CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Jordi Bertran

Project Number

J1401

Project Title

Improving Gun Safety with Biometric Identification

Abstract

Objectives/Goals

Modern technology has always been a part of my life and I wanted to learn more about biometrics and how they can be applied to weapons in the armed forces and child safety. The number of children involved in accidental gun deaths has been increasing. The armed forces are constantly saving lives of millions of Americans and fighting for our freedom. In many cases, they use guns to defend themselves. If an American gun is to be stolen, or taken away from a soldier, the other person may have the power to shoot the weapon. In both of these cases, a smart-gun would solve the problem. With a smart gun, unauthorized users would not be able to fire the gun.

Methods/Materials

For my science project, I use two toy guns, a fingerprint sensor, C# programming language to program my biometric gun software, and many other materials in the process of my experiments. First, I programmed my gun software for the fingerprint sensor. Next, I disassembled the toy gun and placed the fingerprint sensor inside, connected to a USB cable to the computer. Then, I re-assembled the gun with the fingerprint sensor inside. I tested my fingerprint in many different ways; clean, dirty, sandy, and soaking wet. I tested the sensor with an unauthorized user many times as well.

Results

I performed 579 tests. I tested my clean fingerprint 296 times, dirty fingerprints 143 times, soaking wet fingerprints 40 times, and unauthorized user 100 times. With clean fingerprints, my print was identified 100% of the time, in an average of 1.6 seconds. With dirty fingers, the fingerprint was identified 73% of the time. With soaking wet fingers, the fingerprint was not able to be identified, but with a wipe of the fingers on clothing, the print was then identified 100% of the time.

Conclusions/Discussion

According to my results, a biometric smart gun would be able to recognize the gun owner and be able to prevent any unauthorized users from firing the weapon.

Summary Statement

The goal of my project was to create a smart gun that could detect the fingerprint of the owner and prevent unauthorized users from firing the weapon.

Help Received

Thanks to my parents for purchasing the toy guns on Amazon, for my father for providing me with the fingerprint sensor. Thanks to my science teacher Mrs. Hunker for all of her guidance.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Erin M. deCastongrene

Project Number
J1402

Project Title
Monty Hall in Megabytes

Abstract

Objectives/Goals
My objective was to find the best answer to the Monty Hall problem using a computer program I created.

Methods/Materials
Materials:
Computer
Scratch 2.0 Programming Language from MIT Media Lab

Methods:
Step 1: Create an interactive computer program that stimulates the Monty Hall problem.
Step 2: Revise the program so it is automated.
Step 3: Run the program in three sessions, with 1,000,000 plays in each session.
Step 4: Adjust the program so that it doesn't switch doors.
Step 5: Run this version in three sessions, with 1,000,000 plays in each session.

Results
I tested the Monty Hall problem 6,000,000 times with my computer program. Of these trials, during 3,000,000 the program switched doors, and during 3,000,000 the program did not switch doors. I split each set of 3 million into three parts, with 1,000,000 trials in each part. In the first one million trials, with switching doors, the computer chose the correct door 666,236 times and a wrong one 333,764 times. In the next million, still switching, the computer chose the right door 666,103 times and an incorrect one 333,897 times.In the third million with switching doors, the correct door was chosen 666,039 times while a wrong one was chosen 333,961 times. When the computer didn't switch its choice of door, for the first million the right door was chosen 333,873 times and a wrong door was chosen 666,127 times. In the next million, still not switching, the computer chose the correct door 333,734 times and an incorrect one 666,266 times. For the final million without switching, the computer chose the right door 332,692 times and an incorrect one 667,308 times.

Conclusions/Discussion
My computer program chose the correct door more times when it switched doors after its original choice than when it stayed with its choice. While switching doors, the correct door was chosen about two-thirds of the time, but when not switching, the correct door was only picked around one-third of the time. So, switching doors doubles the chance that you#ll pick correctly. Clearly, the best answer is to switch doors.

Summary Statement
The purpose of this project is to find the best answer to the Monty Hall problem using a computer program I made.

Help Received
Dad gave feedback on how to improve computer program; teacher reviewed initial idea

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Arshia Deep; Neyaz Siddiqui; Viren Srivastava

Project Number

J1403

Project Title

Teknolink: In an Emergency, Information Is Safety

Abstract

Objectives/Goals

During an emergency, when releasing students to their parents is time critical, schools still have to sift through binders of information to match the students to their authorized guardians. The objective of our project is to find a secure and efficient solution for releasing the students.

Methods/Materials

In order to understand the problem better, we first interviewed the Emergency response team at our school. This helped us brainstorm what features the solution must have.

We then created a mockup of the solution and presented it at our school to gather feedback from the staff members. We researched different ways to identify a person and found that card-swiping was the most efficient.

