CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Farhad Akbari

Project Number

J1201

Project Title

To Buy or Not to Buy

Abstract

Objectives/Goals

This project's objective is to conclude which is more economical to buy or to rent houses or apartments for different incomes. It will also determine the sufficient down payment, and the length of mortgage. Renting an apartment will probably be cheapest, followed by renting a home, buying an apartment, and buying a home should be most expensive. 15-year mortgage will most likely be cheaper than 30-year mortgage, but will only be available to higher-class homeowners. A higher down payment will almost definitely be required.

Methods/Materials

Data for ten apartments and houses sold recently and rented apartments and houses from the same area, size, and number of rooms were averaged and used to determine an average price for the area. Data was then gathered from 15 families with five members for assorted bills and expenses were averaged separately as well as yearly. Annual salaries used were $24,000; $36,000; $48,000; and $60,000. Down payments used were 0%, 20%, 25%, and 30%. Mortgage was then figured out. The rate was dependant on the amount of the loan and the type (15- or 30-year). A second loan up to 20% of the property value is also taken with 0% down payment. Rent increase was then established. Next, salary increase was found out. The savings are then comprehended by subtracting the various expenses from the salary for 15 and 30 years. The property value increase was then determined. The total wealth after 15 and 30 years was then concluded by adding the property value with the savings.

Results

The results were that sold apartments were better at 15 and 30 years as the salary increased, then rented apartments, then sold homes and finally rented homes. 15-year mortgages were cheaper, and a down payment lowers the lost money form interest by a very large number.

Summary Statement

To determine the best real estate choices for different incomes

Help Received

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Tristan R. Brown

Project Number

J1202

Project Title

The Function of Diffusion

Abstract

Objectives/Goals

The goal of my project was to design a computer program that could determine the rate of diffusion between solids using the Scheme programming language.

Methods/Materials

First I learned how to program using "How to Design Programs" and Dr. Scheme. Next I designed a program that computes first-order differential equations, and then I designed a program that computes second-order differential equations. Finally I started working on the diffusion equation.

Results

The two programs that were designed both returned their expected results. The constants in the second-order differential equation caused the results to change.

Conclusions/Discussion

The fact that different results were obtained from the second-order differential equation depending on the constants means that a different diffusion constant would change the rate of diffusion, and this should be researched further. Also, the Improved Euler method will be researched further, as it is a more accurate way of solving differential equations. Because the diffusion equation is just a complicated second-order equation, and I successfully wrote a program that solves a second-order differential equation, it can be assumed that the diffusion equation can be programmed.

Summary Statement

My project is about programming the Diffusion Equation.

Help Received

Mr. Dan Anderson, my computer teacher, taught me programming skills and beginning calculus.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Benjamin I. Filippenko

Project Number

J1203

Project Title

Simulated Billiard Ball Paths

Abstract

Objectives/Goals

My objective was to determine how the initial angle of an idealized billiard ball path, starting from a corner of a rectangular table with integral dimensions, affects whether the path will eventually end in a corner. Based on some mathematical background research, I hypothesized that the path will terminate in a corner if and only if the tangent of its initial angle is rational.

Methods/Materials

Using the Logo programming language and its turtle graphics facilities, I wrote a computer program to simulate rectangular tables and billiard ball paths launched from a corner. A test harness executed the basic simulation program for many different rational tangent angles and integral rectangle dimensions, recording the results in a file. This automated technique was made possible by the fact that all such paths did, in fact, terminate. Irrational tangent angle paths, on the other hand, required manual execution because such paths appeared never to terminate, making them unsuitable for automatic scheduling.

Results

I tested 63 different angles with rational tangents (systematically generated and with elimination of duplicates), and for each angle 100 rectangles of different integral dimensions, for a total of 6300 tests. In all of these, the paths terminated in a corner. I also tested angles with irrational tangents, such as 60°, 30°, and 50°, and found that such paths did not terminate in a corner. Because the tests in this second group never terminated, I could not run as great an abundance of them as in the rational tangent case.

Conclusions/Discussion

My hypothesis was correct. The paths with rational tangent angles terminated in a corner, whereas those with irrational tangent angles did not. While the simulation could only test a finite number of cases and was subject to the usual issues of numerical precision, my experiment sets the stage for confidently attempting to prove the mathematical statements of these outcomes.

Summary Statement

My project investigated, via computer simulation, the relationship between the initial angle of an idealized billiard ball path and the potential termination of the path in a corner.

