 140 moves. This result shows that after performing twenty random moves, the cube is as scrambled as it can be.

Conclusions/Discussion
After running the program 25 million times, the highest number of moves needed to solve the Rubik's cube was 222. This suggests that my program can solve the Rubik's cube in or under 222 moves every time. My program can usually solve a Rubik's cube in about 140 moves. On the computer, this takes less than 0.04 seconds! After testing my Rubik's cube solver over 25 million times, I programmed the animations for my Rubik's cube solver so that I could visualize the solutions.

Summary Statement
I wrote a computer program to solve a Rubik's cube, evaluated the results, then wrote a program to display animations of the solutions.

Help Received
Father taught me the basics of programming when I was ten; Uncle wrote a program with me that solves Sudoku puzzles.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Paul M. Mayer

Project Number
J1311

Project Title
Generating Random Numbers

Abstract

Objectives/Goals
This project tested three random number generators (functions in Excel, C++, and Java) and evaluated the results using chi-square values from each experiment to determine which program was most likely to generate unbiased random numbers. My hypothesis was that C++ was most likely to generate unbiased random numbers because this language is used to construct many computer programs and games which require a random number generator.

Methods/Materials
Random number functions in Microsoft Excel 2002, C++ (Borland C++), and Java (Microsoft J# 2005 express edition) were tested. Random numbers generated by each program were converted to integers between 0 and 9. When converting the random numbers to integer values care was taken to round the generated values in an equivalent manner to prevent bias. Each program was used to generate sets of 10, 100, 1,000, and 10,000 random numbers. The sets of random numbers (10, 100, 1,000, and 10,000) were generated five times with each program.

Results
For each experiment the measured frequencies were compared with the expected frequencies (10% of the total integers generated in each experiment). Chi-square tests were used to evaluate if each program was likely to be generating independent and unbiased random numbers. From the chi-square test results calculated for each experiment it was found that each program tested was likely to be generating unbiased random numbers.

Conclusions/Discussion
From the chi-square test results calculated for each experiment it was found that each program tested was likely to be generating unbiased random numbers. For larger sample sizes (1,000 and 10,000 random numbers) it was found that Excel was the most likely to generate unbiased random numbers.

Summary Statement
This project tested three random number generators (functions in Excel, C++, and Java) and evaluated the results using chi-square tests to determine which program was most likely to generate unbiased random numbers.

Help Received
Father showed how to use a chi-square distribution table out of a math handbook

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Lucas D. McGrew Bayon

Project Number
J1312

Project Title
What's My Vector? Finding My Way in this Digital World

Abstract

Objectives/Goals
Evaluation of the vector formed using the odometer and compass traveled in each of the eight cardinal directions compared to GPS locations of start to finish point. My hypothesis is that the vector formed by the accumulated directions shown on the compass will match the GPS locations of start to finish.

Methods/Materials
Materials: Toyota Sienna Odometer and digital compass, GPS device # Mio Digiwalker C230.
Method: 1. Record the starting location readings from the GPS; 2. Set the car#s trip odometer to zero; 3. Travel to destination. As the direction changes record total distance traveled. Repeat until destination is reached; 4. Calculate distance in each direction. These represent the individual vectors. Reduce vectors by: N-S, NE-SW, E-W, SE-NW. Compute cardinal directions for NE, SE, SW, NW by using pythagorean theorem. 5. Calculate distance N, E, S, W from GPS by subtracting the starting location from the destination location; 6. Compare distances traveled and direction from GPS to summary cardinal vectors calculated from the car#s compass.

Results
My hypothesis was supported. The vector from my starting and ending GPS readings was close to summary vector calculated from the car#s compass. I evaluated the variation of distance and direction.