We also researched possible approaches and finally implemented them into the application for the solution. This involved the following tools and programming languages:

- Parse.com for creating online database
- Webstorm and Xcode development environment
- HTML, Javascript, JQuery mobile, Phonegap

Results

After presenting our solution at the school, they felt that the proposed solution was a marked improvement over the current process, and also provided us feedback to ensure low cost for the device. We also found that different schools may have different release processes that the solution might have to address if we were to expand the usage beyond our home school. The currently demonstrated prototype incorporates feedback from the school staff.

Conclusions/Discussion

The solution provides an easy approach to swipe a card for authorized adults and students to quickly access their information. This makes it easier to not just limit the usage to a situation of emergency at the schools but extend it to a day-to-day usage as well. The solution met the desired goal for the project.

Summary Statement

Teknolink - a low cost device to facilitate the student release process at schools.

Help Received

School Emergency response team members for providing information on the current process and feedback on the proposed solution. Vandana Deep and Ajay Srivastava for formulating our idea in slides. Rohit Deep and Vandana Deep for programming and web resources to help us create the solution. Kukie

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Connor M. Driscoll-Natale

Project Number
J1404

Project Title
Expanding Sabermetrics: Do College Graduates Perform Better in Pro Sports?

Abstract

Objectives/Goals
I want to use statistics in a new way to find out if professional athletes who graduate from college perform better than those who don't. I believe that the hard work and focus required to graduate from college will transfer to better performance from college graduate pro athletes. I will analyze current performance statistics to determine if this is true.

Methods/Materials
I gathered data on college graduate pro ball players from several sports-related websites and sports almanacs. I researched their performance compared to the average for the league in seven specific areas. I determined statistical averages for Major League Baseball based upon the average player on the average team for the 2013 season. I expanded my comparison to include NBA basketball league statistics that were readily available from web sources. I graphed the performance data for each league to see if college graduates were above average performers.

Results
College graduates in pro baseball and pro basketball performed better than average in almost all selected categories. They performed significantly better in the categories related to hitting in baseball and to scoring in basketball (80% of the random sample college graduate players had better batting averages or average points per game).

Conclusions/Discussion
My statistical analysis shows college graduates do perform better in pro baseball and pro basketball. I would suggest that pro team owners and managers expand their use of multi-variable statistics in baseball (Sabermetrics) to include college graduation. My research shows that basketball teams should do the same.

Summary Statement
I used statistics to determine if athletes who graduated from college performed better than average in professional baseball and basketball.

Help Received
My parents helped me to set up the graph format in Microsoft Excel and I entered the statistics. They also helped to proofread my poster.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Ethan B. Elshyeb

Project Number

J1405

Project Title

Creation of a Digital Voice Assistant Capable of Learning from Its Users

Abstract

Objectives/Goals

The purpose of this project is to create a digital voice assistant application for Android which can learn from the people using it. If a user tells the application something, it should add that item into the database, using a key-value system where the subject is the key and the direct object is the value. When a user queries information, the application should return the value which matches the requested key.

Methods/Materials

Materials used were a Windows 7 computer and an Android device+cable. I tested the application by asking Speak 9 items using the "tell me" method, and recording the success rate. Then I added 9 items into the database and recorded the new success rate.

Results

Before entering data, my application had a success rate of 1 out of 9. After entering data, my application had a 9 out of 9 success rate. The results show that my experiment was successful, as it was able to return back every item I entered.

Conclusions/Discussion

This project utilized a speech recognition system and a speech synthesis system, both provided by Android. It uses PHP for the server and MySQL for the database.

One key point I have noticed after developing this application is the exstensability. What I realized is that the key point of the application is not its current limited functionality but rather what is possible using the system I have created. I am currently working on adding an events system where people will be able to add events and then find events relevant to them based on date, time, and location, with the ability to automatically show nearby events based on the user's GPS location. This will be a major step forward by introducing relevant real-world use capabilities into the application.

Summary Statement

My project is about creating a digital voice assistant which is capable of gathering data from its users, uploading it to the web, and enabling others to find that data.

Help Received

Friend helped come up with idea; Mother helped edit report; Family helped test application.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Aaron O. Feldman

Project Number
J1406

Project Title
Where'd Those Swimmers Go?

Abstract

Objectives/Goals
A camcorder filmed a pool with swimmers above and below the water, and a computer system determined when swimmers were in danger of drowning.

