

E6893 Big Data Analytics Lecture 10:

Big Data and AI Applications in Finance Industry

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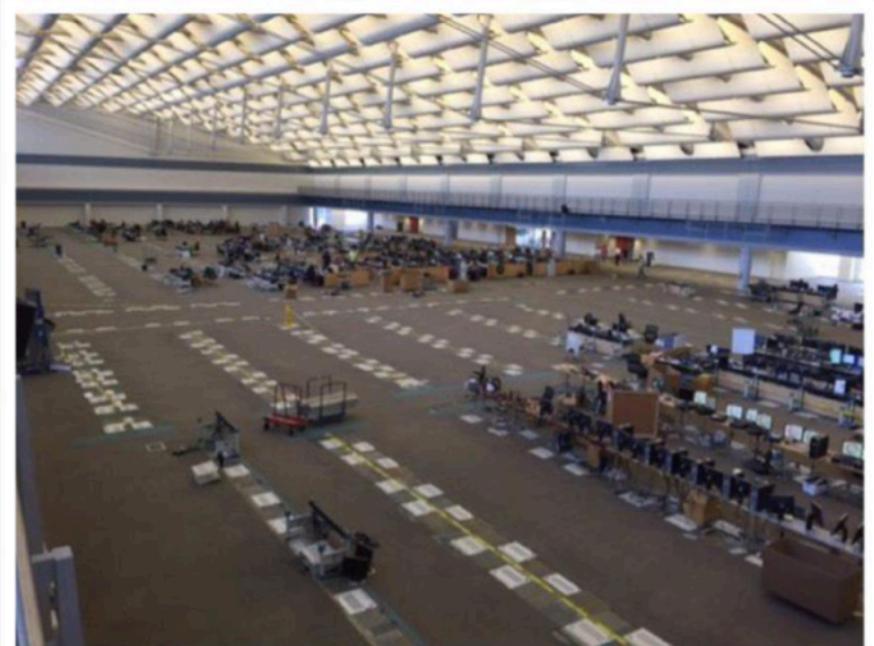


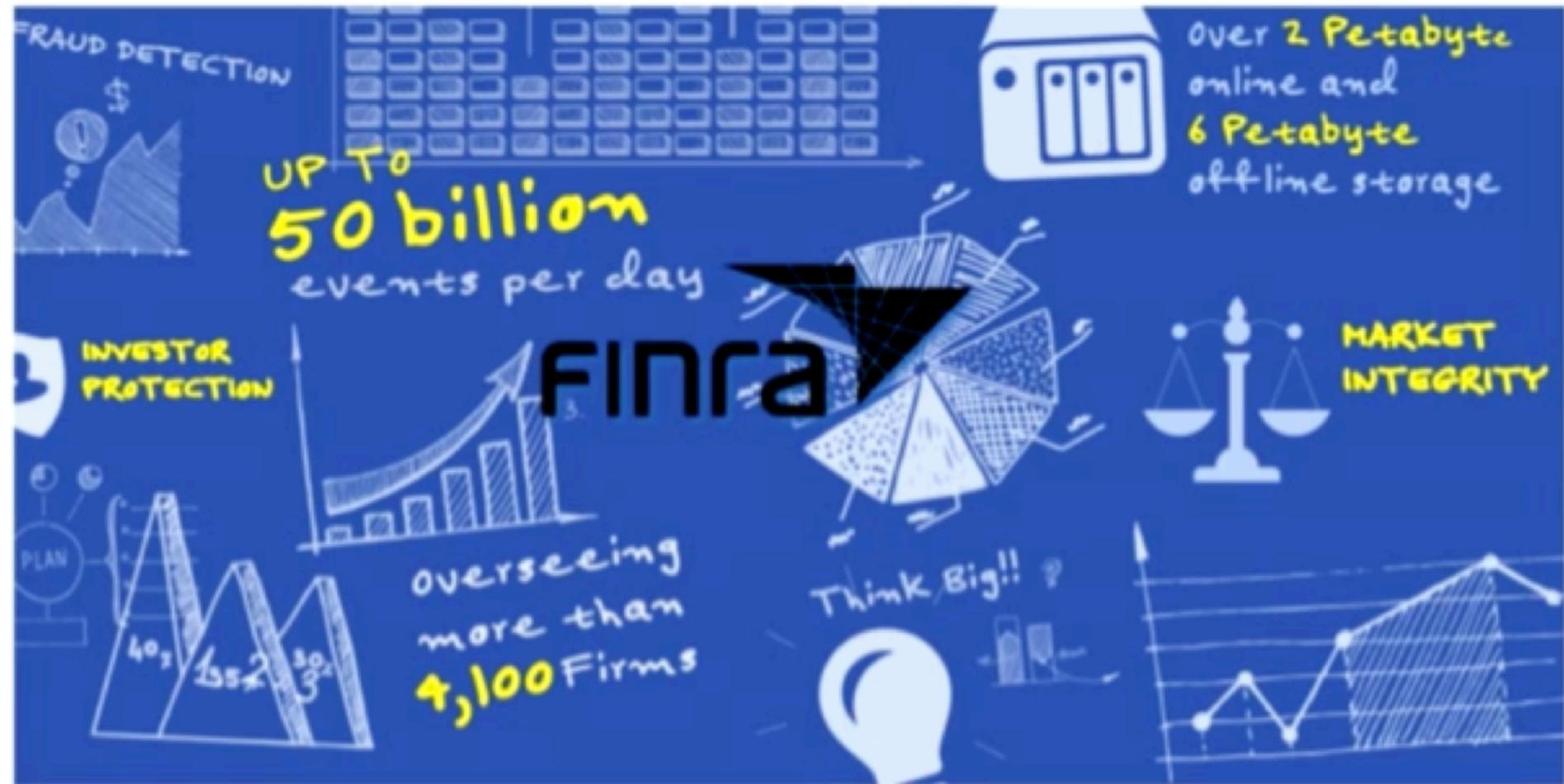
November 15th, 2019

Before



After





- How does FINRA analyze ~50B events per day TODAY? - Build a graph of market order events from multiple sources [\[ref\]](#)

Example: Help reduce AML cost

Tremendous Compliance Costs & Workload

CNN Money U.S. + Business Markets Tech Media Personal Finance Small Biz Luxury Stock Tickers 

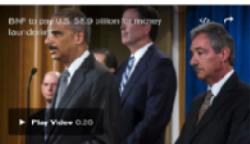
Deutsche Bank fined for \$10 billion Russian money-laundering scheme

by Jethro Mullen @CNINMoneyInvest

January 31, 2017 5:32 AM ET

Business

France's BNP Paribas to pay \$8.9 billion to U.S. for sanctions violations


Play Video 0:20

The U.S. Justice Department announced on Monday that the French bank will pay nearly \$9 billion to settle two criminal charges and submit to a \$1 billion fine for its own charges that violated U.S. sanctions laws. (Reuters)

By Danielle Douglas June 30, 2014

US Federal Reserve for violating anti-money laundering act

All the three branches in New York, Chicago and Silicon Valley were fined

Like 32 Share Tweet G+ Share

By Taiwan News, Staff Writer
2018/01/18 16:58

THU JAN 4, 2018 / 1:38 PM EST

DFS FINES AGRICULTURAL BANK OF CHINA \$215 MILLION FOR VIOLATING ANTI-MONEY LAUNDERING LAWS AND MASKING POTENTIALLY SUSPICIOUS FINANCIAL TRANSACTIONS

December 12, 2016
Contact: Richard Lacoste, 212-709-1691

DFS FINES INTEZA SANPAOLO \$235 MILLION FOR REPEATED VIOLATIONS OF ANTI-MONEY LAUNDERING LAWS

August 16, 2016
Contact: Richard Lacoste, 212-709-1691

DFS FINES MEGA BANK \$180 MILLION FOR VIOLATING ANTI-MONEY LAUNDERING LAWS

48 Days

onboarding new customers

30

Minutes to clear a generated alert

X 20,000

Alerts per day

= 10,000 = 1350 Analysts

Total hours lost per day

The World's Best Cross-Border Investigative Team

ICIJ The International Consortium of Investigative Journalists

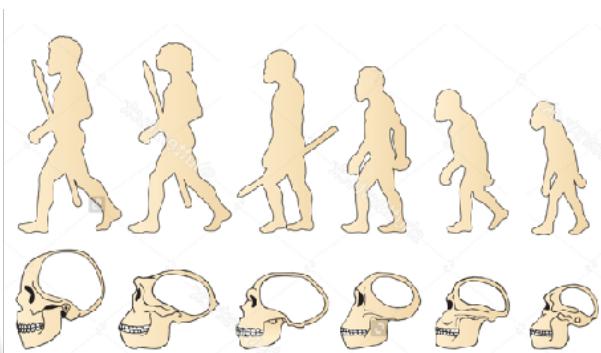
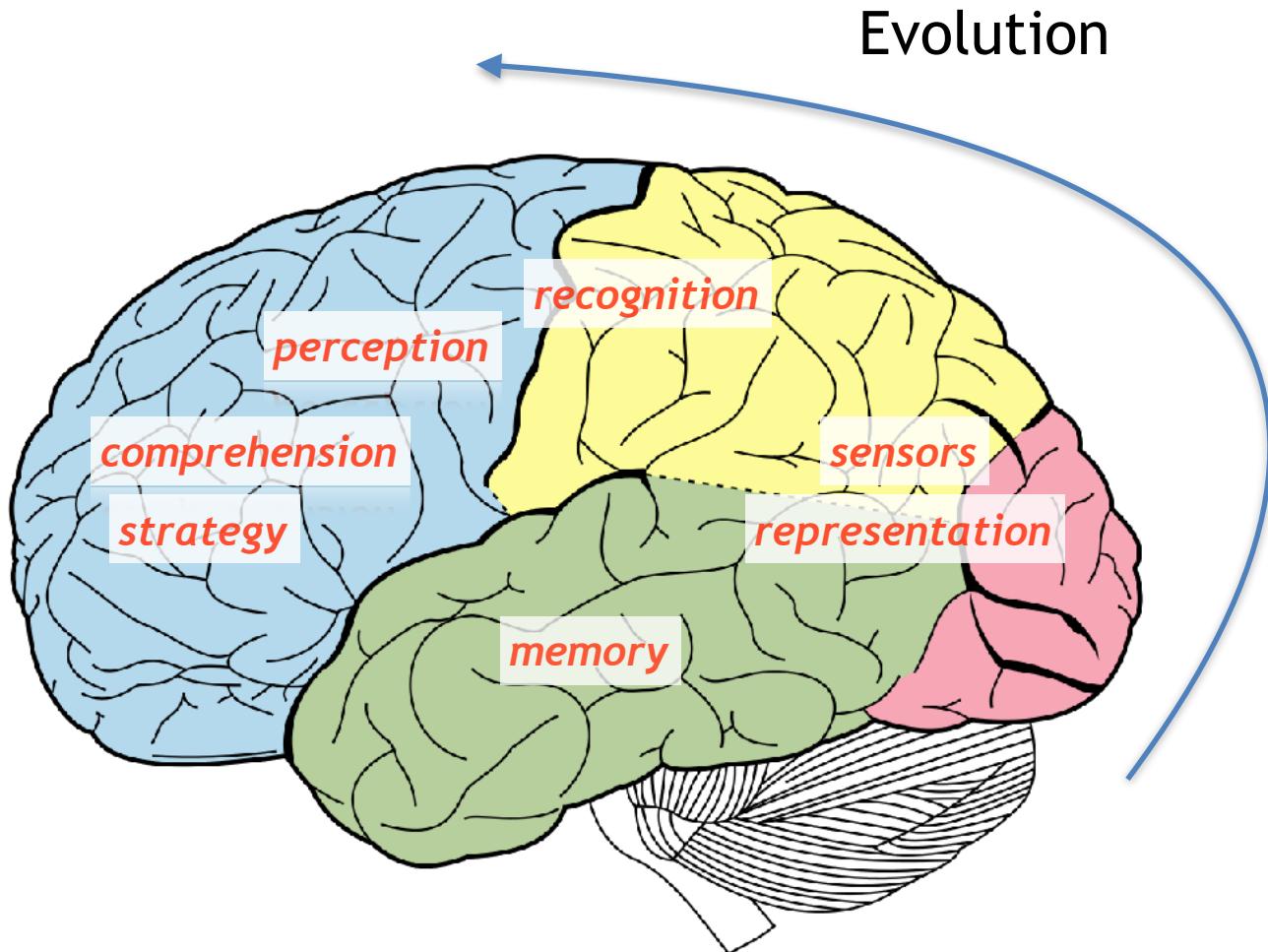
HOME LATEST PROJECTS JOURNALISTS RESOURCES ABOUT ICIJ PRESS KIT LEAK TO US DONATE SEARCH

Data Heist Reveals HSBC's Secrets

Swiss Leaks: Murky Cash Sheltered by Bank Secrecy

- How did journalists uncover the Swiss Leak scandal in 2014 and also Panama Papers in 2016? -- Using graph database to uncover information thousands of accounts in more than 20 countries with links through millions of files [ref]

Animal Intelligence Evolution



Future of AI ==> Full Function Brain Capability

- **Machine Cognition:**

- Robot Cognition Tools
- Feeling
- Robot-Human Interaction

- **Machine Reasoning:**

- Bayesian Networks
- Game Theory Tools

- **Machine Learning:**

- ML and Deep Learning
- Autonomous Imperfect Learning

Most of existing “AI” technology is only a key fundamental component.

- **Advanced Visualization:**

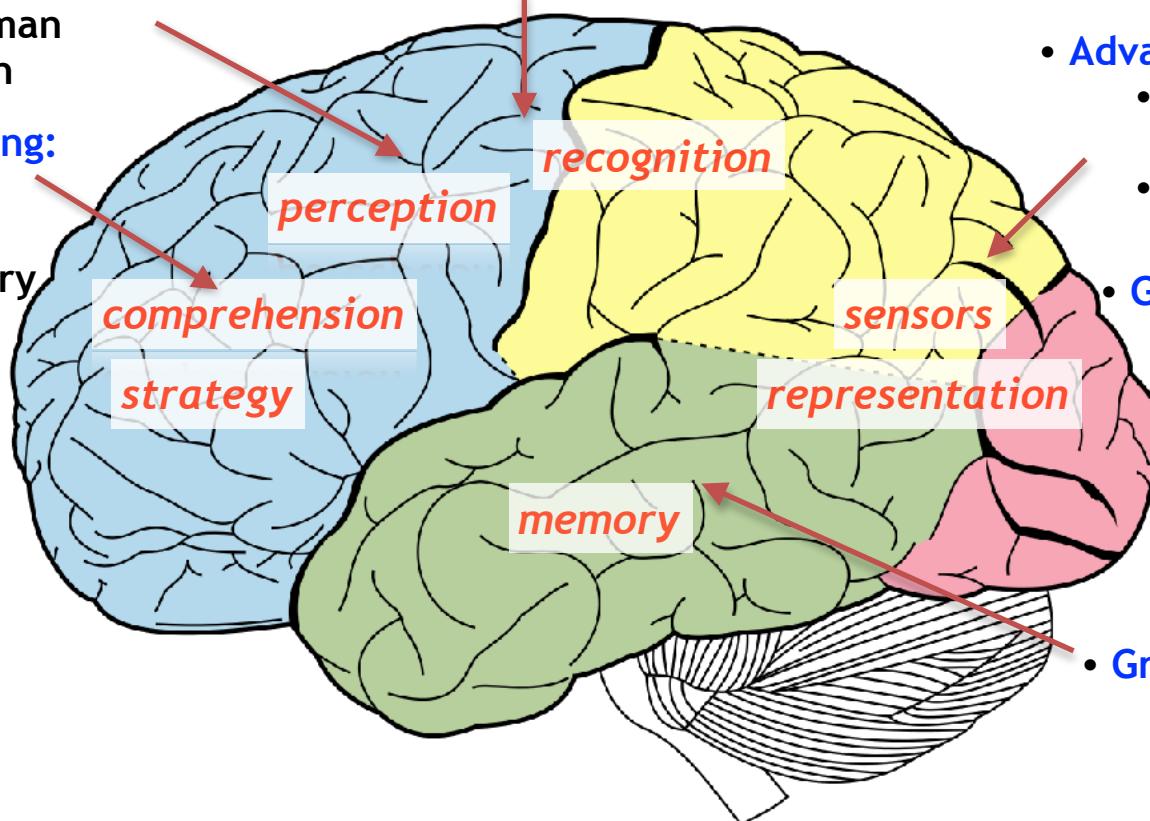
- Dynamic and Interactive Viz.
- Big Data Viz.