Help Received

My father provided mathematical background that helped me to formulate my hypotheses. He also commented on my program and report. My mother helped with the layout of the display.

Name(s)

Philip Gerstoft

Project Number

J1204

Project Title

Creating a Tic Tac Toe Computer Program

Abstract

Objectives/Goals

The objective of this project was to achieve creating a code that could never lose, when going second.

Methods/Materials

To achieve this goal,using my laptop and the program MATLAB I went through a series of proceduces. Firsty, I created a script that detected ties,win, and loses. Testing its effectiveness, I created a random player (player that places x's or o's randomly about the board), and had the two random playersplay against each other, having the script test itself. At the point of perfection I analyzed strategies,so that i could program counter-attacks against the moves that would result in a loss. To program strategies preventing loss, I used roughly 300 if-then statements, creating a "smart player".
To test the efficiency of the "smart player", I had random player go against the smart player, and made any neccesary corrections, repeating this process till the point of perfection. At which point I tested against human subjects

Results

To prove my hypothesis the computer program was placed against a "random player" and a human.
The random player was simply a program that placed x/o's randomly about the board. Against the "random player" the "smart" computer program only tied 19.97%, the rest of the games the computer program won, 80.03%.
The three human subjects, played against the computer program and never won, tied 86% of the games and lost 14%.
Therefore the results consist of 0% of the games overall, of the humans and "random player", were lost.

Conclusions/Discussion

The computer program was successful in that it was able to never lose, as seen when it played three human players. In the 100 games against the humans 14% was lost, the rest tied. Not only did it never lose to a human but it was also able to never lose, but instead win, 80.03% of 10,000 games when playing against a random player. This proves my hypothesis correct; therefore it is possible to create a computer game that never loses, although it goes on the second turn.

Summary Statement

Creating a Tic Tac Toe Computer Program that never lost, when it goes second.

Help Received

Father helped with understanding how to program.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Aruna O. Gnanasekaran

Project Number

J1205

Project Title

Pi of Pieces Unlimited: A Continuation

Abstract

Objectives/Goals

There are three objectives in this project. The first is to derive an upperbound recursive equation for Pi using regular polygons circumscribed about a circle to approximate its circumference. The second goal is to show the equivalence of François Viete's and my Last year's lowerbound expression for Pi. And the last objective is to derive an Algebraic Polynomial of which one root is Pi itself. I have also found other roots of this polynomial which I call The Pi Associates.

Methods/Materials

I used regular circumscribed polygons about circle of radius 1 for deriving an upperbound expression for Pi. I used the perimeter of each polygon to approximate the circumference of the circle and from there of Pi. Starting from a square an 8-sided regular polygon is constructed, doubling the number of sides. This procedure can be repeated endlessly doubling the sides of the polygon with every step. The polygon with a larger number of sides closely approximates the circle. The side of the 2n-sided polygon can be determined from the side of the n-sided polygon. This produces a recursive relationship for the side of the 2n-sided polygon in terms of the side of the n-sided polygon. (For the Algebraic Polynomial and the equivalence between Viete's and my expression for Pi I used my results from last year.)

Results

I was able to derive a recursive equation for Pi using regular polygons circumscribed about a circle of radius 1. I have shown that Viete's expression for 2/Pi is equivalent to my last year's expression for Pi. Using my last year's expression for Pi from the lower bound I can derive an Algebraic Polynomial, of which one root is Pi itself and the others I call the "Pi Associates".

Conclusions/Discussion

I was able to derive a recursive equation for Pi using regular polygons circumscribed about a circle, although I did go through quite a bit of trial and error, finding faster and better ways of deriving it. I also was able to show that François Viete's expression for Pi is equivalent to my last year's lower bound expression for Pi. And Lastly, I have introduced the Pi Associates, numbers whose properties I have yet to discover. What kinds of numbers are the Pi Associates? Are they also transcendental numbers? I would like to investigate further on these questions.

Summary Statement

I must prove my last year's expression for Pi is equivalent to Viete's expression for 2/Pi, Pi can be obtained from an Algebraic Polynomial, and to derive an expression for Pi using regular polygons circumscribed about a circle of radius 1.

Help Received

My father has been by me through many sleepless nights, helping me with the tedious cutting and pasting that is involved with the making of a board, and making sure I am equipped with supplies I need. My Biology teacher has been supportive of me, and put deadlines for different elements in the project.

