

Trade Surveillance system

Future of Financial Fraud
Prevention

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Project Link:

<https://github.com/ShwetaBarge/TradeSurveillance>



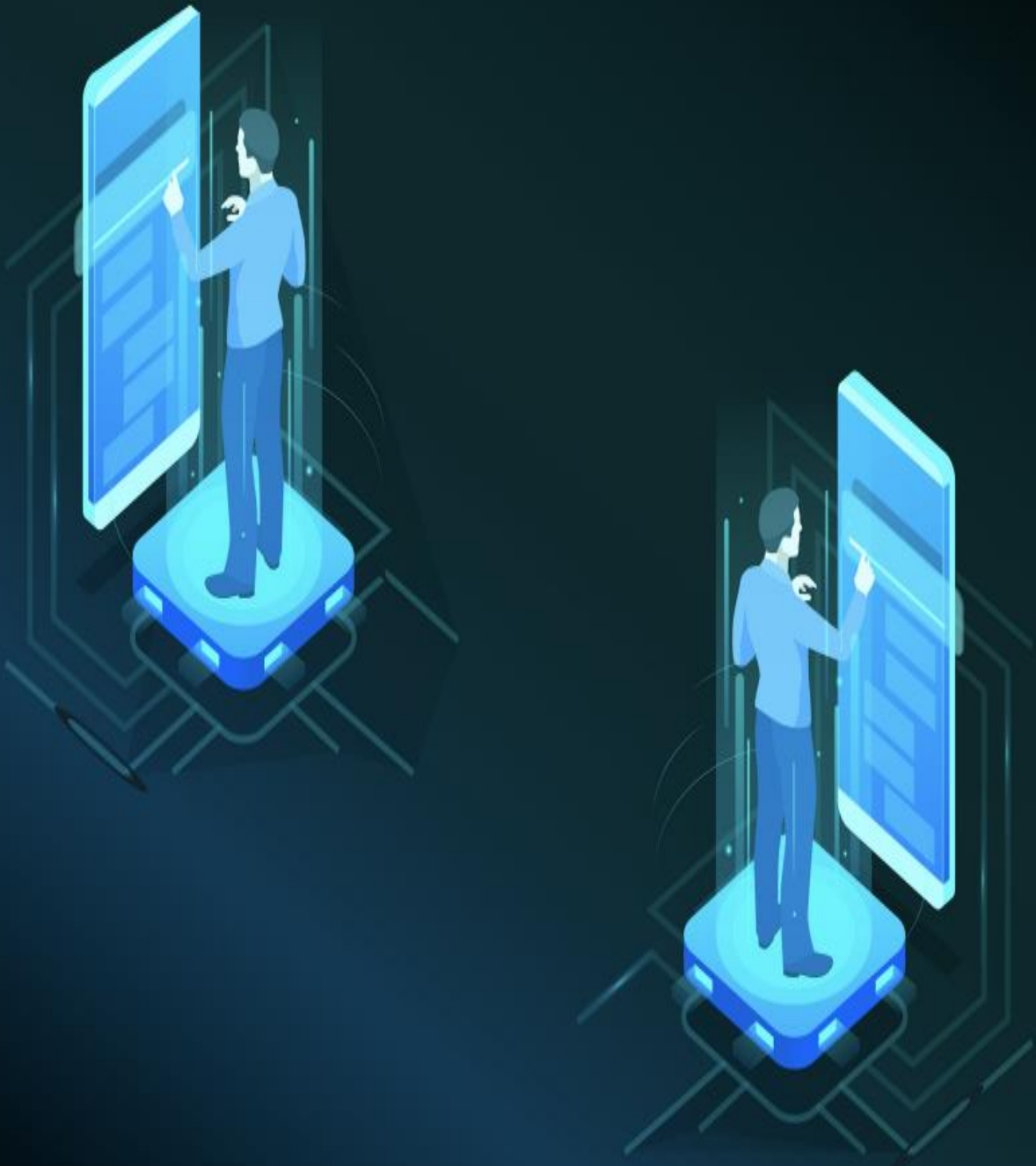
Trade Surveillance System

This project:

1. Detects all possible front running scenarios and wash trades involved in trading activity
2. Provides alerts to middle office surveillance system whenever a fraud action is detected

Project Overview

- ✓ **Front Running Sell-Sell-Buy and Buy-Buy-Sell scenario detection**
- ✓ **Wash Trade Detection**
- ✓ **Identification of Brokers in fraud activities**
- ✓ **Automated Trade surveillance system in middle office to detect all possible front running scenarios**
- ✓ **Fraud report generation of all trades involved in front running scenarios and wash trades**



Front Running Scenario

Any illegal practice of purchasing a security based on advance non public information that will affect price of security.

