MARIAN UNIVERSITY
Indianapolis

MARCH 13, 2021

SENIOR DIVISION

PROJECT LISTING

Project Categories

- [ ] Animal Sciences (AS)
- [x] Behavioral and Social Sciences (BE)
- [x] Biochemistry (BI)
- [x] Biomedical and Health Sciences (BM)
- [x] Chemistry (CH)
- [x] Computer Sciences (CS)
- [x] Earth and Environmental Science (EA)
- [x] Engineering (EN)
- [ ] Mathematics (MA)
- [ ] Microbiology (MI)
- [x] Physics and Astronomy (PH)
- [x] Plant Sciences (PS)
- [x] Robotics and Embedded Systems (RO)

Table of Contents

GRADE 9 1

Huang, Alan (09-01-01, RO) 1

Using Recycled Products to Create an Affordable, Interactive Robot 1

Zahran, Sama (09-02-02, BM) 1

Which cloth is more effective as a mask? 1

Alberto, Elizabeth (09-03-03, BI) 2

Does the size of an apple affect how fast it reaches enzymic browning? 2

Makanjuola, Mercy (09-04-04, CH) 2

Rocketology: Baking Soda + Vinegar= Lift Off! 2

Akinkuehinmi, Praise (9-05-05, EN) 2

Does the quality of batteries affect how long a light will shine? 2

GRADE 10 3

Mickens, Jayden (10-01-06, BI) 3

How much fat is in your food? 3

Sriram, Raghav (10-02-07, BI) 3

Computationally Analyzing Interactions between Nattokinase Binding Partners: Insights on new Staphylococcus aureus Biofilm Dispersal Techniques 3

Kalra, Archit (10-03-08, PH) 4

Planck Stars: Investigating further solutions to the black hole information paradox using loop quantum gravity 4

Mo, Lucca (10-04-09, PH) 4

Utilizing the Swift UVOT Data to Improve the Classification of Gamma-Ray Bursts through Color-Color and Color-Magnitude Diagrams 4

Akindele, Ayomide (10-05-10, EA) 5

Water Purification and Filtration 5

Alcantara, Matthew (10-06-11, EN) 5

Jetting Into the Future: Calculating Outlet Air Velocity to Optimize Convergent Nozzle Design for Subsonic Exhaust Flow Efficiency Through Wind Tunnel Testing With Laminar Flow 5

Marin-Bravo, Maribel (10-07-12, CH) 5

Chemistry of Ice-Cream Making : Lowering the Freezing Point 5

Yang, James (10-08-13, CS) 6

Systematic Survey of Pathways Perturbed in Complex Diseases 6
GRADE 11 7
ARIYUR, ADITYA (11-01-14, CS) 7
Detection of Nm Sites using XgBoost and One-Dimensional Convolutional Neural Network 7
ROMEU, POL (11-02-15, BM) 7
FRANK, NATHAN (11-02-15, BM) 7
The Creation of Manganese (IV) Oxide Nanosheets as a Cheap and Effective Method of Measuring Blood Glucose 7
CHUNDI, SOWMYA (11-03-16, BM) 8
A Machine Learning Approach for Target Identification and Drug Discovery in Amyotrophic Lateral Sclerosis 8
LAPIDO, DAVID (11-04-15, PS) 8
Test for the presence of starch in leaf 8
WASHINGTON, JAYDA (11-05-18, EA) 9
The Effect of Temperature on the Resolidification of Crystals 9
KOKAN, AISHA (11-07-20, EN) 9
Computational design of optimal machine learning algorithm for cancer detection in PET scans 9
PATIL, REVA (11-08-21, BI) 9
The Effects of Rosmarinic Acid on Crystallin Lens Opacity 9
GRADE 12 10
SANKARI, SAFIYA (12-01-22, BM) 10
Comparing Outcomes of COVID-19 Positive Individuals with and without Chronic Kidney Disease using Python and CoRDaCo 10
VASQUEZ GAYTAN, EMMANUEL (12-02-23, EA) 10
Build an Earthquake-Resistant House 10
GAO, NICHOLAS (12-03-24, BE) 11
Effect of the MC/MB Factor as an Investment Sentimental Indicator - Evidence from a VXX-Based Simulation Study 11
INDEX: PROJECTS BY CATEGORY ii

