CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Kevin R. Danh

Project Number
J1401

Project Title
Testing the Null Hypothesis H0: u1 = u2

Abstract

Objectives/Goals

When a new medical procedure gets tested, a large population may get tested against a small trial population. Since the null hypothesis states that there should be is no difference between the result means of the two methods, the researcher hopes to reject the null hypothesis and conclude that the method he developed is the better of the two, rather than a ratio equal or worse.

How large do the two comparative groups have to be to get a fair statistical evaluation of the null hypothesis?

Methods/Materials

1. Construct a data chart of two separate model populations for comparison by coin flipping with ten groups of ten for each chart labeled population A or B.
2. Determine the ratio by comparing the amount of heads for sample A to the amount of heads for sample B.
3. In the first comparative test continue to add number of heads from each set cumulatively for each as two separate populations and divide the results from Sample B into A to get the comparative ratios; i.e., compare 10:10, 20:20, etc., until 100 datum are compared.
Examine whether H0: u1 = u2.
4. In the second comparative test, individual groups of 10 datum are compared to the larger population of 100 datum. Examine whether H0: u1 = u2.

Results

PHASE I Test POPULATION A versus POPULATION B

SET	1	2	3	4	5	6	7	8	9	10
RATIO 1:	0.8	1.0	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.978

PHASE II Test POPULATION A mean versus POPULATION B

SET	1	2	3	4	5	6	7	8	9	10
RATIO 1:	0.9	1.1	1.3	0.7	0.9	0.9	0.9	1.1	1.1	1.11

Conclusions/Discussion

I was trying to determine what the minimum comparative population sizes would have to be to get validation of the null hypothesis H0: u1 = u2. My results indicated that I was near that 1:1 ratio, but never truly achieved it. In the phase II aspect of the study I compared two populations: one very small and one very large. I found out that population means of 10 datum or less may not be valid for comparison against larger population means.

Summary Statement

This project examines the statistical validity of very small population groups versus larger ones with the null hypothesis.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Diana Garcia

Project Number
J1402

Project Title
Math and Origami

Abstract

Objectives/Goals
I want to prove that Euler's formula works in a easier way. Also I want to see if the formula works for all three dimensional origami.

Methods/Materials
I'm going to use color construction paper to do the origami. Then I will put the origami in my board with my information.

Results
What I got for my results were that for all polygons the formula works.And also I proved the Euler's formula in a easier way.

Conclusions/Discussion
My conclusion is that the formula works for some three dimensional origami. Also that the formula could be proved in a easier way.

Summary Statement
My project is about proving the Euler's formula in a easier way.

Help Received
My sister helped type

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

Ben F. Hannel

Project Number

J1403

Project Title

Cracking the Code: The Effect of Key Length on the Security of a Public Key Encryption

Abstract

Objectives/Goals

The objective is to determine how the length of the key used to encrypt a code affects how long it takes to decipher the code, and how codes can be deciphered faster using different algorithms.

Methods/Materials

Programs were written in Java to crack codes with key lengths between 15 and 70 bits (5 to 23 digits). The test machine had an Athlon II X4 635 processor and 4 gigabytes of OCZ RAM. Three versions of the program were used. The first cracked the key by trying every possibility. The second tested only certain possibilities that were the most likely, and the third tested the most likely possibilities on all four cores of the processor using multi-threading.

Results

Each bit added to the key length increased the time to decipher the code by about 40 percent. The second version of the program used to decipher the code, which eliminated testing of unlikely keys, was three times faster than the first version. The third version, which used multi-threading, was four times faster than the second version.

Conclusions/Discussion

The time to decipher the code went up exponentially with key length, making keys beyond 85 bits essentially undecipherable. The deciphering time decreased by testing only the most likely keys and using all four cores of the processor. Keys used for online bank accounts and other online transactions are usually between 512 to 1024 bits long, so bank accounts are safe from anyone without a large supercomputing budget and thorough knowledge of the general number field sieve.

Summary Statement

This experiment tested the difficulty of deciphering an encrypted code by varying the length of the key used to encrypt the code and by increasing the efficiency of the algorithm used to decipher the code.