This project deals with major front running scenarios and provides an alert, if found.

Wash Trade



A trading firm buys stocks or futures contracts, and then sells the same securities.

These offsetting trades draw other traders to the market



The trading firm can distort prices or volume, and profit from those distortion

Wash Trades

Market manipulation in which investor simultaneously sells and buys same financial instruments to create misleading activity in marketplace.

This project detects all wash trades present in the trade list and alerts the surveillance team.

Workflow Model

Front Office

- *Customer places a trade through broker from front office*

Middle Office

After trade confirmation middle office surveillance system analyzes all trades and detects possible fraudulent activities

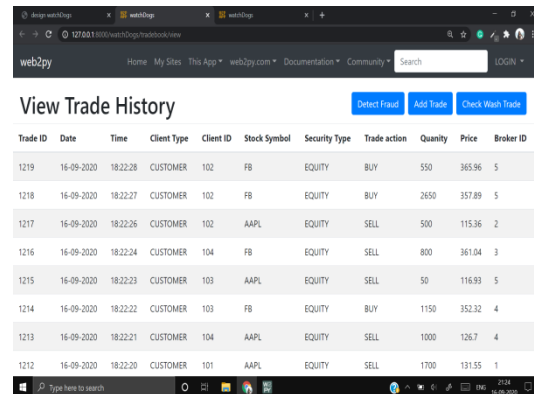
- *Once the fraud is detected Surveillance team cross check and validate the trade and takes action on brokers involved, if any fraud found out to be true.*

USE CASE: Front Running Detection

Front office gets the live trading information

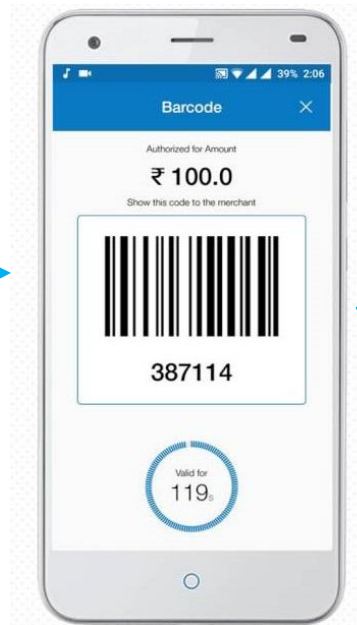
Alert raised on detection of front running scenario

New Trade Action



Trade ID	Date	Time	Client Type	Client ID	Stock Symbol	Security Type	Trade action	Quantity	Price	Broker ID
1219	16-09-2020	18:22:28	CUSTOMER	102	FB	EQUITY	BUY	550	365.96	5
1218	16-09-2020	18:22:27	CUSTOMER	102	FB	EQUITY	BUY	2650	357.89	5
1217	16-09-2020	18:22:26	CUSTOMER	102	AAPL	EQUITY	SELL	500	115.36	2
1216	16-09-2020	18:22:24	CUSTOMER	104	FB	EQUITY	SELL	800	361.04	3
1215	16-09-2020	18:22:23	CUSTOMER	103	AAPL	EQUITY	SELL	50	116.93	5
1214	16-09-2020	18:22:22	CUSTOMER	103	FB	EQUITY	BUY	1150	352.32	4
1213	16-09-2020	18:22:21	CUSTOMER	104	AAPL	EQUITY	SELL	1000	126.7	4
1212	16-09-2020	18:22:20	CUSTOMER	101	AAPL	EQUITY	SELL	1700	131.55	1

