CS 540 – DATABASE MANAGEMENT SYSTEMS

CRYPTOGAMBIT PROJECT REPORT

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1. PROJECT GOAL

Cryptocurrency and its trading is already trending all over the world with market capital of more than $350bn. It's a highly fluctuating market and hence best for arbitrage strategy. **Arbitrage** is simultaneous buying and selling of a same asset on different markets/exchanges to take advantage of differing prices. Focus of the project is to identify arbitrage opportunity in cryptocurrency market by capturing and analyzing cryptocurrency quote price data for multiple crypto assets from various exchanges. Arbitrage results will be displayed on the web UI.

2. DATA SOURCE

CoinAPI.io is a platform which provides fast, reliable and unified cryptocurrency data from multiple exchanges. One of the data sets provided is quote price data, for 1500+ crypto assets from 90+ exchanges, which is crucial for derivation of arbitrage opportunity. It supports REST & JSON for on-demand and Websocket protocol for live feed. For this project we have used REST API and JSON data format as live feed requires a paid subscription. The following snippet is a sample JSON object showing quote price data. Quote price service returns array of such JSON objects for all possible unique symbols.

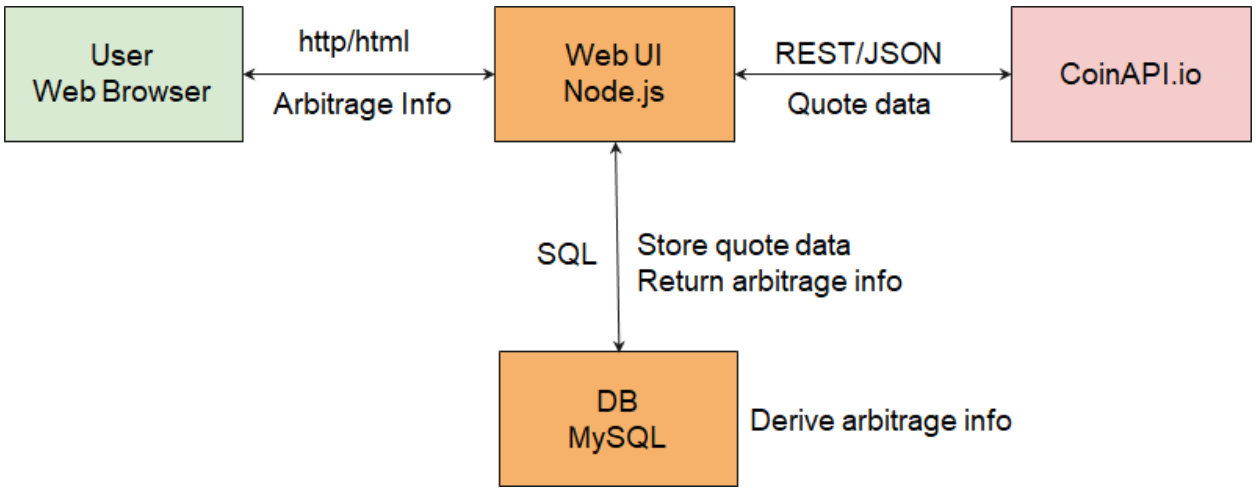

```
{
    "symbol_id": "BINANCE_SPOT_BTC_USDT",
    "time_exchange": "2018-03-17T03:20:25.5870000Z",
    "time_coinapi": "2018-03-17T03:20:25.7025064Z",
    "ask_price": 8225,
    "ask_size": 0.173612,
    "bid_price": 8221,
    "bid_size": 0.009172,
    "last_trade": {
        "time_exchange": "2018-03-17T03:20:24.8670000Z",
        "time_coinapi": "2018-03-17T03:20:24.9523855Z",
        "uuid": "01b10caa-79b8-4638-81c2-bd172584018c",
        "price": 8224.95,
        "size": 0.064391,
        "taker_side": "SELL"
    }
},
```


Here symbol_id is always of the form <exchange_id>_<quote_type>_<asset_base>_<asset_quote>. We are only interested in SPOT prices for this project. Other fields which are of interest are

ask_price (lowest sell price), ask_size (quantity of asset available at ask_price), bid_price (highest buy price), bid_size (quantity of asset available at bid_price). Data returned by CoinAPI.io is latest at the time of service call. Approximately returned data contains 11k records for SPOT quote type.

3. SOLUTION ARCHITECTURE

Node.js is used to develop a web-based UI to present arbitrage opportunities on home page. It also provides a link on the home page to fetch latest quote data from CoinAPI. Fetched quote price data is filtered for SPOT type of records and symbol_id is split into three columns (exchange_id, asset_id_base, asset_id_quote) and finally stored in MySQL server database table named *'quote'*. Arbitrage calculation is performed in a stored procedure named *'FindArbitrageInQuote'* and result is shown on the UI.