GRADE 9

Huang, Alan (09-01-01, RO)

Project Submission

Using Recycled Products to Create an Affordable, Interactive Robot

"According to the EPA, less than 20 percent of old, unwanted cell phones are recycled every year. Outdated cell phones are one of the fastest-growing electronic equipment waste hazards in the world right now. They are hard to dispose of due to dangerous chemicals. On the other hand, most old smartphones still have valuable and powerful hardware which can be utilized for many new purposes. My project idea was to use old phones and recycled goods like plastic bottles, as well as cheap store-bought parts to create an interactive robot. Like many other children, I've been interested in robots from a young age but most advanced robots were very expensive and not available to the public. Therefore, I decided to use cheap household items and tools that everyone has at home to make the robot. I explored different mechanical structures and building methods to simplify the process of making one's own robot. I built two types of robots, one stationary and the other moving. The movable robots are modular and a Micro:bit based programmable toy car was used. The phone controls the car by sending commands via a Bluetooth connection. Although it is slightly more expensive to build than stationary robots, it is also more powerful, sophisticated, and interactive, and it is still affordable for most people. Both types of robots are voice-activated and able to have an intelligent conversation with users, powered by Google's natural language understanding platform Dialogflow. The standard edition of Dialogflow is free, easy to code, and powerful enough to use on this project. By integrating prebuilt functions of Dialogflow, modifying open-sourced scripts and dataset, and writing my own programs, the chatbot I constructed can answer human's questions, information such as the weather and news, carry out simple entertainment tasks such as playing music and telling jokes, control smart home devices, and support many other functions. Finally, I tested the compatibility of my software with a variety of devices and showed that it works well with even the lowest-end smartphones on the market. This homemade robot is versatile and even comparable to some commercial robots around $500."

Zahran, Sama (09-02-02, BM)

Project Submission

Which cloth is more effective as a mask?

"The purpose of my experiment is to find out which fabric used for masks is most useful in protecting against pathogens. The transmission of pathogens across a fabric was evaluated by measuring the distance that aerosol travels through a cloth mask made of different materials. The thickness, mesh size, and breathability of each material were measured using a digital caliper, optical microscope, and custom-made air flow meter, respectively. My problem statement is which fabric used for masks is effective to protect from pathogens? In my experiment, I compared eight different fabrics to see which one is most effective in protecting against pathogens. I investigated the relationship between the properties of the fabric material and the ability to block the transfer of pathogens droplets. My results show that the thickness and the mesh size of the fabric are critical properties for making an effective mask. The uniform pant, which is made of 100% cotton, was the most effective in blocking aerosol droplets. On the other hand, the girl's shirt, made of three different fabrics, rayon, polyester, and spandex, was the most breathable."

Alberto, Elizabeth (09-03-03, BI)

Project Submission

Does the size of an apple affect how fast it reaches enzymic browning?

"I am testing to see if the size of a apple determines the time it takes to reach a process called enzymatic browning. I thought that bigger apples would take longer to turn brown. I chose this project because this can be helpful for me during cooking. I tested this by cutting the apples in half and timing on how long it takes. My results show that bigger apples take longer to reach enzymatic browning than smaller apples."

Makanjuola, Mercy (09-04-04, CH)

Project Submission

Rocketology: Baking Soda + Vinegar= Lift Off!

"I'm going to be testing on how many quantity of baking soda do I need, to get the highest pop from a canister. My guess on the experiment is that the more baking I add the more higher it will going but the difference in height my not be a lot because as I add baking soda the weight also increases. I chose this project out of curiosity. I tested this theory by doing different trials to compare the results. The results was the height of the cork decreases when I added more baking soda."