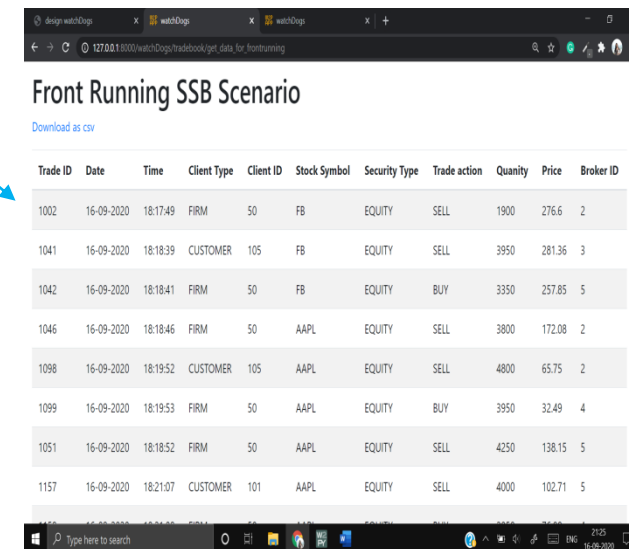
User response to buy or sell financial instrument



Middle Office
2-step verification



Data is processed in the middle office and used to verify front running scenario



Trade ID	Date	Time	Client Type	Client ID	Stock Symbol	Security Type	Trade action	Quantity	Price	Broker ID
1002	16-09-2020	18:17:49	FIRM	50	FB	EQUITY	SELL	1900	276.6	2
1041	16-09-2020	18:18:39	CUSTOMER	105	FB	EQUITY	SELL	3950	281.36	3
1042	16-09-2020	18:18:41	FIRM	50	FB	EQUITY	BUY	3350	257.85	5
1046	16-09-2020	18:18:46	FIRM	50	AAPL	EQUITY	SELL	3800	172.08	2
1098	16-09-2020	18:19:52	CUSTOMER	105	AAPL	EQUITY	SELL	4800	65.75	2
1099	16-09-2020	18:19:53	FIRM	50	AAPL	EQUITY	BUY	3950	32.49	4
1051	16-09-2020	18:18:52	FIRM	50	AAPL	EQUITY	SELL	4250	138.15	5
1157	16-09-2020	18:21:07	CUSTOMER	101	AAPL	EQUITY	SELL	4000	102.71	5

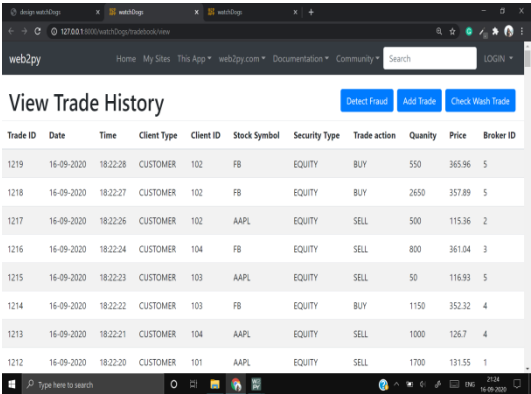
Trade Surveillance team validate the detection and takes necessary action

USE CASE: Wash Trade Detection

Middle office gets the live trading information related to wash trades

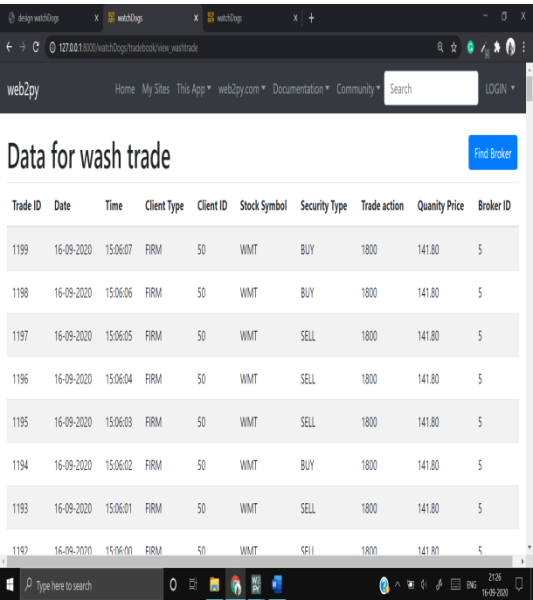
Alert raised on wash trade detection and broker details involved in the trades are sent.