Conclusions/Discussion
Conclusion: Although the GPS readings and compass vectors were close, I was disappointed they weren#t closer. I have tried to understand some of the reasons they weren#t the same.
Discussion
Variance of compass direction: There are eight compass directions in 360° / 8 = 45° per direction. That means I could be 45° / 2 = 22.5° right or left from any of the eight compass readings without changing compass direction
Declination of compass in the car: Correcting magnetic north isn't always true north everywhere on earth. Here in Sacramento the declination (variance from magnetic north to true north) is currently 14 degrees, 38#. I found information in the owner#s manual on correcting for this delineation, or variation.
Difference in Longitude calibration: I did a calibration of latitude and longitude by traveling a specific distance S to N and E to W. As you go south towards the equator one unit of Longitude (East to West) is bigger # think of an apple slice. This could explain why longitude varied the most.

Summary Statement
Evaluation of vector formed by car's odometer and digital compass compare to GPS locations (longitude and latitude) of start to finish point.

Help Received
I appreciate the support of my Math Teacher, Ms. Yamamoto. My mom and sister assisted in collecting the GPS, compass and odometer data. My father assisted me in summarizing the data in Excel. I also appreciate my parents paying for the gas!

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Travis McHugh

Project Number
J1313

Project Title
Breaking the Law

Abstract

Objectives/Goals
To prove if Benford's Law applies to randomly generated numbers, and not just numbers occuring from natural data sets.

Methods/Materials
Materials:
Microsoft Excel Random Number Generator
Calculator
Reliable Helper
Methods:
Generate a certain amount of data sets, with a specific amount of numbers per set
Calculate the occurance of each number 1 through 9 as the first digit of a number within the data set
Compare the tested results to Benford's Law

Results
Benford's Law does not hold valid for all types of numerical data sets; Benford's Law does not apply to randomly generated numbers

Conclusions/Discussion
The law does not occur to randomly generated numbers because the percentage for each number to occur as the first digit of a number is the same.

Summary Statement
I tested the validity of Benford's Law when applied to randomly generated numbers

Help Received
mom assembled board, dad was "reliable helper"

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Michael L. Monaghan

Project Number
J1314

Project Title
Robots: Are They Better than Us?

Abstract

Objectives/Goals
To discover if a human is better than a program for controlling a robot. My hypothesis is that a program would be better than a human for controlling Roomba, a robotic vacuum cleaner I reprogrammed. The Roomba is not intended to be reprogrammed, but can be.

Methods/Materials
A cable for a similar but entirely different robot, the iRobot Create, was obtained to modify the negative polarity and 15 volt electrical outputs from the Roomba to suit a communications port on a computer. A maze like path was constructed to compare two humans controlling Roomba through a joystick control program that I wrote and a different program I wrote directly making decisions for Roomba. I recorded the results of the two programs controlling Roomba 10 times in the maze ending at the finish line. Programming was done through Microsoft robotic studio's visual programming language. I had no experience in the Microsoft's visual programming language and robotics, with a few clues, I figured out how to reprogram Roomba on my own. The "wall hugging" algorithm is less complex than the joystick control program because there was less algebra involved. My joystick is used so a human could give input to the joystick to Roomba conversion program. A joystick program for converting a joystick axis to be recognizable by Roomba has many calculations for transforming values from a joystick to values recognizable by Roomba. For example, the straight value for Roomba = 32768.

Results
A program is best for a robot as observed in my experiment. A human given only an array of sensors could not beat the best time of a program not intended for navigating through a maze but to effectively clean it. The human could beat the program when it could use an addition of its own senses mainly sight. The human given only an array of sensors was the slowest and eventually exceeded 10 minutes or became overly confused. If the human became confused, the time until confusion was recorded. The human with the sensors and its own senses had the shortest finish time.

Conclusions/Discussion
A human can do things that a robot cannot do but the opposite can occur on occasion. My experiment shows the importance of programs and shows how programs can be better than their creators. Robots can replace us in good ways, but they will not take over completely. A human still needs to maintain robots and program them.

Summary Statement
I reprogrammed an iRobot robotic vacuum cleaner and created a maze to see if a human is better than a program for controlling a robot.