Help Received

My mother helped me edit the report, debug code, and fill out this application.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Sasha Langholz

Project Number
J1404

Project Title
FIBonacci? Exploring Spiral Geometry within the Natural World

Abstract

Objectives/Goals
The objective of this project was to determine the prevalence of both logarithmic spirals and more specifically Fibonacci spirals within mollusk families. It was concluded that logarithmic spirals occur often in nature and indeed serve as a common growth strategy. However, Fibonacci spirals are not often found within the spirals of mollusk families. The results of this project demonstrate how the prominence of the Fibonacci spiral in shells can be exaggerated and this topic is under-researched. However, logarithmic spirals do appear in mollusk families reflecting an efficient biological growth pattern.

Methods/Materials
Materials: turbinidae, angarridae, and naticae shells,camera, ruler, pencil, calculator
Methods:
1 Collect and photograph turbinidae, naticae, and angariidae species.
2 Measure the ratio between two consecutive radii of the spiral Repeat 10 times.
3 Calculate mean and sample standard deviation.
4 Calculate a 95% margin of error to determine whether the ratios are #the same# and the spiral is logarithmic.
5 Use the equation for logarithmic spirals r=ae^b*theta to see how logarithmic growth changes the variables a and b.
6 Solve for a and b, plug theta and r values.

Results
No shells contained the Fibonacci spiral. However, 1/3 of the sample did display logarithmic growth.

Conclusions/Discussion
Finding no Fibonacci spirals raises questions about whether mathematicians over-promote the Fibonacci spiral in shells. Shells do use logarithmic spirals as a biological growth pattern. Shells of the same family share aspects of spiral progression. The geometry of logarithmic spirals is applicable to other organisms and formations within the natural world.

Summary Statement
This project explores the frequency of the appearance of logarithmic or specifically Fibonacci spirals appear within mollusk families.

Help Received
Math teachers Erik Perkins and Jordan Johnson verified background info and reviewed mathematical procedure. Science teacher Eliina Karyndina helped with procedure.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Derrick T. Li

Project Number
J1405

Project Title
Plagiarism Analysis Program

Abstract

Objectives/Goals
To create a program in the C# programming language that is capable of pairing texts together as plagiarized off of each other.

Methods/Materials
PHYSICAL MATERIALS:
1. Group of students to write a paragraph
2. Paper to write on
3. Pencils
4. Controlled classroom environment
5. List to track students who plagiarized
6. Computer
7. Calculator to find program accuracy

SOFTWARE:
1. Plagiarism Analysis Program
2. Notepad or other text editor to compare data

Results
1. To determine if the program successful: Did it catch at least half of the students who plagiarized? 2. To determine the overall accuracy of the program: Divide the number of correctly identified cases of plagiarism by the actual amount. Was it at least eighty percent? FINAL RESULTS: 1. The program did accurately detect plagiarism. It successfully paired together 20 out of 22 texts as plagiarized (more than half) 2. The program's accuracy was over 80%. After dividing the total amount of correct results (20) by the total texts (22), the percentage returned was 90.9%.

Conclusions/Discussion
For my experiment I created a program in the C# programming language to pair texts together as plagiarized. I hypothesized that the program could successfully pair together at least half of the texts, and would have an overall accuracy of at least 80%. I gathered a group of 44 students together in a controlled classroom environment to obtain the paragraph samples required for my experiment, that conducted the analysis with the program at home. My hypothesis was correct. The program did accurately detect plagiarism to the conditions specified (Giving accurate results at least half of the time). Additionally, the program's accuracy was 90.9%, which was 10.9% higher than the required 80%.

Summary Statement
The aim of my project is to create a computer program in the C# programming language that can detect plagiarism between two texts.

Help Received
Used students of Mrs. Cameron to obtain texts; Obtained help with testing methods from Mr. Briner; Support from parents

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Nikhil Lonberg

Project Number
J1406

Project Title
The Effect of Impaired Judgment and Speed on Traffic Accidents

Abstract

Objectives/Goals
The interactions between cars in traffic are not just attributed to parameters such as the distance to the car in front; they are affected by the behavior of the drivers. Some drivers are speeders, have bad judgment on the road, or both. These behaviors cause accidents. But which of them cause more accidents: bad judgment or speeding?

Methods/Materials
The hypothesis is tested by simulating the interactions between cars on a track with a Microsoft Visual Basic computer program. The program will place traffic on a single lane 20-mile stretch and move the cars forward in one-second intervals. A random number generator is used to assign the drivers speed and judgment values. The program will blame whichever car runs into the car in front of them and remember its driver type. This way data as to drivers causing the most accidents can be collected.