New Trade Action



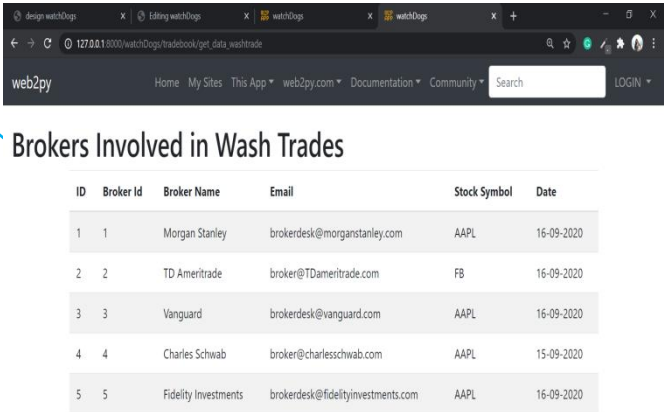
The screenshot shows the 'View Trade History' page in the web2py application. It includes buttons for 'Detect Fraud', 'Add Trade', and 'Check Wash Trade'. Below these is a table of trade history.

Trade ID	Date	Time	Client Type	Client ID	Stock Symbol	Security Type	Trade action	Quantity	Price	Broker ID
1219	16-09-2020	18:22:28	CUSTOMER	102	FB	EQUITY	BUY	550	365.96	5
1218	16-09-2020	18:22:27	CUSTOMER	102	FB	EQUITY	BUY	2650	357.89	5
1217	16-09-2020	18:22:26	CUSTOMER	102	AAPL	EQUITY	SELL	500	115.36	2
1216	16-09-2020	18:22:24	CUSTOMER	104	FB	EQUITY	SELL	800	361.04	3
1215	16-09-2020	18:22:23	CUSTOMER	103	AAPL	EQUITY	SELL	50	116.93	5
1214	16-09-2020	18:22:22	CUSTOMER	103	FB	EQUITY	BUY	1150	352.32	4
1213	16-09-2020	18:22:21	CUSTOMER	104	AAPL	EQUITY	SELL	1000	126.7	4
1212	16-09-2020	18:22:20	CUSTOMER	101	AAPL	EQUITY	SELL	1700	131.55	1



The screenshot shows the 'Data for wash trade' page in the web2py application. It includes a 'Find Broker' button and a table of wash trade data.

Trade ID	Date	Time	Client Type	Client ID	Stock Symbol	Security Type	Trade action	Quantity	Price	Broker ID
1199	16-09-2020	15:06:07	FIRM	50	VMT	BUY	1800	141.80	5	
1198	16-09-2020	15:06:06	FIRM	50	VMT	BUY	1800	141.80	5	
1197	16-09-2020	15:06:05	FIRM	50	VMT	SELL	1800	141.80	5	
1196	16-09-2020	15:06:04	FIRM	50	VMT	SELL	1800	141.80	5	
1195	16-09-2020	15:06:03	FIRM	50	VMT	SELL	1800	141.80	5	
1194	16-09-2020	15:06:02	FIRM	50	VMT	BUY	1800	141.80	5	
1193	16-09-2020	15:06:01	FIRM	50	VMT	SELL	1800	141.80	5	
1192	16-09-2020	15:06:00	FIRM	50	VMT	SELL	1800	141.80	5	



The screenshot shows the 'Brokers Involved in Wash Trades' page in the web2py application. It includes a table of broker details.