Name(s)
Ariana G. Haro

Project Number
J1206

Project Title
Magnitude Math: A Study of Mathematical Patterns

Abstract

Objectives/Goals
By analyzing the recorded data of the past and developing mathematical tables, spreadsheets and graphs, I attempted to find conclusive patterns that would assist in future earthquake predictions.

Methods/Materials
I gathered earthquake information from the U.C. Berkeley web site for the Los Angeles basin, and then transfered data into mathematical tables from which magnitudes were pulled to form spreadsheets by year. Utilizing these spreadsheets, I created graphs using different variables for each magnitude group. These individual year graphs showed no apparent pattern. To further evaluate the data, continuing with the magnitude groups, I combined the years in groups of five, ten, and twenty years. I then gathered totals and averages, and created new spreadsheets from which new graphs were created for analysis.

Results
To carry out this experiment, each graph was thoroughly analyzed for a repeatable pattern. The individual year graphs showed no obvious pattern. The five, ten, and twenty year graphs however did show a some possible repeatable pattern. It would appear the increase in the lower magnitude earthquakes did indicate an increase in frequency of greater magnitude earthquakes, but only within a general time frame, not to a specific point of time reference.

Conclusions/Discussion
The original hypothesis was that by looking at the patterns of the past we might be able to develop mathematical models for future prediction. Based on my analysis, this hypothesis could be accepted as true in part. The increase in the lower intensity earthquakes did correlate with a rise in greater intensity earthquakes. Although this project shows an evident pattern in the relationship between the lower intensity and the higher intensity earthquakes, there is no precise equation to show the relationship in quantity and magnitude, nor highly exact time frames; only generalities and trends.

Summary Statement
By using mathematical tables, spreadsheets, and graphs, I was able to analyze earthquake magnitudes to define patterns.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Leith G. Hathout

Project Number

J1207

Project Title

Endless Snowflake: Constructing Shapes with Infinite Perimeters and Finite Areas

Abstract

Objectives/Goals

To determine whether it is possible to construct shapes with infinite perimeters but finite areas.

Methods/Materials

Using the Geometer's Sketchpad program and a Koch curve, I began with an equilateral triangle and grew a snowflake through various generations which, if taken to infinity, would have an infinite perimeter but a finite area. Using power series, I calculated what that area would be. I then decided to develop a new fractal curve based on a square shape rather than the traditional triangular Koch curve.

Results

I calculated that this fractal pattern for the triangle would produce a figure of infinite perimeter, but whose area is only 1.6 times the area of the original triangle. Meanwhile, for the square, the area for an infinite perimeter shape would be 2.0 times the area of the original square.

Conclusions/Discussion

Ordinarily, when shapes are magnified, area grows faster than perimeter. However, using the idea of convergent series, it is possible to add ever-smaller increments of area such that while the perimeter grows to infinity, the sum of the areas remains finite. It may be possible to generalize this approach to three dimensions, producing a shape of infinite surface area and finite volume.

Summary Statement

My project uses the ideas of fractals and power series to construct a Koch snowflake, and to explore new families of curves with infinite perimeters and finite areas.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Gregory A. Hirshman

Project Number
J1208

Project Title
The Pleasure of Pi

Abstract

Objectives/Goals
The hypothesis of the experiment is that the ratio between the error in determining I using by inscribing polygons within and circumscribing polygons about a circle with (km) sides and that obtained using polygons with (kn) sides will approach (n/m)^2 as k increases.

Methods/Materials
To test my hypothesis, I needed to develop formulas to determine the perimeters of the regular polygons inscribed within and circumscribed about a circle. I discovered that the perimeter of the regular polygon with X sides inscribed in a circle with a diameter of 1 is X(sin(180/X)). The perimeter of the regular polygon of X sides circumscribed about a circle with a diameter of 1 is X(tan(180/X). I estimated I by using the expression:
(X(sin(180/X) + X(tan(180/X))) / 2, and I calculated the error in estimating pi using polygons with the formula:
error = ((X(sin(180/X) + X(tan(180/X))) / 2) - I.
I calculated the ratios of the errors of the estimates using polygons of m and n sides employing six different values for m and n [(m=8, n=10,) (m=6, n=8,) (m=4, n=6,) (m=4, n=8,) (m=4, n=10,) and (m=4, n=12)]. I then calculated the error ratios for polygons of km and kn sides using those given m and n values, and k = (1, 2, 3, 4, and 1000). Finally, I graphed the results.