Results
The data gathers that drivers with poor judgment cause the majority of accidents. It also shows that it is uncommon for accidents to occur when every car has good judgment.

Conclusions/Discussion
The results suggest that drivers with poor judgment are more at fault for traffic accidents. This supports the hypothesis that judgment is a greater factor in preventing accidents than speed. This does not mean that speed is not a major contributor to traffic accidents. There are many adjustments to the computer program that can be made to do this experiment differently or to study different patterns.

Summary Statement
The project uses a computer program to test whether impaired judgment or speeding has a greater effect on traffic accidents.

Help Received
Father helped debug program; Mother helped with presentation and assembly of project.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Anna J. Lou

Project Number
J1407

Project Title
Position or Piece: Computer Simulation and Study of the Strategy Board Game Blokus

Abstract

Objectives/Goals
Blokus is a new strategy board game that has won 26 worldwide awards since its launch in 2000. My objective was to investigate which strategy was more effective in winning the game, the "Position" Strategy (blocking the opponent) or the "Piece" Strategy (placing the biggest possible piece first). Also, when both strategies were used, which one should be given priority? My hypothesis in Experiment 1 was that the "Position" would be more effective and should be given priority.

Methods/Materials
After researching on artificial intelligence, commercial software, algebra, geometry, and programming, I decided to simulate the game by writing my own Microsoft Silverlight program in C# language. 820,000 games divided into 82 tests were simulated and analyzed. For each test, 100 trials were run with 100 games in each trial to get accurate results. Each game has Player 1 (using different strategies) versus Player 2 (always playing randomly with no strategy).

Results
(1) In Experiment 1, I tested 4 different strategies. The "Piece" Strategy was more effective than the "Position" (average winning chance of 90.82% vs. 70.73%). When both strategies were used, "Piece-Position" was more effective than "Position-Piece." The results didn't support my first hypothesis. The Side Experiment also confirmed it. (2) Thinking that the "Piece" was better because the original board size 14x14 was small, I hypothesized in Experiment 2 that the effectiveness of the strategies would change with the board size. The results from 75 tests at different board sizes (12x12 through 40x40) supported my second hypothesis. When the board size was under 18x18, the "Piece" Strategy was more effective. When it was over 18x18, the "Position" was more effective.

Conclusions/Discussion
(1) The effectiveness of the "Position" and "Piece" Strategies actually depends on the board size. Their effectiveness switches at 18x18. Interestingly, 18x18 levels the playing field between the two strategies. (2) At the original board size 14x14, the "Piece" Strategy is more effective and should be given priority over the "Position" when both are used. (3) The "Piece-Position" Combined Strategy has achieved a 98.23% winning chance when played against random playing. For future research, I would simulate more strategies to have the winning chance increased toward 100% as much as possible and then have my program use its "intelligence" to play against real people and win!

Summary Statement
By writing a computer program to simulate 820,000 Blokus games, I investigated the effectiveness of different strategies at different board sizes and derived a strategy that achieved a 98.23% winning chance at the original board size.

Help Received
I completed a college online course at Irvine Valley College and learned C# language. My father mentored me in programming. Math Professor Xue taught me about advanced topics in statistics.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Eric S. Luxenberg

Project Number
J1408

Project Title
Three Player Prisoner's Dilemma

Abstract

Objectives/Goals
My purpose was to discover how classic Prisoner#s Dilemma changes or stays the same when expanded to three players, in terms of winning strategy and defection versus cooperation.

Methods/Materials
I programmed a tournament which allowed the strategies I created to compete against each other. My experiment variables were the individual strategies, and they were tested to determine which one would win the tournament.

Results
A modified version of the classic strategy #Tit For Tat#, with a tendency towards cooperation, was the most successful when competing against thirteen other strategies in a tournament. Tit For Tat type strategies did the best overall.

Conclusions/Discussion
The principles behind Prisoner#s Dilemma remain valid when expanded for multiplayer scenarios, and the most effective strategy in classic PD, Tit for Tat, remains the best in the three player version. Also, the results showed that a tendency towards cooperation is the better than aggression.