- **Graph Analytics:**

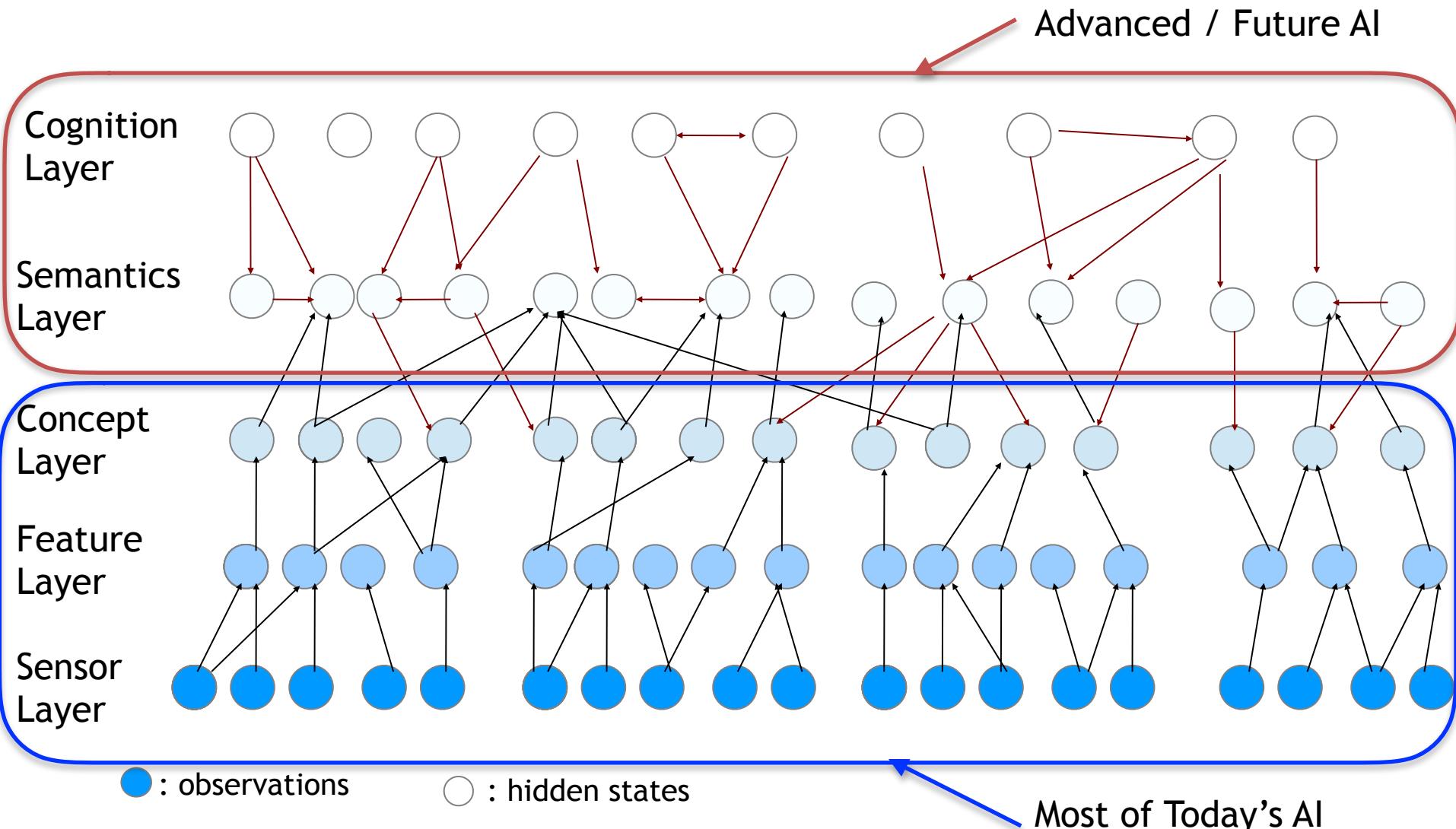
- Network Analysis
- Flow Prediction

- **Graph Database:**

- Distributed Native Database



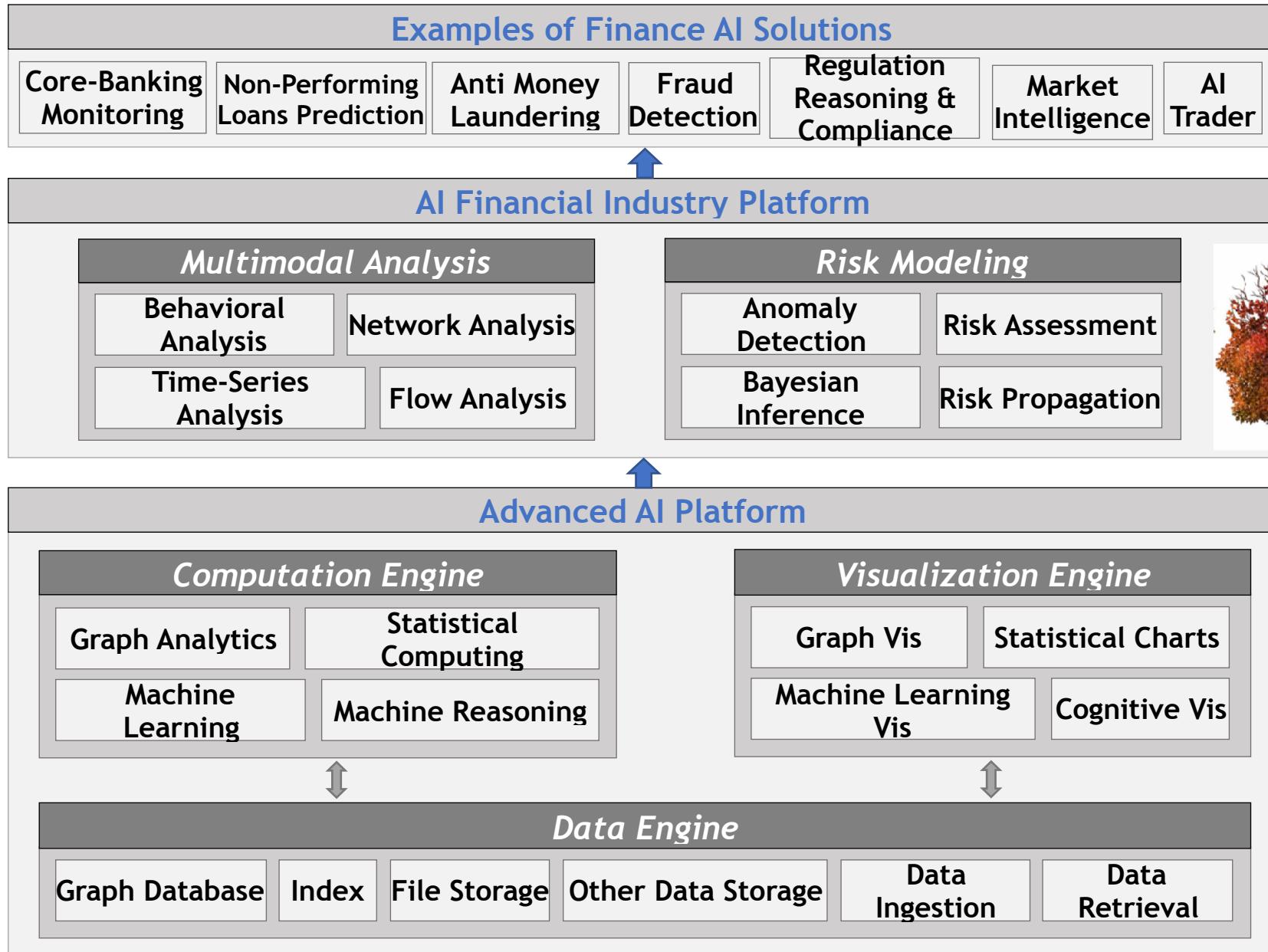
Layers of Artificial Intelligence





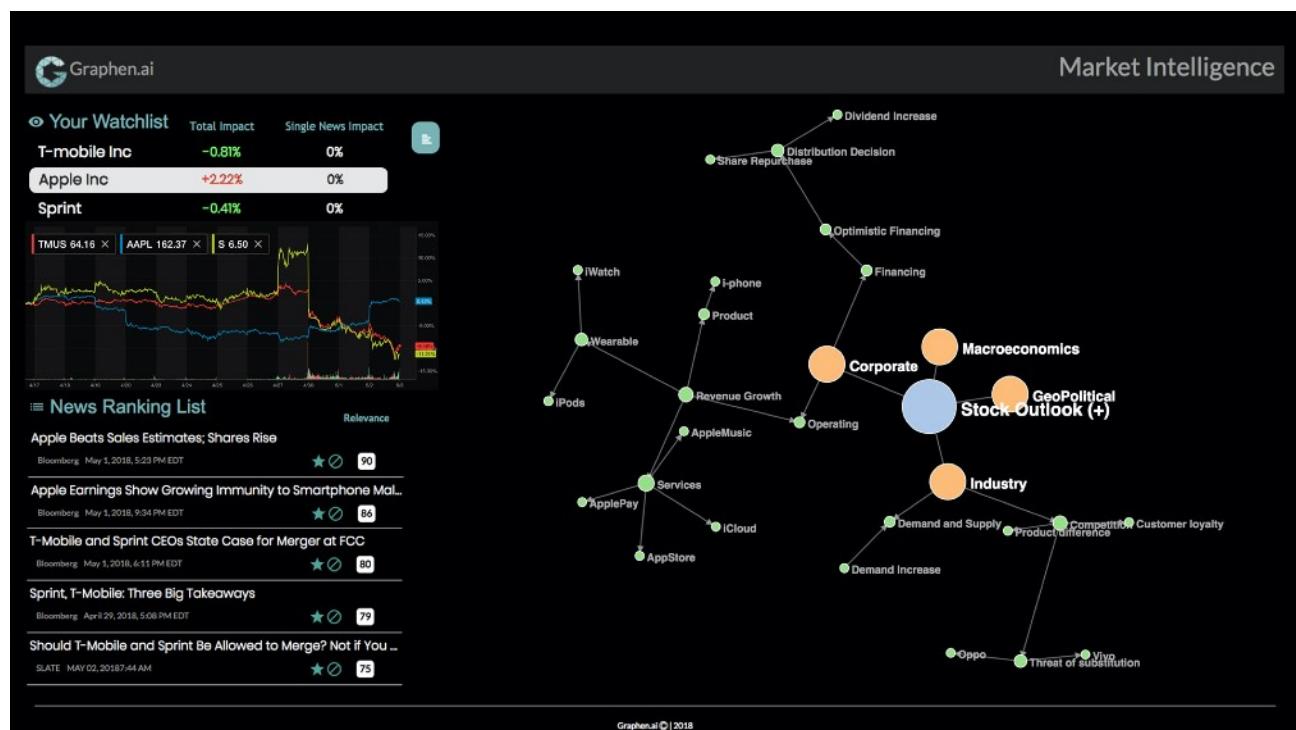
**AI Makes Safer, more Intelligent,
and more Efficient Banks**

Example of AI Finance Platform (Graphen Ardi Platform)



Graphen AI FinTech Examples

- Significantly improved Non-Performing-Loan accuracy rate in one of the world's largest banks (from ~20% prediction accuracy to ~60% accuracy).
- Advanced Anti-Money Laundering for banks — capable of predicting unknown unknowns.
- Detecting Fraud from Real-Time on Transactions in one of the world's largest transaction platform — on the scale of billions.
- Analyzing relationship data for an European bank.
- Cyber and Physical Security for another European bank.





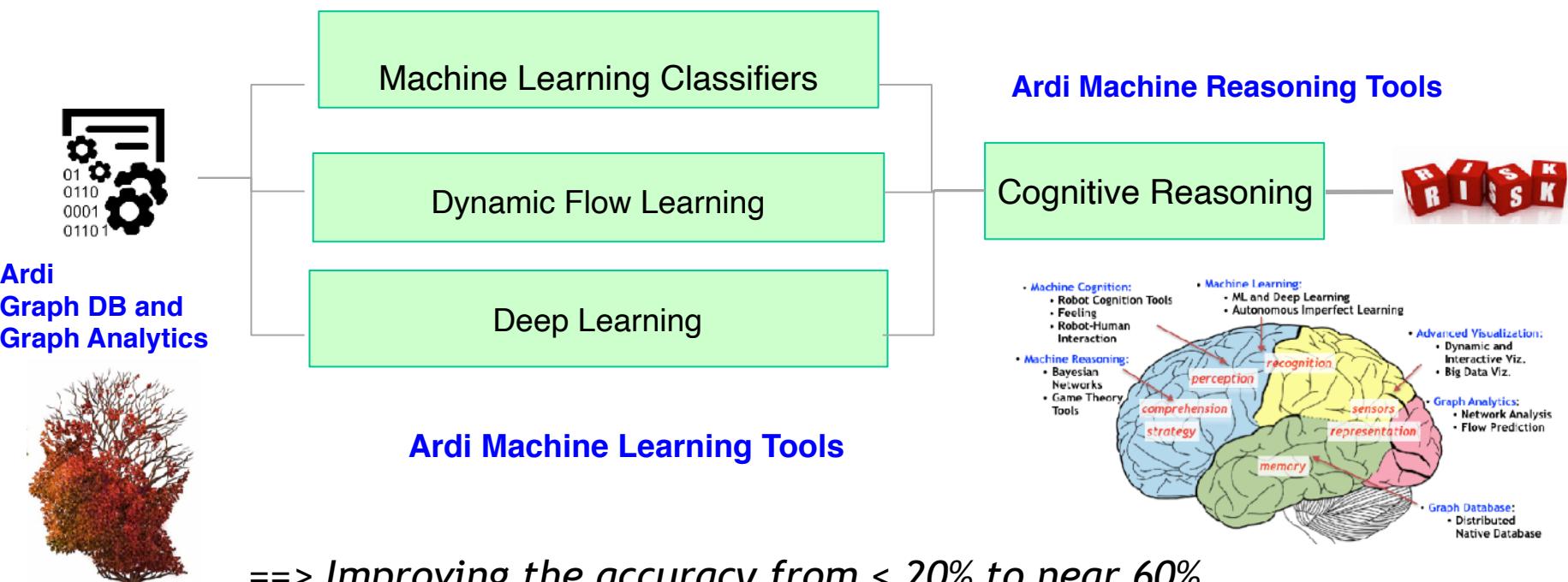
Short Introduction of AI Loan Risk Prediction Solution

Predicting Non-Performing Loans

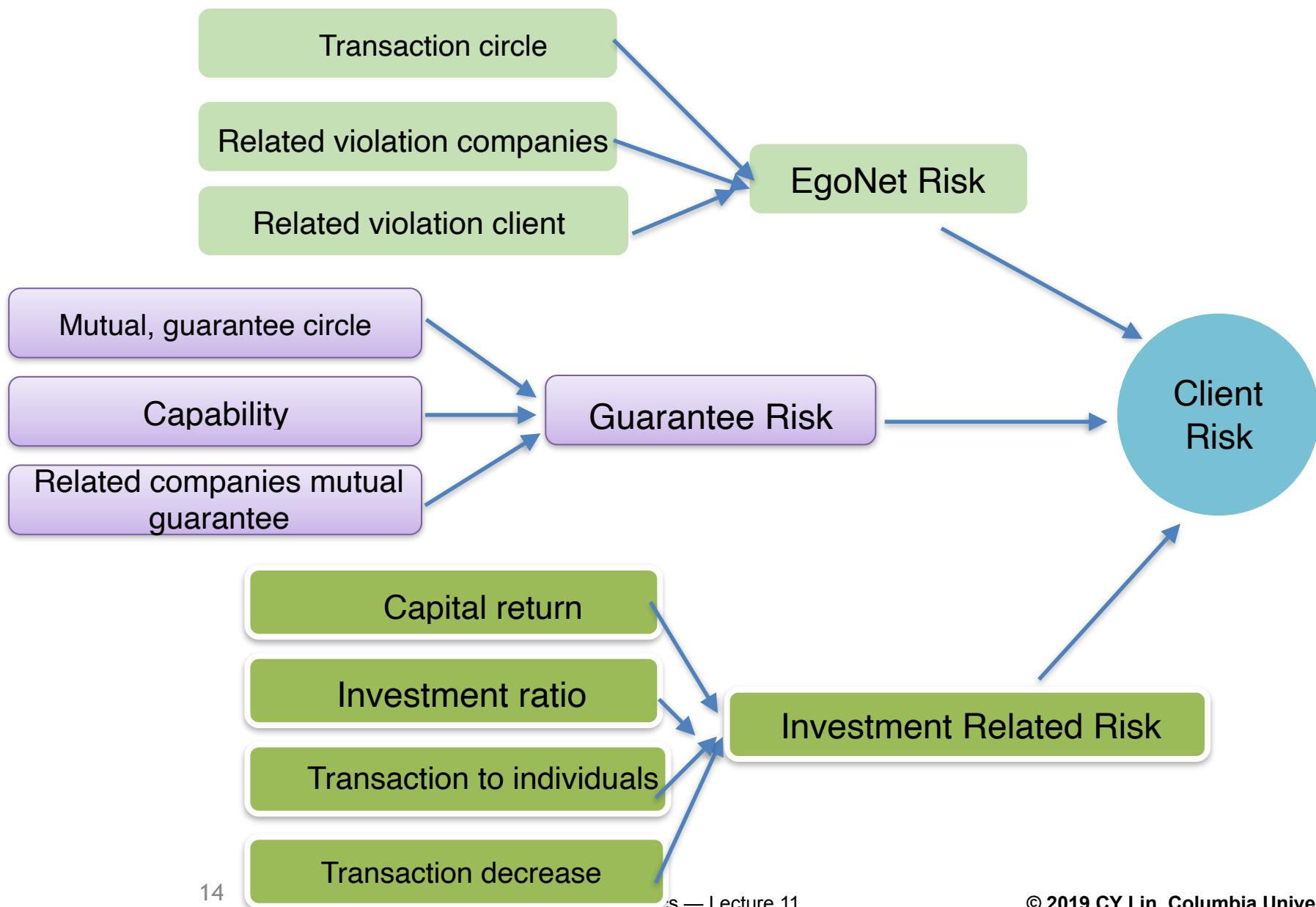
Utilize AI Platform to predict NPL via:

