



CALIFORNIA STATE SCIENCE FAIR 2008 PROJECT SUMMARY

Name(s) Kunal Agarwal	Project Number S1301
Project Title Making Plastic Stronger: Innovating Credit Card Security	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objective of Project Zier is the design and construction of a new security system to prevent identity theft and credit card fraud by employing a dynamic credit card system guarded by an accurate fingerprint verification process, timestamped card number and a SMS verification process.</p> <p>Methods/Materials Materials used during the creation of this project include the Futronic FS80, one laptop, and one desktop. Exact specifications of the computers are arbitrary as it scarcely affects the project's running. This project employs IBM Cloudscape SQL database and Griaule Fingerprint SDK. All code was created on Sun JDK 1.6 in the Eclipse Java IDE running on both Windows and Ubuntu platforms. All of this software and hardware is required. The timestamp mechanism utilizes MD5 technology to properly crypt the raw timestamped serial.</p> <p>Results The program Zier was successful in providing safer transactions compared to that of a standard verification. After thorough testing and trying to break the fingerprint verification, SMS verification, and the timestamped hash, there were no weaknesses that could be found in the system. The fingerprint algorithm holds the lowest false acceptance rate in the world and has won an award for its ingenuity. The only possible way of breaking the system to make unverified purchases in any scenario with Zier is to gain access to the card's owner, most likely under duress. Another way to exploit the system would be to inject packets into network streams to and from the station. This has not yet been tested, but a simple encryption mechanism can be added on later to deter any possible break-ins.</p> <p>Conclusions/Discussion After thorough development and execution it is clear that the Zier is a robust security system that can't be broken into unless the secure servers housed by the bank are compromised in which case there would be very little point of security on anything as attackers would have free reign on all sorts of accounts and funds. In an ideal scenario the Zier would be able to generate a hash on call and an e-paper type interface would display the hash to speed up the process of timestamp generation. Nevertheless, the basics of the system in place would be unaltered with some basic modifications and the introduction of a more intuitive GUI.</p>	
Summary Statement Project Zier is the foundation of a brand new credit card security system that deters fraud by incorporating dynamic credit card numbers, biometrics, and cellular text notification.	
Help Received	



**CALIFORNIA STATE SCIENCE FAIR
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Name(s) Emil J. Barkovich	Project Number S1302
Project Title What Really Makes a Hitter's Ballpark? An Analysis of the Effect of Field Area on Baseball Offensive Statistics	
Abstract Objectives/Goals This project was designed to look for a correlation between the area of the fair and foul territory and individual offensive statistics (specifically hits, batting average, singles, doubles, triples, home runs, and slugging percentage) produced in major league ballparks. Methods/Materials Because square footage values are not readily available, satellite photos were used and the areas were determined using Adobe Photoshop. However, due to difficulties in finding accurate satellite photos, (fields obscured by shadows and domes, out-of-date photos, and out-of-proportion photos) only 22 out of the 30 major league ballparks could be measured. Results Singles and triples had a strong positive correlation with fair territory; small negative correlations were found with doubles and home runs. Foul territory had significant negative correlations with batting average, hits, and doubles and a significant positive correlation with triples. Conclusions/Discussion Overall, the study found offensive statistics are affected by field area, but not as strongly as suspected.	
Summary Statement How differing field areas affect baseball offensive statistics	
Help Received I received computer help from my brothers and help from my father concerning methods of statistical analysis.	



**CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY**

Name(s) Ryan P. Batterman	Project Number S1303
Project Title The Effects of Alpha-Beta Pruning on the Playing Strength of a Chess Playing Algorithm	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals This project investigates improved computer algorithms to find good chess moves and limit the time spent examining poor moves, more specifically, an algorithm called alpha-beta pruning.</p> <p>It was believed that alpha-beta pruning would improve the playing strength of the algorithm due to its ability to cut-off nodes that could be assumed to be bad. The algorithm would then be able to spend more time analyzing more important chess boards. Therefore, playing strength should improve.</p> <p>Methods/Materials An original chess playing algorithm (min-max search) was modified so that it pruned certain nodes from the game tree that could be assumed to be bad. Both of these algorithms were created in Visual Basic 6. After this modification was completed, the enhanced alpha-beta pruning algorithm and the original min-max algorithm were played against another chess playing algorithm on different levels of difficulty, and humans of varying playing strengths on an online chess site, FICS; all games were completed on the same computer.</p> <p>Results The algorithm with alpha-beta pruning was able to defeat multiple opponents that the original algorithm had lost to.</p> <p>Conclusions/Discussion It was concluded that the algorithm with alpha-beta pruning played significantly better than the original algorithm due to its ability to analyze boards to an extra depth. Future research should be done to determine the effects of other modifications on chess algorithms (such as an endgame database) on the playing strength of a chess playing algorithm.</p>	
Summary Statement This project investigates improved computer algorithms to find good chess moves and limit the time spent examining poor moves.	
Help Received	



**CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY**

Name(s) Benjamin I. Filippenko	Project Number S1304
Project Title Determining the Optimal Iterated Prisoner's Dilemma Strategy	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The goal of the project was to determine, through computer simulation, which strategy performed best on average against all other strategies in the Iterated Prisoner's Dilemma. The Prisoner's Dilemma is a classic situation that illustrates the main points of Game Theory, a recently developed branch of mathematics.</p> <p>Methods/Materials There were seven strategies tested including Random, Cooperate, Defect, Unforgiving, Perfect Memory, Tit for Tat, and Tit for Two Tats. Each strategy employed a different method of choosing when to defect or cooperate based on its own mechanics and the previous actions of its opponent. Depending on its action and its opponent's action, each node scored a certain number of points. The goal was to get the most points on average. Each test consisted of two nodes in the virtual playing field interacting with each other. A node of each strategy played against a node of every strategy, including itself. Each trial ran for 20,000 time steps, or ticks. During this amount of time, the two nodes interacted thousands of times. After each trial, the average score for each node was recorded in the data table. For all seven strategies to interact with each other, a total of twenty-eight trials were required. Each trial was performed three times.</p> <p>Results On average, the Perfect Memory strategy performed most optimally. As can be seen in Table 4, it had an average score of 2.637127245. Following Perfect Memory in order of highest to lowest average score came Tit for Tat with 2.568127949, Unforgiving with 2.428539477, Tit for Two Tats with 2.319091081, Cooperate with 2.098350741, Random with 1.948382486, and Defect with 1.850758917. All strategies except for Random had an average deviation of less than 2%.</p> <p>Conclusions/Discussion The hypothesis was supported and the Perfect Memory strategy was the most optimal. The reason for this may have been that Perfect Memory was equipped with the ability to detect an opponent's strategy and counter it accordingly. It had an average score of 2.637127245. The least optimal strategy was defect with an average score of 1.850758917. The percent deviations for all data were relatively low. This allowed the conclusion to be made that the data was significant and Perfect Memory was truly the most optimal strategy.</p>	
Summary Statement Using computer simulation to test many proposed strategies for the Prisoner's Dilemma, a cornerstone of Game Theory, against one another.	
Help Received	



**CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY**

Name(s) Casey L. Fu	Project Number S1305
Project Title The Efficiency of Prime-Testing Algorithms	
Abstract Objectives/Goals The purpose of this project is to determine the most efficient prime-testing algorithm from a widely used algorithm (control) and four algorithms I developed. The algorithms include: 1. dividing by odd numbers less than or equal to the square root of the number being tested (control) 2. applying divisibility rules 3. dividing by odd numbers less than or equal to the square root of the number tested that are not multiples of 5 4. dividing by odd numbers less than or equal to the square root of the number tested that are not multiples of 3 5. dividing by odd numbers less than or equal to the square root of the number tested that are not multiples of 3 or 5 Methods/Materials A Java program that applies all of the five algorithms was written. The program takes an entered number and then determines and displays the next five prime numbers along with the time taken to do the calculations for each algorithm. Five numbers, randomly selected with a unit#s digit of 1, 3, 7, or 9 for each number length of twelve to nineteen digits, were entered in the program to be run by all five algorithms. Results Algorithm #5, which skips divisors that are multiples of 3 or 5, was the fastest and about 1.9 times as fast as the control. The second fastest was algorithm #4 (skipping multiples of 3), 1.5 times as fast as the control, followed by algorithm #3 (skipping multiples of 5), 1.3 times as fast as the control, and algorithm #2 (applying divisibility rules), 1.1 times as fast as the control. Conclusions/Discussion I hypothesized that the fastest algorithm was #2 (applying divisibility rules). My hypothesis was not supported because #2 turned out to be the second slowest. This is because it requires more calculations in each dividing step. The most efficient algorithm was #5, which indicates that by skipping divisors that are multiples of 3 or 5, the time for prime testing can be saved by about 47%. For further investigation, I will test a new algorithm that skips multiples of 3, 5, and 7 to see how much it improves the prime-testing efficiency.	
Summary Statement The goal of this project was to determine the most efficient prime-testing algorithm from a widely used algorithm and four that I created, and the most efficient algorithm was algorithm #5 (skipping divisors that are multiples of 3 or 5).	
Help Received Math teachers Mrs. Herrington and Mrs. Brown gave advice on how to improve my report. Mother taught some Java concepts.	