Results
The graphs are consistent with the hypothesis. As k increases, the error ratio approaches (n/m)^2, the square of the inverse of the ratio of the number of sides.

Conclusions/Discussion
By completing this experiment, I discovered that the ratio between the error in determining I using by inscribing polygons within and circumscribing polygons about a circle with (km) and (kn) sides approaches (n/m)^2 as k increases.

Summary Statement
The summary is that I determined that the ratio between the error in estimating pi using by inscribing polygons within and circumscribing polygons about a circle with (km) and (kn) sides approaches (n/m)^2 as k increases.

Help Received
Dad helped edit my report.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Benjamin D. Holtz

Project Number
J1209

Project Title

What Patterns Are Formed When Number Sequences Are Translated into Different Base Systems and Interpreted in Base-10?

Abstract

Objectives/Goals
The goal of my project was to find and study patterns formed through the translation of the first thirty terms of figurate number sequences into bases-2 through 20 when the results of these translations are interpreted in base-10. I hypothesized that I would find patterns related to the original sequences.

Methods/Materials
An iMac AppleWorks spreadsheet application's base translator, pencil, and paper were used. The sequences were entered into the spreadsheet, creating a chart for each sequence and its translations from base-2 through 20. For each sequence studied, the chart was scanned for patterns formed across many or all of the base systems.

Results
Overall twenty different patterns were found that demonstrated connections between bases. Most of the patterns created were related to the sequences that created them. Many patterns were related to each other even when the sequences that created them were different.

Conclusions/Discussion
This study demonstrates the relationship between the laws of place value in base number systems and the functions that produce the sequences. Many of the patterns are explainable in mathematical terms, as discussed further in this study. Future investigation may involve translation of longer or more complex sequences into higher bases and/or the use of a computer program to search for patterns.

Summary Statement
This project explores the mathematical relationships between number sequences and patterns formed by their translation into multiple base systems.

Help Received
Mother and Father helped edit report and display.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Rebecca E. Jacobs

Project Number

J1210

Project Title

The Secret of Nim: Mapping Finite Groups under Nim Addition to N-Dimensional Simplexes

Abstract

Objectives/Goals

The purpose of this project is to determine if there is a mapping between Nimbers (non-negative integers under Nim addition) and multidimensional objects called Simplexes, thus demonstrating the power of finite groups to relate very different mathematical objects to each other.

Methods/Materials

I researched the impartial mathematical game of Nim including Nimbers, the basics of Nim addition (binary addition without carrying), group properties, and the winning strategy for Nim as proven by Charles L. Bouton. I also researched Simplexes and their properties. I proved that Nim addition has the properties of an Abelian group and showed how Nimbers can be counted with their base 2 representations. I also determined a way to find the number of vertices, edges, and face-ns in a Simplex and proved that there is a one-to-one mapping between Nimbers and Simplexes. I then explored properties of this mapping to show how a Simplex could be used for Nim addition and how Nimbers determine their own unique Abelian groups and are locations in multidimensional space. I constructed a Simplex-3 using Zometool to illustrate this mapping. Materials used in this project are Zometool, a Dell PC running Microsoft Windows 98 and Word 97 and an HP printer.

Results

This project describes Nim addition as binary addition without carrying and shows how to use Nim addition to win a game of Nim. It demonstrates that Nim addition has the 5 Abelian group properties. Graphing Nimbers onto Simplexes is shown for lines, triangles, and tetrahedrons. The mapping of Nimbers to n-dimensional Simplexes is proved and illustrated using Pascal's triangle.

Conclusions/Discussion

The hypothesis that there is a mapping between Nimbers and Simplexes was proven. This required an analysis of Nim addition with proofs of its Abelian group properties. Combinatorics, one-to-one mappings, Pascal's triangle, and the binomial theorem were all utilized for the proof. Other observations include how to use the graph for Nim addition, and the fact that Nimbers are locations in multidimensional space and determine their own unique Abelian group.

Summary Statement

This project maps finite Abelian groups under Nim addition (binary addition without carrying) to multidimensional objects called Simplexes, demonstrating their use to win the game of Nim.

Help Received

My dad helped me research difficult topics and taught me how to set up a backboard. My mom made sure that the project could be understood and helped with the backboard layout. Mr. Sewell, my math teacher, suggested various corrections to my report.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Stefani A. Khushigian

Project Number
J1211

Project Title
The Monopoly Mystery: Probability vs. Personality

Abstract

Objectives/Goals
My objective was to determine which AI computer player wins the most games. I believe the more aggressive player, Type A, will win more games.