- Mining relationship of customers
- Analyzing all kinds of network topological structure
- Understanding the entities
- Predicting the bad loan flows

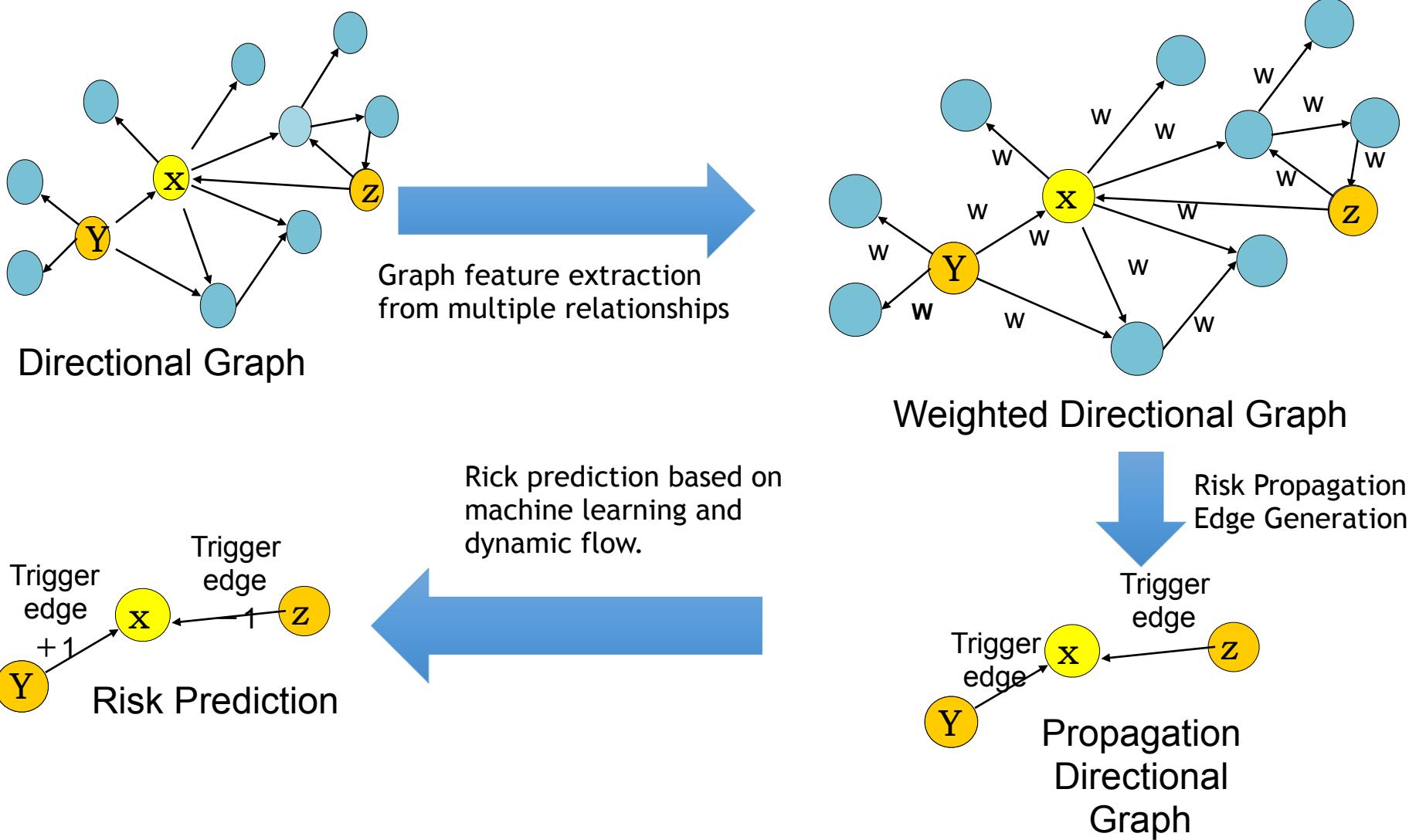
很多时候bad loan不是自己不好，跟周围关系有关
propagate



Debt Performing Analysis to determine the Risk Factors

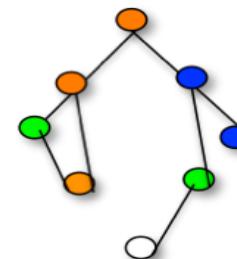


Graph Analysis to Predict Risk

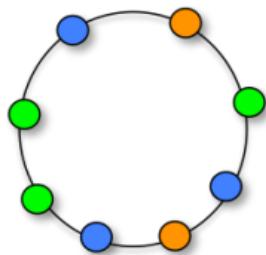


Example of Graph Analytics Library

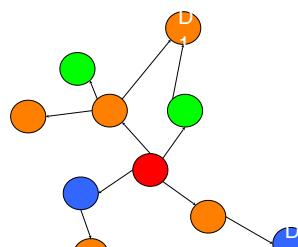
- Breadth First Search (BFS)
- Centrality Computation
- (Strong) Connected Component
- Cycle Detection
- Ego Net
- Pagerank
- Shortest Path (Dijkstra)



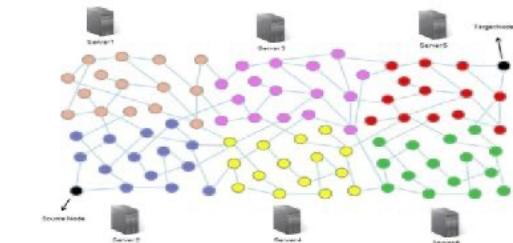
Connected component



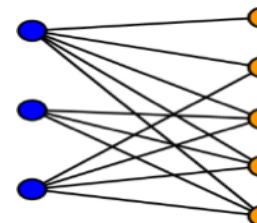
Cycle detection



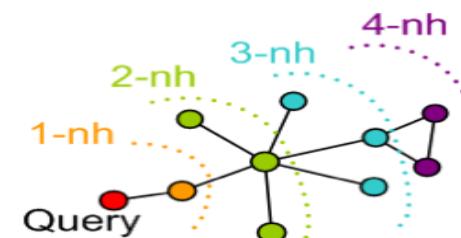
Egonet



Shortest paths



Collaborative filtering



K-neighborhood



Introduction of AI Anti-Money-Monitoring Solution

AML Challenges Banks Are Facing Now

Increased Regulatory Expectations & Enforcement of Current Regulations

- AML laws and regulations keep evolving and become increasingly daunting. AML programs and IT systems need to be updated to ensure effectiveness and efficiency.
- Regulated institutions have to address recent regulatory changes to ensure that their transaction monitoring and filtering programs are designed to comply with regulatory standards and expectations.

According to a survey conducted by Dow Jones and ACAMS on 812 respondents in 2016, 60% of respondents cited this as the greatest AML compliance challenge. Over 75% of respondents cited FinCEN's proposed Beneficial Owner Rules as a contributor to **increased workloads and shortage of trained staff**, followed by FATCA, other tax evasion legislation and Fourth EU Anti-Money Laundering Directive.

On Dec. 21st 2016, the European Commission proposed a series of legislative proposals, hoping to strengthen the EU's legal framework for anti-money laundering, controlling illegal cash flow, and freezing confiscation of illegal assets, thus strengthening the EU's efforts to fight against terrorism and organized crime.

According to ACAMS 2017 survey, financial institutions in U.S. have had to perform sweeping overhauls of their customer screening, monitoring and reporting processes courtesy of the U.S. Treasury's Office of Foreign Asset Control (OFAC). Changing OFAC priorities have significantly impacted operations for 53 percent of survey respondents who regularly engage in sanctions screening.

On Jul. 25 2016, the Monetary Authority of Singapore (MAS) stated that it will step up anti-money laundering controls and take prompt actions against the banking industry. Previous investigations have revealed that several financial institutions based in Singapore involved funds related to the 1MDB scandal.

2017 AML Penalties -- I

Date	Punished Agency	Regulatory Agency	CCY	Amount
13-Jan-17	Toronto Dominion Bank of Canada	U.S. Treasury Department Overseas Control Office	USD	520,000
19-Jan-17	Western Union Financial Services	U.S. Financial Crime Enforcement Agency	USD	184,000,000
30-Jan-17	German Deutsche Bank	New York State Financial Services Bureau	USD	425,000,000
30-Jan-17	German Deutsche Bank	UK Financial Conduct Authority	GBP	163,000,000
9-Feb-17	Japan Mitsubishi Tokyo Union Bank	British Prudential Regulation Authority	GBP	17,850,000
16-Feb-17	Tabcorp	Australian Trading Report and Analysis Center	AUD	45,000,000
17-Feb-17	Australian Trading Report and Analysis Center	Florence, Italy Prosecutor	EUR	600,000
27-Feb-17	California Merchants Bank	U.S. Financial Crime Enforcement Agency	USD	7,000,000
7-Mar-17	Guangdong Securities	Hong Kong Securities Regulatory Commission	HKD	3,000,000
14-Mar-17	Sino-Thai International Securities	Hong Kong Securities Regulatory Commission	HKD	2,600,000
5-Apr-17	Guoyuan Securities Broker (Hong Kong)	Hong Kong Securities Regulatory Commission	HKD	4,500,000
11-Apr-17	British Careers Bank	Hong Kong Monetary Authority	HKD	7,000,000
26-Apr-17	Irish Union Bank	Irish Central Bank	EUR	2,200,000
22-May-17	National Bank of Mexico, United States Branch	United States Department of Justice	USD	97,440,000
30-May-17	German Deutsche Bank	Federal Reserve Board	USD	41,000,000
30-May-17	Irish Bank	Irish Central Bank	DUR	3,150,000

2017 AML Penalties - II

Date	Punished Agency	Regulatory Agency	CCY	Amount
31-May-17	Credit Suisse Bank	Singapore Financial Regulatory Commission	SGD	700,000
31-May-17	Singapore UOB Bank	Singapore Financial Regulatory Commission	SGD	900,000
3-Jun-17	BNP Paribas	French Prudential Supervision Association	EUR	10,000,000
16-Jun-17	Bank of China Milan Branch	Italian tax authorities and the Ministry of Economic Affairs	EUR	20,000,000
22-Jun-17	Edmund Rothschild Group, Switzerland	Luxembourg Financial Supervision Commission	EUR	9,000,000
6-Jul-17	Latvian Rito Bank	A court in Paris	EUR	80,000,000
27-Jul-17	Bitcoin Trading Platform btc-e	U.S. Financial Crime Enforcement Agency	USD	110,000,000
3-Aug-17	Australian Commonwealth Bank	Australian Trading Report and Analysis Center	AUD	18,000,000
7-Sep-17	Habib Bank of Pakistan	New York State Financial Services Agency	USD	225,000,000
29-Sep-17	Real Madrid multibank	Panama Banking Authority	USD	300,000
1-Nov-17	Lone Star Bank	U.S. Financial Crime Enforcement Agency	USD	2,000,000
27-Nov-17	Italy Union Bank of Sao Paulo	Irish Central Bank	EUR	1,000,000
21-Dec-17	Merrill Lynch	U.S. Securities and Exchange Commission	USD	13,000,000
21-Dec-17	Korea Agricultural Association Bank	New York State Financial Services Agency	USD	11,000,000
21-Dec-17	Danske Bank	Danish Severe Economic and International Crime Control Agency	DKK	12,500,000

Source: <http://www.yangqiu.cn/HT-AML/4007141.html>

AML Challenges Banks Are Facing Now

Legacy/Outdated Systems & Inaccurate Results

- Financial institutions are saddled with legacy AML compliance systems that were built piecemeal and can no longer meet current needs and regulatory expectations.
- The work flow involves multiple separate IT systems and databases and thus requires significant manual work for data integration and retrieval.
- Previous AML systems have limited capability to uncover hidden relationships among customers and accounts.
- Rules are often created based on specific scenarios but don't consider different contexts of individuals, resulting in many **false positives** which make alert review labor-intensive and time consuming.

Average time to clear a generated alert requires 19 mins in 2016. For a bank reporting 10,000 alerts per day, it's a lost of 3,167 hours.

	2013	2015	2016
Cost issues	38%	40%	46%
Too many false-positive alerts	48%	47%	45%
Too many false-negative alerts	40%	40%	43%
Poor customer service/roadmap	31%	33%	36%
Consolidation of software across risk areas	32%	38%	35%
Enterprise technology consolidation	33%	34%	35%
Inability to handle non-Latin script	10%	12%	11%

Source: Dow Jones & ACAMS 2016

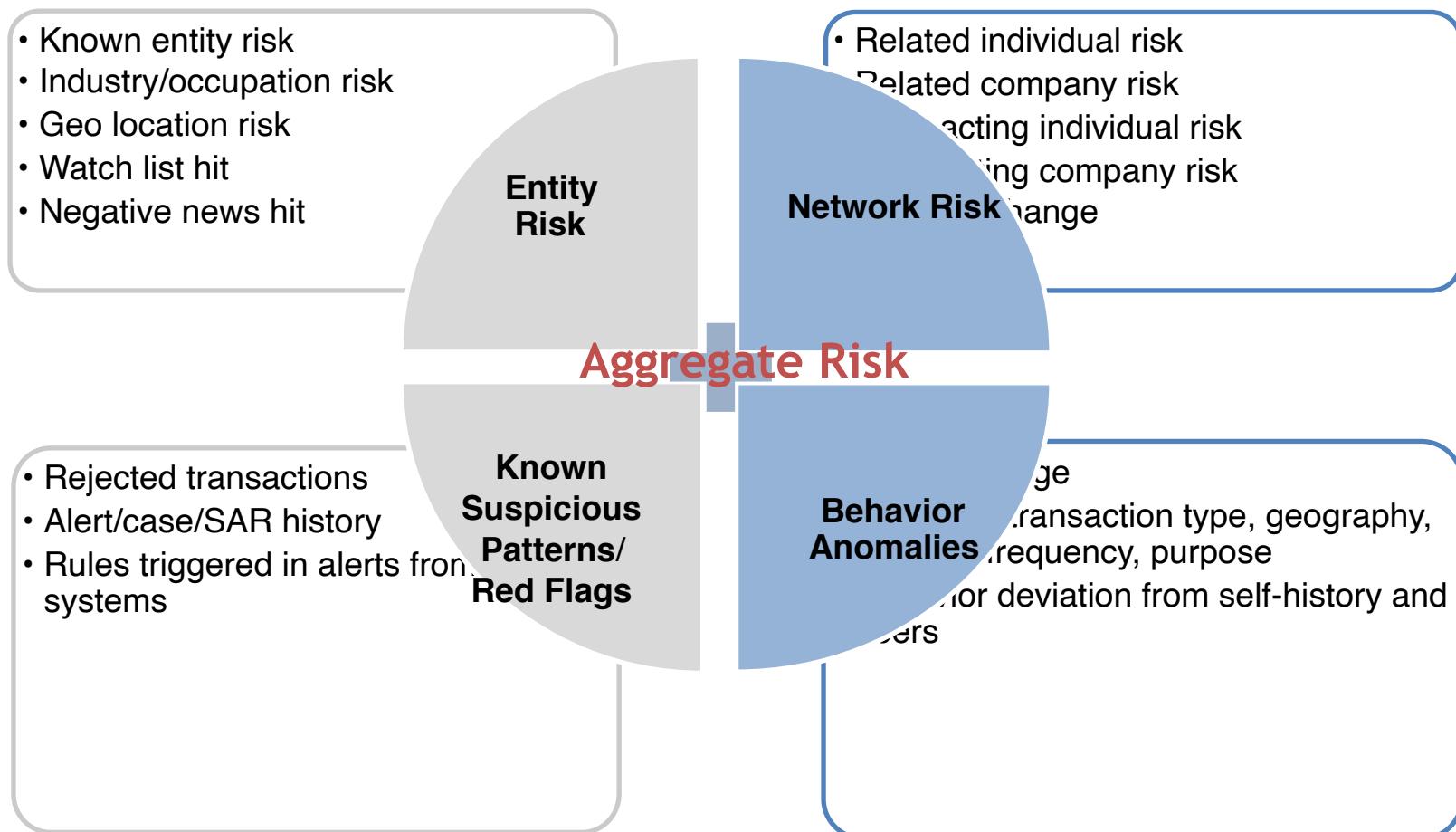
AML Challenges Banks Are Facing Now

New Money Laundering Techniques – Unknown Unknowns

- Money launderers change techniques over time, and FATF has to update its recommendations every couple of years.
- The use of proxy servers and anonymizing software makes the third component of money laundering, integration, almost impossible to detect, as money can be transferred or withdrawn leaving little or no trace of an IP address.
- The use of the internet allows money launderers to easily avoid detection. The rise of online banking institutions, anonymous online payment services, peer-to-peer transfers using mobile phones and the use of virtual currencies such as Bitcoin have made detecting the illegal transfer of money even more difficult.
- Adding rules to cover newly discovered money laundering techniques and patterns requires a lot of manual work.
- Rule-based transaction screening system can only identify suspicious transactions with known patterns; however, there are always new money laundering techniques. It is very important for banks to catch the “**unknown unknowns** (things we don’t know we don’t know)”.