CALIFORNIA STATE SCIENCE FAIR 2008 PROJECT SUMMARY

Name(s) Dhruv R. Garg	Project Number S1306
Project Title Real-time Feedback Modules to Enhance User Learning in Surgical Simulation	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objective of a surgical simulation is to a) Simulate as precisely as possible a real surgical procedure b) Gauge user performance based on a set of metrics c) Augment user learning through accurate and intelligent feedback Advancements in (a) and (b) suggest that surgical simulators today are viewed more as a practicing tool for those already familiar with surgical procedure complexities, than a teaching tool in which a user, new to a procedure, can learn that procedure from scratch. Progress in (c) has been confined to basic textual and visual feedback, both of which are not utilized as instructional tools but as directional ones. Their remains an untapped potential for surgical simulators to teach novice surgeons and medical students the intricacies of surgical procedures rather than merely provide a platform to practice.</p> <p>Methods/Materials This 12-month research study focuses on the innovative design and construction of three unique and open-source feedback modules: step-by-step monitoring system, audio-assisted commands, and an intelligent video assessment system, whose main focus is to augment the user learning of a specific surgical procedure. The workflow monitoring system aims to break down a complex procedure into a dynamic chart of easy-to-follow steps that the user can comprehend. Audio-assisted commands aim to communicate and convey procedural information with the user, ingraining the contents of the procedure in their mind. Lastly, the video assessment system intends to replay the users action accurately and intelligently pinpoint areas that need improvement.</p> <p>Results Formative research on a working prototype have validated a positive combinatorial of feedback configurations on end user performance and learning. The metrics measured include time, path length, size of operating site, number of errors, and error recognition time; an improvement of 22.2%, 90.3%, 13.7%, 58.3%, and 37.6% was observed in these metrics, respectively.</p> <p>Conclusions/Discussion In the future, my plan is to license these open-source feedback modules as additional features to commercial simulators in the market today. The prototype is highly versatile and can also be leveraged across a multitude of surgical procedures as well as other industries. Several components of the prototype have also been proposed to be patented.</p>	
Summary Statement The design and implementation of three unique real-time feedback modules to enhance user learning and foster a "teaching" environment in virtual reality surgical simulators.	
Help Received I conducted the research and used lab equipment at Stanford University School of Medicine under the supervision of Dr. LeRoy Heinrichs, MD, PhD, who was my mentor for the project.	



**CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY**

Name(s) Azhia C. Haga	Project Number S1307
Project Title Oh, The Places You'll Go: A Statistical Analysis of the Traveling Salesman Problem	
Abstract Objectives/Goals To determine the cheapest route when flying between five cities. Methods/Materials Using Internet Explorer and the website Expedia.com, five cities were selected. A calendar provided dates of travel with one business day stop-over at each city. I then used the Brute Force Method to determine if a pattern existed. Pricing data was collected for each location and a tree diagram was used to interpret the information. Results No definite pattern emerged. In seven out of ten trials, one route proved to be the cheapest. While four out of ten trials showed another was cheaper. Conclusions/Discussion Although no definite pattern emerged, traveling in a circular pattern between cities resulted in lower prices.	
Summary Statement Without using the Brute Force Method, there is no distinct pattern to find the cheapest route between five cities.	
Help Received Dad helped create mechanism for keeping boards together.	



**CALIFORNIA STATE SCIENCE FAIR
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Name(s) Allison D. Hall	Project Number S1308
Project Title JavaScript Sudoku Corrector	
Abstract Objectives/Goals To find out how fast a JavaScript Sudoku Corrector program that I have handwritten works on Mozilla Firefox, Internet Explorer, PCs, and laptops. Also, to find out which combination of computer and internet source works the fastest. Methods/Materials Test 10 puzzles with 9 mistakes each from 3 different level categories and time how long the program takes to work when each wrong number is entered. Results I found that the program was faster on the PC and on Internet Explorer. Conclusions/Discussion I concluded that PCs are faster than laptops and that certain web programs do go faster than others. Also, there are loopholes in every program.	
Summary Statement Writing JavaScript and how different programs and computers use the program.	
Help Received A Graduate Student at Chapman University helped me simplify my program.	