Summary Statement
My purpose was to discover how classic Prisoner#s Dilemma changes or stays the same when expanded to three players.

Help Received
Math teacher oversaw the programming portion

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

Peter J. McLeod

Project Number

J1409

Project Title

What Is the Best Method for Generating Dungeons and Dragons Ability Scores?

Abstract

Objectives/Goals

Dungeons and Dragons is a fantasy role-playing game in which players create fictional characters and have them go on adventures. It is often played on a board with miniatures and dice. Dice are used to determine character abilities such as strength, dexterity, constitution, intelligence, wisdom and charisma. In the first edition of Dungeons and Dragons, there were five methods for determining ability scores. The purpose of this project was to methodically find out which method gave the most favorable results.

Methods/Materials

Materials used in this experiment included 21 six-sided dice of varying colors and markings, a dice cup, and a smooth cooking pan. The five methods tested include: the Old (Basic) Dungeons & Dragons method, and Advanced Dungeons & Dragons methods I-IV. In the Old Dungeons & Dragons method, I rolled 6 groups of three six-sided dice and then re-rolled the character if there were two or more ability scores below 6, or if the highest ability score is below 9. In method I, six groups of four six-sided dice are rolled, and the lowest result for each group was discarded. In method II, six groups of 3 six-sided dice were rolled twice, and the highest six scores were retained for each group. In method III, three six-sided dice were rolled six times for each ability category, and the highest group of three is chosen for that category. In method IV, six groups of 3 six-sided dice were rolled a sufficient amount of times to generate 6 ability scores, in order, for 12 characters.

Results

The method that provided the best results was method III. After that, in order from best to worst results were: method II, method I, Old method, and method IV.

Conclusions/Discussion

Method III was the best method for generating ability scores because each ability score is rolled for six times each and the highest score is chosen.

Summary Statement

To determine which method for determining ability scores gave the most favorable results in the Dungeons and Dragons fantasy role-playing game.

Help Received

Mom helped me by proofreading my report and practice my speech. Dad helped with data entry and graph creation.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Manooshree R. Patel

Project Number
J1410

Project Title
Net the Net

Abstract

Objectives/Goals
Many internet surfers experience frustration and aggravation while using an internet search engine, from the lack of relevant result information or the numerous results that rank over ten million. Also the surfer may want to search for images, but the image search engines, today, search images by the file name rather than the visual content of the image. The objective of my project is to determine whether search tips could be used on search engines to reduce the number of search results and get exactly the information the user wants. Also I wanted to know if, by using internet search tips, the user could get the same information and same number of hits from each search engine. When searching for images, I hypothesized that an algorithm could be written which searches images by their image content, rather than their file name.

Methods/Materials
I developed 29 internet search tips (they consist of Boolean logic, special characters, and wildcards) which I used on four different search engines (Google, Bing, Yahoo, AOL). My control was each of my search engines without search tips. I recorded my data in a chart, and later converted it into graphs. For images, I developed an algorithm which uses color, location, and correlation of pixels in an image to determine if two images are visually analogous or not.

Results
My graph showed that when using search tips, the number of search results in the search decreased a great deal. During the time I was executing my search tips on the various terms I learned that the information coming from each search engine was not the same. Also, the number of search hits was not the same. I also designed an algorithm which finds images that are visually similar, rather than having similarity of file name.

Conclusions/Discussion
I concluded that internet search tips could reduce the number of search results and give the user the information they wanted. However, the user does not get about the same number of hits or about the same type of information from each search engine. This makes my hypothesis partially correct. I also concluded that an algorithm could be written to give the user images that are visually similar to their search. My project has a very practical application. Every day, millions of people all over the world use a search engine. My project will help them get the information they are looking for without getting millions of results back.

Summary Statement
This project determines if internet search tips could be used to reduce the number of search results and bring more relevant information to the search and explores an image searching algorithm that searches by the visual similarity of images.

Help Received
My parents helped me organized the science board.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Adhayana Paul

Project Number
J1411

Project Title
How Big Is Your Icosoikaihenagon?

Abstract

Objectives/Goals
The purpose of this project is to find out if there is a relation between the area of any regular polygon and it's height.