Help Received
Father helped with scientific method, Mother helped with maze construction and glueing papers on display board.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Jacob A. Riess

Project Number
J1315

Project Title
There Are No Limits: A Project Testing a Roller Coaster Design Computer Program, No Limits

Abstract

Objectives/Goals
The problem being studied is whether the run time of a computer-designed rollercoaster model, using the software No Limits, can be used to predict the run time of a model rollercoaster through the use of an equation. I believe that the program can be used to predict the run time of the model rollercoaster.

Methods/Materials
Rollercoaster designs were created on No Limits and were used to make models at 1:16.46 scale using vinyl tubing, velcro, carpeting, and a steel ball. Each design, both on the computer and the model, was filmed, then uploaded to iMovie and timed to 1/30 of a second. Then, the three trial times were averaged. The computer average time was divided by the model time to get the equation. The equations were compared.

Results
The equations were not consistent. The smaller track had a larger proportion and the longest tracks had smaller proportions, with the exception of the loop design.

Conclusions/Discussion
My conclusion is that you cannot use the rollercoaster design program to predict the run time of a model rollercoaster. However, further testing using a series of shorter and longer tracks at the same angle of decent is required to determine if there is a pattern in the equations related to the length of track.

Summary Statement
There are No Limits is an experiment to see if a roller coaster design from a computer program, No Limits, can be used to predict the run time of a scale model.

Help Received
Mom helped with finding research on the internet and with understanding how to create charts on Excel. Mom and friend helped with holding the video camera as balls were dropped. Mom helped hold the measuring tape as scale model designs were placed.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Arjun B. Sharma

Project Number
J1316

Project Title
The Ket to a Winning Streak

Abstract

Objectives/Goals
The object of this project is to identify the most significant baseball statistic associated with winning streaks.

Methods/Materials
Winning streaks were identified in the 2006 and 2007 season using the website <www.mlb.com>. The four categories Batting Average, Runs Scored, Earned Run Average, and Errors were calculated during the winning streak and the whole season. The statistics during the winning streak were compared to the season average using the T-test, which required data values such as mean and standard deviation.

Results
The Earned Run Average was most significantly associated with the winning streak in 74% of the winning streaks. Whereas the other three categories (Batting Average, Runs Scored, and Errors) were less than 44% significantly associated with the winning streaks.

Conclusions/Discussion
The team Earned Run Average is the most significant statistic in relation to a winning streak.

Summary Statement
This project examines the statistical significance of baseball parameters during winning streaks

Help Received
I recieved help from supervisor Mr. Schwab for ideas on statistical analysis. My parents purchased posterboard and binder.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Bernhard H. Shiveley

Project Number
J1317

Project Title
Comprehensive Evaluation of Computer Operating Systems

Abstract

Objectives/Goals
The goal of my experiment was to evaluate three computer operating systems (Windows Vista, Mac OS Leopard and Linux) to determine which operating system is the best system. My hypothesis was that Mac OS Leopard was the best operating system. This experiment required (i) the development of objective criteria to evaluate each system and (ii) a survey of experienced computer users to incorporate practical user experience.

Methods/Materials
Methods included web based and text book research on each operating system, downloading and using each operating system, preparing a user survey and compiling its results. I also determined how experts review operating systems and developed objective evaluation criteria.

Results
My experiment was successful. I found it was possible to develop objective criteria to evaluate operating systems. It was also possible to measure each operating systems performance against the criteria. There was a significant amount of research available to prove my hypothesis.

Conclusions/Discussion
I learned that my hypothesis was incorrect and concluded that Linux was by far the best operating system. I learned that while Mac OS Leopard is a very nice operating system, its advertising on television influenced my hypothesis inaccurately. Linux proves that the power of many people working toward a common goal (developing a completely open operating system technology that is free to the user) is as strong as a big company like Apple or Microsoft. I believe that my project can expand the public awareness of Linux and increase its use.

Summary Statement
My project is to evaluate three popular computer operating systems to determine which one is best.