CALIFORNIA STATE SCIENCE FAIR 2008 PROJECT SUMMARY

Name(s) Haixiang Huang; Sukyeon Jung	Project Number S1309
Project Title Extending Swarm Economic Systems using Agent-Level Adaptation	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Increasing the capacity of the swarm translates to holding the prices of commodities steady for long periods of time using swarms of individual agents while in the presence of agents whose behavior is contrary to this group action. We find that economic swarms with greedy agents can be designed to withstand the effect of these ρrogue agents. We also demonstrate a method of both statically and dynamically increasing the capacity of the swarm.</p> <p>Methods/Materials This study is a computational study of a simulated economic system. We first use the swarm engineering methodology to theoretically examine an economic system. We then utilize a computer simulation to verify our theoretical results.</p> <p>Results We find that prices are stabilized in systems containing consumers which have a high aversion toward purchasing products that generate large vendors' profits or in systems containing consumers which have a long memory of the last lowest price. Rogue agents, those agents that do not have any aversions or memory of past prices. The maximum number of rogue agents that can be in the system is called the capacity of the system. Increasing the effect of the characteristics mentioned above and increase vendor number tends to increase the capacity of the system.</p> <p>Conclusions/Discussion This study extends the previous research by designing examining the effects of rogue agents and behaviors of consumers which tend to absorb the effects of such agents, also the effects of number of vendors and consumers. Increasing the effect of several characteristics of the system tends to increase the capacity of the system and lower stabilized prices. A decrease in the number of vendors tends to result in a more likely unbounded increase in price. We have demonstrated that these types of mergers increases the effect of rogue agents, and with fewer needed for unbounded inflation. While increasing the effects that bring stability to the system will aid in stabilizing the system, beyond the critical number of rogue agents, the system becomes unstable no matter what any of the ρnon-rogue agents do. It has demonstrated how consumers should behave in order to stabilize the price. If consumers are informed about the vendors' profit margins, they can act in a way to stabilize prices. This would seem to be a first step in helping money to regain its function as value determiner without government</p>	
Summary Statement This project extends swarm economic system by examining how swarms of agents can react to rogue agents that are interfering the economic system	
Help Received Dr. K assisted us in theoretical and conceptual issue.	



CALIFORNIA STATE SCIENCE FAIR 2008 PROJECT SUMMARY

Name(s) Rui Jin	Project Number S1310
Project Title Intelligent Irrigation Control System	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals An enormous amount of real-time information that is available on the Internet can be accessed and used in traditional control systems to improve performance. The objective of this project is to design and build an autonomous control system that manages an irrigation system to save water using Internet-obtained weather forecasts and local-obtained rainwater level information.</p> <p>Methods/Materials The control system consists of a computer and a circuit controlled by a microcontroller. In the computer, a Java program developed by the exhibitor downloads XML weather data from the Internet, parses the data to interpret the probabilities of precipitation for the next five days, and sends the precipitation data to the microcontroller through a serial port. An exhibitor-developed BASIC program in the microcontroller then interrupts the irrigation system if rain is predicted within two days. During and after a rain, the control system utilizes a rain sensor to detect the presence of rainwater, and keeps the irrigation interrupted when rainwater is present. To interrupt irrigation, the microcontroller breaks the connection between the irrigation system power supply and the irrigation valves.</p> <p>Results The control system successfully interrupts an irrigation system when one of the following conditions is met: precipitation is predicted within two days based on Internet weather forecasts, or rainwater present during and immediately after a rain is detected by the rain sensor. In arid environments such as San Diego, this control system could save an estimated 8000 gallons of water per year for a 1000 square feet lawn, or 21% of the total water to irrigate the lawn. The water savings from using both weather forecasts and a rain sensor is 53% more than the water savings from using only a rain sensor.</p> <p>Conclusions/Discussion Water conservation is vital in today's world parched by record droughts. Using Internet-obtained weather forecasts as an additional input for an irrigation control system significantly increases the system's performance, saving large amounts of irrigation water. In addition to irrigation control systems, Internet resources may be accessed and used in other applications, such as in traffic light control systems, thermostat control systems, and electrical grid control systems.</p>	
Summary Statement The exhibitor designed and built an autonomous control system that manages an irrigation system to save water using Internet-obtained weather forecasts and local-obtained rainwater level information.	
Help Received None	