Methods/Materials
First, all the areas were calculated for the regular polygons with sides 5-21 and heights 1-15 for each of them. This was done using a website. Then I found the ratios for them which was area/height squared. Then, I graphed the deltas (pi/4 - constant) using Excel and it looked like an exponential decay (d=De^-kn). I tried to derive k (constant) which would satisfy all the deltas, but one individual k could not be identified.

Results
I found out that the area/ height squared for each polygon had it's own constant. The constant got closer to pi/4, or 0.78, as the number of sides increased. Then the k values were derived but every k value was different and the results were too inconsistent to make into a formula.

Conclusions/Discussion
It was not possible to find a formula for all the regular polygons, but it was possible to find a pattern for each individual polygon. There should be an equation since the line is such a perfect curve, but I couldn't find that equation.

Summary Statement
The project's goal was to find out the relation between the height of any regular polygon and it's area.

Help Received
My dad helped me using Excel, introduced me to exponential decay formulas, and taught me how to find the constant values in the formula.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Alison L. Ren

Project Number
J1412

Project Title
Spidrons

Abstract

Objectives/Goals
To find a mathematical relationship between the angles of different numbered spidron nests.

Methods/Materials
Methods:
1.Three spidron nests were constructed.
2.The valley fold angles from above and below the spidron were measured in the clockwise and counterclockwise direction resulting in 36 angle measurements
3.Counterclockwise top angles and clockwise below angles were averaged for the three different spidron nests
4.Data was analyzed for apparent relationships
Materials:
1.22"x22" Construction paper for building spidrons (4)
2.Scissors
3.Scotch tape
4.Protractor

Results
For the 4 spidron nest the average valley fold low angle was 90 degrees and an average valley fold high angle was 115 degrees.
Averages for the 6 spidron nest were 106 degrees and 139 degrees.
Averages for the 8 spidron nest were 106 and 146 degrees.
Averages for the 10 spidron nest were 111 degrees and 145 degrees.

Conclusions/Discussion
At first I constructed several test spidrons to determine the ease of constructing spidrons. After I constructed and measured the valley fold angles for the 4, 6 and 8 spidron nests I could see no visual relationship between the number of spidrons in the nest and the average angles. After entering the data into excel, my teacher helped me fit a polynomial trendline to the low angle, high angle, and overall average angle for the different spidron nests. In order to test the equation, I constructed a 10 spidron nest and compared the measured valley fold angles to the predicted valley fold angles. Sadly, all of the measured angle averages were at least 5% different from the predicted values. So at this point, my hypothesis is disproven, as there appears to be no relationship between the angles of various spidron nests.

Summary Statement
A study of the relationships between the angles of different spidron nests.

Help Received
N/A

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Casey L. Schneider

Project Number
J1413

Project Title
Artificial Intelligence: Modeling with Tic-Tac-Toe

Abstract

Objectives/Goals
This science experiment is to determine if a computer can outplay a human player in a game of Tic-Tac-Toe after it has been programed to play. My hypothesis is: if a computer is taught some basic Tic-Tac-Toe algorithms, it will win at a higher rate against a human player. I used this hypothesis because it is assumed that a computer will play better. If it has been programed correctly, then it will always refer back to those algorithms and perform them exactly as they were supposed to be used.

Methods/Materials
I used my Windows 7 laptop and notepad. I set up the game board with buttons representing the squares. I made a square to contain an X or O whenever it has been clicked and switch between X and O. I made the program alternate turns when someone clicked a square. I created a button that would start a new game when it was clicked. I added the artificial intelligence to the game. Three people each played 10 games against the computer. I recorded who won and lost, or if it was a tie and compared the overall ratios of wins to losses of each person.

Results
I found that my hypothesis was rejected because the human players, overall, played better than the computer. For example, in matches 2 and 3, the ratios of the human players were 2:1 and 1:0, while the computer#s ratios were 1:2 and 0:1.

Conclusions/Discussion
I concluded that the computer played poorly because of two very important weaknesses: first, it didn#t see a trap that could be used by the human player to win; and, second, it didn#t take the advantage to trap its opponent.

Summary Statement
I programmed my computer to play Tic-Tac-Toe against a human player.

Help Received
Uncle taught me computer programming.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Prem M. Talwai

Project Number
J1414

Project Title
Chinese Checkers Strategy

Abstract

Objectives/Goals
The main goal of my science fair project is to create an effective opening repertoire and strategy for penetrating the opponent#s formation in a two-player Chinese Checkers game. My technique helps the player understand exactly how he should force his way through the opposing player#s marbles and gain the upper edge in a position.