Akinkuehinmi, Praise (9-05-05, EN)

Project Submission

Does the quality of batteries affect how long a light will shine?

"My experiment was testing if the quality of batteries affects how long a light shines. I believed that after I have made the flashlights, and the batteries run, they may not last more than 5 hours. I think the batteries from Dollar Tree(Alkaline batteries) will stop shining first at 1 hour, then the ones from Aldi (Active energy batteries) at maybe 2-3 hours, and last but not least the ones from Walmart(Energizers) at 5 hours. The reason why I believe the ones from Dollar tree will run out first is because, it is of lower quality, and the Energizers will last longer because they are of higher quality. I made a flashlight out of tissue paper rolls, paper cups, wires, and led lights to test it out. It wasn't what I originally expected because the batteries were closer in timing than I thought, but I was right, the Dollar Tree batteries died first, then the Aldi batteries, then the Walmart batteries."

GRADE 10

Mickens, Jayden (10-01-06, BI)

Project Submission

How much fat is in your food?

" The question of this projects was: How Much Fat is in Your Food? Almost every food we eat has some fat in it; often invisible and we don't notice. The purpose of this project is to investigate how much fat and what fat types are in different foods and if the nutrition labels are correct."

Sriram, Raghav (10-02-07, BI)

Project Submission

Computationally Analyzing Interactions between Nattokinase Binding Partners: Insights on new Staphylococcus aureus Biofilm Dispersal Techniques

"Nattokinase, a serine protease of the subtilisin family (99.5% identical with aprE), is an enzyme produced by natt'kin that is commonly used to treat biofilm formation which often causes Staphylococcal infections after surgery due to formation on surgecial tools. Despite preliminary knowledge on nattokinase, there is a desperate need to understand the interactions occurring during nattokinase facilitated biofilm removal. Therefore, determining specific residues involved in interactions between nattokinase and its binding partners provides further insights into the protein-mediated interactions occurring during nattokinase-aided biofilm degradation. This project utilized LZerd, AutoDock Vina, and SAPS (Structural Analysis Protein Structure) software to generate the most probable protein-protein interactions. These theoretical predictions were then compared to experimental results to determine the strength and accuracy of the computational model. After the model achieved a 95% trained classification accuracy, potential non-experimentally determined binding partners were inputted and modeled in the software. Results indicate nattokinase as a heparin-binding protein with an affinity of ~217 nM. Additionally, for interactions to occur, the model showed nattokinase binding partners must have N-sulfo groups, 3-O-sulfo, and 6-O-desulfo groups, but not 2-O-sulfo groups (which was previously believed to be involved), present. Hydrogen bonds formed between residues D60, S33 S62, and T220 which stabilized the binding site, and G127, L126, and S125 often served as the substrate binding sites. Furthermore, differently sized binding partners determined nattokinase interactions were side-chain-length dependent. These insights on the requirements for potential nattokinase binding sites provide a deeper understanding of the structure of biofilm surface proteins and the nattokinase pathway which allows others to develop more efficient and effective biofilm dispersion techniques. Further experimentation will involve modeling lumbrokinase, another commonly used enzyme for biofilm dispersion, and isolating biofilm surface proteins based on the presence of necessary nattokinase binding residues to experimentally determine the nattokinase-facilitated biofilm degradation pathway."

Kalra, Archit (10-03-08, PH)

Project Submission

Planck Stars: Investigating further solutions to the black hole information paradox using loop quantum gravity