Help Received
Father and Mother helped with research and preparing presentation board charts

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Kaitlyn M. Sims

Project Number
J1318

Project Title
"Fair Deal" or "No Deal"?

Abstract

Objectives/Goals
My objective was to use ratios to find a pattern in the Banker#s offers in the game show #Deal or No Deal# to see whether the Banker knows what#s in the case or not? I think by the ratios of the live and online game show will be different and will show that the Banker deviates his offers.

Methods/Materials
I used the online Deal or No Deal game to play the game show. I filled a spreadsheet with assorted pieces information from the games. I did the same thing for the live show, and then compared the ratio of Offer/Sum of Remaining cases (Ratio X) for the live show and online games.

Results
In the online game, I found that the difference between the average of the winning Ratio X (offer divided by the sum of the remaining cases) and the losing Ratio X (Losing subtracted from Winning) was a minute amount, usually less than .05. The difference between the average of the winning Ratio X and the losing Ratio X in the live show, I found that the losing Ratio X#s had an average that was up to .22867.

Conclusions/Discussion
The difference in the average of winning and losing Ratio X is a small amount in the online game show, usually around .05. In the live show, the average of losing Ratio X is larger than the average of winning Ratio X by a large amount, up to .22876. The ratios I used to find patterns suggests that the Banker deviates his offer. The offers on the live show in instances where the contestant holds a losing amount in their case are larger than proportionately dictated on the online show. This is because when the numerator in a fraction (or ratio) is increased, the value of the fraction is increased. In the online show, the proportion of the offer divided by the sum of remaining cases is very similar or exactly the same for both winning and losing amounts. This can be proven because the difference of winning and losing average Ratio X#s is a very small difference, which could possibly become more exact through more testing. In order for a different ratio to be used for cases losing amounts, this would suggest that the Banker knows what is inside the case.

Summary Statement
I used ratios and other various mathematical formulae to attempt to find a pattern in the Banker's offers in the game show "Deal or No Deal", and if a pattern was found, could I use it to try and determine whether or not the Banker knows what's inside the case?

Help Received

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Henry R. Solomon

Project Number
J1319

Project Title
Is Bingo Random?

Abstract

Objectives/Goals
My experiment was designed to test whether winning at Bingo is random.

Methods/Materials
Materials used:
1. 4 different Bingo cards
2. A Bingo Set: a Bingo calling cage, a bingo ball counter, and 75 bingo balls
3. 50 Bingo recording sheets
*Note: All of the Bingo balls were counted to make sure that there where 75 of them.

Experimental Method:
1. Turn the lever on the calling cage one time to dispense ball.

2. Record the following:
a. The number on the ball
b. The column the ball came from
c. The order in which the balls were called.

3. When the game finishes, record the following:
a. How long the game took
b. The amount of calls until a Bingo showed up on a card
c. The five number Bingo sequence
d. Whether the sequence used the FREE space
e. The winning number
f. Whether the Bingo sequence was vertical horizontal, or diagonal
g. The card that had the Bingo.

4. Repeat this process 50 times

Results
In the winning card test, Card #2 won 40% of the time versus the 25% probability. Similarly, 36% of the winning numbers were in the O column, versus the 20% probability. These two tests indicated that winning at Bingo is not random. However, in the FREE space test, 62% of the winning sequences did

Summary Statement
My project tested whether winning at Bingo is random.

Help Received
My family and friends played Bingo with me but I recorded all the data. My dad helped me with the equations to identify the expected probabilities for winning using the free space and winning horizontally, vertically, and diagonally.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Robyn J. Swift

Project Number
J1320

Project Title
Time for Primes Phase II: Experimental Verification of the Prime Number Theorem

Abstract

Objectives/Goals
The average distance between prime numbers is calculated using a random sampling method. The average distance between the primes up to a positive integer n is numerically showed to be approximately ln(n)-1.

Methods/Materials
A random sampling method is used both by hand and using the computer program mathematica to calculate the average distance between consecutive prime numbers.

Results
The average distance between prime numbers is shown to be approximately ln(n).