**CALIFORNIA STATE SCIENCE FAIR
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Name(s) Ramanan Kandasamy	Project Number S1311
Project Title An Optimization of Dijkstra's Shortest Path Algorithm	
Abstract Objectives/Goals The goal of this project was to optimize path finding around polygonal obstacles in 2-dimensional euclidean space. An increase in performance was achieved by allowing for imperfect paths, but the question was whether the performance increase was enough to justify the loss in accuracy. Methods/Materials The objective was achieved by first converting 2-dimensional maps into abstract node graphs, while preserving data on geometric location. Dijkstra's algorithm was then used on the node graph, but modified to run faster using this extra data. However this optimization changes Dijkstra's Algorithm so that it only finds a path, rather than the shortest path. Results It was found that although factoring in this optimization to larger degrees did lead to significant imperfections, a balanced level was located where not only were perfect or near-perfect paths were found, but they were also found in the shortest time. Conclusions/Discussion While this project focused on a particular problem, the approach can be applied to many other computing applications. Perfect solutions are not always necessary, and by allowing a small error vast increases in performance can be achieved. This is already demonstrated in lossy compression of media, but it can and should be explored further.	
Summary Statement This project explored the use of a heuristic in pathfinding to improve performance while possibly sacrificing accuracy.	
Help Received Parents helped with brainstorming idea and assembling the display board.	



**CALIFORNIA STATE SCIENCE FAIR
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Name(s) Beverly S. Levene	Project Number S1312
Project Title Reducing Atmospheric CO₂ by Iron Induced Phytoplankton Blooms: A Computer Model	
Abstract Objectives/Goals Iron seeding has been proposed as a solution to global warming. Iron seeding would cause a phytoplankton bloom which would absorb more atmospheric CO ₂ . The objective of this project was to create a computer model to see if the phytoplankton bloom would use up CO ₂ and if the amount of CO ₂ removed from the atmosphere would be a substantial amount and if the phytoplankton bloom would cause a bloom in other organisms thus disrupting the ecosystem. Methods/Materials The model was created using Starlogo TNG, a graphical programming language. Results After a simulated seeding, a phytoplankton bloom was produced that absorbed excess CO ₂ but realistic parameters could not be found that would produce a bloom as big as that observed in experiments and neither the modeled bloom nor the experimental bloom was large enough to reverse global warming. Starlogo was not able to directly link the phytoplankton bloom to changes in the ecosystem (e.g. copepod populations). Separate programs had to be used. Conclusions/Discussion My model suggested that iron seeding could not reduce CO ₂ enough to reduce global warming. However, it was decided that a more complex model would be needed to make accurate predictions on how effective iron seeding is and if it would disturb the fragile ecosystem.	
Summary Statement A computer model was created to see if iron seeding in the open ocean could cause a phytoplankton bloom that would fix enough CO ₂ to reverse global warming.	
Help Received Kathy Barbeau and Jerry Wanetick, both of Scripps Institute of Oceanography, provided me with background information. Dr. Neil McCurdy, my emergence teacher at High Tech High, introduced me to Starlogo and Dr. Jay Vavra, my biotech teacher at High Tech High, helped with the poster presentation.	



**CALIFORNIA STATE SCIENCE FAIR
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Name(s) Nicholas Lieberman; Alexander Tsebelis	Project Number S1313
Project Title 29728284988146 (Base 97)	
Abstract Objectives/Goals The purpose of our project this year was to create a cipher based on a numerical system where all values corresponded with a printable character. Methods/Materials Our first step was to figure out what system we wanted to employ. When we looked at the ASCII table to see all of the characters we wanted to encode, we realized that the only system that would work was base-97. We decided that Flash Actionscript would be ideal to create a graphical user interface. We proceeded to learn Actionscript as quickly as possible, and wrote our program. Results In the creation of this project we met our goal of not only expanding our original program to include any character, but in simplifying the interface to make it easier to use. Conclusions/Discussion Unlike last year, we feel that we have designed and built a finished product that is a fitting end to two years of work. Though we did deviate slightly from our original goals, our base 97 encoder/decoder accomplishes everything that we intend it to accomplish quickly and accurately.	
Summary Statement Our project is about a program that encodes and decodes using a cipher based on a base-97 system.	
Help Received Keith Maxwell, our school's technical advisor, helped us write the code for our program	