Methods/Materials
The initial approach used a FLIR T640 infrared camera in attempting to distinguish hot swimmers from their cooler surroundings--water and objects. However, experimentation showed that reflected sunlight could often falsely make the surroundings appear hotter than swimmers. Consequently, an alternative approach was implemented using a Sony PMW-EX1 Camcorder. Streamed video was captured at two frames per second and processed in real-time using a Python program. To ignore objects, only closely-spaced pixels with a skin hue were clustered together. Thresholds for a cluster's perspective-adjusted area as well as the absolute number of pixels determined whether a cluster was significant, i.e., corresponded to an above-water swimmer. Once clusters were initialized in a frame, the locations and constituent pixels for the significant clusters were simply updated in subsequent frames, enabling swimmers to be tracked. The updating procedure was faster than clustering. When a swimmer submerged, the corresponding cluster was eliminated because its area and/or number of pixels dropped below the thresholds. In response, the program scanned new frames and re-initialized the clusters to see if the swimmer had resurfaced. For real-time implementation, the program code was optimized for speed and also rewritten to run on multiple computers and cores. A master process running on one core launched slave subprocesses. The slaves analyzed multiple images simultaneously, performing the skin pixel classification and clustering. The master used this data to update clusters and determine when swimmers were underwater.

Results
Using hue to classify pixels worked well, enabling the system to ignore objects in the pool. In identifying significant clusters, it was necessary to adjust the cluster area because a swimmer's apparent area depended on his distance from the camera. With multiple cores and speed-optimized code, the system was able to process two frames per second with a maximum five second latency.

Conclusions/Discussion
The system accurately tracked swimmers in real-time and determined when they submerged or resurfaced. It monitored the duration that a swimmer was underwater and generated an alert if too long a time elapsed without the swimmer resurfacing.

Summary Statement
A computer system was developed to detect when swimmers are underwater and possibly drowning.

Help Received
father, uncle, and cousin provided advice on Python programming and suggested some ideas to try

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Atul Jalan

Project Number

J1407

Project Title

Constructing an Adaptive Blackjack Computer Program to Self-Improve Itself Based on Previous Performance

Abstract

Objectives/Goals

A major challenge in programming is building a program that is adaptive and can make decisions that can mimic human behavior. Many programs are written on pure conditions and have the same output every time. The limiting factor is having to have humans intervene every time in order to get the correct response from the program, but having a program that can mimic this behavior on its own could minimize human intervention, maximizing productivity. This experiment aims to construct a program that is adaptive and improves itself based on the outcome of its previous decisions. This means that it will be able to actively monitor what it is doing and the how it is getting there in order to conciously change that in order to increase its performance.

Methods/Materials

The medium used is a card game called Blackjack. Two AIs play 10000 games of Blackjack against each other with one having a slew of code that will allow it to monitor its performance in order to improve itself. In order to isolate the variable which will be possessing this adaptive function, 5000 games will be played with both AIs using the same prefixed strategy. Another 5000 games will then be played with both AIs beginning with the same strategy, but one will have the adaptive function in order to change itself in order to improve over time.

Results

Results show that the AI with the self improving function experiences a trend in which it starts to win the games of Blackjack more often as it adapts itself in order to mimic human behavior. When it has the self-improving code, it goes from about 50% of wins to 64% of wins by the end, while when it does not have it, it stays stagnant right below 50%.

Conclusions/Discussion

These results show that it is possible to create an adaptive program and actually shows that this can be applied universally in order to maximize efficiency in all aspects of human life such as industrially, medically, and to create future technologies having major benefits in areas like education. This technology makes it possible to create educational models that check how a student is learning in order to change how it teaches that student, or use it to make devices that slowly adapt to the users needs and wants. Either way, this technology has vast benefits and can be used by all of humanity.

Summary Statement

Using the java programming language to develop an adaptive program that will monitor how it works and the different techniques it uses in order to adapt itself to get rid of these inefficiencies.

Help Received

No help was received.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Aadarsh Jha

Project Number
J1408

Project Title
Evaluation of the Stronger Data Encryption Type for Secured Communication

Abstract

Objectives/Goals
The goal of this project is to evaluate the most secure data encryption technique.

Methods/Materials
I developed three separate encryption software programs using the Python programming language. I conducted three separate focus group experiments with the same ten volunteers. Each participant was assigned to make an educational guess of the original message in each of the three encryption programs. It was a timed experiment to measure the time it took to decipher/guess the original encrypted message. My independent variable was the time it took to decipher the encrypted message. My dependent variable was the encryption strength level.

Results
Based on the data collected during the experiment, I found that encryption software using method number two took the most time to decipher/guess. Additionally, it took between one and four minutes for volunteers to decipher the encrypted message. I had expected it to take much longer.

Conclusions/Discussion
One major result from my experiment, that I find surprising, is how encryption software using method number two had taken the longest. Since I had not predicted this, and instead predicted encryption method number three to be the strongest, I disproved my hypothesis. If I were to do this project again, I would make sure to make software using more advanced encryption methods such as using randomization techniques to make it harder to decipher/guess using the past patterns and knowledge. Also, for more complete and reliable data, I would have recruited more volunteers in my focus groups, with a broader age group.