"The black hole information paradox is a surreal scientific quandary that has involved myriad research groups in controversy for years. Given that black holes eventually evaporate and release all their mass through Hawking radiation, there must be an explanation that can accurately describe the perceived loss of information and violation of quantum determinism and reversibility. Although different theories have attempted to resolve the paradox using novel methods, often involving the replacement of the singularity with another construct (such as the fuzzball in string theory), one of the prevailing analyses so far has incorporated the Page curve, which serves to describe the return to an entropy S = 0 as the black hole evaporates. In addition to this, there have been some key advances in the discipline of loop quantum gravity that can accurately describe solutions to the information paradox with the Planck star as well, a celestial object where quantum gravitational pressure becomes a dominating factor in stability. However, they both involve entirely different solutions: Page curves suggest that information can be released from the black hole, whereas Planck stars imply that there is enough space within the black hole to store all absorbed information. Here I propose a thought experiment incorporating tenets of both loop quantum gravity as well as the Page curve model by superimposing the systems in question. I simulate black hole evaporation and evolution using existing black hole simulation softwares and calculate thermodynamic changes within the black hole over time to determine the viability of the model in relation to empirical results and whether the competing effects are notable."

Mo, Lucca (10-04-09, PH)

Project Submission

Utilizing the Swift UVOT Data to Improve the Classification of Gamma-Ray Bursts through Color-Color and Color-Magnitude Diagrams

"Gamma-Ray Bursts (GRBs) have been classified into two recognizable categories designated as short-hard (Type-I) and long-short (Type-II). However, the possibility of newer classes of GRBs has been debated and speculated due to the current methodology of short vs long GRBs. Therefore, I present a further discrimination of the classification of GRBs through color diagrams to further research on newer GRB classification techniques. I utilized the SWIFT dataset to form two classification graphs based on the Burst Alert Telescope (BAT) and the X-Ray Telescope (XRT). With BAT being separated by the traditional dividing line of T90 = 3 and XRT having the dividing line at early flux = 50 keV. Subsequently, I observed the relationship between the V filter of UltraViolet Telescope (UVOT) to short and long GRBs from XRT and BAT. This allowed for an identification of the burst power range of short and long. Following the V filter comparison graph, I created color-magnitude diagrams (CMDs) to find the color through specific filters while comparing the colors together by using color-color diagrams (CCDs). This methodology led to the results of most GRB values clustering at the center of the CMD and CCD graphs. This would indicate that many of the values were hard to identify as short and long. As a result, the color will not be able to further discriminate the classification of all GRBs due to the irregularity and variability of GRBs. But color will confirm the GRB class if the T90 and early flux indicate a specific class."

Akindele, Ayomide (10-05-10, EA)

Project Submission

Water Purification and Filtration

"The purpose is to explore other way of absorbing and filtering water molecules through charcoal filtering system. Activated charcoal is widely used in water purification, whether in a community water treatment, plants or in aquariums, it is used to remove impurities and pollutants. You will carry out 3 different experiments with 3 different water solutions , water with coffee,lemonade, milk and kool aid and you will see how the end product will differ."

Alcantara, Matthew (10-06-11, EN)

Project Submission

Jetting Into the Future: Calculating Outlet Air Velocity to Optimize Convergent Nozzle Design for Subsonic Exhaust Flow Efficiency Through Wind Tunnel Testing With Laminar Flow

"The purpose of my experiment was to determine whether I can use Bernoulli's Equation of Continuity as a predictor for convergent nozzle design performance for subsonic exhaust flow during wind tunnel testing. Hypothesis: Bernoulli's Equation of Continuity will be an accurate predictor of convergent nozzle performance for subsonic exhaust flow when evaluating nozzles with varying outlet area, but will not be an accurate predictor of performance in nozzles of varying length during wind tunnel testing. Null Hypothesis: Bernoulli's Equation of Continuity will have no predictive bearing on evaluating convergent nozzle design performance. Procedure: Using CAD software and a 3D printer, I created 10 convergent exhaust nozzles, 5 with varying outlet diameters and the same length, and 5 with varying lengths and the same outlet diameter, and then calculated the outlet velocity for each nozzle. Using wind tunnel testing with laminar flow, I evaluated each convergent nozzle design and used a multimeter to measure how much electrical pressure was generated in volts. Results: Nozzles with smaller outlets areas produced more electric power than those with larger outlets and this performance was successfully predicted by Bernoulli's Equation of Continuity. Nozzles with shorter lengths produced more electric power than longer ones, but this was not predictable by using Bernoulli's Equation of Continuity. Conclusion: The results support my hypothesis, so I accept my hypothesis and reject my null hypothesis. Bernoulli's Equation of Continuity is a useful predictive tool for the performance of exhaust nozzles with varying outlet diameters, but not for those with varying lengths."