Methods/Materials
I programmed variables into Type A and B AI players with the help of personality profile research. I had the computer play 300 games; the first 100 with a Random AI player, the second 100 with a different Random AI player and the third 100 acting as a control with Type A and B players only.

Results
The results of my investigation indicated that the Type B AI player had the best playing strategy when all 3 AI players were playing. In the first 100 games Type A won 28, Type B won 55 and Random won 17. In the second 100 games Type A won 17, Type B won 58 and Random Jr. won 25. In the third 100 games Type A won 49 and Type B won 51. This proves that personality only plays a significant role in 3 player games while 2 player games rely totally on probability.

Conclusions/Discussion
After completing my investigation, I found that my hypothesis was incorrect. I stated Type A would win the most games but actually Type B did. I learned that both probability and personality play a significant role in who wins or loses the game and that trading is very important. Also 3 player games are much more complex and in-depth than 2 player games.

Summary Statement
To determine whether probability or personality plays a key role in winning the game Monopoly.

Help Received
Mother helped with gluing papers on the board.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Elliot R. Kroo

Project Number

J1212

Project Title

Artificial Intelligence: Can a Neural Network Learn to Play Connect 4?

Abstract

Objectives/Goals

The goal of my project was to find if a neural network would be able to learn how to play Connect 4 (a board game where the goal is to get four tokens in a row) well enough that it could beat a human opponent. A neural network is an artificial intelligence program that uses a network of connections between input values and output values to eventually learn how to do something. A neural network uses weights to determine the output for the given input. To find a good set of weights, the neural network can be trained. One type of training method for a neural network is a genetic algorithm. The genetic algorithm creates a model of individuals, based on the set of weights. It uses the basic idea of natural selection to eliminate the weak and promote the strong.

Methods/Materials

I created a computer program that played Connect 4 with a simulated opponent for the neural network to play. Then I tried out different ways of training a neural network. Finally, I created a training method for the neural network, using a genetic algorithm.

Results

The neural network learned to beat the simulated opponent that I could rarely beat, but I could still beat the neural network because I had a different strategy than the opponent.

Conclusions/Discussion

The neural network did not learn to play a wide variety of strategies. Therefore, it learned to play the opponent, not the game in general. If I had played the neural network instead of the opponent, it probably would have been better at playing me. In conclusion, the neural network did not have all of the information it needs to be very good at the game of Connect 4. It might be improved by having it play against me or several opponents with different strategies.

Summary Statement

My project involved creating and training an artificial neural network to play the game of Connect 4.

Help Received

My dad showed me how a genetic algorithm worked and helped with editing.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Christina K. Llanes

Project Number

J1213

Project Title

Neurotic About Neurons

Abstract

Objectives/Goals

A neural network was designed and coded to identify decimal digits using Visual Basic and Excel. It was hypothesized that the neural network would have a 75% accuracy in recognizing the digits.

Methods/Materials

The neural network was composed of three layers: the input layer, the hidden layer, and the output layer. The neural network was trained with twenty examples of each digit, for a total number of 200 trials. The input pattern for each digit was inserted into the neural network in the form of an eight by four array of data, and the neural network generated an answer. The back propagation algorithm was used to train the neural network, iterating 30,000 times and achieving a 0.01 mean square error.

Results

The neural network was able to identify the training set of digits with a 90% accuracy. The results of the training data showed that the network learned properly and identified the digits with a high accuracy. Next, experimental data was created by people who had not seen the original training data. After all the experimental data was propagated through the neural network, the results showed that it identified the experimental data with an 83% accuracy. The experiment data results showed that the network could identify new patterns of digits that had not been propagated through the network in the training data. The network adapted to the new information and identified the digits with a high accuracy. To achieve those results, 30,000 iterations of the training data were executed in order to reduce the mean square error as much as possible so that the network could identify new patterns properly. The learning rate was also lowered so that the weights were adjusted by smaller increments. Although this lengthened the convergence time, it was necessary to prevent false minimum errors in the network.

Conclusions/Discussion

The neural network was successfully created and identified the decimal digits from the training and experiment data. The hypothesis stated that if a neural network was trained to identify decimal digits, then it would be able to identify the digits with a 75% accuracy. The results prove that the hypothesis is valid because the neural network correctly identified the experiment data with an 83% accuracy.