Conclusions/Discussion
The data obtained experimentally verifies the prime number theorem.

Summary Statement
To experimentally show that the average distance between consecutive primes increases.

Help Received
Parents helped assemble display board.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
James J. Thomas

Project Number
J1321

Project Title
An Algorithm to Minimize Memory Usage in Graph-based Applications

Abstract

Objectives/Goals
The objective of this project was to invent an efficient algorithm to minimize the memory usage of software applications that use graph data structures. Based on analysis of possible approaches to solving the problem, it was hypothesized that an optimum algorithm could run in approximately O (S^2*E) time, S and E being the number of sources and number of edges in an input graph, respectively. A heuristic algorithm was considered an acceptable solution if its runtime benefits over optimum algorithms outweighed its lack of consistent optimality.

Methods/Materials
To minimize its memory usage, a graph-based application must dynamically free memory used by graph edges and vertices that are no longer reachable by any sources yet to be traversed. In this context, the weight of a graph edge is assumed to indicate the amount of memory being used by data stored as part of the edge. A graph's average weight is defined as the average of S graph weights, the total weight of the graph being taken after each source traversal. An algorithm that optimally frees memory used by graph edges is defined as one that produces for any input graph a source ordering that enables minimization of the graph's average weight. Use of the average weight system allows early elimination of significant graph weight to be valued highly, an important factor in producing optimum results. A brute force algorithm that checks all possible orderings of a graph's sources was developed to verify algorithm optimality.

Results
The proposed algorithm uses recursion to find the optimum source ordering of an input graph; it divides the graph into smaller and smaller subgraphs until it reaches a base case and then works its way back up, eventually returning to and solving for the original input graph. The algorithm is a heuristic that produced optimum results for most tested graphs; it has sizable runtime benefits over considered optimum algorithms. Analysis shows that the algorithm runs in approximately O (S^4*V*log E) time.

Conclusions/Discussion
The major contributions of this work to the field of graph theory are the definition and implementation of the concepts of average graph weight and optimum source ordering for dynamic graph weight minimization. In addition to its applications in improving software efficiency, the proposed algorithm has numerous other practical uses. Most notable among them is its ability to minimize energy usage in factories.

Summary Statement
The purpose of this project was to develop an algorithm that would enable minimization of an input graph's weight by producing an optimum source ordering by which to traverse its sources.

Help Received
Father suggested project idea and reviewed board material

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Page A. Uriarte

Project Number
J1322

Project Title
From Another Angle: The Epic Tale of Ten Regular Polygons

Abstract

Objectives/Goals
The problem I will be experimenting on is how the number of sides on a regular polygon affects the area of the polygon, in comparison to other polygons with the same fixed perimeter. I believe that the area of a regular polygon increases as the number of sides the polygon has increases.

Methods/Materials
In order to test this, I will calculate the area of the regular polygons with a number of sides ranging from three to twelve, but keeping the perimeter the same for all the polygons. I chose 30 cm as my perimeter because a great majority of the numbers between three and twelve divide 30 evenly, or at least rationally. With other perimeters, the length of the sides would be an irrational number, which can cause the calculations to be accurate, but not as accurate as possible.

Using trigonometric ratios, I found the area of the regular polygons, and then, in order to ensure that my calculations were not faulty, I had my Algebra 2 teacher, Mr. Remillard, look over my work, and he checked it, making sure there were no errors in calculation. I was then able to conclude that my work was accurate and I was then ready to analyze that data, and make a conclusion.

Results
I found that if the number of sides on a regular polygon increases, then the area of the polygon increases as well.I addition, I was also correct in predicting that the polygon with the apothem had the largest area, because when using the formula for the area of a regular polygon, the only variable that could have affected the area on this situation was the apothem, so the longer the apothem, the larger the area.

Conclusions/Discussion
After analyzing my data, I made one significant observation not stated above. I noticed that as the number of sides increased, the more the polygon looked like a circle. I decided to do some additional experimentation, so I found the area of a circle that had a circumference of 30 cm.I found that the more sides on the polygon, the closer the area will be to that of a circle, but it will never have the same area as that of a circle.