How does Graphen AI Help AML?

- Automatically considers features from multiple aspects to more accurately assess the risk of each party.
- Automatically builds activity-based behavior models, analyzes every party's current behavior in the context of self-history and the behavior of peers, and identify behavior outliers.



Where Can AI Help AML?

AI-Powered AML System

Traditional AML System

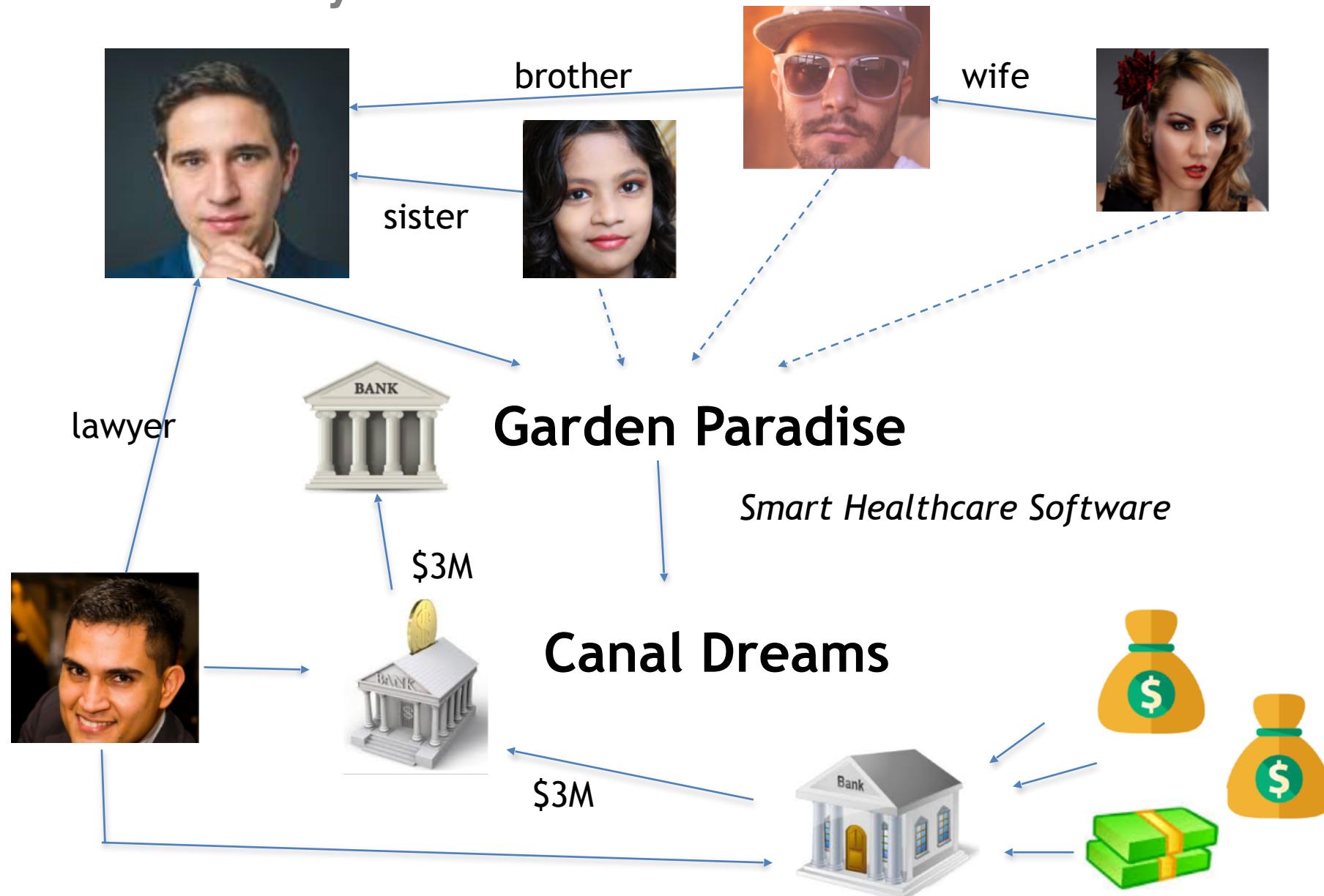
		SAR	No SAR
		SAR	No SAR
SAR	SAR	<ul style="list-style-type: none"> Both systems agree on SAR. 	<ul style="list-style-type: none"> Finds “unknown unknowns” by detecting outliers and identifying abnormal patterns. Reduces the risk of AML compliance failure.
	No SAR	<ul style="list-style-type: none"> Reduces “false positives” via automatic EDD and in-context analysis of accounts and parties. Reduces manual workload to filter false alarms. Improves efficiency with aggregate risk ranking and automatic retrieval of case-relevant data for investigation 	<ul style="list-style-type: none"> Both systems agree on no SAR.

Use Case Story

Jose Rose is a drug dealer from Central America living in New York. In order to send his money to US, he set up a Company – Garden Paradise in New Jersey. Its legal representative and managers are Mr. Rose and his relatives. He opened an account at a local C Bank in Jersey City. However, the company's book seemed to have failed to explain Mr. Rose's huge annual income. So he needed a money laundering plan, executed in five steps:

1. Over a few years, he slowly transported huge sums of money to Panama through various means to Bank A (via mail, shipping, entrained in various goods).
2. Mr. Rose flew to Panama to find a lawyer and set up a Company - Canal Dreams, with an account opened at Bank B in Panama.
3. Mr. Rose represents Garden Paradise to negotiate with Canal Dreams. They 'discussed' selling a service contract of Smart Healthcare software to Garden Paradise and finally signed a contract of 3 million US dollars.
4. At this point, Mr. Rose's secretly authorized lawyer transferred the money he has deposited in Bank A to Canal Dreams' account in Bank B.
5. Wait until the legal procedures were completed. The money was then transferred from Bank B account to Mr. Rose's C Bank account in New Jersey.

Use Case Story



AI: How they related to each other?



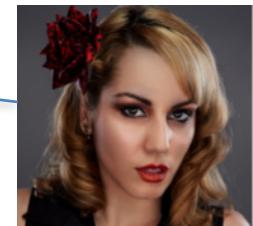
brother



sister



wife



AI: Who are their employees?

AI: What are their relationships? What did they discuss in legal documents?



Garden Paradise

AI: What did they sell? Any other 'related' customers?



\$3M

AI: Is this company capable of creating expensive software?

Canal Dreams

AI: Is it related to Healthcare business?



User Interface Demo (I)

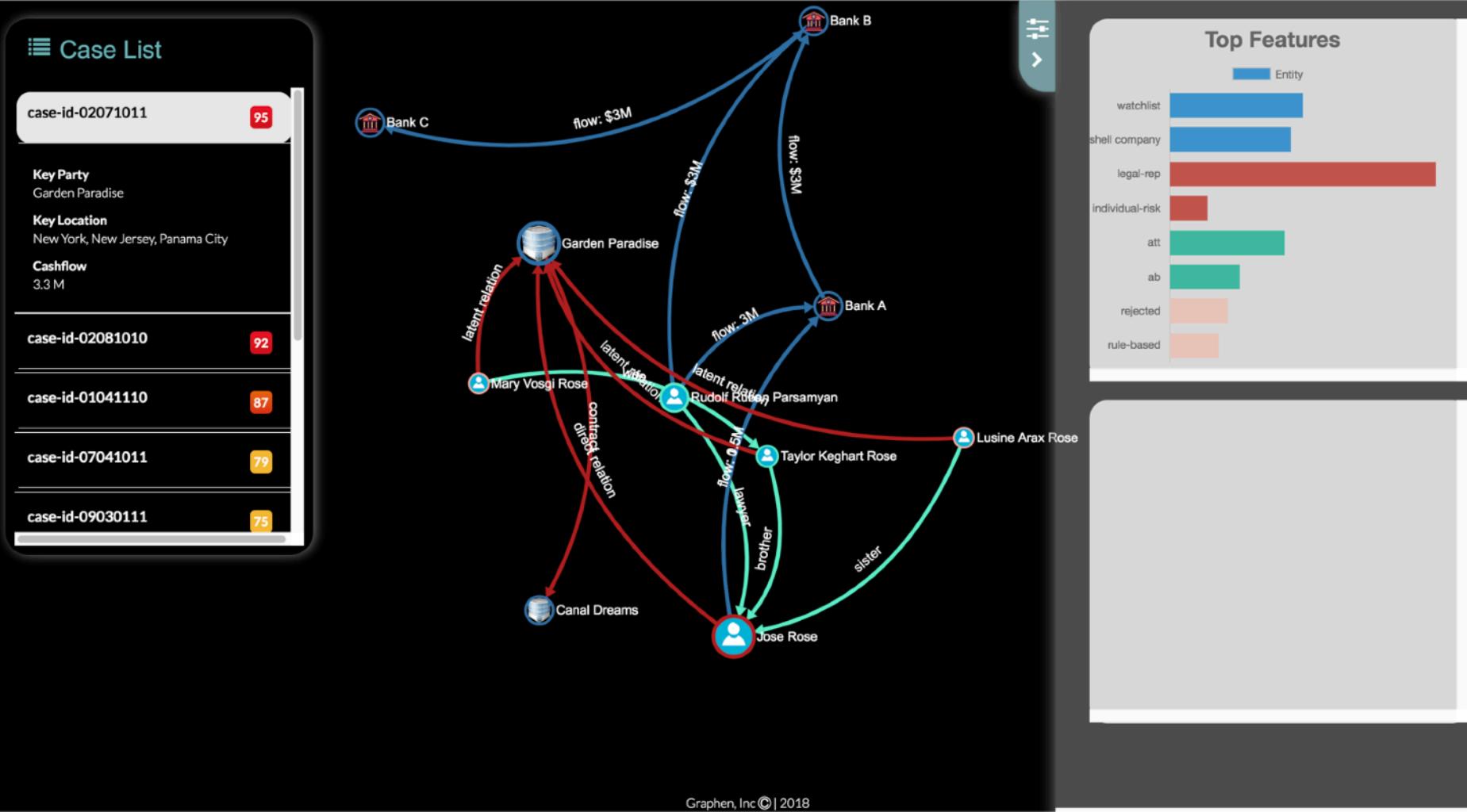
 Graphen AML Solution



- Highlight the most suspicious case, including the involved entities,

User Interface Demo (II)

 Graphen AML Solution

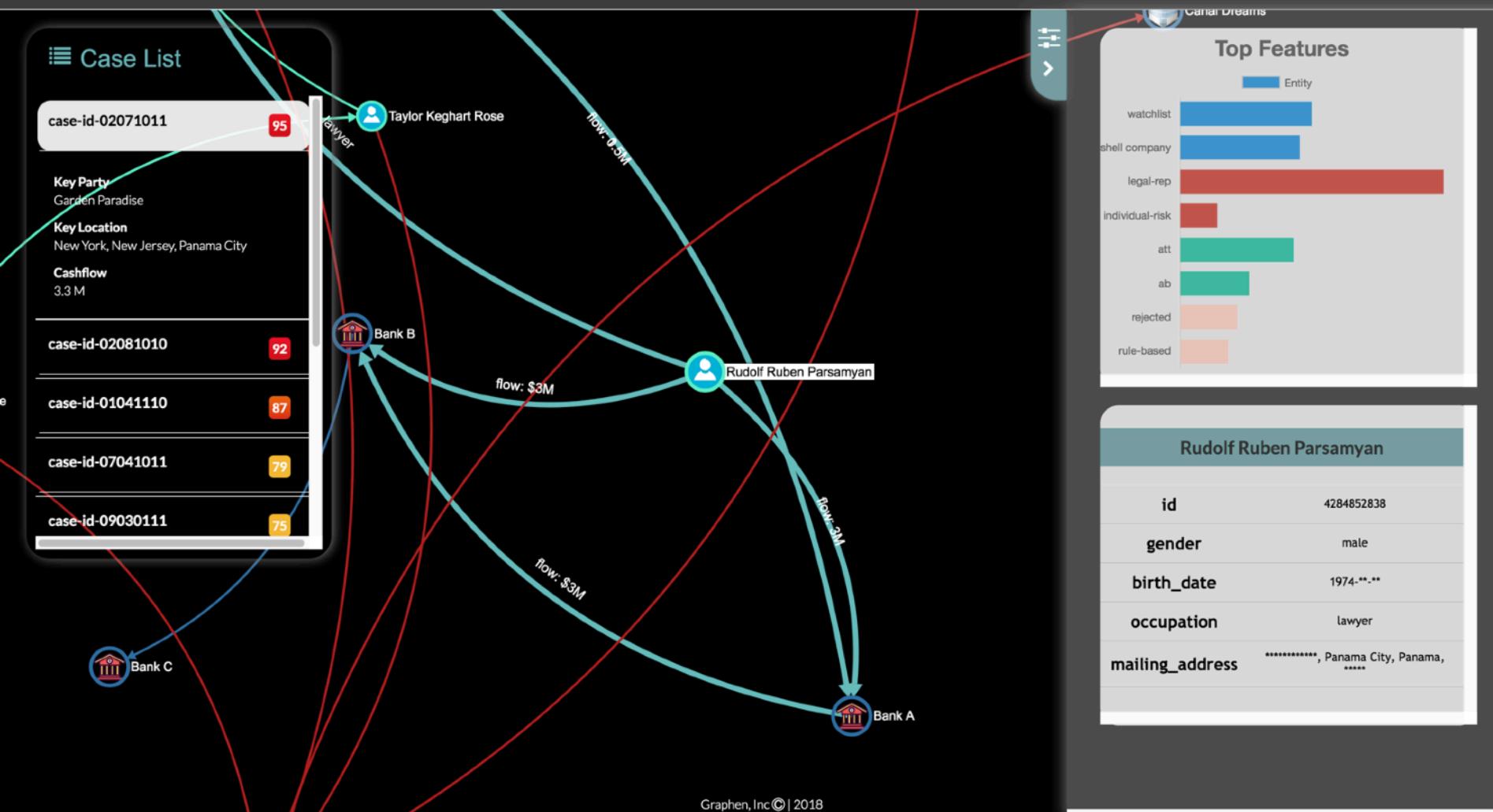


Graphen, Inc © | 2018

- Show top anomaly features of the four categories: entity, network, pattern, and behavior. Highlight abnormal relationships in the graphs.

User Interface Demo (III)

 Graphen AML Solution



- Investigate suspicious individuals

How Can AI Help Reduce False Positives?

Example

A party has 5 international wire transfers of \$10K+ each time within last month.

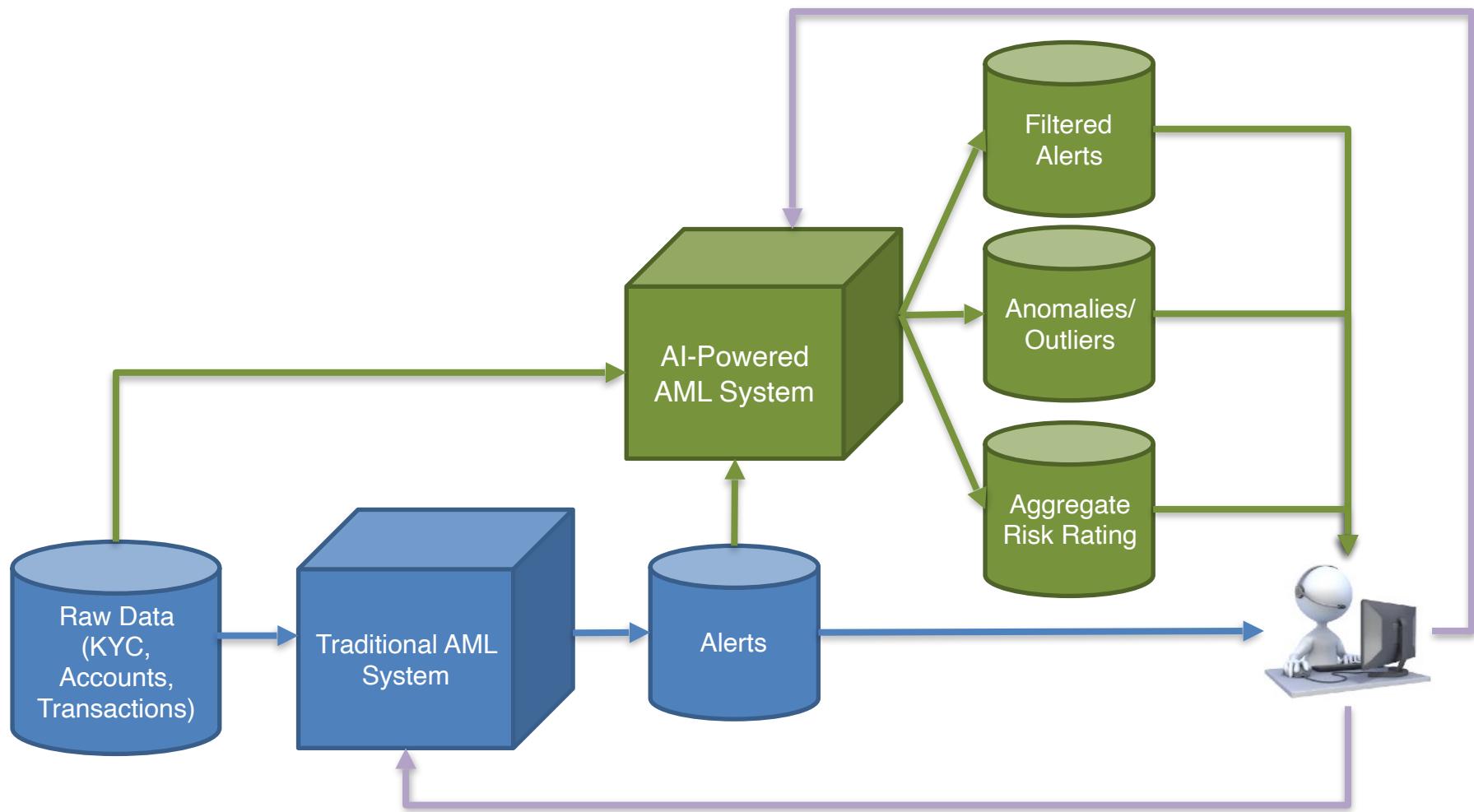
Traditional Rule-Based AML

1. Matches the rule of “3+ international wire transfers of at least \$10K each within 30 days”.
2. Creates an alert.

AI-Powered AML

1. Computes the answers to the following questions:
 - What is the occupation or business nature of this party?
 - How often did this party have international wire transfers before?
 - Who are the most frequent debit/credit counterparties of this party?
 - Has this party had transactions before with the counterparties of these wire transfers?
 - Does this party have other relationships (e.g. same account, address, phone, email) with these counterparties?
 - What are the case/SAR histories of this party and the counterparties?
 - Do peers of this party (e.g. individuals with the same occupation, or businesses of the same nature) often have wire transfers of similar frequency and amount?
 - ...
2. Determines the aggregate risk of this party based on all of the above answers.
 - Import/export company with frequent foreign trades → low risk (**false positive**).
 - A salon worker with small-amount of monthly activities and few wire transfers → high risk.