Summary Statement

A neural network was designed and coded to identify decimal digits using Visual Basic and Excel.

Help Received

My father helped me to understand the back propagation math, and he bought me a new computer to finish the project. My mother and sister helped to create the experiment data. Professor Michael Crowley, from USC, gave me some suggestions for my project.

Name(s)

Karl J. Lowood

Project Number

J1214

Project Title

Lose to Win? It's Not Impossible: A Computer Simulation of Coin-Tossing Games in C++ to Test Parrondo's Paradox

Abstract

Objectives/Goals

My objective is to explain Parrondo's Paradox and provide an example and variation of it by using the C++ programming language to program coin-tossing games.

Methods/Materials

Parrondo's Paradox is a recent discovery stating that games designed to lose can be combined into one game that will win. The project required me to program games in the C++ programming language that illustrate the Paradox. I then modified the values that define each game, such as the variables e (a very small number that affects the chances of winning) and m (which affects the way the games are played), and then tested the simulation by combining the games and playing them.

Results

These games confirmed my hypothesis that a simulation of two losing games designed according to Parrondo's Paradox will result in one winning game when combined. My two games, when played alone, lost. But when I played them together, they won.

Conclusions/Discussion

I learned that simulating the games in C++ is an effective way of testing the Paradox, as only a computer program could create the biased coins I needed for the coin-tossing games.

Summary Statement

My project is about programming games in C++ that test Parrondo's Paradox.

Help Received

Parents proofread.

Name(s)

Cory C. O'Brien

Project Number

J1215

Project Title

Evolution of Data: The Effect of Mutation Functions on the Growth of a Computer Generated Population

Abstract

Objectives/Goals

To find an effective mutation function for use in genetic algorithms.

Methods/Materials

I created a program based on a genetic algorithm. The program randomly generated a population of 265 8-bit organisms, each with four traits. 256 was the number of possible variations of the genetic code. Then the program used the values of the traits of each organism to determine whether it would live to reproduce. The goal was to reach a population of 2560. The variable was mutation. There were two groups with different mutations that had a 10% chance to occur, and a control group with no mutation.

Results

The mutation that swapped two random bits of a beings genome caused the population to grow fastest.

Conclusions/Discussion

This program was re-structured based on a previous experiment with 100% mutation rates. The 100% mutation rate turned out to be counter-productive and so I implemented a 10% mutation rate. The slight change caused by the 10% mutation rate caused the population to progress towards better genes more quickly, and allowed strong genes to develop. What I learned in the 100% mutation experiment was extremely important in this experiment.

Summary Statement

My project is about testing different mutation functions in a program based heavily on genetic algorithms

Help Received

My cousin Sheldon taught me to program in Visual Basic.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Emily Olewiler

Project Number

J1216

Project Title

Hydroharmonics: Is There a Formula?

Abstract

Objectives/Goals

It is long known that musical notes can be created by stiking a glass of water filled to various heights. Is it possible to mathematically calculate a musical note based upon the geometrics of a glass?

Methods/Materials

Procedure-Line up the glasses in an order with all necessary materials on the counter. Fill each glass up abut half way with regular drinking water using the pitcher of water. Strike the first glass with the knife having the tuner in. If the note is flat or sharp, alter the amount of water with the syringe changing the pitch closer to Bb. *Note: Upon initially striking the glasses it was determined that it didn't matter where the glass was struck or what part of the knife was used or with what force it was struck. Repeat step #3 for all glasses tuning them to the note Bb. Record the following measurements of each glass: the amount of water, the weight of the water, the weight of the glass, the diameter of the surface, and the total volume of the glass. Randomly select formulas involving the data from each glass. Record the formulas and the calculated results for each glass looking for numbers that are consistently close together. Look for numbers that are within 1 or 2 percent with each other across the chart or graph. If a close occurrence is found, apply the formula to an additional glass for additional data based upon the calculations.
Materials-6 different types of glasses, Chromatic-20 Tuner, Pelouze 2 lb scale, 100ml Beaker, Metric ruler, Calculator, Syringe, Water, Knife.

Results

After randomly selecting various formulas or combinations of the data I found a series of numbers that varied approximately 1%. This provided close enough data to prove that one of my formulas was quite accurate. This formula was interpreted as the amount of water divided by the total volume of the glass. Values ranged from .61 to .62. To prove my theory I added two additional different glasses, calculated their maximum volumes, and filled them 62%. I struck them with the instrument and verified the note on the tuner. As my calculations proved, the notes produced both were Bb.