I think that if you even look at my experiment logically, it makes sense that the polygons with the most sides had the largest area, but my data proves this mathematically. My project was successful, and I am thrilled at the knowledge and experience I have acquired from doing this.

Summary Statement
This project tests how the number of sides in a regular polygon with a fixed perimeter affects its area.

Help Received
Parents and grandfather offered moral, transportational and financial help, teachers offered guidance and support, classmates helped and also endured this process.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Jennie Werner

Project Number
J1323

Project Title
Spirolaterals: Math Is Art

Abstract

Objectives/Goals
The purpose of this experiment is to find number patterns in spirolaterals.

Methods/Materials
Although spirolaterals can be drawn by hand using a ruler and protractor, it is tedious, time consuming, and error prone. Instead a computer program was used to drawn spirolaterals using the following variables:

X = line length
b = turning angle
Z = number of turns
R = number of repetitions

Results
The following patterns were observed:

1) If b * Z = 360 the spirolateral will not close.

2) The number of repetitions to close a spirolateral is 360/ b * z if b * Z equals a factor of 360.

3) Spirolaterals with turning angle values of b and 360 - b will look the same, just flipped.

Conclusions/Discussion
My original hypothesis was that if b was a factor of 360, the spirolateral would be closed because there are 360 degrees in a circle. Having b be a factor of 360 does not make it closed, but rather when b * Z = 360 the spirolateral was not closed.

It is possible to predict how many repetitions it will take to close a spirolateral: R = b * Z/360. However, it is only true when b * Z is a factor of 360.

Spirolaterals with turning angle values of b and 360 - b will look the same, just flipped. This is because b is the inner angle and 360 - b is the outer angle. An example of this is when b = 144 and b = 216 (360 - 144 = 216)

Summary Statement
The purpose of this experiment is to find number patterns in spirolaterals.

Help Received
My mom for helping me find the computer program and editing; Jerry LeVan, Eastern Kentucky University for the computer program that generates spirolaterals; Robert J. Krawczyk, Illinois Institute of Technology, College of Architecture for the paper "Spirolaterals, Complexity from Simplicity"

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Daniel J. Wirtz

Project Number
J1324

Project Title
Identifying Critical Nodes on the Monterey Peninsula Road Network

Abstract

Objectives/Goals
To determine if the network of major roads on the Monterey Peninsula is subject to single point failure

Methods/Materials
Google maps was used to identify about 30 bridges, overpasses, and intersections (nodes) along the major road network on the Monterey Peninsula. I acquired data on the average number of cars that traveled the major roads. I estimated the cost to fix two different sized bridges and I hand drew the road network, noting links, nodes (bridges and intersections) and traffic flows. I used the data from the hand drawn model to populate the computer model. I entered the following data into #Model-Based Vulnerability Analysis# (MBVA): the number of days it would take to fix a node or link, replacement costs, and how the absence of a node or link would affect the traffic flow by recording the average number of cars carried by the node or link.

Results
The Monterey Highway Network is a non-random, scale free, network -- a few nodes play a critical role and the links and nodes in the network are not randomly distributed. Moreover, most of the nodes in the system possess a small degree # that is they only contain two links. 74% of the network nodes have only 2 links, 11% have three and 2% have four. The model identified the critical node in the network, the node that had the greatest number of links that also carried the greatest volume of traffic. Using the capital loss function on the model, I estimated which bridge in the road network was the most critical. The hypothesis was disconfirmed. The Monterey Peninsula road network is not subject to single point failure: The destruction of any one node would not curtail movement across the network.

Conclusions/Discussion
The techniques that I am using are usually employed to model attacks on critical infrastructure. I wanted to used these programs to model the road network to see how it would fare if any number of nodes failed and how other routes could be used to get to a destination regardless of that failure. This could be important, especially if a natural disaster # earthquake or windstorms # destroys some part of the road network.