Summary Statement
The goal of this project is to evaluate the most secure data encryption technique.

Help Received
My father had helped me review my documents, and made corrections. I had also received help setting up my board.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Patrick D. Kao

Project Number

J1409

Project Title

Creating a Space Flight Simulator Program

Abstract

Objectives/Goals

I wrote a real-time, 3D, interactive space flight simulator program. The biggest challenge was predicting the trajectory of a spacecraft. An existing simulator, Kerbal Space Program, uses "Patched Conic Approximation" to predict the trajectory of a spacecraft. Although Patched Conic Approximation is accurate for two bodies, it uses heuristics to handle three or more bodies. I wanted to see if numerical integration could accurately solve the general n-body problem with efficiency sufficient for a real-time simulator.

Methods/Materials

I wrote programs using Java, JavaFX 8 and JInput. I experimented with two different integration methods: Forward Euler and Trapezoidal. I also tried two methods for determining the length of the time increment: fixed and variable. The results of these experiments allowed me to optimize the performance of numerical integration. Then, I ran experiments comparing the accuracy of numerical integration against Patched Conic Approximation.

Results

My first two experiments revealed that Trapezoidal is 12 times more efficient than Forward Euler, and variable time increments are 1,260 times more efficient than fixed ones. My optimized algorithm can compute a trajectory in 6 ms. My final experiment revealed that numerical integration can handle more general n-body configurations with significantly greater accuracy than Patched Conic Approximation.

Conclusions/Discussion

I conclude that numerical integration is superior to Patched Conic Approximation. Numerical integration is efficient enough for a real-time simulator and can duplicate the accuracy of Patched Conic Approximation for two bodies. It is also more accurate for more general scenarios; it can handle thrust and model three or more bodies.

Summary Statement

I wanted to see if Numerical Integration is better than Patched Conic Approximation for computing spacecraft trajectories in a real-time, interactive space flight simulator.

Help Received

My Dad knew that numerical integration can be used to solve circuit equations and suggested I try using it to solve the laws of motion.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Andrew J. Kim

Project Number
J1410

Project Title
Solar Trackers in Motion

Abstract

Objectives/Goals
To demonstrate a system that can constantly create a 90º angle of incidence on a solar panel attached to a moving object. We will demonstrate this system by building a robot using Lego NXT and program it using LabVIEW. Together, they will demonstrate a way to track the sun while moving.

Methods/Materials
Design a robot that can move in all three dimensions (Put that can spin vertically on top of a motor that spins horizontally). Test and see if your robot is stable and strong, if not, add beams or make the base wider to make it so. Open LabVIEW on your computer. Take your robot and plug it in to your computer with the USB cable. Get the Solar Elevation and Azimuth on LabVIEW using the GPS sensor. Use the solar elevation to move the vertical motor. Take the difference from the Azimuth and the compass reading to move the horizontal motor, this will move the solar panel so that it faces the sun even if it is not facing North. This program will allow your robot to track the sun from any position.

NXT brain NXT building kit 2 motors AA batteries (You may need a lot, one NXT brain needs 6 AAs and they drain pretty fast) Dexter Industries GPS sensor for NXT NXT compass sensor (2 if your plan on making it move) 1 60 volt solar panel A roll of tape (masking, scotch, or duct) A computer with LabVIEW (preferably laptop) An area with view to the sun A calculator Lots of paper Pencil and eraser

Conclusions/Discussion
I was unable to finish the last and key part of the experiment, which was to have the robot track the sun whilst moving. The robot did track the sun, but it was unable to do so while on the move. I had failed to consider how challenging it would be to find the correct equation to find the solar elevation. Most of the websites which I believed to have the formula were wrong. The first constantly gave a negative number that was nowhere close to where the sun was in the sky. One gave odd numbers that were tens of degrees off. Only on the third try did I find the real equation for solar elevation, which is given in the research section of this report. After finding the formula, I was able to make a robot that track the sun from any position. However, I encountered some problems when I tried to make this program run continuously. The program needs to run continuously for the robot to be able to track the sun while on the move.

Summary Statement
Developing a program that will maximize the power output of a solar panel by tracking the sun using a GPS and a digital compass.

Help Received
Father helped decipher formula from a website. Mother helped to glue/tape the board.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Naren G. Kolli

Project Number
J1411

Project Title
The Effect of Natural English on Commanding Robots

Abstract

Objectives/Goals
The problem to be solved is the difficulty of programming. As new technologies arise, it is becoming harder for the general population to program, as there is a learning curve. I aim to solve this problem by writing a program enabling a user to program a Mindstorms NXT robot using English commands.

