69TH ANNUAL GREATER SAN DIEGO SCIENCE & ENGINEERING FAIR - 2023

Project ID: 681

JR - Computer Science and Systems Software

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Advisor: Diana Quincannon

Creating a Model to Forecast Change in Prescription Drug Prices

I applied data science techniques, proven to be so effective in other industries, to forecast prescription drug prices. Being able to anticipate price movement of a drug would be of great value to various stakeholders in the pharmacy supply chain. While considerable research has gone into clinical issues in the pharmacy industry, pricing analytics has received surprisingly little attention. I trained a model to forecast future movement in the cost of a drug based on recent changes in its supply and/or demand.

I was provided with pharmacy claims and pricing data by XXXXXXXX, a healthcare analytics firm. In Excel, I created model input variables indicating movement in supply and demand. Supply was based on the number of manufacturers providing the drug, while demand was based on the amount of claims activity associated with the drug. I also created a target variable measuring future movement in the drug’s acquisition cost.

This training data was used to develop the forecasting algorithm. I found that supply correlated with cost, but that demand did not consistently do so. The forecast effectively isolates a set of drugs that, on average, increase in price and another set of drugs that, on average, decrease in price.

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How Does Mass Affect an Active Ragdoll?

Active ragdolls have been growing in popularity in video games. They can be made to be floppy or act like a person with algorithms. I wanted to compare two types, character controller and rigidbody(see background on slide 3) to see which would perform the best at different weights. In my experiment, I first shoot a cube at the active ragdoll twenty times for each mass I compare. Then I record the average success rate and recovery time to find the best performance. A success is when the ragdoll balances without falling, and the recovery time is the time taken to rebalance. By best performance I mean highest success rate and fastest recovery time. The average results show that the rigidbody preformed the best according to my criteria.

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The Effects of Light and Distance on Face ID

In today's world, technology plays a vital role in daily activities. More importantly, we keep sensitive and personal information on our devices; such as our banking information, our passwords, and emails. To protect these different types of information, we use passwords, our fingerprint, and Face ID. Can factors like light and distance manipulate Face ID? The hypothesis is that being 6 inches away from the Face ID scanner in a room with light will allow for the most frequent results (unlocked the most amount of times.)

Procedure: 40 human test subjects were used. Each subject set up Face ID and stood 6 inches, 1 foot, and 2 feet away from the iphone in a room with the lights turned on and the lights turned off. The control variable was the same phone used on the same iOS update during experimentation. The dependent variable was the phone locking or unlocking in different lighting conditions and distance from the camera. The independent variable was the different lighting (dark and light) and the distances (6 in, 1 ft, 2 ft). I used an age range of 6 years - 14 years within the test subjects.

Results: Face ID did not unlock for all trials. The most frequent results came from standing 1 foot away from the camera in both the light and dark room followed by standing in a dark room 6 inches away, lit room 6 inches away, lit room 2 feet away, then dark room 2 feet away.
Lit room - 6 inches away unlocked 35 out of 40 trials; 1 foot away unlocked 38 out of 40 trials; 2 feet away unlocked 26 out of 40 trials
Dark room - 6 inches away unlocked 36 out of 40 trials; 1 foot away unlocked 38 out of 40 trials; 2 feet away unlocked 24 out of 40 trials

Project ID: 684

JR - Computer Science and Systems Software

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Virtual Piano Teacher - Personalized Piano Lessons

Pianists may not hear their mistakes during their piano practice. How can they visualize their own mistakes every time they play?

The goal of this project was to build a Virtual Piano Teacher that takes the piano teacher's audio and the student's audio of the same song, and then generates a music score that identifies the student's errors. This was accomplished by determining each note onset, predicting the note/chord and duration in each onset, and comparing with the teacher's audio to find the student's errors.

To evaluate my prototype, two datasets were created - training and test. The training dataset had a combined total of 96 piano audio samples from four different songs. Similarly, the test dataset had a combined total of 32 piano audio samples of student audios, where 18 of them contained a combined total of 37 intended pianist mistakes. The initial prototype trained the model only once, which did not yield the desired accuracy for the teacher's audio. The current prototype has been redesigned to find the optimized epoch - the number of time the training process needs to be repeated.

My final design successfully produced a music score highlighting errors from a student's audio. It had 97.6% accuracy for onset detection, note/chord prediction accuracy ranging from 60% to 84.7%, duration prediction accuracy of 92.9% and pianist error detection accuracy of 78.4%. In the future, this prototype can be expanded to include more songs, noise filtering, and other instruments.

Project ID: 685

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Can an Arduino Control a Lamp?

The purpose of this project was to determine if an Arduino could control a voice-controlled lamp. It is hypothesized that an Arduino can control a lamp with voice control. To conduct this experiment, a system was set up by connecting the Arduino, Ratsotoke speaker, and IoT relay. The relay is connected to the grounds of the Arduino and the Ratsotoke speaker is connected to solderless pins in the back and the hardware is ready. The software is coded in by the Arduino IED app and everything is set up. The code turns the lamp on and off with the trained code from the IED app. The results indicated that 85% of all tests were successful in that the Arduino would follow the command to turn on and off the lamp. The success rate could have been higher if more controlled tests were used, such as a quieter environment, measured distance from the microphone, or not using the stock microphone but a better receiving one instead. The result had a common trend after 5 tests, the intake would be overloaded and result in a failure. The success of the Arduino following simple commands may allow or enable further creation and development with Arduino technology and the creation of more compact devices.

Project ID: 686

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Respiratory Sound Classification Using AI

This project uses the ICBHI Challenge dataset to develop machine learning models for respiratory sound and disease classification. The ICBHI challenge dataset consists of a total of 5.5 hours of recordings of participants' breathing containing 6898 respiratory cycles, of which 1864 contain crackles, 886 contain wheezes, and 506 contain both crackles and wheezes, in 920 annotated audio samples from 126 subjects. The project experimented with multiple machine learning models, tuned their configurations, and demonstrated the 4-way classification and diagnosis accuracy performance. Using the machine learning method for respiratory sound classification eliminates the issue of multiple doctors' different/contradicting opinions, and allows more breathing cycles to be factored into the classification as the patients perform self examinations.