Summary Statement
The project undertakes a #Model-Based Vulnerability Analysis# (MBVA) to characterize of the Monterey Peninsula Road Network and to assess its vulnerability to single point failure.

Help Received
Dr. Ted Lewis at the Naval Postgraduate School provided me with the computer model used in the project. My father helped me cut and paste graphics from the model for my presentations.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Yibing Zhang

Project Number
J1325

Project Title
Iris Analysis: Monochrome or Contrast?

Abstract

Objectives/Goals
My goal is to find an alternative way to recognize the different iris patterns in each eye. Inside every eye, there is a special swirling, colored pattern that makes every one of us unique and different from the other. Among grayscale, monochrome, infrared, and contrast, I chose monochrome and contrast as the two color scheme I will then compare.

Methods/Materials
To start the experiment, I gathered a few usable images that showed the texture and color of an iris pattern. I found two high resolution pictures of a hazel and a blue iris. To change the color scheme, I opened Microsoft Word #C drawing, and found a section that listed the different colors such as grayscale, washout, monochrome and contrast. Then, I created a template chart to make different sections for easier counting of pixels. Afterwards, I downloaded a free image editing program called GIMP. I used that to count the differnt color pixels in each section of the area from the Template chart. I recorded and analyzed the data on Microsoft Excel. This procedure can be used to collect and analyze iris patterns.
Materials include: computers, microsoft word, microsoft excel, GIMP, and two high resolution images of irises.

Results
The monochrome blue iris image, on average had 73% black pixels and 27% white pixels, while the monochrome hazel image had 79% black pixels and 21% white pixels. The blue iris contrast image had 53% black pixels, 12% blue pixels, 21% aqua pixels and 14% white pixels in total. The hazel iris contrast image had 39% black pixels, 43% red pixels, 10% yellow pixels and 8% white pixels.
The average standard deviation of the hazel and blue monochrome image of black pixels is 381and 344 for white pixels. The hazel and blue contrast images had a 156 average of standard deviation for black pixels, 364 for dark colored pixels, 144 for light colored pixels, and 199 for white pixels.

Conclusions/Discussion
The data collected support my hypothesis because contrast images provides a better resolution for iris pattern analysis and includes many ranges of colors that can be used for the finding of a even more accurate distinguish between irises.
Uncontrollable factors that might effect this experiment include the light of the camera lens reflecting through the eyes. The upper eyelid in the hazel iris image disrupts the fullness of the iris. Sometimes, eyelashes are also reflected through the iris causing a bit of difference in results.

Summary Statement
This project is to compare the two color (monochrome and contrast) and see which one is better for iris pattern analysis.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Tina A. Zolfaghari

Project Number
J1326

Project Title
iRobot

Abstract

Objectives/Goals
My main goal was to build a robot that commands by my voice. I also wanted to learn how to put together electronic components using a soldering iron, static mat, and other electronic devices. I wanted to also learn how to write a program.

Methods/Materials
Mark III Robot Kit(ooPIC)
Firefly Bluetooth RS-232 Adapter
Apple Laptop
Speech Recognition-Mac Based
ooPIC Software Development Tool(IDE)
Parallels (To Run Windows for IDE)
MacOS (Unix)
Static Mat
Tool Kit
Soldering Iron
Batteries

Results
After assembling all the parts I tested the unit and found out that there was a short were I solderered. After I fixed the problem the green LED light came on indicating that all parts where working. Then I had to upload a program into the robot. When everything was finished I had to test everything all together. When I said forward it would go forward in a circle and when I said back it would go back in a circle. This was because the servo motors where not aligned. Using a screwdriver I aligned the servo motors.The project was finished.

Conclusions/Discussion
I learned several things.I learened a handy phrase to remind me how to read the values of resistors. I also learened about Ohms law.I learned what speech recognition is.I also learned a little programming in C language.I learned about basic electrticity.

Summary Statement
I built a voice activated robot.

Help Received
Teacher helped with Robot assembly and software program.