Methods/Materials
Materials for the project can be divided into mechanical and virtual materials. The mechanical materials included the Mindstorms NXT robotics set and a Dell laptop with Windows 7. Digital materials software packages had to be installed: NXT-G, Bricx CC, Easy-Gui, and Python software.
To create the program, I first sketched frameworks. Then I created a graphically based program that would translate English commands to executable code. After many tests, the prototype was complete, analyzing 126 keywords. Testing the prototype, I looked to see if it interpreted the command correctly, and looked to see if the command was translated to Bricx, and then to NXT. I also looked for kinks in the program, and how to make it faster or more intuitive. The prototype was tested 15 times for each factor. For testing intuitiveness I brought programming novices to test the program. The program was redesigned three times, before it was released. Qualitative measures were taken to see if the commands were analyzed correctly.

Results
From testing the prototype it was found that the Hermes program translated English commands into NXT code. When the prototype was created, all 126 keywords were tested and they all passed the tests. After redesigning the program, the software was more user friendly, simplifying programming. Another main result found was that if two different commands relatively meaning the same action were entered, the program would execute the commands the same, because of the framework mentioned before.

Conclusions/Discussion
In conclusion, the Hermes Program prototype simplified programming and translated English commands to NXT code. The program also met every design goal, by having an intuitive interface. The simplifying of programming could bring robots into a practical use at home, and bring more people into STEM fields.

Summary Statement
This project aims to simplify programming by translating natural English commands to executable code.

Help Received
Ms. Andrea Thomaz from Georgia Tech mentored me on the user experience and intuitiveness of the program. My father taught me basic programming, and my mother helped me create the display board.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Joao M. McGuire; Brandon Paisant

Project Number

J1412

Project Title

How Fast Is Your Computer? The Benchmarking Process

Abstract

Objectives/Goals

Our objective is to test and explore how our benchmarking software, SiSoftware Sandra, tests the software and hardware of our 6 PCs.

HYPOTHESIS:

We predict that the desktop with the greatest processing power, energy input, and fan size will perform the best in our benchmarking procedure. That desktop would be the HP Touchsmart. We do not think a laptop will "win" the test.

Methods/Materials

LAPTOPS:

HP Pavilion g6 Notebook PC, Dell Latitude E6430, HP ENVY Slimbook 6 1100 PC, Acer Aspire E1-572

DESKTOPS:

HP TouchSmart 520 PC	Compaq Presario Desktop PC
Model:	Model:
520-1145t	CQ5700F

OTHER:

SiSoftware Sandra (One copy for each Computer must be downloaded)

Google Docs and/or notebook for recording and sharing results, making graphs.

EXPERIMENT:

Run all benchmarks on all computers, wait for 1-2 hours each device for process to finish. Read and record data, compare, simplify, graph, present.

Results

We did test how our benchmarking software, SiSoftware Sandra, handles and uses the hardware and software of the device to find its actual performance, but, our beginning hypothesis was incorrect. We had thought that one of the desktops would perform a lot better than the rest, but in fact a laptop did and a desktop performed the worst.

Conclusions/Discussion

Through our experiment we had reached our objective, but, the results disproved our hypothesis and our results were actually the complete opposite of what we had initially thought. We now know that the benchmarking process can find the efficiencies of these computers, and we know they do this by running one and/or multiple parts of the device to see how they perform jobs together and alone.

Summary Statement

This project uses the benchmarking process to explore the speed, power, and capasiy of 6 different models of PC.

Help Received

Father looked over writing for grammatical/spelling errors; Mother provided board construction materials; Willing volunteers provided 6 computers to test; Dr. Whitaker aided in finding correct benchmarking software.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Simon V. Montrose

Project Number
J1413

Project Title
Speedsolving a Rubik's Cube: Which Algorithms First?

Abstract

Objectives/Goals
Certain algorithms for orienting and permuting the unsolved portion of a Rubik#s Cube will come up more frequently than others, and learning those will decrease my average solve time.

Methods/Materials
I scrambled the cube using computer-generated software. I solved the first two layers of the cube, stopped, and recorded the algorithm(s) I would use to solve the last layer of the cube in a spreadsheet. I then solved the last layer of the cube. I repeated this process 9 more times per weekday for 10 weeks, for a total of 500 solves. Every weekend, I did 10 speedsolves and calculated my average solve time.

Results
Yes, some algorithms are used more frequently, and learning those did decrease my average solve time by approximately 10 seconds, or about 33%.

Conclusions/Discussion
While my results did support my hypothesis, two other complications arose during the testing period. The first is a tendency towards what I would call personal bias, or unconsciously looking for certain patterns first during a typical solve. The other issue is, obviously, that doing 500+ solves over 10 weeks definitely decreased my average time in and of itself.