Methods/Materials
The materials used were a pencil or pen, a Chinese Checkers board, and a computer opponent against which to play practice games. I started by analyzing my games, and noticed many recurrent strategies that were being used to advance one#s marbles to the center. By combining these strategies, I formulated an opening repertoire that helps the player start off strong. To complement my repertoire, I created a middlegame strategy that guides the player to which plans he should undertake after the opening phase. Further analysis led me to discover certain formations that transport marbles across the board, which in turn served as the foundations of my #vacancy test# and finally my two-step technique.

Results
I invented an opening repertoire and middlegame strategy which, when combined, created a two-step technique that can be used to devise a plan for penetrating the opposing formation.

Conclusions/Discussion
I was able to successfully create an opening repertoire and formulate a novel strategy for finding the best plan(s) in a two player Chinese Checkers game. I then used the opening and strategy to create a two-step technique that enables a player to gain the advantage in a game, which met my initial need. In further research, I plan to extend my findings to multi-player Chinese Checkers games.

Summary Statement
My project creates an effective technique for penetrating the opponent#s formation and gaining an advantageous position in a two-player Chinese Checkers game.

Help Received
No help was received.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Arjun M. Tambe

Project Number
J1415

Project Title
Computing Cancer: Can Markov Decision Processes Computationally Model Cancer?

Abstract

Objectives/Goals

Cancer is a growing problem in the US and the world. Despite advances in treating cancer, growing cancer rates prove the need for additional research. Computational models for studying cancer are being studied more as they may prove more efficient in studying the impacts of drug delivery on cells, as opposed to testing on lab animals. This study is among the first to use Markov Decision Processes (MDPs) to model cancer.

MDPs model agents attempting to maximize their expected utility by taking actions that move them between states. This study used an MDP to model cells that could move, stay, or reproduce. The program was executed in twenty environments by changing five values for a reward if the cells reproduced and four values for a cost if the cells moved.

The goal was to establish whether or not MDPs are a viable alternative to current computational models of cancer by determining whether MDPs can respond to changing environments. The hypothesis is that MDPs can model cancer since the cells would act differently under different environments.

The results validated the hypothesis. Cells in the environment with the highest reward and cost were ten times more likely to clone, one-fourth as likely to stay, and never moved, compared to cells in the environment with no rewards or costs. The study concluded that MDPs are an alternative to current models of cancer. This study is intended as the first step towards an MDP comparable to real cells. Refinement is left for further research.

Summary Statement

Computational model of cancer cells using Markov Decision Processes

Help Received

Dad helped with the project idea and research material. Mother and brother helped with the board design.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Indraneel A. Tambe

Project Number
J1416

Project Title
Nonlyrical Music Search Algorithm

Abstract

Objectives/Goals
The engineering goal of this project has two parts: one is to create a program to parse a MIDI file, and the second goal is to have the program run searches between MIDI files, in a "music search." Today, the prevalent way to search for music is to enter the lyrics or title of a song into a search engine, like Google. However, this can be disadvantageous for music without lyrics (such as western classical music), or if you do not know the lyrics. Also, musicians frequently steal music from one another, and this often goes unnoticed. This project, however, can defeat musical copyright infringement; it can search a single song against a large database of songs, and find matches.

Methods/Materials
In the beginning, I use the MidiSwing software to record input from a MIDI-compatible keyboard, then it is saved to a file called mqry.mid, which is the file that is used as the search query. Then I use Terminal to run the search program, which searches mqry.mid against a song bank of MIDI files. The search results are displayed in the Terminal window. To create this search program, I used Xcode, a programming environment for Mac OSX. I wrote the code in the C++ programming language.

Results
The program was able parse every MIDI file it was given, and was able to find matches between the query file and the song bank.

Conclusions/Discussion
It is possible to create software that can perform a "music search," instead of a lyrics-based music search.

Summary Statement
My project is a music search based not on the lyrics, but on the song itself.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

Luke A. Thompson

Project Number

J1417

Project Title

Mission Control: Programming for Optimal Error Reduction in Line-Following Applications

Abstract

Objectives/Goals

The objective of my project was to determine the most effective way of controlling a line-following robot in regards to oscillation and speed. I believe that the program that accounts for the most variables and has the greatest range of speed will oscillate the least and will travel the fastest.