CALIFORNIA STATE SCIENCE FAIR 2008 PROJECT SUMMARY

Name(s) David C. Liu	Project Number S1314
Project Title Content-Based Image Retrieval	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals With the astounding number of digital images available, there is an increasing need to search image collections. Many systems such as Google and Flickr use text-based search, but the vast majority of photos (particularly family albums) have no text description available. Content-based image retrieval searches images using visual similarity, rather than text. This research investigates methods to improve the performance of image retrieval systems.</p> <p>Methods/Materials A novel technique is presented for automatic combination of features using machine learning to improve retrieval accuracy. Perceptual characteristics (color and texture signatures) are extracted as a mathematical representation of images. Color signatures are extracted based on k-means clustering of Lab color space coordinates, and texture signatures are extracted using k-means clustering of Gabor filter dictionaries of 4 scales and 6 orientations. Signature dissimilarities are measured using the Earth Mover's Distance, and integrated through normalized linear weighting. k-nearest neighbor supervised learning is used to predict weights based on statistical characteristics of color and texture signatures: "color spread" and "texture busyness".</p> <p>Unlike other research in which entire images are analyzed, this research indexes images by using specifically tagged regions. This eliminates irrelevant content and backgrounds and allows users to specify what they are looking for and make more precise queries.</p> <p>Results It was found that the learning model significantly improves retrieval accuracy: by 9.32% (6.56 percentage points) over using color signatures alone, and 37.06% (20.81 percentage points) over texture signatures alone. This is a statistically significant improvement (p-value < 0.001).</p> <p>An extensible framework is also presented, which visualizes color and texture signatures. This helps researchers understand the relationship between the optimal weights and signature characteristics. It also includes an intuitive user interface for tagging regions and querying.</p> <p>Conclusions/Discussion Content-based image retrieval is a very active research topic that has the potential to significantly change digital image management as well as image search engines. This research contributes a new technique to improve retrieval accuracy.</p>	
Summary Statement This project explores image searching by visual similarity. A novel algorithm is presented to improve retrieval accuracy through machine learning of color and texture characteristics.	
Help Received	



**CALIFORNIA STATE SCIENCE FAIR
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Name(s) Tanooj Luthra	Project Number S1315
Project Title Adaptive Signal Processing for Optimal Wireless Networking	
Abstract Objectives/Goals A major problem in a wireless networking system is that interference hinders the speed and distance of a network connection. This interference originates from a variety of sources including common household objects such as cordless phones, microwave ovens, and even the neighbor's home networking system. This project is centered on adaptively removing a significant amount of interference and thus improving the effectiveness of wireless networking. Methods/Materials A new fast adaptive algorithm is developed and exploits the fact that the signals received from the direction of a desired source and the direction of an interferer have different characteristics across the antenna phased array. Using this to my advantage I created two virtual antenna arrays and added their output such that only the interference is removed while the desired signal is preserved. I wrote a computer program using C programming language to simulate and characterize my algorithm. Results The software simulation shows that by using my new algorithm the distortion in the signal due to the interference decreases on average by more than a factor of 100 when compared to the conventional method. As shown in several graphs and tables, the algorithm adaptively nulls out the distortion regardless the location of the interferer while remaining equally effective for these various locations. Conclusions/Discussion The high interference rejection allows a significant reduction in bit errors and thus increases the speed of a wireless network. It also allows preservation of the signal quality over greater distances, and therefore expanding the range of a wireless network in the presence of interference.	
Summary Statement To significantly increase the speed and distance a wireless network by adaptively reducing the interference.	
Help Received Mother helped put board together; Father helped gather books and background information	



**CALIFORNIA STATE SCIENCE FAIR
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Name(s) Maria J. Ly	Project Number S1316
Project Title Tracking Down Methicillin-Resistant Staphylococcus aureus	
Abstract	
Objectives/Goals The objective of this project is analyze at my school the transmission rate of Methicillin-Resistant Staphylococcus Aureus if an outbreak occurred, and how to prevent such an outbreak.	
Methods/Materials To measure the transmission rate, a SIS model will be used, in which a transmission coefficient (based on the probability of contamination, hygiene and the transmission rate at hospitals) is required. The probability of contamination can be acquired through analysis of handwashing skills-UV lotion will be distributed to consenting subjects and UV lotion residues left on their hands on the day after distribution would show contamination(average surface area of a cut divided by average surface area of UV residue would yield the probability of contamination). Hygiene can be determined through the use of surveys.	
Results The SIS model yielded data showing that if such an epidemic occurred at my school, the transmission rate would be in a linear fashion, infecting about 5 people after a period of 14 days.	
Conclusions/Discussion Since a theoretical MRSA epidemic at my school would occur in a linear fashion, a plan has to be made to stop the epidemic from possibly becoming logarithmic in rate. Students MUST be taught (or re-taught) to wash their hands thoroughly and properly. MRSA awareness should be heightened as well, so that students would not dismiss their possible infection as a mere acne pimple.	
Summary Statement My project concerns calculating the transmission rate of a theoretical MRSA epidemic at my school, in order to help prevent or slow down such an epidemic.	
Help Received My mentor helped me think of the general idea of this experiment, revise my procedures to keep them accurate, showed me my mistakes, and helped me fix these mistakes.	