Summary Statement
Using pattern recognition and algorithms to decrease my solve time on a Rubik's Cube

Help Received
Mother helped record timed solves into spreadsheet

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Anish Muthali

Project Number
J1414

Project Title
The Minotaur of the Labyrinth

Abstract

Objectives/Goals
The objective of this project is to find the most efficient maze solving algorithm among Random Mouse Algorithm, Right Side Rule Algorithm, and Tremaux#s Algorithm for a variety of endpoints on a maze with a fixed design. The hypotheses state that Random Mouse Algorithm will never solve the maze, Right Side Rule Algorithm will always lead the maze runner to the endpoint of the maze, and Tremaux#s Algorithm will take the most time to complete the maze.

Methods/Materials
For this project, a LEGO Mindstorms NXT robot is the maze runner, a thick mat is the base for the maze, and Styrofoam sheets are the walls. A laptop with the Mindstorms NXT GUI programming interface installed on it is used to program the different algorithms for the robot. Green and red sheet of paper is used to mark the entrance/starting point and the exit/endpoint respectively.

Results
On average, Tremaux#s Algorithm took the shortest time to traverse the maze. Right Side Rule was 35% slower and Random Mouse Algorithm was 40% slower compared to Tremaux#s Algorithm. Right Side Rule Algorithm took the least time when the endpoint was towards the right side of the maze. Maze solving time for Random Mouse Algorithm varied significantly over the many trials.

Conclusions/Discussion
The results did not support all hypotheses. The hypothesis that Right Side Rule Algorithm would always solve the maze was correct, but the hypothesis that Tremaux#s Algorithm would take the longest time to solve the maze was incorrect and the one that Random Mouse would never solve the maze was also incorrect. This project attained the objective of finding the most efficient maze solving algorithm which turned out to be Tremaux#s Algorithm. Earlier, in the history of mazes, people used these algorithms to solve a maze not knowing which algorithm was most efficient for their situation. This project has provided useful insights in the quest for such maze solving situations. The knowledge gained from this project could be applied to search and rescue missions where engineers could design a robot to traverse maze-like structures in inhospitable circumstances.

Summary Statement
The quest for the most efficient maze solving algorithm

Help Received
Dad helped in debugging compile error messages; Mom helped with providing materials for the maze; Science teacher helped with suggestions on test scenarios.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Karthik Ramachandran

Project Number

J1415

Project Title

Tag Your Meds: Reduce Accidental Drug Overdose Using NFC Tags

Abstract

Objectives/Goals

In 2010, accidental drug overdoses led to over 2 million visits to the ER and 30,000 deaths. According to the Centers for Disease Control, more Americans die each year from drug overdose than from traffic accidents or firearms. I devised a solution to reduce the occurrence of accidental drug overdose by tracking medicine consumption using Near-Field-Communication (NFC) tags and Android smartphones.

Methods/Materials

I encoded NFC tags with information about the medicine and attached the tags to the medicine labels. I then developed an Android smartphone application that reads the information in the NFC tag to track medicine intake and warn users about potential overdose. Users tap their smartphone against the medicine label before consuming the drug. To validate my app, I conducted 2 phases of tests with 24 adult participants. Phase 1 was a usability test for my app and NFC technology. In Phase 2, participants performed 4 tests # 2 manually, and 2 with my smartphone application. All tests were simulations and no medicines were actually ingested. In Tests 1 and 2, I asked participants to select medicines and record their selection manually on paper. In Tests 3 and 4, participants tracked their consumption with my smartphone app. In Tests 2 and 4, participants were asked to consume 2 medicines with acetaminophen to see how many would detect the potential overdose. At the end of the test, the subjects were asked for their feedback on this experience.

Results

The tracking accuracy using the manual method was 94%, while the accuracy using my solution was 100%. In Test #2, where participants selected medicines manually, only 12% of the users detected the overdose. In Test #4, the app warned participants about a possible drug overdose and 82% of participants correctly chose to not consume the medicine. My solution reduced the occurrence of accidental overdose by 70%. All participants reported feeling more confident knowing that their medicine intake was being monitored.

Conclusions/Discussion

These results, along with feedback from participants and pharmacists prove that my application is feasible and has tangible real world benefits to patients and their caregivers. In future versions, the app can be integrated with medical databases for up-to-date drug advisories and can be extended to accurately track patient participation in drug trials.

Summary Statement

My project explores the possibility of using technology to improve tracking of medicine consumption and reduce the occurrence of accidental overdose.