Marin-Bravo, Maribel (10-07-12, CH)

Project Submission

Chemistry of Ice-Cream Making : Lowering the Freezing Point

" My Abstract is that in my experiment was that i had to find the freezing point and what I did was see how long would in take for the mixture to freeze and with that I did a ice cream mixture and I did one with salt ice and the other one with sugar and ice and I saw that salt with ice did make the Ice cream mixture thick. Have you ever made your own ice cream? If you have, you probably know that you need to get the ice cream mixture really cold to freeze it quickly. Ice cubes alone will not do the job, but if you add chemicals, such as salt or sugar, to the ice cubes that surround the ice cream container, the mixture gets cold enough to freeze. Why does that work? How does adding salt or sugar affect the freezing point of water? Find out with this ice-cold science project and use your results to make your own delicious ice cream."

Yang, James (10-08-13, CS)

Project Submission

Systematic Survey of Pathways Perturbed in Complex Diseases

“Tissue and pathway enrichment tests associated with mutations of BMI (Body Mass Index). Is the mutation of genes associated with BMI and is enrichment tissue-specific? My hypothesis is that some mutations will occur in the pathway they disrupted showing varying results of enrichment in tissues Adipose Visceral Omentum and Adipose Subcutaneous. To address my research question, I applied loci2path to analyze sets of genomic intervals associated with the trait BMI(body mass index.) To run loci2path, I downloaded the GWAS (Genome-Wide Association Study) BMI data from PheGenI and converted the file into a loci2path (.txt) readable file. Also, the 23 eQTL sets I generated, (each contains about 600,000 eQTL) with only p-values of 2 tissues (Adipose subcutaneous and Adipose Visceral Omentum), the most enriched pathways were initially generated. Two pathways (autoimmune and insulin associated) have been found to be enriched in the studied two tissues. The reasoning is because both adipose tissues have a strong relation with insulin resistance, especially Adipose subcutaneous. Meanwhile, Adipose Visceral Omentum regulates immune and metabolic functions which explain the enrichment in immune pathways as well. My next goal would be to find all associated genes of the tissues to specify the correlation."

GRADE 11

Ariyur, Aditya (11-01-14, CS)

Project Submission

Detection of Nm Sites using XgBoost and One-Dimensional Convolutional Neural Network

"One of the most common RNA modifications is Nm (2'-O-methylation), where the 2' hydroxyl group of the ribose sugar is methylated. Recent studies have shown the significance of the Nm modification in multiple biological processes. Due to this importance, several biochemical methods have been developed to detect Nm sites. However, these experimental approaches are expensive and time-consuming. Recently, computational approaches have provided more efficient ways to detect Nm sites. Nonetheless, there is a need for more precise and accurate computational models. The objective of this study is to address these issues by developing two machine learning models that detect Nm sites with higher precision and accuracy. Because Nm is abundant among mRNAs in the HeLa and HEK293t cell lines, mRNA was sequenced from the respective cell lines using the Oxford Nanopore Sequencing Technology: the third generation of DNA/RNA sequencing. The sequenced information was then extracted and used to compile a dataset for each cell line using the Nanopolish software package. After each dataset was preprocessed, two machine learning models, XgBoost and One-Dimensional Convolutional Neural Network (Conv1D) were developed and trained with data from both cell lines to identify Nm sites in the mRNA. The XgBoost and Conv1D models both had high accuracies of 93% and 98% and precisions of 93% and 98% respectively, reinforcing how these models can be used to identify more Nm sites than before, which is vital for studying and learning about the Nm modification."