**CALIFORNIA STATE SCIENCE FAIR
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Name(s) Marie E. Nielsen	Project Number S1317
Project Title Is Safe Good Enough? The Value of Added Complexity in Password Security	
Abstract Objectives/Goals The objective of this project is to predict the ability of brute force password decryptors to decode passwords, then compare the predicted decoding times with experimental results. Methods/Materials Password lists were created for multiple character ranges and lengths, encoded as Unix passwords and then decoded. Predicted decoding times were compared with experimental results. Predicted password decoding times were proportional to the number of possible character combinations, and was calculated from the number of guesses per second, number of bytes in passwords, character types used in passwords. A personal computer, password lists, and opensource software was used. For each experiment 20 random passwords were encrypted. The time to decode 20 passwords using exhaustive guessing was recorded. Statistical analysis compared predicted versus actual results. For each experiment, a password list was created for a specific character range and length. Results The amount of time predicted to decode passwords exponentially increases as the length and character choices in a password increased. A high correlation was shown to exist between the predicted and actual time measured to decode the passwords. The exponential relationship between complexity and time to decode can be extrapolated to determine how large a random password must be to be safe. Conclusions/Discussion Through the course of predicting data, collecting data, and analyzing the data, certain relationships and patterns were seen. A highly correlated relationship appears to exist between password length and the time (seconds) it takes to decrypt as well between the character set employed and the time to decrypt. Shorter, less complex passwords, even when encrypted, can take mere seconds to be decrypted. When these results are considered in light of real passwords, the patterns in real passwords that people select themselves allow the passwords to be more vulnerable to decoding.	
Summary Statement Predicting password decryption based on combinatorics.	
Help Received My parents helped explain statistical and encryption concepts, Paul Roth for usage of the UCSC library.	



**CALIFORNIA STATE SCIENCE FAIR
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Name(s) James Noraky	Project Number S1318
Project Title An Investigation into the Optimization of Control Systems	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objective of this project was to determine the best control algorithm for a system where energy and time is important. The project considered the more prevalent PID and Fuzzy logic controllers against a control, the bang-bang controller in a heating simulation program. It was then hypothesized that the fuzzy logic controller would be the "best" controller because it imitated human intelligence.</p> <p>Methods/Materials The algorithms were written in BASIC in the Excel environment, with the data being easily accessible and easily manipulated. Within each program, the heating simulation was constant that is the assumed initial temperature, desired temperature, maximum output, etc were the same for every program. Once the basic theory of each system was coded, the programs were executed to provide data for each controller.</p> <p>Results The results yielded conformed with the nature of each controller. The simulation for the bang-bang resulted in oscillation. The simulation for the PID resulted in less oscillation and stabilization. The fuzzy logic simulation resulted in maintaining the desired with no overshoot. The data was further analyzed by the efficiency matrix. The matrix provided a score based off of total energy usage, oscillation, and time, and by comparing the individual scores against the control Bang-Bang controller, it became evident that the Fuzzy Logic Controller was the most effective in this context, validating the initial hypothesis.</p> <p>Conclusions/Discussion It is important to realize that this experiment sought to compare three different controller theories in the most unbiased manner. The efficiency matrix allowed for an objective comparison, but the supremacy of the Fuzzy Logic controller is not always the case. The PID algorithm itself could be optimize to approach the results of the Fuzzy Logic controller. At the same time, because these algorithms are often integrated onto microcontrollers, the size of the individual controller programs must also be taken into account. Given all these constraints, the generalized rule is that the "optimal" control system is very much based on the context.</p>	
Summary Statement This project sought to compare different control algorithms (Bang-bang, PID, and Fuzzy Logic) in an objective fashion.	
Help Received	



**CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY**

Name(s) Ernesto E. Nunez, Jr.	Project Number S1319
Project Title Taking It to the Edge	
Objectives/Goals In this project I will investigate the relationship between the amount of information stored on a CD-R disc and the size of the "burn" by measuring with a ruler. Last there will be some questions I answered from my experiment, which you might have asked yourself.	
Abstract	
Methods/Materials The materials I used are the following: #I Computer #I CD burner (internal or external) #I About 10 blank CD-R discs #I A photo, music file, or folder about 100 MB in size #I Permanent marker #I Ruler with centimeters	
Results The CDs that I burned kept getting an area kept on getting higher. But there was a limit for the CD capacity.	
Conclusions/Discussion When I finished my experiment; I found out that the CDs had a limit as you can see in the graph on the top.	
Summary Statement In my project I Burned CDs to find the measure of the information on them.	
Help Received Father helped me buy all my materials.	



**CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY**

Name(s) Stephanie Salcedo	Project Number S1320
Project Title Morphing Circles with Trig: A Third Year Investigation	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The main purpose of this year's project is to investigate how the area changes when a sine curve is added to the graph of a circle. By using the program Nucalc, I plan on calculating the areas of different morphed circles and see how they change with distinct sine functions. My hypothesis is that when adding a sine curve to a circular graph, the area of the morphed circle will not change from that of the original circle.</p> <p>Methods/Materials In rectangular form, I graphed a circle and overlaid it with the graph of a circle with the same radius but with a sine function added to its equation. I decided to calculate the area of the whole morphed circle and compared it to that of the original circle. I repeated this with circles ranging from radii of 2 through 5 and with sine functions with various periods. Next, I looked at morphed circles in polar form. I graphed the circle $r = 2$. and overlaid it with the equation $r^2 + \sin(\theta) = 4$. I then calculated its area. I repeated this several times using the same circle, but I just increased the value of n in $\sin(n\theta)$. I also looked at graphing the morphed circles by using $r + \sin(n\theta) = 2$. I calculated the area using the same formula, and I then compared it to the original circle. I also altered the value of n to look at different morphed circles.</p> <p>Results In rectangular form, I noticed that the morphed circle areas were really close in value to the areas of the original circle. This is because the area of the morphed circle is going to be equal to the area of the original circle. The integral of sine from 0 to 2π is simply 0, so when you add it to any graph that you are calculating the area of, you are simply just adding zero. Since I was approximating the limits of the morphed circle in order to find the area, my calculations were not the exact values. When calculating the areas of the morphed circles with the equations $r + \sin(n\theta) = c$, in which c is a constant representing the radius of the original circle, the area would always be $\pi/2$ more than the area of the original circle. When I looked at morphed circles with equations $r^2 + \sin(n\theta) = c^2$, the areas of these equaled the areas of the original circles.</p> <p>Conclusions/Discussion My hypothesis was fairly accurate. Knowing how to calculate the areas of morphed circles could be helpful because you can take a complex shape and make them into simpler ones, which would be easier to work with.</p>	
Summary Statement I want to see how the area changes when a sine function is added to a circular graph.	
Help Received Mother helped put together board; Mrs. Herrington helped proofread my work.	



**CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY**

Name(s) Patrick Yiu	Project Number S1322
Project Title Fibonacci and Phyllotaxis	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals This project in its present form is the result of investigation and experimentation on the correlation between the Fibonacci sequence and the spiral phyllotaxis, or leaf arrangement, of various plants occurring in nature. This is being done in order to model various occurrences of the Fibonacci sequence in nature and to explore possible applications of the Fibonacci sequence in real-world situations.</p> <p>Methods/Materials Phyllotactic ratios (leaf arrangements) were determined by means of measuring the ratio of a complete turn between each successive leaf growing around the stem of a specimen. Helianthus annuus and Ulmus americana, among other plant species, were observed and the phyllotactic ratios of each specimen were recorded. Initial hypotheses predicted that there would be a direct correlation between both the Fibonacci sequence and the spiral phyllotaxes of various plant specimens. Upon further analysis, a correlation was confirmed between the Fibonacci sequence and plant phyllotaxes.</p> <p>Results The leaf arrangements of each specimen were compared to the Fibonacci sequence in order to find any patterns, and each consisted of members of the Fibonacci sequence. The numerator and denominator of each leaf arrangement ratio consisted of a member of the Fibonacci sequence and its second successor. The results support my initial hypotheses that there is indeed a direct correlation between the spiral phyllotaxes of plants and the Fibonacci sequence. Given that there in fact is a correlation, the Fibonacci sequence can then be harnessed and applied to human purposes by first observing its application in nature.</p>	
Summary Statement The Fibonacci sequence is a wonderful relation with virtually infinite applications, and it is perhaps best expressed in the spiral phyllotaxis of flora throughout nature.	
Help Received Friend helped to proofread project; Mother helped to glue display board together	