Help Received

Science teacher, Mrs. Nguyen, guided me; Parents helped gather test subjects and materials; Test subjects who participated; Pharmacists provided feedback

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Manaal A. Sayed

Project Number

J1416

Project Title

Ethical Hacking: Invisible Sharks in Cyberspace

Abstract

Objectives/Goals

It only takes one lost email or online banking password, or one hacked Facebook account to turn your world upside down. The average consumer does not realize the fact that persons with a malevolent intent can access everyday consumer personal information using a Man-in-the-Middle (MITM) attack. This attack is oblivious to the victim. My hypothesis is that an attacker can not only obtain usernames and passwords from a regular HTTP website accessed over a public Wi-Fi network, but an attacker can also take advantage of the insecure way in which SSL is implemented in HTTPS websites.

My objective is to not only make people aware of the dangers that exist at public Wi-Fi networks, but also to make people aware that Secure Socket Layer (SSL) - one of the world#s standard forms of commercial encryption - is not a complete solution to the problem.

Methods/Materials

In order to test my hypothesis, I simulated the environment of a public Wi-Fi network using a wireless router. I connected a workstation as an attacker, along with another windows laptop, an iPad, and a windows tablet as victims, to the wireless router. From the attacker machine, I initiated a sniff attack on the network. From each victim device, I was able to access several regular HTTP and SSL encrypted HTTPS websites using different browsers.

The experiment was based around a man-in-the-middle attack, where the system attempted to sniff and obtain data from insecure and secure websites. The attacker used software, such as Cain and Abel, Wireshark and SSL Strip to compromise the information sent between the user and the supposedly secure webpage.

Results

The attacker was able to retrieve the passwords from all the regular, insecure websites using HTTP. I was also able to obtain data from the SSL encrypted websites, such as PayPal, Gmail, Yahoo, and Facebook, including credit card numbers and control of several email accounts.

Conclusions/Discussion

Based on my results, I conclude that user passwords are not secure over a public Wi-Fi. There is a real and tangible threat to HTTP and HTTPS websites from attackers. There are several highly probable solutions, which will require additional testing by internet security companies in order to prove their validity in today's environment.

Summary Statement

This experiment was conducted to determine the vulnerabilities of obtaining personal user data at a public Wi-Fi network using secure and insecure channels, and the probable solutions to these problems.

Help Received

I was helped by Mr. Charles Pascal - Amateur Radio Group Chairman at California Yacht Club - to understand and simulate public wireless networks.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Brooke Schwind

Project Number

J1417

Project Title

Game On: Creating a Worthy Connect Four Opponent with Heuristic Algorithms

Abstract

Objectives/Goals

The objective was to design a computer program to model the game of Connect Four and to sometimes win against average human beings using defensive, offensive, and look ahead algorithms.

Methods/Materials

Four algorithms to play Connect Four against a human player were constructed using JavaScript: random, defensive, aggressive, and look ahead. The random algorithm placed pieces randomly on the board compared to the more strategic defensive algorithm that placed pieces using heuristic scoring to block the human opponent. The aggressive algorithm combined both defensive and offensive strategies, also using a heuristic scoring system. The look ahead algorithm built upon the aggressive algorithm by simulating one opponent move ahead on the game board and scoring the possible moves accordingly. The algorithms were tested against a variety of human subjects to find average success rates for the algorithms.

Results

The look ahead algorithm was the most successful of the four algorithms in trials against human opponents.

Conclusions/Discussion

Heuristic algorithms like these could be worthy opponents because their success rates are comparable to human players themselves. These are usable algorithms to create an engaging game play experience for a wide variety of practical applications.

Summary Statement

I designed a computer program to model the game of Connect Four and to be a worthy opponent against humans using several heuristic algorithms.

Help Received

Father helped understand and learn JavaScript language and debugging

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Patrick I. Wildenhain

Project Number
J1418

Project Title
Resurrecting the Thylacine to Save the Tasmanian Devil: An Ecological Exploration with an Agent Based Model

Abstract

Objectives/Goals
The objective is to develop the code to simulate the environment of the Tasmanian devil, including the devil facial tumor disease, and to add Thylacines into that simulated environment. It is hoped that the program will accurately simulate the Tasmanian Devil's environment, and that the Thylacines reduce disease prevalence and let the Tasmanian devil's survive. The effect of changing the number of Thylacines added will be observed.

Methods/Materials
A computer was used for the coding and running of this experiment. The program used for the creation and running of this experiment was Starlogo TNG. The program would generate 850 Tasmanian devils and a set number of Thylacines, then infect a number of the Tasmanian devils. It would then run until the last devil had died or when the disease had been eradicated and there were 50 devils alive. Then Starlogo TNG would export a log of the numbers of infected, incubating and healthy Devils.