Methods/Materials

A line-following robot was constructed using a microcontroller, motor shield, two geared DC motors, three solderless breadboard wires, an LED, two resistors, a photo resistor, 6 AA batteries and pack, a solderless breadboard, and 6 rubber bands. After constructing a track of electrical tape on a large sheet of paper, three different programs were written and tested on the track. Each of the programs were tested with a different colored marker attached to the robot, which allowed accurate measurement and recording of data. Each program completed 5 laps and the speed, oscillation, and wavelength were recorded.

Results

The proportional controller consistently completed a lap in the fastest time and with the least amount of oscillation. The 3-step controller completed the laps significantly slower and had a greater oscillation height then the other two. The 2-step controller consistently completed the lap the slowest as well as had a greater degree of oscillation then the proportional controller.

Conclusions/Discussion

The experiment demonstrated that my hypothesis was correct. The proportional controller, which accounts for the greatest number of variables, was the most effective controller at reducing error and increasing speed. This has significant implications for a wide range of fields. Any technical device that needs to correct errors, can use this program: from rovers, to space shuttles, or even something as simple as an oven.

Summary Statement

My project is about programming to reduce error and to increase the effectiveness of a line-following robot.

Help Received

My Mom helped me tape pieces of paper for my board and my dad helped me build the penholder for the robot. He also helped with the timing and measurement of the robot.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

M. Evan Wildenhain

Project Number

J1418

Project Title

Evolving Neural Networks to Play Mastermind

Abstract

Objectives/Goals

The objective is to write a computer program that trains neural networks using a genetic algorithm to play Mastermind. It is hoped that the program can train neural networks to be able to, on average, solve at least 1%, or 13 combinations, of all 1296 combinations of Mastermind. The impact of changing different settings of the neural networks and genetic algorithm will be explored.

Methods/Materials

A computer was used for programming and running the experiment. The Mastermind simulating program itself was coded by the researcher in Java using resources from both Heaton Research's open source Encog Project and Sun Microsystems. The program generates a population of neural networks, trains the networks on a random subset of Mastermind combinations using a genetic algorithm for 20,000 epochs, then exports a log summarizing the number of combinations solved by the best-evolved network as well as the score the network received from the fitness function.

Results

With four different settings, the program was able to evolve a neural network that could solve at least 13 out of 1296 combinations. The four settings that allowed the program to achieve this were with the baseline settings (off of which all of the other settings were varied), with the hidden layer size decreased, with the mutation rate increased, and with the crossover rate increased.

Conclusions/Discussion

Increasing the crossover rate allows more networks to survive, which may lead to greater diversity in the population; this diversity means a greater chance for a latent beneficial gene to survive until it is needed, producing more successful results. Also, introducing a "supermutation" function into the program greatly improves performance. Supermutation involves randomly mutating every neural network in the population when no progress is made after a certain number of epochs. This allows the neural networks to escape from local maxima and continue improving.

Summary Statement

This project involves writing a Java program that uses a genetic algorithm to train a population of neural networks to play Mastermind.

Help Received

Parent helped with discussing the design of the program.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Parker A. Williams

Project Number
J1419

Project Title
Homemade Electronic Whiteboard

Abstract

Objectives/Goals
My goal was to determine if larger monitors would provide higher accuracy when used with an electronic whiteboard program.

Methods/Materials
Using an infared camera connected to my computer wirelessly via BlueTooth, I used a homemade infrared light pen as a mouse pointer. This was tracked by the infrared camera and data was collected by a software program. I tried several different monitors of various sizes to see which one was most accurate.

Results
A larger computer monitor provided better accuracy.

Conclusions/Discussion
My conclusion supported my hypothesis. Electronic whiteboards benefit from larger monitors.

Summary Statement
Accuracy of an electronic whiteboard made from a homemade infrared light pen, a Nintendo Wii remote, and a BlueTooth dongle on a PC.

Help Received
Dad purchased BlueTooth dongle and infrared LEDs and supervised soldering of infrared light pen.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Alice R. Zhai

Project Number
J1420

Project Title
Bad for One, or Bad for All? A Cancer Genome Anatomy Project

Abstract

Objectives/Goals
My project aims to identify highly over-expressed genes in one type of cancer and examine how over-expressed these genes are in other types of cancer.