Romeu, Pol (11-02-15, BM)
Frank, Nathan (11-02-15, BM)

Project Submission 2

The Creation of Manganese (IV) Oxide Nanosheets as a Cheap and Effective Method of Measuring Blood Glucose

" Diabetes mellitus diagnosis and monitoring has long been an issue in third world and developing countries. Vast numbers of people live their everyday lives without knowing that they have type I or type II diabetes. While doing preliminary research, we discovered the potential use of manganese (IV) oxide nanosheets as accurate trackers of glucose concentration. This led us to ask the question: Can we use manganese (IV) oxide nanosheets to create a cheap and effective method of measuring blood glucose? In order to answer this question we made manganese (IV) oxide nanosheets in order to monitor blood glucose levels and coded an effective method of monitoring blood glucose levels. The manganese (IV) oxide nanosheets were made from potassium permanganate and 2-morpholinoethanesulfonic acid, or MES. The manganese (IV) oxide nanosheets are originally a dark yellow in color, but as they react with hydrogen peroxide, they lose this yellow color and eventually become colorless. This is because the manganese ion (Mn^{2+}) is responsible for the yellow color, but in the reaction with hydrogen peroxide, the manganese ions are released. In order for the reaction to occur between glucose and the nanosheets, the glucose had to be broken down into hydrogen peroxide. This breakdown was done using glucose oxidase from Aspergillus Niger (GOD). GOD converted the glucose from the original glucose solution and produced hydrogen peroxide, which then reacted with the manganese (IV) oxide nanosheets to create a color change. In order to best model the glucose levels of the blood, a 7.8 mM glucose solution was made to model normal blood glucose levels and a 11.1 mM glucose solution was made to model increased blood glucose levels which are seen in diabetes patients. In order to create an effective way of monitoring blood glucose levels for the patients, the color changes from these 2 benchmarks as well as other glucose concentrations in between the two values were recorded and merged together

to form a color gradient relating to specific glucose levels. This gradient was then placed on an OMR Sheet with bubbles under each color for the patient to bubble in. Next, we coded an OMR Sheet reader, allowing the patients to scan their OMR Sheets and get their data directly uploaded into an excel sheet for simple tracking of their blood glucose levels. These excel sheets can then be seen by doctors or other medical professionals and can be used to provide better treatment for these people. This project is extremely important to helping the health of thousands of people in developing countries that cannot afford a normal blood glucose test and live without knowing that they have a life threatening disease. By providing a cheap method to diagnose and monitor diabetes, we improve the available healthcare for low income communities across the world."

Chundi, Sowmya (11-03-16, BM)

Project Submission

A Machine Learning Approach for Target Identification and Drug Discovery in Amyotrophic Lateral Sclerosis

"Amyotrophic Lateral Sclerosis (ALS) is a disease where an individual's motor neurons gradually break down and die. Currently, there is no cure and 80 percent of ALS patients die within two years of diagnosis. Today, drug development for diseases like ALS is time-consuming, expensive, and riddled with high failure rates. Fortunately, machine learning can identify drug targets and treatments using mass amounts of data on disease pathways and compounds. Recently, a Harvard study proved targeting multiple proteins in ALS is critical for a cure. From this, a machine learning model was built to identify drug targets and compounds that can attack multiple proteins in ALS. To find drug targets, microarray data from ALS and healthy participants was obtained. A linear model was fit on each gene using the hierarchical Bayes' model. A gene network was constructed and the correlation coefficient was calculated to find proteins with significant changes in expression due to ALS. From this, 749 differentially expressed genes were narrowed to 12 genes most expressed in ALS (R2 values > 0.92 and P-values < 0.02). To find drugs, data on thousands of compounds was acquired from the ChEMBL database. Bioactivity data, chemical fingerprints, and pIC50 values were obtained for each compound. For each protein, 80% of data on compounds was used to train and 20% of data was used to test the model. A Random Forest Regressor predicted pIC50 values and a Classifier labelled compounds as active or inactive. Models narrowed over 45,000 drugs to 14 compounds that could target multiple proteins in ALS (92% accuracy and R2 of 0.87). This machine learning approach can be applied to other genetic disorders to improve drug discovery. The 14 drug compounds identified in this research should be optimized and tested in-vitro to find a treatment for ALS."