ID	Broker Id	Broker Name	Email	Stock Symbol	Date
1	1	Morgan Stanley	brokerdesk@morganstanley.com	AAPL	16-09-2020
2	2	TD Ameritrade	broker@TDameritrade.com	FB	16-09-2020
3	3	Vanguard	brokerdesk@vanguard.com	AAPL	16-09-2020
4	4	Charles Schwab	broker@charlesschwab.com	AAPL	15-09-2020
5	5	Fidelity Investments	brokerdesk@fidelityinvestments.com	AAPL	16-09-2020

User response to buy or sell financial instrument

Middle Office
2-step verification



Data is processed in the middle office and used to verify wash trading scenario

Trade Surveillance team validate the detection and takes necessary action on broker

Algorithm for Trade Data Random Generation

- Initialize stock symbol list , price list
- Initialize size of customer orders
- Select parameters for customer order and store in customer order table
- Traverse customer order table
 - 1.if quantity > threshold
 - choice=commit_fraud
 - if(choice)
 - generate BBS/SSB
 - Add order in tradebook

Algorithm for Front Running Detection

- Retrieve all firm orders and customer orders where $\text{quantity} > \text{threshold}$
- Traverse over firm order
 - Generate nested dictionary on basis of date, action and stock symbol
- Traverse over Customer order
 - if action == buy
 - find buy with lesser timestamp and sell with higher timestamp
 - else
 - find sell with lesser timestamp and buy with higher timestamp
 - if both orders are present
 - check if security type is same
 - Raise alert to middle office team

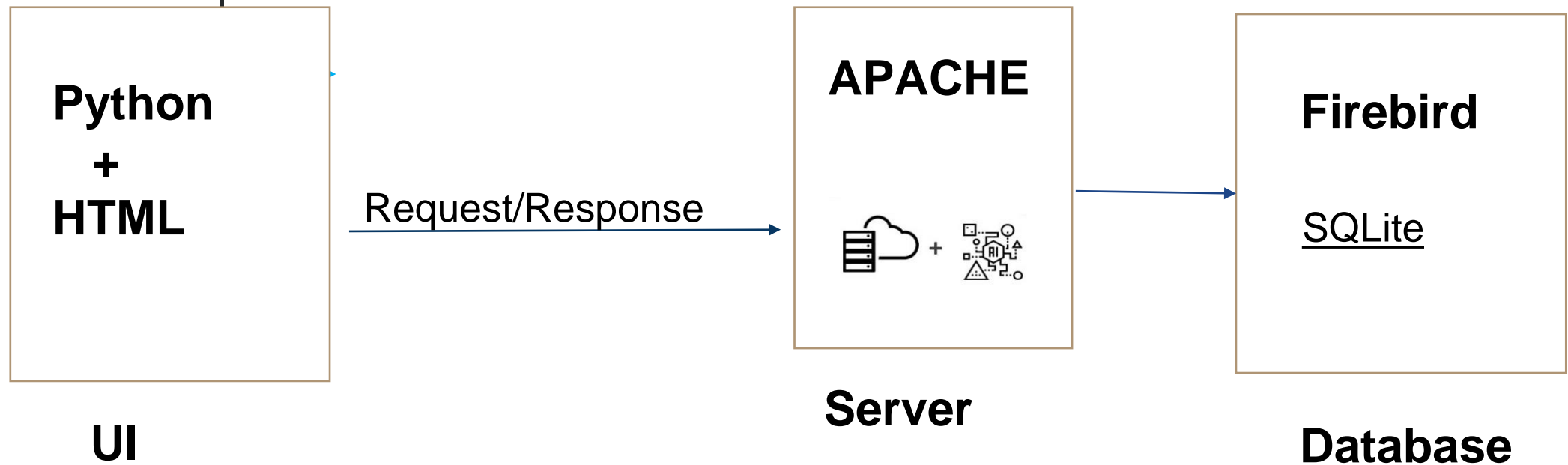
Algorithm for Wash Trade detection

- Retrieve firm orders
- Traverse firm orders
- Segregate order on basis of date, action stock symbol
Calculate security worth = $\text{volume} \times \text{price}$
Assign security worth positive if buy else negative
Traverse dictionary
For every list find size of largest subset with netting zero
if $\text{size} > \text{threshold}$ alert the middle office surveillance team.