Methods/Materials
Using the web-based software and bioinformatics tools from the Cancer Genome Anatomy Project (CGAP) developed by the National Cancer Institute (NCI), I identified 10 over-expressed genes in lung cancerous tissues. Then I searched for the expression frequency of these 10 genes in the normal and cancerous tissues of 17 human organs, and assigned each expression frequency a number between 1 and 10, which represents the base-2 logarithm of gene expression frequency. I subtracted the number assigned to normal tissue from the number assigned to cancerous tissue to indicate the level of over-expression of each gene. Next, I examined the statistics of the over-expression indices of each gene for all 17 types of cancer, including the counts of positive over-expression, the average, and the range of positive over-expression indices. I found that the highest over-expressed gene for lung cancer is not the highest over-expressed in other types of cancer. Instead, the moderately over-expressed genes tend to be more over-expressed in other cancers. I repeated the procedure using the 10 over-expressed genes from pancreatic cancer and found similar results. The 10 over-expressed genes from pancreatic cancer are generally more active in other cancers than the 10 genes from lung cancer. I concluded that some genes are unique to certain cancers, and some genes are universal for most types of cancer.
I used my laptop with high-speed Internet to access the online database. I also used Microsoft Excel to make tables and graphs. I used Microsoft Word to type up my report. Besides my computer, I used a printer to print out the charts, a glue-stick and a stapler to attach the print-outs to my lab notebook.

Results
I found that the highest over-expressed gene in either lung or pancreatic cancer is not the highest over-expressed gene for all 17 types of cancer together. Instead, the 4th (3rd) gene in lung (pancreatic) cancer ranks the highest for all 17 types of cancer together.

Conclusions/Discussion
I concluded that that some genes are unique to certain cancers, and some genes are universal for most types of cancer. The moderately-expressed genes in one type of cancer can be the highest over-expressed in all types of cancer. If sciences can identify these genes, they may be able to find a universal cure for all cancer. If I am to repeat the experiment, I would use the actual counts instead of the coarse color coding to indicate the expression frequency of each gene. I would also conduct the analysis using genes from other

Summary Statement
My project is to find out if over-expressed genes in one type of cancer are over-expressed in other types of cancer.

Help Received
After an experience in the kitchen with a skillet, I wanted to test four common metals and their resistance to a change in temperatures. My hypothesis is that the cast iron would cool the slowest due to my experience in the kitchen and the aluminum would cool the fastest.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Evelyn S. Zhang

Project Number
J1421

Project Title
My School Is Awesome (Academically). Or Is It?

Abstract

Objectives/Goals
My project is to find out if my school is really good or not, academically.

Methods/Materials
I download school APIs and CST testing scores over the past 6 years from the website of California Department of Education. Then I performed statistical analysis such as histograms on those data using Excel, and compared the results for my school to other top schools in the state, in Sacramento County, and in my district, in terms of API or mean CST testing scores. I also made the same comparisons with two schools that were similar to my school for the last 5-6 years.

Results
From API comparison, it showed that my school is good, but not the best. From mean CST testing score comparison, it showed that our 6th grade is doing very good, close to the state tops. Our 7th and 8th grades are okay, but not as good as 6th grade. Histograms on the CST testing scores showed that our 6th grade is terrific, sometimes even better than the state tops. Looking at the scores for GATE students only, it showed that actually our 7th and 8th grade GATE students are doing better than our 6th grade GATE, when comparing to the state tops at the same grade. Our 6th grade non-GATE students are also good. Their scores stay close behind to our 6th grade GATE and the state tops. Since most of our 6th graders are in I.B., a special program at my school (not the case for 7th and 8th grades), this indicates that our special program is good.

Conclusions/Discussion
My conclusion is that my school is not the best in the state as I expected, but it is a good one, better than most schools. Students in our I.B. program are awesome, GATE and non-GATE. The analysis I performed here can also be used by schools and districts to find the problem area so they can focus on for future improvement.

Summary Statement
Statistical analysis, such as histograms, were performed on API and CST testing results to find out if my school is awesome or not, academically.

Help Received
Mother helped to build macros in Excel to extract data and post pictures. That speeded up the process.