Lapido, David (11-04-15, PS)

Project Submission

Test for the presence of starch in leaf

" Photosynthesis is the process in which green plants (primarily) convert energy from the sunâ€™s light into usable, chemical energy. Plants require energy for growth, reproduction, and defense. Excess energy, created from photosynthesis, is stored in plant tissue as starch. Starch is a white and powdery substance. It houses glucose, which plants use for food. The presence of starch in a leaf is reliable evidence of photosynthesis. That's because starch formation requires photosynthesis."

Washington, Jayda (11-05-18, EA)

Project Submission

The Effect of Temperature on the Resolidification of Crystals

"What I knew beforehand was that crystals usually grow in a cool temperature. They also grow in many different shapes. Crystals become solids from liquid. What I am going to be doing in this project is comparing how much the crystals grew between the Ice water, room temperature and the Refrigerator."

Kokan, Aisha (11-07-20, EN)

Project Submission

Computational design of optimal machine learning algorithm for cancer detection in PET scans

"The use of machine learning and image recognition holds tremendous potential in the treatment of cancers like lymphoma. PET scans are used as a key input to decide on staging of cancer prior to starting treatment. It is also used as a decision point to predict prognosis during treatment based on the patientâ€™s responsiveness to chemotherapy or immunotherapy, and as a datapoint for future course of action in the case of a relapse. A form of deep learning neural networks, known as convolutional neural networks, can analyze visual imagery through training and testing data sets using various amounts of hidden layers and nodes. The goal of this experiment was to design and train a machine learning algorithm that utilizes a data set to assess if artificial intelligence and machine learning can recognize and distinguish if a PET scan image is positive for cancer or negative. The first data set contained a minimal amount of PET scan images that were used to train an AI algorithm to detect cancer. From there, the amount of training was increased in increments of ten images, ending with a larger data set. The results of this experiment showed that a machine with a limited data set could not distinguish the PET scans as accurately as a human. However, the altered and increased data set resulted in increased machine learning and optimal recognition of the presence of cancer. The use of machine learning in PET scan image analysis to detect cancer allows a physician to spend more time interacting with a patient and better prescribe treatments. Future enhancements to the algorithm could be used to aid oncologists in tracking risks of secondary cancers or track chemotherapy related side effects and help recommend long term imaging and blood tests follow ups with a patient decades after treatment."

Patil, Reva (11-08-21, BI)

Project Submission

The Effects of Rosmarinic Acid on Crystallin Lens Opacity

" In Vitro Cataracts continues to be the leading cause of age-related blindness, due to the Î±-crystallin protein aggregation in the lens. Surgical removal is currently the only available therapeutic approach, however surgery can be very expensive and emerging techniques do not ensure complete transparency. In previous studies, ex vivo assays that screened for drug candidates that reduce human lenticular protein aggregation were hypothesized. This in vivo study tests different concentrations of Rosmarinic acid as an agent that reduces the opacity of the crystallin lens over a two day period. Running this through an assay can present the concentration (Î¼L) of aggregate remaining in the lens. Using the Lens Classification System III, the numerical value of opacity was able to be detected in each of the lenses. Thus, this in vivo experiment may provide a basis for screening potential novel therapeutic agents towards future pharmacological treatment of cataract."

GRADE 12

Sankari, Safiya (12-01-22, BM)

Project Submission

Comparing Outcomes of COVID-19 Positive Individuals with and without Chronic Kidney Disease using Python and CoRDaCo