Conclusions/Discussion

To tune a glass of water to a Bb, simply calculate the maximum volume of the glass and then fill it 62%. Therefore it is possible to tune a glass to a Bb based upon the geometrics of the glass.

Summary Statement

I have proven that there is a formula to mathematicaly tune a glass of water.

Help Received

My father assisted me in coming up with the project idea.

Name(s)

Sidharth D. Reddy

Project Number

J1217

Project Title

Software Speech Recognition

Abstract

Objectives/Goals

My project analyzed the performance and accuracy of different software libraries and how well they compared against each other.

Methods/Materials

Four different software libraries: Scansoft's Dragon Naturally Speaking Version 6 and Dragon Professional Solution Version 6, IBM Via Voice Version 9, and a written program designed to see how well it functions in contrast of the other software. Each software was tested in different texts: basic grammar, medical, legal documents, computer, and scientific terminology. Five tests for each software and for each text were completed and accuracy and performance was recorded. This information was placed in graphs and charts with the variables for percent correct and for the test number. A data sheet was made from features such as installation time, microphone, vocabulary storage, and etc.

Results

Via Voice contained fewer mistakes in all test categories with over 90% accuracy in basic grammar and scientific terminology and above 80% in the other three. Dragon Standard ,however, had above 85% accuracy in basic grammar and scientific terminology and above 79% accuracy in medical, legal documents, and computer. The testing was done to show that both Standard and Via Voice were comparable and each had its own advantages over the other. Dragon Professional was used to notice how close Standard and Via Voice were in accuracy rate. The home-designed software was created to compare how well software brought in store performs against one that is created at home.

Conclusions/Discussion

The information shows that even though Via Voice had the least mistakes, it was missing several key features such as a user-friendly wizard, or a proper method to help fix problems and answer common questions, which both of the Dragon software had. Looking at the price the written software was the cheapest of all the software. Via Voice was approximately half the price of Dragon Standard, which does put some serious thought into which software is the best to buy and use.

Summary Statement

My project is about the analyzation, testing, and comparison of different software libraries.

Help Received

Father taught how to write programs, helped prepare board, and made sure the testing was coducted properly.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Hannah L. Ruble

Project Number

J1218

Project Title

Fastest Route: Graph Theory Applied

Abstract

Objectives/Goals

My goal was to determine how graph theory can be applied to determining the fastest route through random stops.

Methods/Materials

I used maps of my neighborhood, paper and pencils, Microsoft Streets and Trips software. I chose random delivery stops by dropping a pencil onto the map of my neighborhood. I moved the stops onto another blank piece of paper and determined, using graph theory principles, the best route to take. I then measured the actual route and beeline distance from stop to stop and compared them in a ratio.

Results

My results showed that the beeline distance was considerably shorter than the actual distance. The actual distance was pretty consistently 1.6 times farther than the beeline.

Conclusions/Discussion

I concluded that graph theory did not provide the most efficient route because it overlooked all natural barriers. I also found that it was consistently 1.6 times less than the actual distance. My results tell me that is a good measurement for geometric shapes, but needs to be changed to work in the real world. My future projects might try to find out how you could use graph theory to find good random routes in the real world.

Summary Statement

In my project I tried to use graph theory to find the most efficient route with random stops.

Help Received

Dad helped with my board and with typing.

Name(s)

Kouhei Ueno

Project Number

J1219

Project Title

Mathematics Behind Realistic Computer Graphics

Abstract

Objectives/Goals

My project's title is "Mathematics Behind Realistic Computer Graphics". I was interested in how realistic non-realtime computer graphics are made, so I made a 3D computer graphics program to learn computer algorithms to make realistic CGs.

Methods/Materials

I made a computer program to demonstrate algorithms I studied. I used three computers to develop and debug my program, but only one computer is needed for compiling this program. I used asemmbly (x86 and MIPS) and C++ for faster execution of the program.

Results

I made realistic computer graphics images from my program. It clearly showed correct shade, shadow, reflection, and refraction.

Conclusions/Discussion

I learned lot of computer algorithms from making this program. I never knew vector mathematics was used in computer graphics.

The program is significant because it is one of the few computer graphics programs that can run on a regular computer. It can even run on PocketPC PDA.