Integrate AI-Powered AML with Current Workflow



Summary -- AI Technologies for AML

Basic Layer

Transaction Patterns

- General rules
- Customized rules for specific scenarios
- Expert-defined rules and thresholds

Account Profile

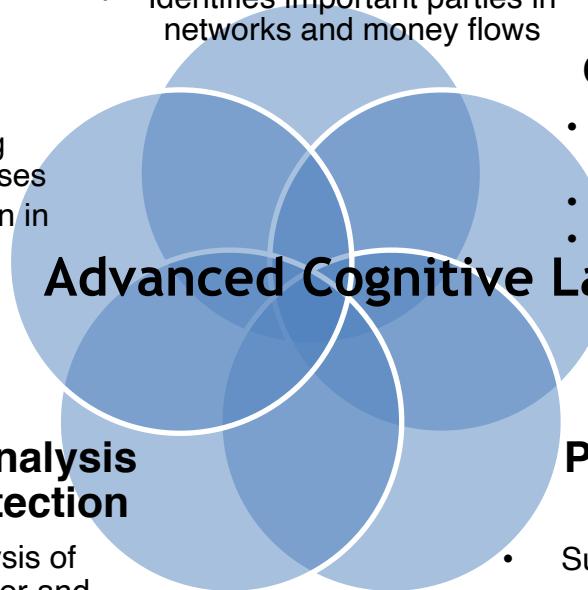
- Know your customer
- Watch list filtering
- Politically exposed individuals

Multi-Modality Analysis for Anomaly Detection

- Time-series analysis of transaction behavior and relationship change
- Behavior outlier detection against self history and peers
- Cognitive reasoning with Bayesian network inference

Graph Computing

- Flow analysis
- Advanced KYC, including the related parties of the customers
- Determines true relationships between accounts and parties
- Identifies important parties in networks and money flows



Grouping/Clustering

- By industry, business nature, region, size, etc.
- By transaction behavior
- By typologies, techniques



AI Regulation Reasoning & Compliance Reassurance

Regulation Overwhelms Financial Institutions

- The regulatory regime for Financial institutions are tightened worldwide. Banks are subjective to regulations such as CFPB, FRB, FinCen and others in U.S.
- Conventional compliance architecture is entangled in numerous systems, transformations, and mappings. At major banks each new compliance program brings **more** staffs, systems, software, warehouse and more documents.
- Cost fines peaked in 2016 at a total accumulated amount of over \$200 billion globally

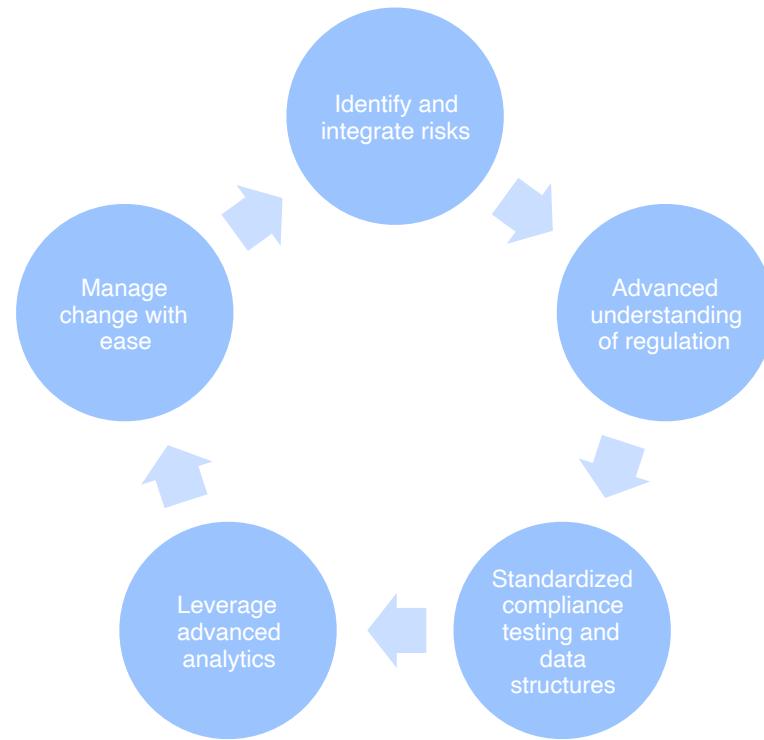


A snapshot of penalties for non-compliance issued recently

Date	News Title	Penalties	Penalty type	Issued by
03/07/2018	Bancorp Bank penalized \$2M for UDAP violations	\$ 2 million plus restitution	UDAP/UDAAP	FDIC
02/15/2018	U.S. Bank NA paying \$598M for BSA/AML failings	\$ 598 million	BSA-AML Civil Money Penalties	FinCEN, DOJ, OCC
2/15/2018	U.S. Bancorp pays \$15M for BSA/AML failures	\$ 15 million	BSA-AML Civil Money Penalties	FRB
2/7/2018	Rabobank pays \$369M for BSA/AML violations and obstruction	\$ 369 million	Forfeiture	OCC, DOJ
1/17/2018	Mega International Commercial Bank pays \$29M BSA penalty	\$ 29 million	BSA-AML Civil Money Penalties	FRB, State Agency
12/27/2017	Citibank earns CMP for non-compliance with BSA C&D order	\$ 79 million	BSA-AML Civil Money Penalties	OCC
11/21/2017	Bureau fines Citibank for student loan servicing failures	\$ 2.75 million and consumer redress	UDAP/UDAAP	CFPB

What is RegTech for banks?

- It is a subset of FinTech which utilize AI technologies such as Nature Language Processing(NLP), Nature Language Understanding (NLU) that may facilitate the delivery of regulatory requirements more efficient and effectively than existing capabilities. Regtech has emerged as the result of top-down institutional demand, in contrast to bottom-up demand that has driven FinTech.
- For banking industry, RegTech allows real time and proportionate regulation that identifies risk more efficient compliance and auditing procedures including:
 - Analyzing and implementing rules
 - Extracting, analyzing and storing data
 - Monitoring employee and customer behaviors



Phase 1 - Manual

Manual data capture based on cyclical timelines (excel)

Phase 2- Workflow automation

Compliance software establishes consistent workflow

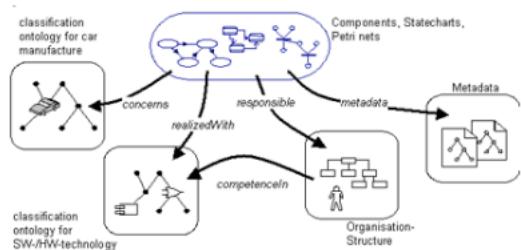
Phase 3- Continuous monitoring

Applying data science to automate the back office

Phase 4 - Predictive analytics

AI and machine learning are proactively identifying and predicting risk

Master the Complexity of GRC (Governance Regulation Compliance) with Graph Approach

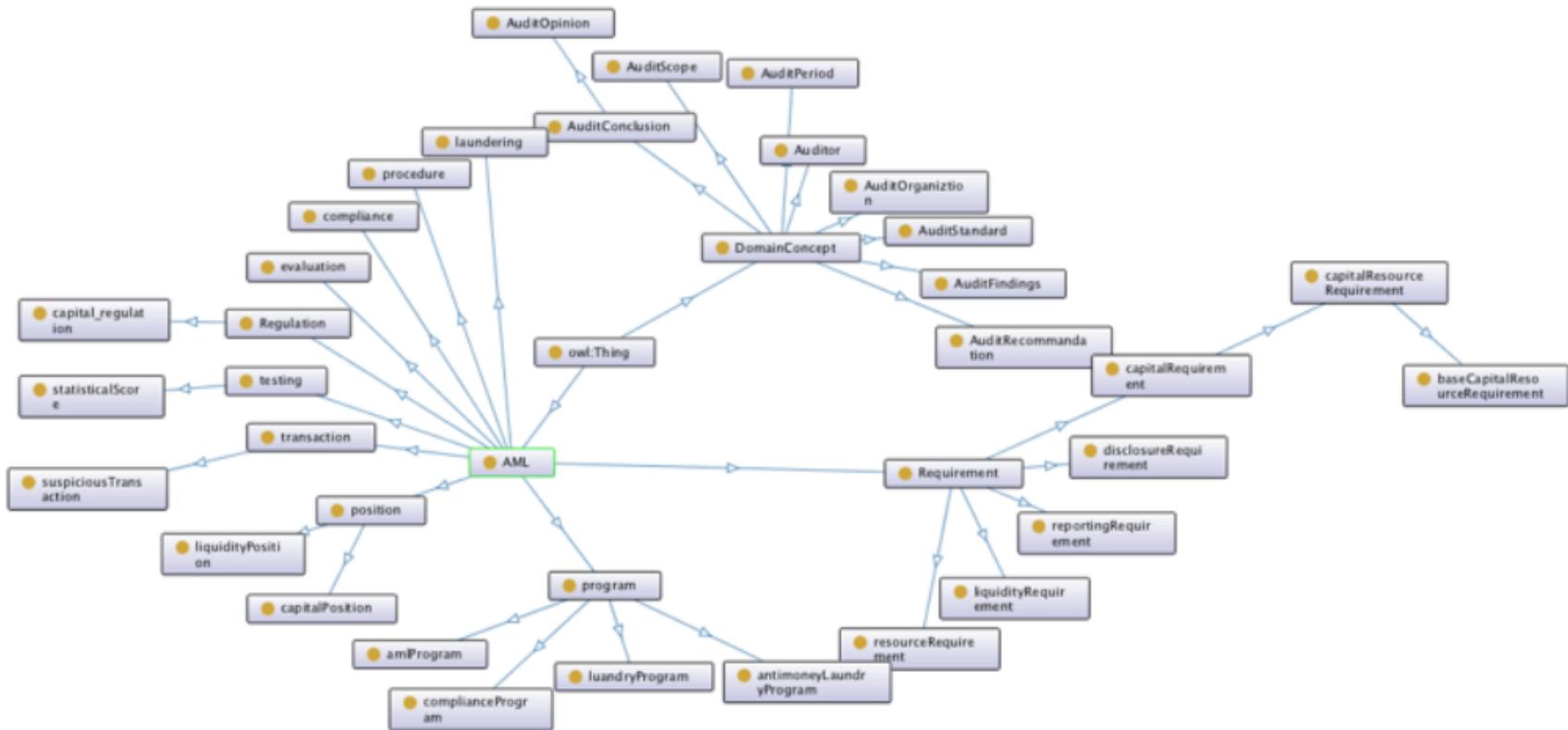


Ontology graph from <https://www.w3.org/2004/12/rules-ws/paper/98/>

- Similar to the medical domain, finance can master the compliance challenge with graph
- The human genome contains more than 3 billion DNA base pairs. Genes direct the production of over a million analyzed proteins. More than 9500 terms define human phenotype and anomalies which describe over 10,000 disease. Almost half a million drugs are approved for treatment.
- The complexity of Bio/Medical is resolved with Semantic Web and Ontology, a graph representation of Triple System (subject/ predicate/ object) which facilitated understanding the relationships of terms.

- AI technologies allow compliance professionals to “interpret regulatory meaning, comprehend what work needs to be done and codify compliance rules” in a fraction of the time normally required. AI can enhance compliance **monitoring, detection, and response**, incorporating forward-looking functions that **identify regulatory changes** and enable businesses to update procedures quickly.
- Extracting metadata: NLP identifies important elements of a regulation and helps users to understand what the document is about.
 - If the regulation is relevant
 - How the organization may be affected and needs to respond
- Identifying entities: NLP can determine the “who” factors in regulation:
 - To whom the document is addressed (such as a firm or department)
 - By whom (such as a regulator)
 - Who are the key actors (such as customers or market participants)
- “Understanding” content: NLP can help users to
 - identify the requirements that are contained within a document
 - using the entities and metadata, determine who they apply to and what products, topics and processes they refer to

Example: AML regulation analysis for auditing



(CNN)French striker Bafetimbi Gomis, who has a history of fainting, said he is now "feeling well" after collapsing during Swansea's 3-2 loss at Tottenham in the Premier League on Wednesday. The worrying incident occurred in the first half at White Hart Lane -- after Tottenham scored in the seventh minute -- but the 29-year-old left the pitch conscious following about five minutes of treatment. The Guardian added that he was wearing an oxygen mask. Play was temporarily stopped before resuming. Fabrice Muamba on playing soccer again 00:56 As the match progressed, Swansea tweeted that Gomis was "fine," with manager Garry Monk using the same word to describe Gomis' condition. Gomis spent the night in hospital as a precaution, Swansea said on its website.

I wanted to reassure you concerning my health," Gomis told the website. "It actually looks much scarier than it is physically dangerous, and I am feeling well now. "I have been under a great deal of stress and fatigue due to my father's health, which requires me to go back and forth from France. "I was disappointed that I couldn't help my team tonight, but now everything is back in order. I also want to thank everyone for their support and get well messages."

Gomis had similar fainting spells in France, which prompted the president of his former club, Jean-Michel Aulas of Lyon, to tell French television in 2009: "We can't not be worried, it scares you each time."

Swansea ran tests on Gomis, said Monk, prior to signing him on a free transfer last July.

"He just has a little bit of low blood pressure which causes you a little bit of problems," Monk said in a televised interview on Sky.

"It's been part of his life. We were well aware of that when we signed him. He's done all the hospital checks and all the medical checks you can possibly do and it's just part of his life.

"It's no problems whatsoever. It's not as serious as it looks."

Gomis has scored two league goals for Swansea this season, mostly in a backup role. He became the Welsh side's top striker when Wilfried Bony signed with Manchester City in January.

Almost exactly three years ago at White Hart Lane, then Bolton midfielder Fabrice Muamba collapsed after suffering a cardiac arrest. He was near death, according to Bolton, but survived after being treated at the London Chest Hospital.

He subsequently retired.

Other footballers, including Cameroon international Marc-Vivien Foe in 2003 and Spanish international Antonio Puerta in 2007, didn't survive after collapsing on the pitch.

News from CNN

Summarization Results:

Reference Summary: Bafetimbi Gomis collapses within 10 minutes of kickoff at tottenham, but he reportedly left the pitch conscious and wearing an oxygen mask. Gomis later said that he was "feeling well" the incident came three years after Fabrice Muamba collapsed at white hart lane .

Generated Summary:

Bafetimbi Gomis says he is now " feeling well" after collapsing during Swansea 's 3-2 loss . the 29-year-old left the pitch conscious following about five minutes of treatment . The 29-year-old left the pitch conscious following about five minutes of treatment .