"As of January 3rd, 2021, there have been 1,839,622 deaths globally and 84,838,747 cases globally caused by COVID-19. Simultaneously, an estimated 15% of U.S. adults suffer from Chronic Kidney Disease (CKD). Individuals with CKD may be particularly vulnerable to COVID-19 as they have larger amounts of circulating ACE2, and ACE2 is the main target of COVID-19.This study is focused on understanding how the comorbidity of CKD impacts patient outcomes for COVID-19 positive individuals. Outcomes were defined as emergency department visitation rate, median length of inpatient stay, inpatient admission rate, and mortality rate. Patients over the age of 18 who tested positive for COVID-19 between January 1-July 13, 2020 were included in this study from over 100 healthcare entities. The median Charlson Index for the CKD COVID-19+ (n=1,946) cohort was 4 and for the Non-CKD COVID-19+ (47,478) cohort was 1. The CKD COVID-19+ cohort was comprised of 52.5% women and 47.5% men . The Non-CKD COVID-19+ was comprised of 54.1% women, 45.4% men, and 0.5% other. The Non-CKD COVID-19 + and CKD COVID-19+ cohorts were further divided into 4 age-by-race subcategories, as race and age were found to be significantly correlated with CKD."

Vasquez Gaytan, Emmanuel (12-02-23, EA)

Project Submission

Build an Earthquake-Resistant House

" An earthquake is the result of a sudden release of stored energy in the Earth's crust that creates seismic waves. An earthquake is caused by tectonic plates getting stuck and putting a strain on the ground. The strain becomes so great that rocks give way by breaking and sliding along fault planes. Earthquakes account for the majority of deaths from a range of natural disasters which amounts to about 60,000 people a year worldwide â€“ around 90 percent of which occur in developing countries. Most earthquake deaths are related to building collapse or damage. By taking such preventive steps according to traditional scientific recommendations, the impact of earthquakes can be avoided or minimized. These measures can prevent loss of life and material in areas susceptible to earthquakes. Building systems are introduced with a proposed earthquake-resistant design framework. Offshore construction structures are classified as offshore structures of a fixed type that are continuously used for the purposes of accommodation, duty, job, service, collection, recreation, sightseeing, etc."

Gao, Nicholas (12-03-24, BE)

Project Submission

Effect of the MC/MB Factor as an Investment Sentimental Indicator - Evidence from a VXX-Based Simulation Study

" Volatility-derived Exchange traded notes (ETN) like VXX has been a popular investment product because of its inherent downtrend during market complacency and uptrend during market panic. In this article, I develop a VXX based portfolio, hedged and rebalanced, when VIX futures curve moves between “Moving Contango” (MC) and “Moving Backwardation” (MB). More importantly, I show that the switch between MC and MB can be detected by the values between the 1-month and the 3-month implied volatility of the S&P 500 index options, VIX3M-VIX. I apply such indicators to examine the performance of a VXX-based investment portfolio through simulation studies. My results provide valuable insights and shed lights on the importance of the MB/MC indicator as a market sentimental factor, as well as how to maximize economic gains from volatility ETPs based on their inherent trending properties under various financial market conditions.

Highlights: - The term structure of VIX futures implies investor risk sentiment into the future. The MC/MB in the VIX futures curve underpins the foundation of using the relativity of VIX3M and VIX as a timing indicator of aggregate market risk sentiments. - If the market is under MC condition, I will short VXX, hedged and rebalanced daily. Whenever the market turns into MB condition, all VXX short positions will be closed as of market closing, then all proceeds will be immediately fully invested (long) into VXX. - A VXX-based investment portfolio performance, hedged and rebalanced, can be significantly improved when MC/MB indicators are applied. Furthermore, such indicators seem to detect the underlying risk trend change and allow early exit from apocalyptic market events.”

INDEX: Projects by Category

BE #12-03-24 11
BI #09-03-03 2
BI #10-01-06 3
BI #10-02-07 3
BI #11-08-21 9
BM #09-02-02 1
BM #11-02-15 7
BM #11-03-16 8
BM #12-01-22 10
CH #09-04-04 2
CH #10-07-12 5
CS #10-08-13 6
CS #11-01-14 7
EA #10-05-10 5
EA #11-05-18 9
EA #12-02-23 10
EN #09-05-05 2
EN #10-06-11 5
EN #11-07-20 9
PH #10-03-08 4
PH #10-04-09 4
PH #11-04-15 8
RO #09-01-01 1