Sourceforge.jp agreed to support this opensource project. They provided me CVS, HTTP, and FTP webserver.

Summary Statement

This project is about making a computer program to learn algorithms and mathematics used for creating realistic computer graphics.

Help Received

Sourceforge.jp approved to provide web server (Apache & CVS) and compile farm for this open source project. My tutor helped me revise my English.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Prashanth Vijayanandan

Project Number

J1220

Project Title

How Does Travel Time Vary between Segments on SamTrans Route 260?

Abstract

Objectives/Goals

The objective of my project was to find out how travel times varied between segments on SamTrans Bus route 260 from my home in Redwood Shores to Ralston Middle School in Belmont.

Methods/Materials

First I divided the route I wanted to study into several segments. I identified the end points of the various segments by traveling the bus route in a car and noting the distances from the start point.

For 23 school days, I used a stopwatch to record the time the bus took to cross the endpoint of each segment. I stopped the watch whenever the bus stopped and children boarded to eliminate boarding delays.

I computed the average travel time and the variation for each segment. Since the segments were not of equal distance, I estimated the time per kilometer for each segment before comparing them.

Results

The segment near Belmont Train Station had the longest travel time of 298 sec./ Km. The segment near Oracle had the lowest travel time of 99 sec./Km. Travel times varied 418% in the segment after Notre Dame High School, while the segment near Oracle showed a 183% variation. The average running time for the section of Route 260 studied was 31:11 min., excluding boarding time. This is more than the SamTrans scheduled time of 27 min., which includes boarding times. The running time was highest on Fridays, with 33:20 min., while it was least on Wednesdays, with 28:59 min.

Conclusions/Discussion

My hypothesis was partly correct - of the two segments that I thought would cause undue delays, only one proved to be correct. The travel time in the segment near the Belmont Train Station was long while the time for the segment near Oracle was not. The reason for the result being different from my original hypothesis is the direction of traffic. There is more eastbound traffic on Marine Parkway near Oracle in the mornings while the bus travels in the opposite direction.

The travel time was the lowest per kilometer in the segment where there were most lanes. The variation was highest in the segment with a single lane. The impact of traffic and signals, however, could not be determined conclusively because there was not sufficient information.

Although Fridays appeared to have the longest running time, the sample size was too small to state this with confidence.

Summary Statement

I investigated the relationships between segments and travel times along SamTrans Bus Route 260.

Help Received

My dad drove me along the bus route so I could divide the route into segments. My mom reviewed my report and the poster.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Victoria B. Hilley

Project Number

J1299

Project Title

Arches and Loops and Whorls, Oh My! A Study of Fingerprint Patterns

Abstract

Objectives/Goals

The objective of my project was to investigate which basic fingerprint pattern, Loop, Arch, or Whorl, had the probability to be the most common. I believe the basic Loop pattern will be the most common by about 50%. Second, the Arch will fall about 30% and then the Whorl pattern will show about 20% probability. This experiment involved taking large numbers of fingerprints from several classes.

Methods/Materials

I took a student's right wrist with my left hand, his/her right index finger with my right hand, and gently but firmly pressed the finger onto the inkpad. Using the same pressure, I then pressed the student's finger onto the fingerprint card, making sure the fingerprint was clear and free of smudges. I repeated the experiment with the remaining students in the class, then with with the remaining classes from 3rd to 5th grade. I counted and categorized all the fingerprints collected.

Results

After applying the experimental probability, the results partially confirmed my objective: the basic Loop patterns have a 49% probability (I predicted 50%). However, the basic Whorl patterns calculated to have 32% probability (I predicted 20%), and the basic Arch patterns have 19%(I predicted 30%). I also observed that taking fingerprints took practice. Some prints were difficult to "read", while others were clear and obvious.

Conclusions/Discussion

Based on the 200 million fingerprint files the FBI has, using a proportionate equation, I calculated about how many people have certain types of prints. However, I will have to perform the experiment on a much larger scale to get a truer picture, because according to the Ventura County Crimb Lab, from their experiences, Loop patterns show up about 60%,(11% difference), the Whorls is about 35% (3% difference), and the Arch at about 5%(a 14% difference)! Findings like these may be essential to anyone working in this field by giving them statistics to work with for any given population, and for any given criminal population.

Summary Statement

My project is about testing probability of which basic fingerprint patterns are common.

Help Received

Mom helped type report. Mesa Union School students for their active participation.