NLP and Knowledge Graph

'Summary of Business Nature of Business Energy West was originally incorporated in Montana in 1909 and was reorganized as a holding company in 2009. On July 9, 2010, we changed our name to Gas Natural Inc. (the "Company," "we," "us," or "our") and reincorporated in Ohio. We are a natural gas company with operations in four states. In October 2016, we implemented a plan of reorganization and formed a new holding company, PHC, an Ohio Corporation, that is the parent company of our regulated utility subsidiaries, Cut Bank Gas, EWM, Frontier Natural Gas, Bangor Gas, NEO, Brainard, Orwell, and Spelman. Gas Natural is the parent company of Energy West Propane, Inc., EWR, GNR, Lone Wolfe and PHC. PHC is the parent company of multiple entities that are natural gas utility companies with regulated operations in Maine, Montana, North Carolina and Ohio. EWR is a natural gas marketing and production company with non-regulated operations in Montana. GNR is a natural gas marketing company that markets gas in Ohio. Energy West Propane, Inc. distributes propane with non-regulated operations in Montana. Lone Wolfe serves as an insurance agent for us. We have three operating and reporting segments: • Natural Gas. Representing the majority of our revenue, we annually distribute approximately 21 Bcf of natural gas through regulated utilities operating in Maine, Montana, North Carolina and Ohio. Our natural gas utility subsidiaries include Bangor Gas (Maine), Brainard (Ohio), Cut Bank Gas (Montana), EWM (Montana), Frontier Natural Gas (North Carolina), NEO (Ohio) and Orwell (Ohio). As of December 31, 2016, we served approximately 69,400 customers. • Marketing and Production. Annually, we market approximately 3.6 Bcf of natural gas to commercial and industrial customers in Montana, Wyoming and Ohio through our EWR and GNR subsidiaries. Our EWR subsidiary also manages midstream supply and production assets for transportation customers and utilities. EWR owns an average 53 % gross working interest (average 44 % net revenue interest) in 160 natural gas producing wells and gas gathering assets located in Glacier and Toole Counties in Montana. • Corporate and Other. Included in corporate and other are costs associated with business development and acquisitions, dividend income, recognized gains or losses from the sale of marketable securities, activity from Lone Wolfe which serves as an insurance agent for us and other businesses in the energy industry, and the results of our discontinued operations from the sales of EWW, Pipeline Assets and Independence. '

Topic:

Business_Finance
Environment

Industry:

Auto, Truck & Motorcycle Parts
Oil & Gas Exploration and Production
Natural Gas Distribution
Food Markets
Wires & Cables

Relations:

Company Affiliates
Company Name Change
Company Reorganization
Personal Career
Company Founded

Tags:

Lone Wolfe
Natural gas
Economy of United States
Energy
Economy of North America

NLP and Knowledge Graph

- Graph analysis by Graphen Ardi platform

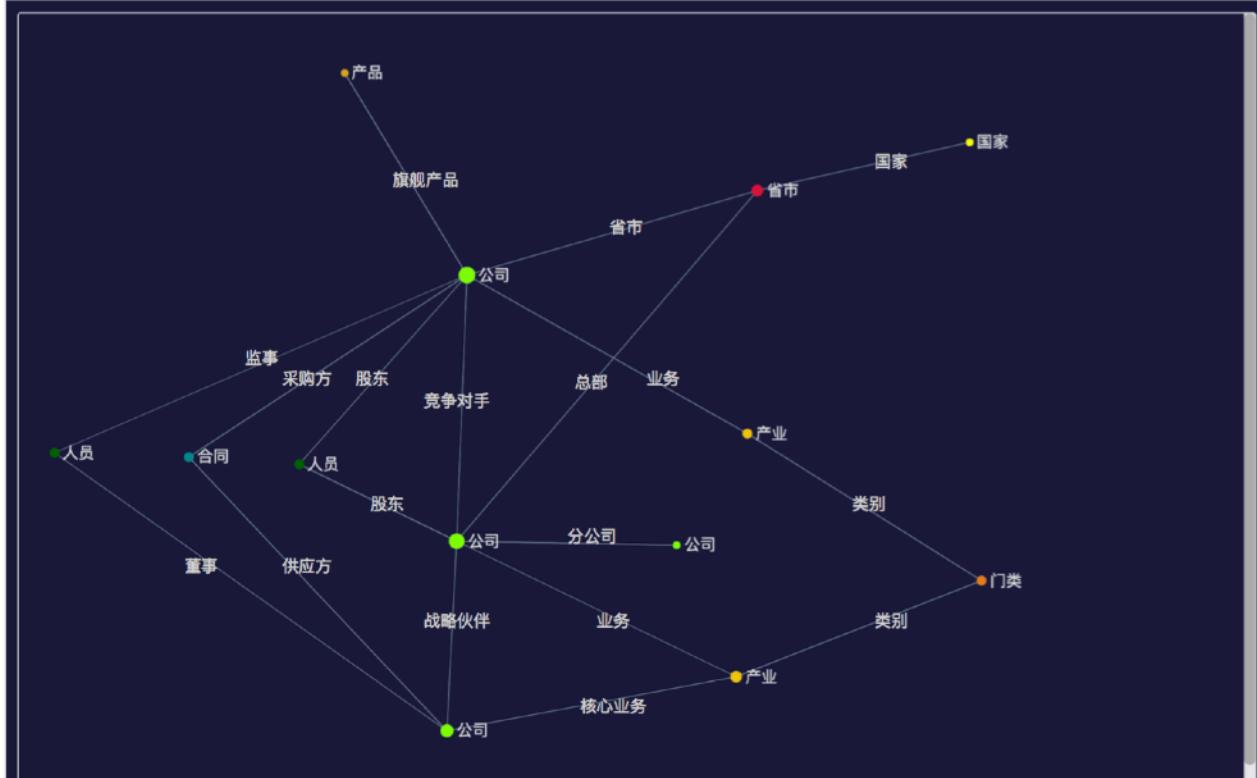
Graphen Visualizer - Graph Database Explorer

PGQL

```
S Query
```

GRAPH VISUALIZATION

Label Mapping categories



Customize Your Graph!

Step One Create A Graph Step Two Load Nodes Step Three Load Edges

Get Ego-Net Get Sub-Graph Search By Node Properties Search By Edge Properties Get Shortest Path

CURRENT DATA

Nodes	or	Edges
<code>id: edge20</code>		
<code>label: relation</code>		
<code>source: 3</code>		
<code>target: 1</code>		
<code>cate: 竞争对手</code>		

A Comprehensive GRC(Governance Regulation Compliance) Knowledge Graph

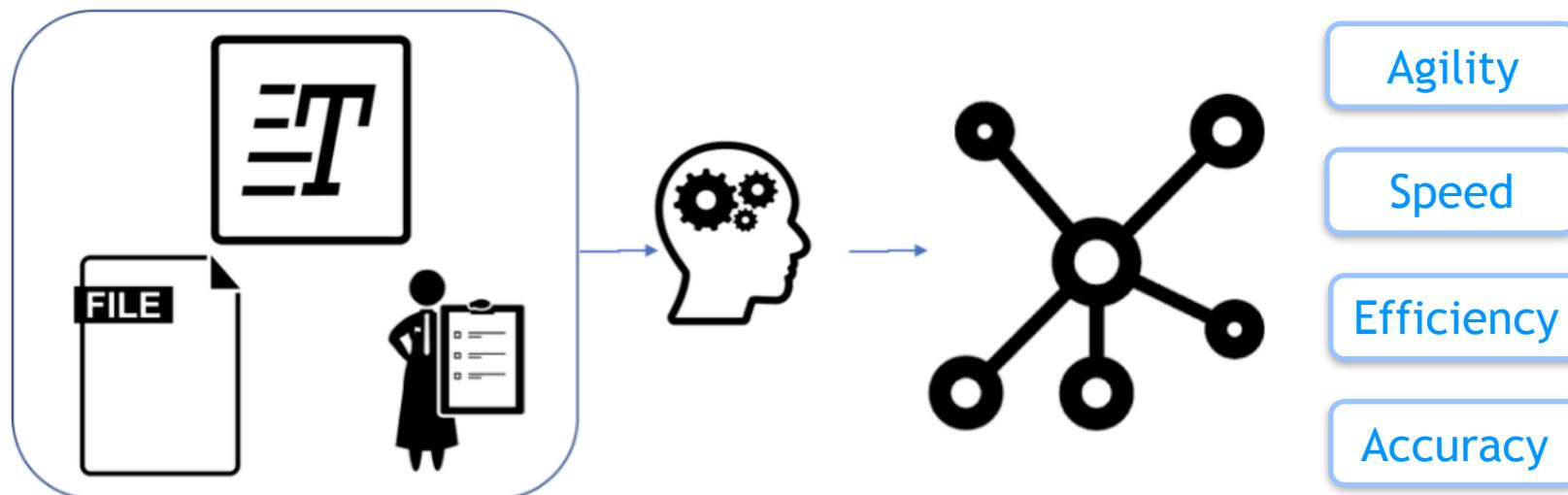
Challenge: Compliance responsibilities are spread throughout the organization so that risk assessment, testing and reporting lacks integrated data with same formats which makes internal compliance and audit process efforts slow and expensive

Solution:

Integrated Data: Design algorithms to extract and integrate data from banks' proprietary system, third-party data providers, regulations, regulatory announcement and public sources including both structured and unstructured data.

Cognitive learning: Utilize both machine learning and human expertise to continuously improve the quality, precision and reliability of data.

Graph Representation Refine the design the domain and linkage of data, and store the data in the powerful graph.



How can Knowledge Graph help?

Improve Regulation Compliance

Understanding the Regulation is the key for three lines of defenses

Graphical representation of regulation as the standard graph

Extract information from internal data such as policy controls, procedures and supporting documents corresponding to regulation terms and represent in the internal-data graph

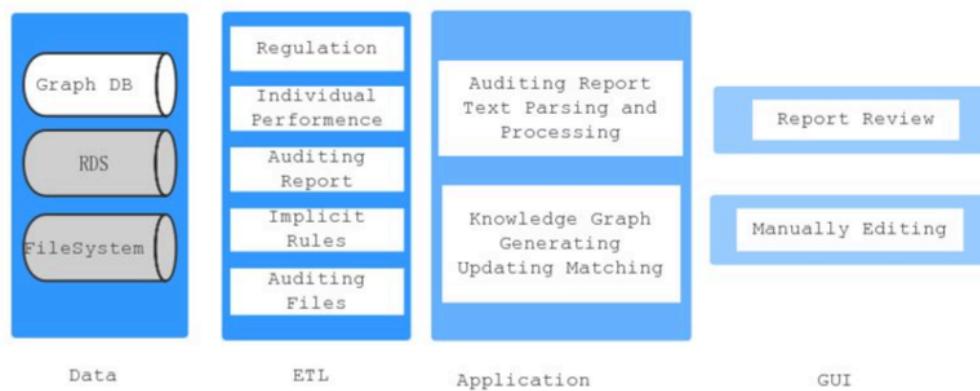
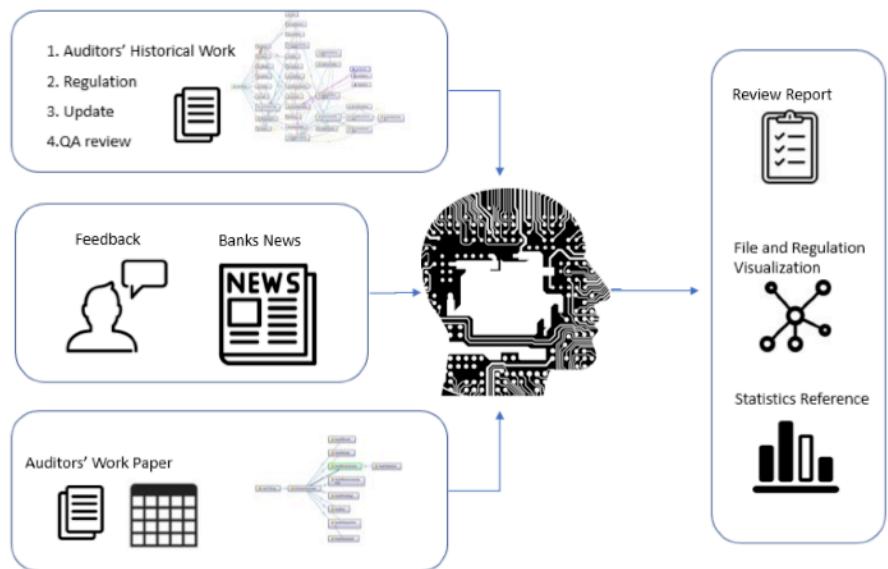
Compare the standard graph with internal-data graph and check the missing requirement and possible violations

Linked data from different domains increase efficiency and reduce cost of repetitive works

Key Functions of Graphen RegTech

- Deep understanding of regulation and your organization
 - Key issues such as KYC, AML, Customer protection services
 - Regulatory agencies
 - Penalty amounts
 - Regulatory requirements (documents, procedures and controls)
 - Related departments
 - Enforcement actions
- Monitoring, detecting and response to compliance risks
 - System will find the missing requirements for given issue
 - Identify other risks regarding the similar problematic internal data
 - Give recommendation for risk reporting, and enable feedback to improve the system

AI-based Auditing Solution



- Key Features:
 - Knowledge Graph based advance regulation comprehension
 - Semantic search of related regulation
 - Auditing report ETL and data mining
 - Report quality assessment
- Financial data, regulations, reports, workpapers and metadata can be stored in a uniform way. A knowledge graph defines the semantics of concepts, their relationships and axioms. Compliance crosses the domains of finance and legal regulations.
- To improve the quality of the auditor's report, the system give recommendation based on
 - Graph comparison of regulation and internal data
 - Other auditor's behaviors analysis as benchmark
- The system keep learning by user's feedback

AI Powered Risk Defense Mechanism

- Traditional Approach

The Three Lines of Defense Model



Graph Adapted from ECIIA/FERMA Guidance on the 8th EU Company Law Directive, article 41

- Graphen AI risk defense in one-stop



Risk Understanding

e.g. Case related regulation review

Risk Detection

e.g. Risk assessment and alert

Risk Analysis, Controls and Reporting

e.g. Quality assurance

- Identify related risks by understanding regulation
- Label different risks to corresponding department, policies, controls, and supporting document types
- Machine learn historical risk profile and risk control approaches

- Advanced Know Your Customer technology to assess risk score of single customer at beginning of loan application
- Predict and monitor the customers' transactions and abnormal behaviors after loan is granted
- Continuously monitoring compliance risk of banking staffs

- Analysis insight of trends and patterns
- Quality assurance of risk, compliance and audit reporting by horizontal comparison with other staffs and by matching regulation requirements
- Suggest actions to identified risks from historical studies



Market Intelligence

Outline

- What is Market Intelligence?
- Market Intelligence Platform Functions
- How Market Intelligence Platform Analyzes A Single News?
 - Bayesian Network
 - The Science Behind Reasoning
- Price Impact Prediction
 - How Market Intelligence Platform Aggregates Information?
 - Aggregate Information Analysis Framework

What is Market Intelligence?

- Personal research analyst
- Provides real-time news information with relevance rankings according to your individual portfolios and watchlists
- Generates overall Price Impact Score from all monitored news sources

Market Intelligence Platform Functions

- Total impact: calculated from all monitored news source
- Single News Impact: calculated from selected news