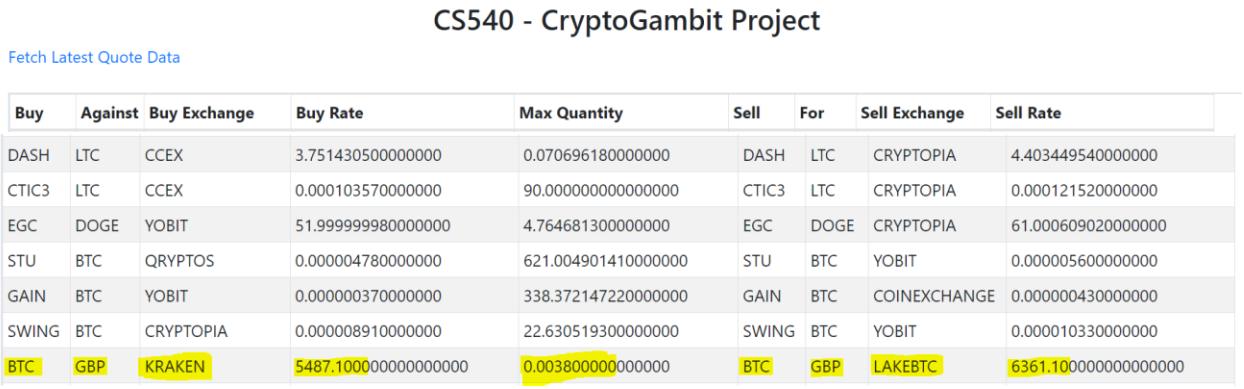
4. ARBITRAGE CALCULATION LOGIC

Stored procedure *FindArbitrageInQuote* first opens a cursor over each distinct pair of *asset_id_base* and *asset_id_quote* from the *quote* table. It also computes minimum of *ask_price* and maximum of *bid_price* for each distinct pair in the cursor query itself. Then it iterates over all crypto asset pairs from the cursor and finds the buy exchange, sell exchange and max quantity. Each record where [max(bid_price) – min(ask_price)] > 0, one record into inserted in temporary '*arbitrage*' table which

is created just to capture the output to be shown on UI. Contents of the temporary table are shown on the UI sorted in the descending order of the price spread percentage.

5. RESULT

Arbitrage opportunities identified in the quote data are shown on the web UI as shown in the below screen shot. Fetch Latest Quote Data link can be used to get latest quote data from CoinAPI and reidentify arbitrage options in new data.



Buy	Against	Buy Exchange	Buy Rate	Max Quantity	Sell	For	Sell Exchange	Sell Rate
DASH	LTC	CCEX	3.751430500000000	0.070696180000000	DASH	LTC	CRYPTOPIA	4.403449540000000
CTIC3	LTC	CCEX	0.000103570000000	90.000000000000000	CTIC3	LTC	CRYPTOPIA	0.000121520000000
EGC	DOGE	YOBIT	51.999999980000000	4.764681300000000	EGC	DOGE	CRYPTOPIA	61.000609020000000
STU	BTC	QRYPTOS	0.000004780000000	621.004901410000000	STU	BTC	YOBIT	0.000005600000000
GAIN	BTC	YOBIT	0.000000370000000	338.372147220000000	GAIN	BTC	COINEXCHANGE	0.000000430000000
SWING	BTC	CRYPTOPIA	0.000008910000000	22.630519300000000	SWING	BTC	YOBIT	0.000010330000000
BTC	GBP	KRAKEN	5487.100000000000000	0.003800000000000	BTC	GBP	LAKEBTC	6361.100000000000000

Each row signified one arbitrage trade opportunity and consists of two recommended transactions. For example, highlighted rows signify –

1. Buy 0.0038 BTC on KRAKEN exchange against GBP at rate 5487.10
2. Sell 0.0038 BTC on LAKEBTC exchange for GBP at rate 6361.10

Though we are only showing best spread prices however such inference can help users to take advantage of other buy/sell rates on these exchanges which are close to these and make more profit.

6. APPLICATION RUN GUIDE

Follow instructions in *Readme.txt* provided in submitted code folder to run code locally or host it on some server. Our project can also be accessed from OSU network at http://flip3.engr.oregonstate.edu:2018/. Please note it takes around 45 seconds to load the UI.

7. CHALLENGES FACED

- Identifying the correct data source
- Optimizing the load time of data in MySQL
- Deducing the logic of arbitrage
- Implementing and mainly optimizing the SQL code to generate output
- Identifying easy way to show inference to the user to be useful

8. FURTHER ENHANCEMENT SCOPE

- Identify arbitrage opportunities among user specified list of exchanges and/or assets
- Procure paid license key of CoinAPI.io and implement same logic with live data feed
- Assess the feasibility of automated trade for identified arbitrage opportunity by utilizing the APIs exposed by popular exchanges