Results
With 10, 25 or 50 Thylacines, the simulations did not survive as many times as with the control number of 0 Thylacines. Of the 30 runs done with no Thylacines, in three of the runs the Devils survived. Of the 30 runs done with 10 Thylacines, in two of the runs the Devils survived. Of the 30 runs done with 25 Thylacines and the 30 runs with 50, none of the runs had the Tasmanian devils successfully survive. However, the simulations with an addition of 10 Thylacines survived for a longer average time than any other runs. Also, the more Thylacines added the faster the disease was exterminated.

Conclusions/Discussion
The addition of Thylacines eradicated the disease of the Tasmanian devil populations faster than without. However, they also hunted the remainder of the Devil populations, stopping the Devils from recovering after the disease. The Thylacines killed too many healthy Devils along with the infected Devils, therefore human culling of infected Devils may be a more effective solution to saving the Tasmanian devils, as it will kill no healthy Devils.

Summary Statement
This project involved creating a Starlogo TNG model to simulate the environment of the Tasmanian devil and to add in the Thylacine.

Help Received
Parent helped with discussing the design of the project.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Eric J. Wilson

Project Number
J1419

Project Title
Balancing Diversity and Fitness while Evolving Neural Networks

Abstract

Objectives/Goals

BACKGROUND: Evolutionary algorithms (or EAs) are used by engineers to optimize and improve designs with many input variables. A population of simulated designs (called creatures) compete to survive in the computer. Better creature reproduce and worst creatures die, and over many generations better and better designs emerge. There have been many success stories, but also problems. It is difficult to set the many parameters involved, and the populations can become too uniform with too little diversity.

OBJECTIVE: The objective was to test a new method for controlling diversity. The method is having all but the best fit creature spontaneously mutate every generation and controlling the "turnover rate" of the population; the "turnover rate" being the number of offspring from the best fit creature that replaces the same number of worst fit creatures every generation, divided by the population size. Lower turnover should lead to more diversity because the creatures have more time to mutate away from the current best fit creature. This should work better for bumpy fitness functions.

Methods/Materials

I used an open source package called PERC to evolve two neural network functions; (1) an analog exclusive OR gate with a bumpy fitness function and (2) a robot controller with a smoother fitness function. I tested population turnover rates between 0.39% and 100% for the analog exclusive OR gate, and between 1.56% and 100% for the robot controller. I did 50 trials for each turnover rate and recorded the best fitness for each trial. For each neural network I graphed the average evolved fitness as a function of turnover rate.

Results

The results support my hypothesis. The optimal turnover rate for the XOR gate with a bumpy fitness function was between 0.8% and 3.1% whereas the best turnover rate for the robot controller with a smoother fitness function was between 12.5% and 25%.

Conclusions/Discussion

Having all but the current best fit creature spontaneous mutate every generation and controlling the turnover rate of the population is a great way to control diversity while evolving neural networks.

Summary Statement

I studied evolutionary algorithms and the problem of too little diversity in the population; then proposed and tested a method for controlling diversity while evolving neural networks.

Help Received

Many open source packages are available to do EA. I wrote a simple one (see binder) but my father wrote the program (PERC) I used in my experiments. My science teacher Mrs.Miller, my father, and Dr. Edgar Reehuis helped me find good articles on EA. My father helped me layout the display board.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Michelle C. Xu

Project Number
J1420

Project Title
A Mathematical Model of Leaf Counting for Carbon Sequestration

Abstract

Objectives/Goals
I started my project in order to create a method to count the number of leaves on a tree. I believe that by combining Leonardo da Vinci tree rule with Fibonacci numbers into one mathematical model (DV+F), I can reliably estimate the number of leaves a tree has, which would be more accurate than the Crown Size model based on well-established Leaf Area Index (LAI_Cs).

Methods/Materials
Materials: a Vernier, measuring tape, a ladder, and a computer;
Major steps to investigate are:
1. Manually count the total number of leaves on a few small trees
2. Obtain model required parameters (DV+F and LAI_Cs) with repeated measurements on the selected small trees
3. Compare model calculated leaf count to the manual counts. Check if DV+F model is better than LAI_Cs model
4. For manually uncountable (large) trees, use computer simulation to validate my DV+F model

Results
The comparison between the two methods, my DV+F model and LAI based Crown Size model, shows that the leaf count derived from my DV+F model is much closer to the actual leaf count, which represents the better estimation.

Conclusions/Discussion
My DV+F model provides a new way to estimate the number of leaves on trees. The comparison between my DV+F model and the well-established LAI based Crown Size model shows that my DV+F model is much more reliable and accurate. With such a better leaf counting method, tree studies on carbon sequestration can be done more accurately.

Summary Statement
To create a method to count the number of leaves on a tree

Help Received
Mr. Ireland helped answer questions; Parents guided me with C programming and helped with project display assembly.