Artificial intelligence and Bayesian network powered causality reasoning graph

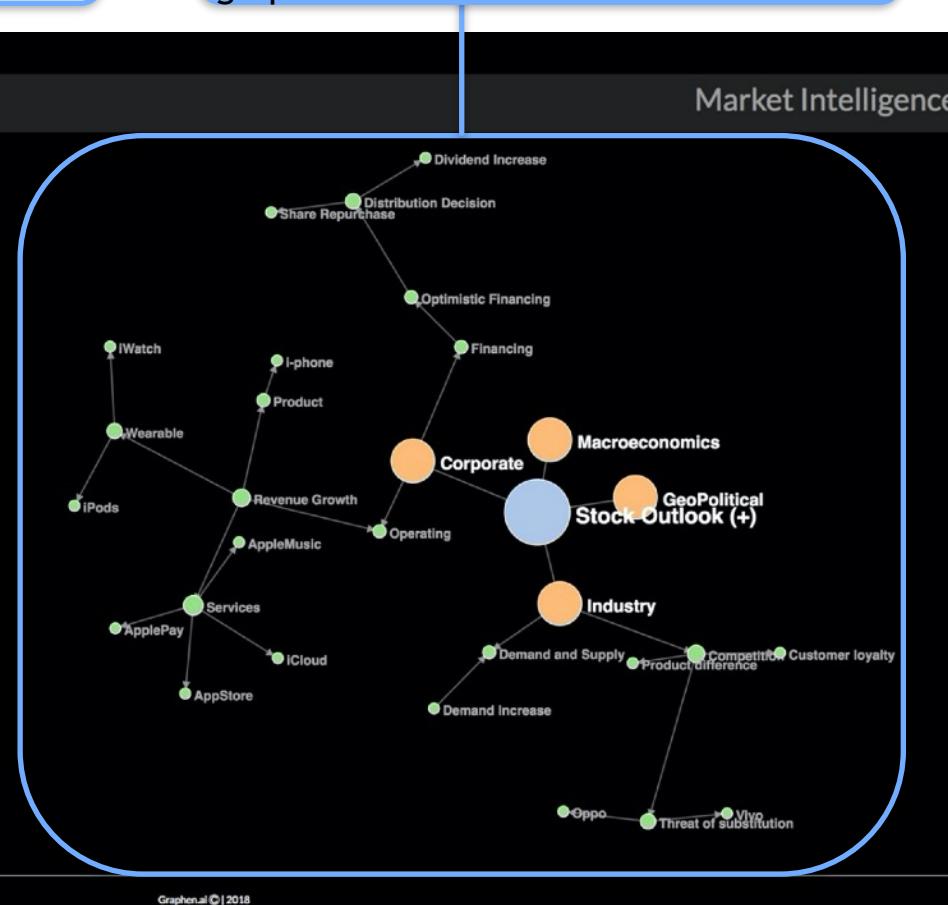
What's in your portfolio

Price Chart

Trending news that has impact on your portfolio



Personalization of news you care



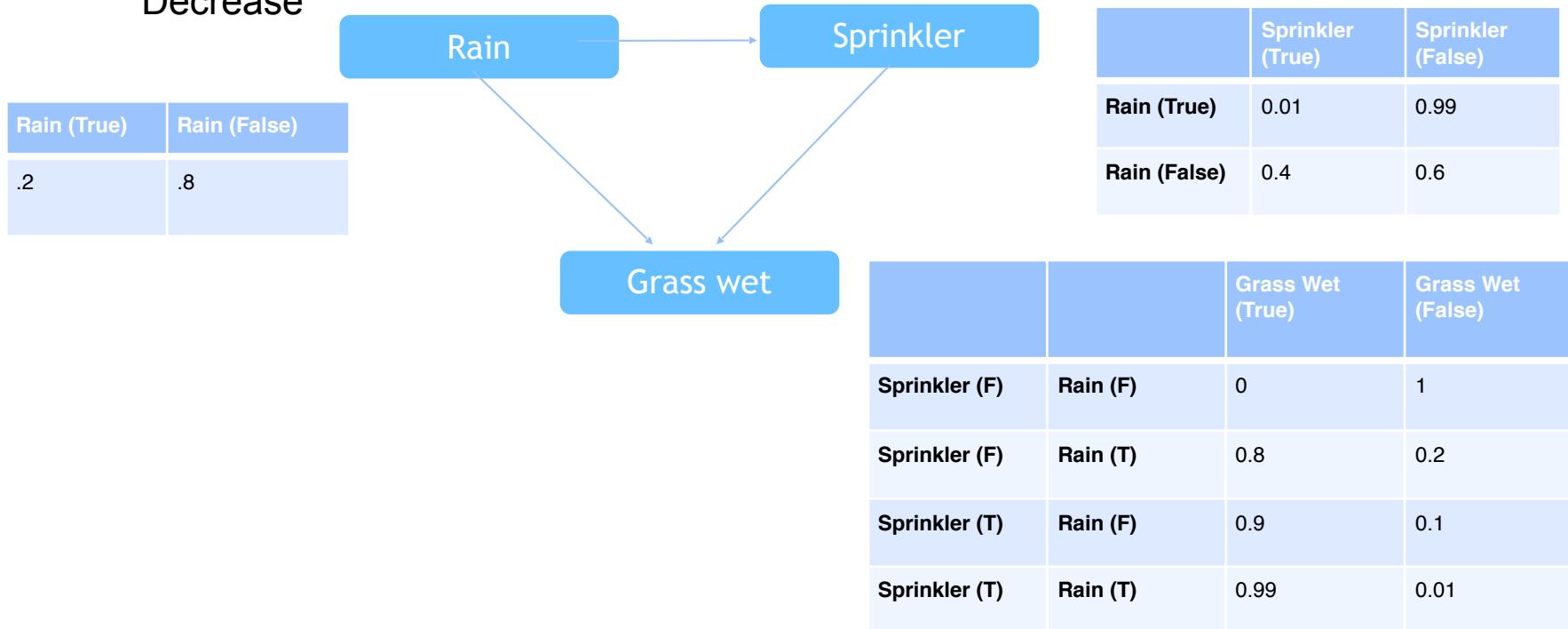
Bayesian Network

Bayesian network is a probabilistic graphical model (a type of statistical model) that represents a set of variables and their conditional dependencies via a directed acyclic graph (DAG)

A simple Bayesian network. Rain influences whether the sprinkler is activated, and both rain and the sprinkler influence whether the grass is wet.

With observed probability, we can answer questions such as what is the probability of raining, given grass is wet.

Similar causality network can be applied to the market: Rain – Negative Economy Outlook; Sprinkler – Negative Company Management ; Grass Wet – Stock Price Decrease

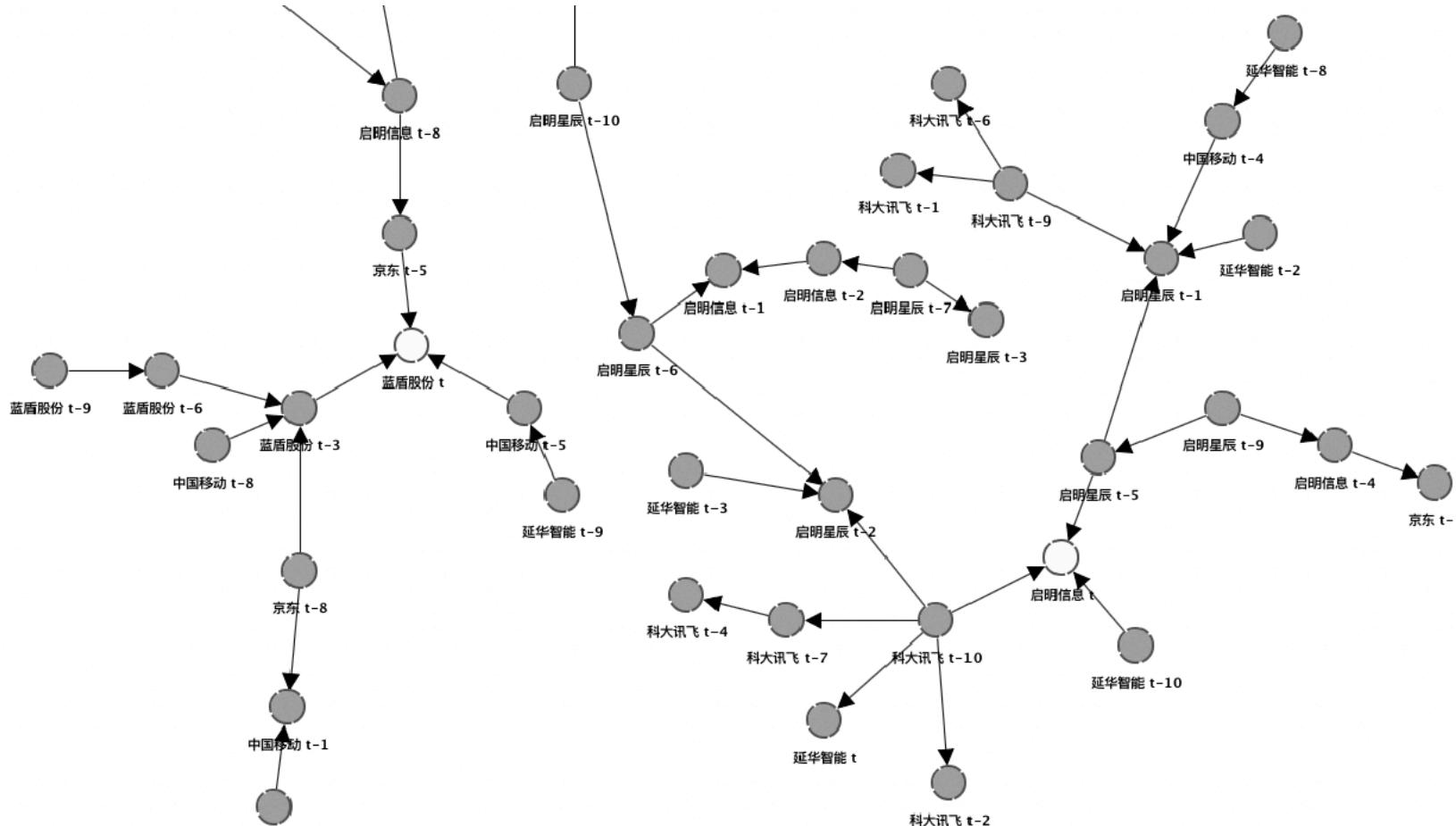


Influence Graph Example

Ticker	Company	Industry	Sector
002178	延华智能	Information Technology	Tech
002230	科大讯飞	Information Technology	Tech
002232	启明信息	Information Technology	Tech
002439	启明星辰	Internet Service Provider	Tech
300297	蓝盾股份	Information Technology	Tech
JD	京东	Internet Service Provider	Tech
CHL	中国移动	Information Technology	Tech

- **延华智能:** 高端咨询，智能建筑，智慧医疗，智慧节能，智慧环保，数据中心。
- **科大讯飞:** 智能语音及语言技术、人工智能技术研究
- **启明信息:** 管理软件、汽车电子产品、集成服务、数据中心
- **启明星辰:** 安全网关、安全检测、数据安全与平台、安全服务与工具、硬件及其他
- **蓝盾股份:** 高端咨询，智能建筑，智慧医疗，智慧节能，智慧环保，数据中心
- **中国移动:** 移动语音、数据、IP电话和多媒体业务，还提供传真、数据IP电话等增值业务
- **京东:** 大型综合型电商平台，出售家电、数码通讯、电脑、家居百货、服装服饰、母婴、图书、食品等商品。

Bayesian Network Industry Example

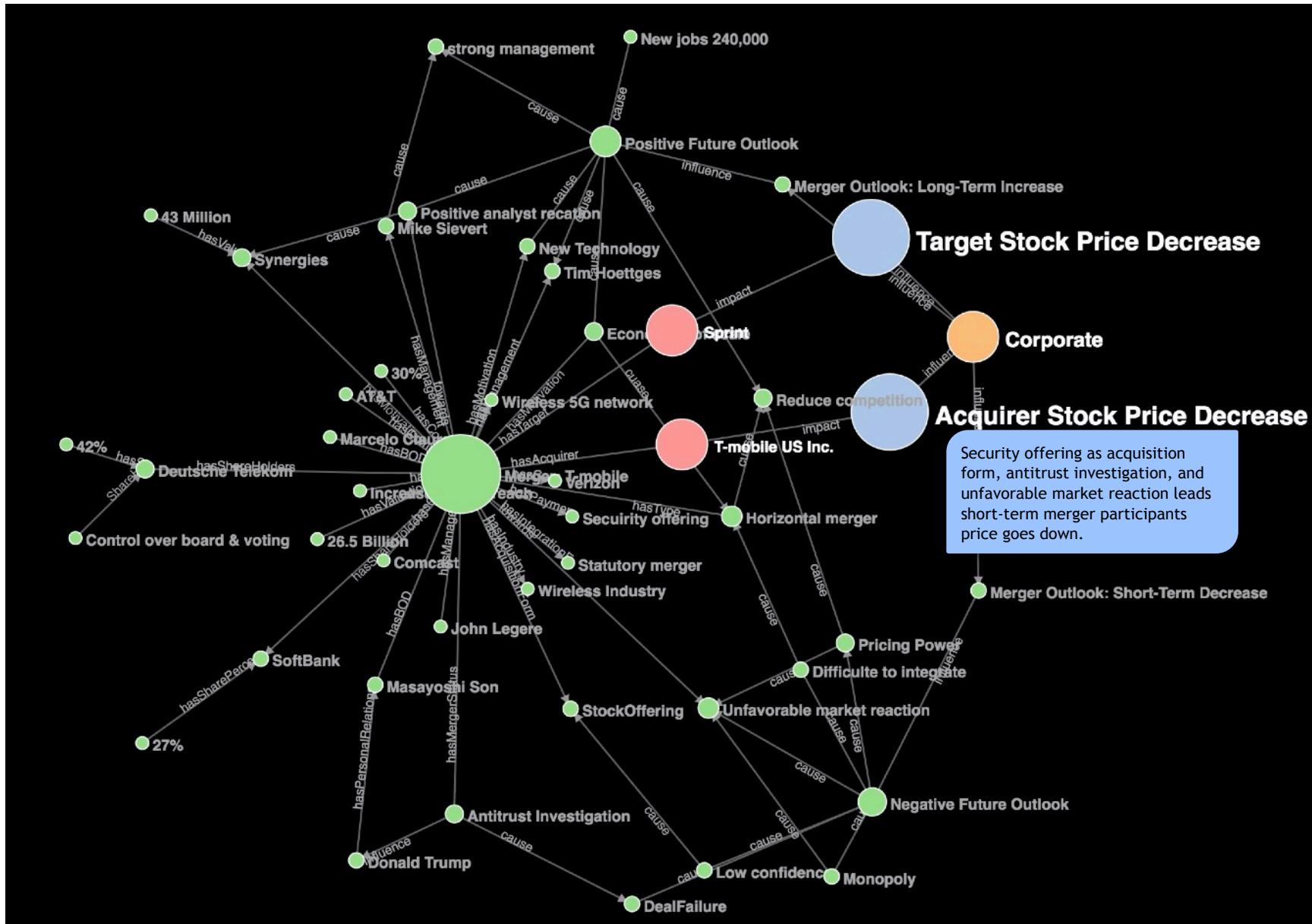


How Market Intelligence Platform Analyze A Singe News?