TECH STACK

Framework

WEB2PY



Model-View-Controller (MVC) Architectural Pattern

design watchDogs x watchDogs x watchDogs x +

127.0.0.1:8000/watchDogs/tradebook/get_data_for_fronrunning

Front Running BBS Scenario

[Download as csv](#)

Trade ID	Date	Time	Client Type	Client ID	Stock Symbol	Security Type	Trade action	Quantity	Price	Broker ID
1011	16-09-2020	18:18:01	FIRM	50	WMT	EQUITY	BUY	3650	106.13	4
1037	16-09-2020	18:18:34	CUSTOMER	101	WMT	EQUITY	BUY	4900	134.05	3
1038	16-09-2020	18:18:35	FIRM	50	WMT	EQUITY	SELL	4900	138.3	4
1044	16-09-2020	18:18:43	FIRM	50	AAPL	EQUITY	BUY	3800	131.01	4
1045	16-09-2020	18:18:45	CUSTOMER	101	AAPL	EQUITY	BUY	3800	149.7	5
1046	16-09-2020	18:18:46	FIRM	50	AAPL	EQUITY	SELL	3800	172.08	2
1042	16-09-2020	18:18:41	FIRM	50	FB	EQUITY	BUY	3350	257.85	5
1070	16-09-2020	18:19:16	CUSTOMER	103	FB	EQUITY	BUY	4750	276.59	1

Type here to search

21:26 16-09-2020

Results

All the transactions involved in front running buy-buy-sell scenario are detected and alerted to middle office.

design watchDogs x watchDogs x watchDogs x +

127.0.0.1:8000/watchDogs/tradebook/get_data_for_fronrunning

Front Running SSB Scenario

Download as csv

Trade ID	Date	Time	Client Type	Client ID	Stock Symbol	Security Type	Trade action	Quantity	Price	Broker ID
1002	16-09-2020	18:17:49	FIRM	50	FB	EQUITY	SELL	1900	276.6	2
1041	16-09-2020	18:18:39	CUSTOMER	105	FB	EQUITY	SELL	3950	281.36	3
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1098	16-09-2020	18:19:52	CUSTOMER	105	AAPL	EQUITY	SELL	4800	65.75	2
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1157	16-09-2020	18:21:07	CUSTOMER	101	AAPL	EQUITY	SELL	4000	102.71	5
1158	16-09-2020	18:21:08	FIRM	50	AAPL	EQUITY	BUY	3850	76.00	4

Type here to search

21:25 16-09-2020

Results

All the transactions involved in front running sell-sell-buy scenario are detected and alerted to Middle Office.

Brokers Involved in Wash Trades

ID	Broker Id	Broker Name	Email	Stock Symbol	Date
1	1	Morgan Stanley	brokerdesk@morganstanley.com	AAPL	16-09-2020
2	2	TD Ameritrade	broker@TDameritrade.com	FB	16-09-2020
3	3	Vanguard	brokerdesk@vanguard.com	AAPL	16-09-2020
4	4	Charles Schwab	broker@charlesschwab.com	AAPL	15-09-2020
5	5	Fidelity Investments	brokerdesk@fidelityinvestments.com	AAPL	16-09-2020

Results

All the brokers involved in Wash trade are detected and list is delivered to Trade Surveillance team

FRAUD DETECTION REPORT

Date : 2020-09-18

The following report provides a summary of front running and wash trades detected by the system.

This report is generated by the system and the mentioned fraud ids are suggestive and a detailed investigation should be carried out in order to ascertain any wrong doing.

BUY-BUY-SELL FRONT RUNNING FRAUDS

The report presents data for dates : 16-09-2020

Total 6 BUY-BUY-SELL frauds have been detected

Fraud Ids are as follows :

1037,1038,1044,1045,1046,1042,1070,1071,1069,1081,1082,1054,1122,1123,1099,1193,1194

SELL-SELL-BUY FRONT RUNNING FRAUDS

The report presents data for dates : 16-09-2020

Total 4 SELL-SELL-BUY frauds have been detected

Fraud Ids are as follows :

1041,1042,1046,1098,1099,1051,1157,1158,1013,1187,1188

WASH TRADES

The report presents data for dates : 16-09-2020

Total 5 wash trades have been detected

List of brokers :

Fidelity Investments
Vanguard
Morgan Stanley
Charles Schwab
TD Ameritrade

Results

A summary report is generated to middle office team involving fraudulent activities along with trade ID and brokers involved in the activity

THANK YOU