Impact score of news on each stock

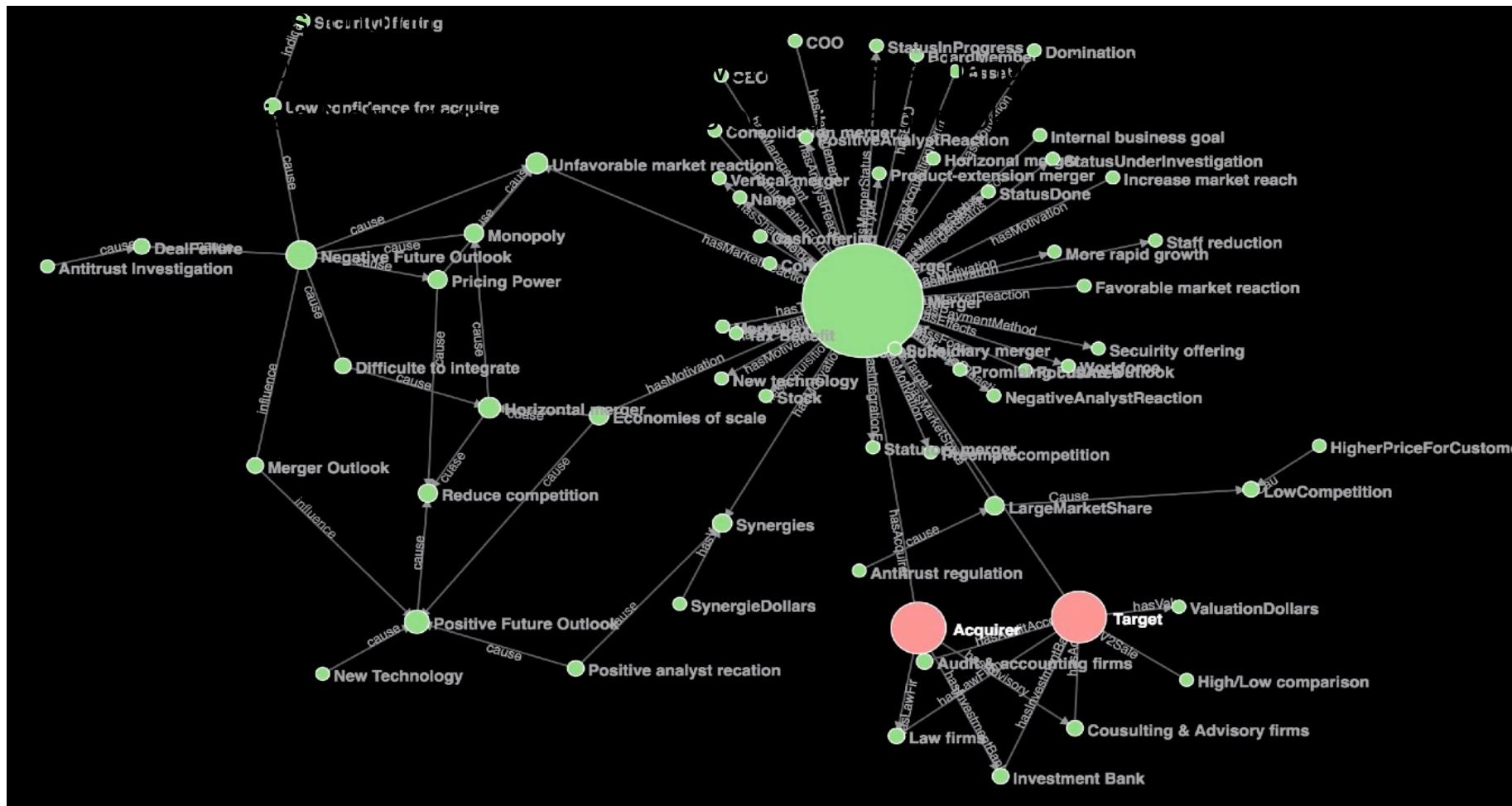


Detailed Reasoning Graph

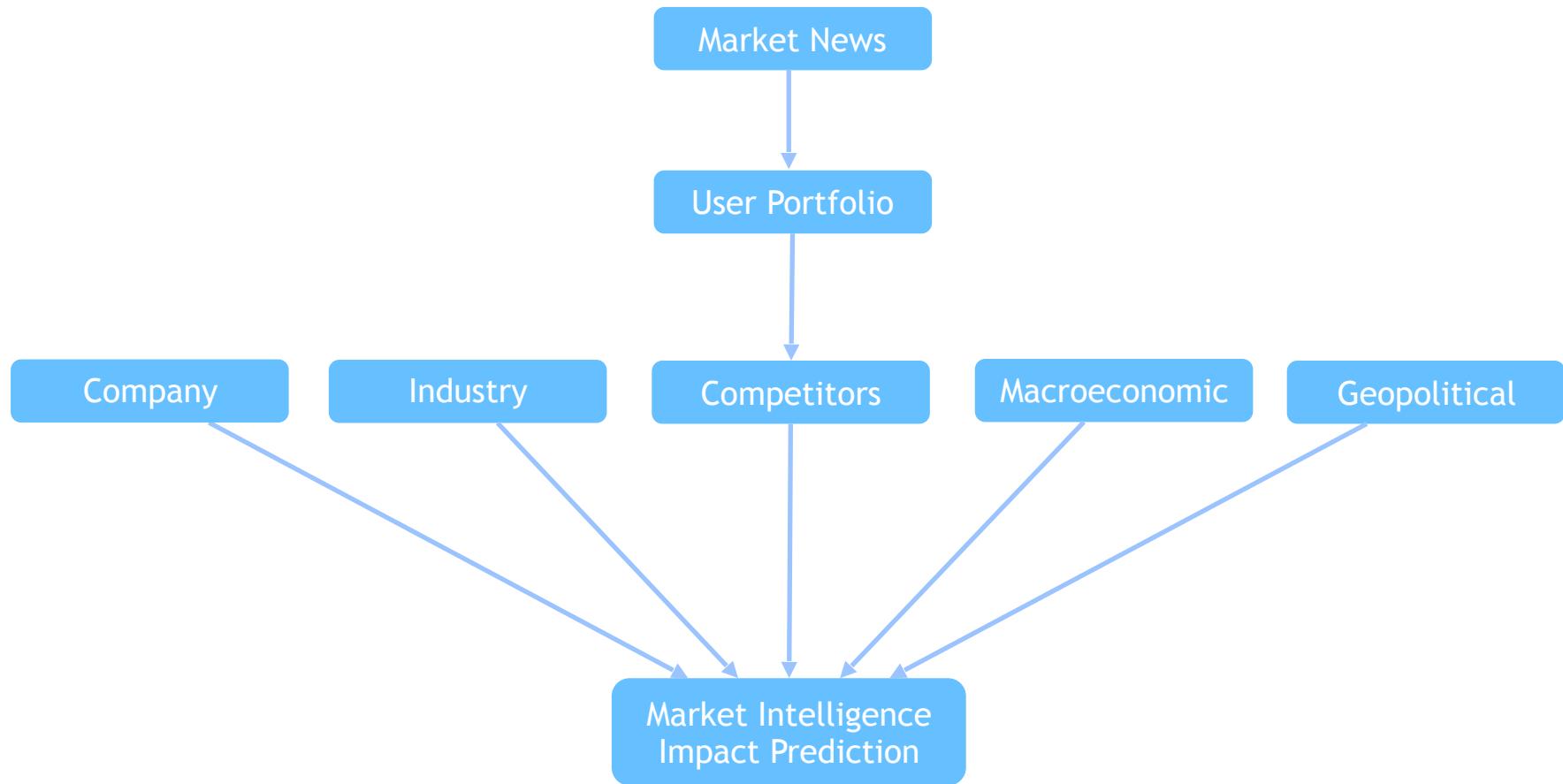


The Science Behind Reasoning

Event analysis module for each type of events



Event analysis module example: M&A analysis framework



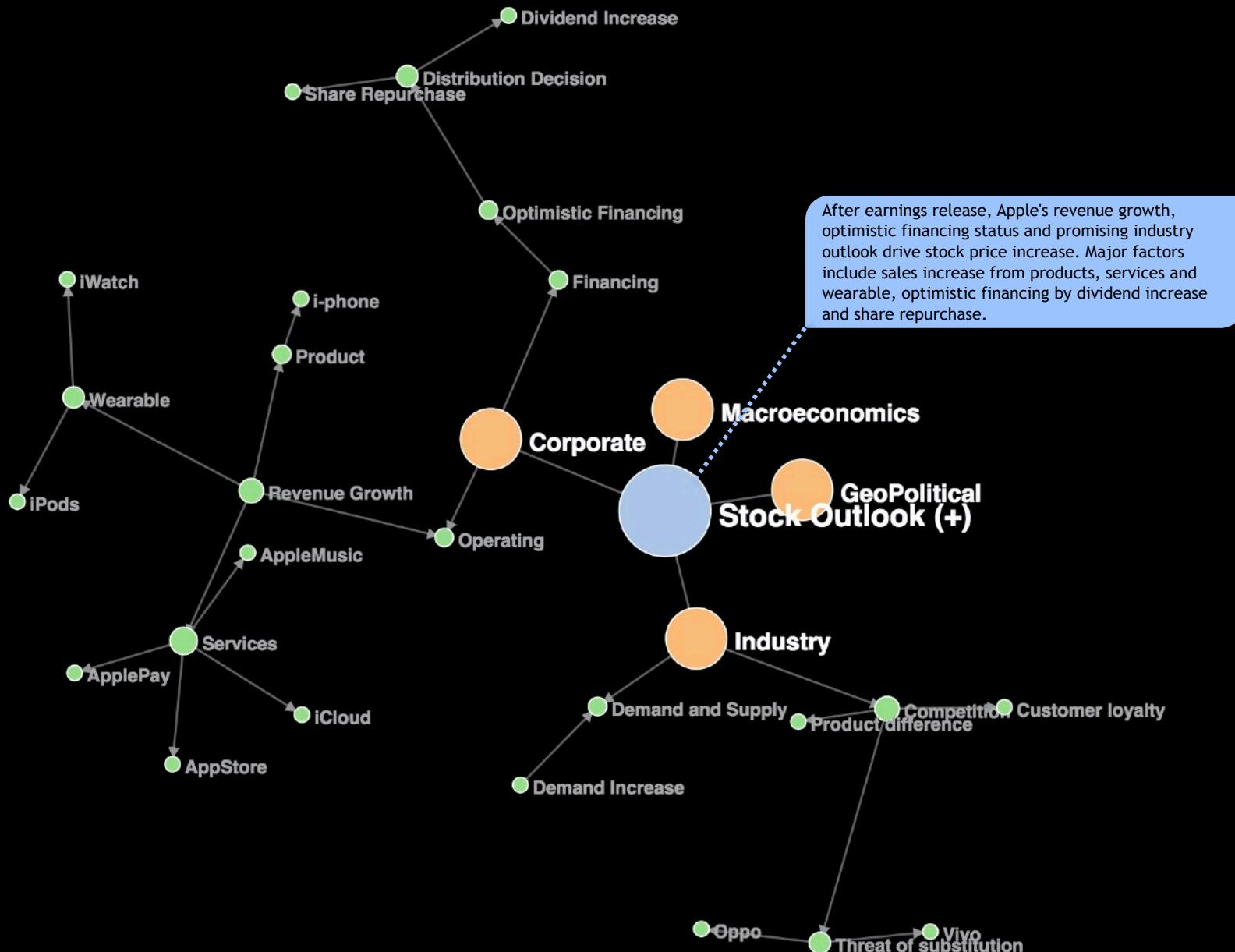
How Market Intelligence Platform Aggregate Information?

Assess aggregate information of Apple Inc. stock



- Stock price predicted to be increase by aggregate all monitored news from four major areas.
- Detailed news reasoning graph of recommended news from left column.

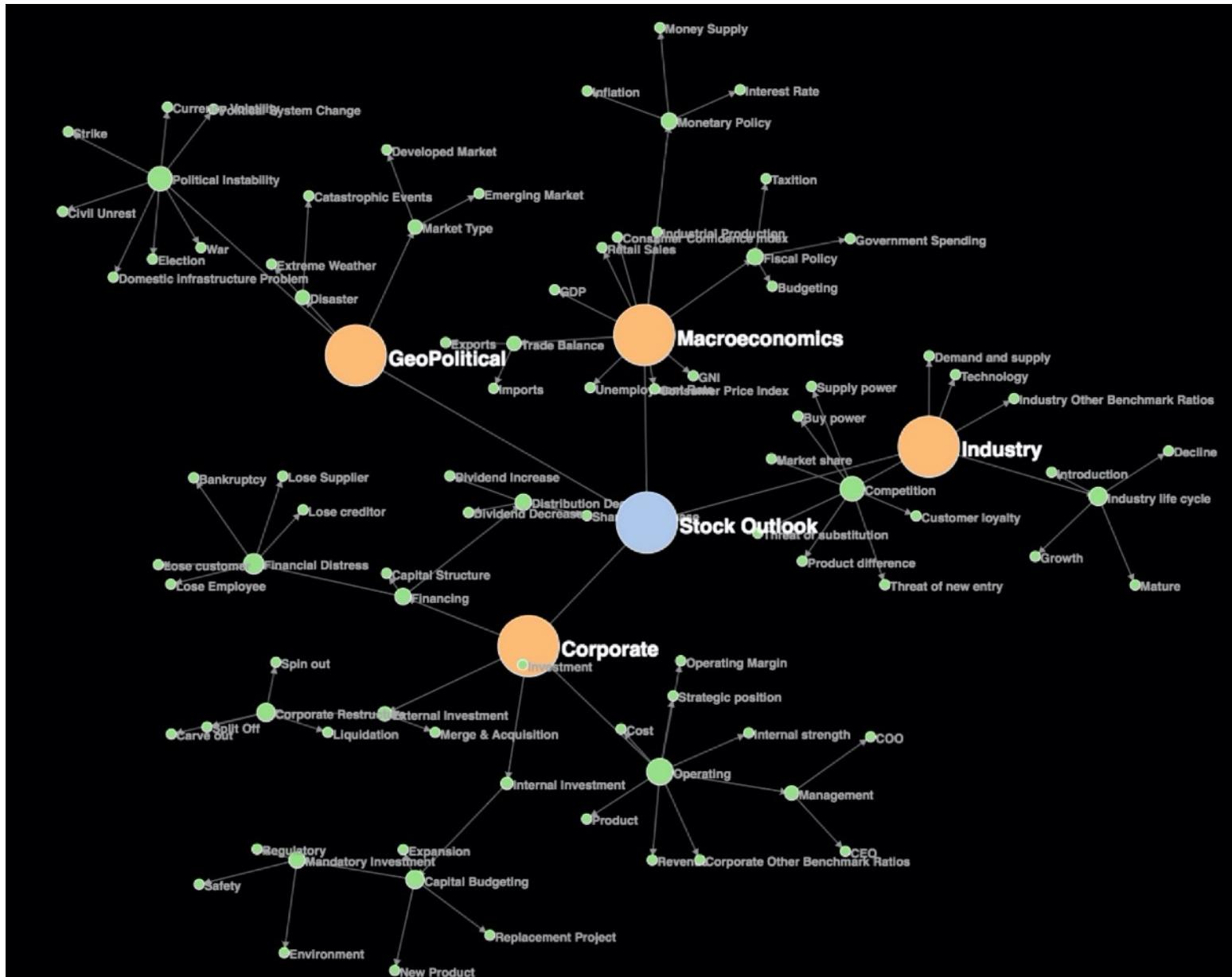
Detailed Apple Stock Reasoning Graph



Aggregate Information Analysis Framework

- Corporate
 - Investing: external investing, internal investing
 - Operating: revenue, cost, management, product
 - Financing: capital structure, distribution, debt
- Industry
 - Lifecycle
 - Demand Supply
 - Future expectation
- Competition
 - Market share
 - Product differentiation
- Macroeconomic
 - Indicators such as GDP, GNI, Retail Sales, Unemployment Rates, CCI and etc.
 - Trade Balance
 - Monetary Policy: Inflation, Interest Rate, and etc.
 - Fiscal Policy: Taxation, Government budgeting
- Geopolitical
 - Market type: Emerging, Developed
 - Nature disaster, extreme weather, catastrophic event
 - Political instability: war, strike, civil unrest

Aggregate Information Analysis Framework

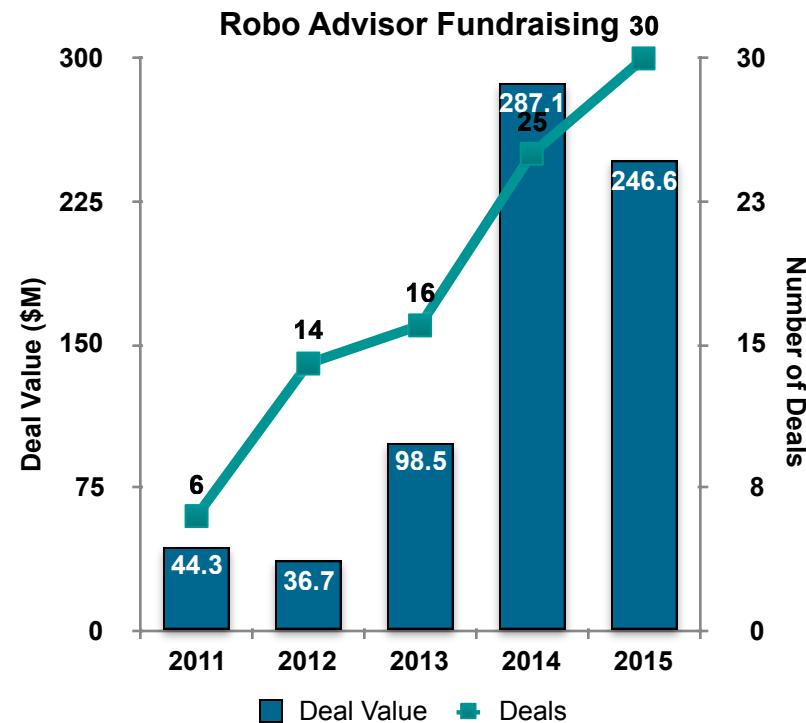




AI for Robo-Advisory

Robo-Advisory Examples

Type	Description	Example	Others
Robo Advisors	Digitalized automatic wealth management platform	   	4Q2015: Top 5 Robo Advisors have combined AUM being \$44.2B.
Retail Investment	New type of digital transaction and investment platform, such as theme investment or combined transactions	 	Robinhood boasts a sign-up time of 4 minutes and free trading



Sources: Investmentnews.com,

What is Robo-Advisor?

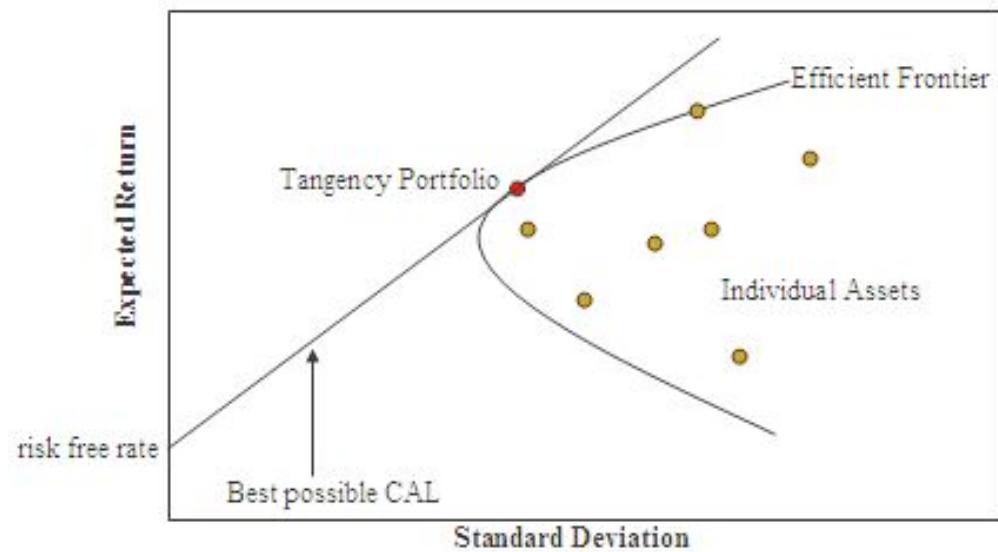
Robo-Advisor is a new type of wealth management service. Based on the risk level and investment goals provided by the investor, and it uses a series of 'smart algorithm' to calculate the optimal investment suggestions.

Robo-advisors directly managed about \$19 billion as of December 2014. By 2020 the global assets under management of robo-advisers is forecast to grow to an estimated US\$255B.

- Non-biased
- Low investment threshold
- Low starting entry money
- Low agent fee

Features :

- Strongly depend on technology, algorithm and financial theory
- Distributed investment, maximum long-term return
- Personalized portfolio allocation.



Harry Markowitz

Example: Wealthfront——low entry requirement, low fee

- Established in 2008. Formerly called 'Kaching'. Renamed in Dec 2011. Headquarter at Palo Alto.
- On Sept 2015, the total asset is \$2.6B.
- The estimated value of the company is \$1B as in 2015.



wealthfront

Find Managers Why Wealthfront How it Works About Over \$175 Million Invested on Wealthfront disclosure

Ditch your mutual fund Upgrade to Institutional Class Asset Management

Outperformed Morningstar 5 Star Mutual Funds

Morningstar 5 Star Equity Funds	managers on wealthfront
▲ 26.5%	▲ 30.0%

Disclosure

Lower Fees than Actively Managed Mutual Funds

Actively Managed Mutual Funds	managers on wealthfront
2.17%	1.30%

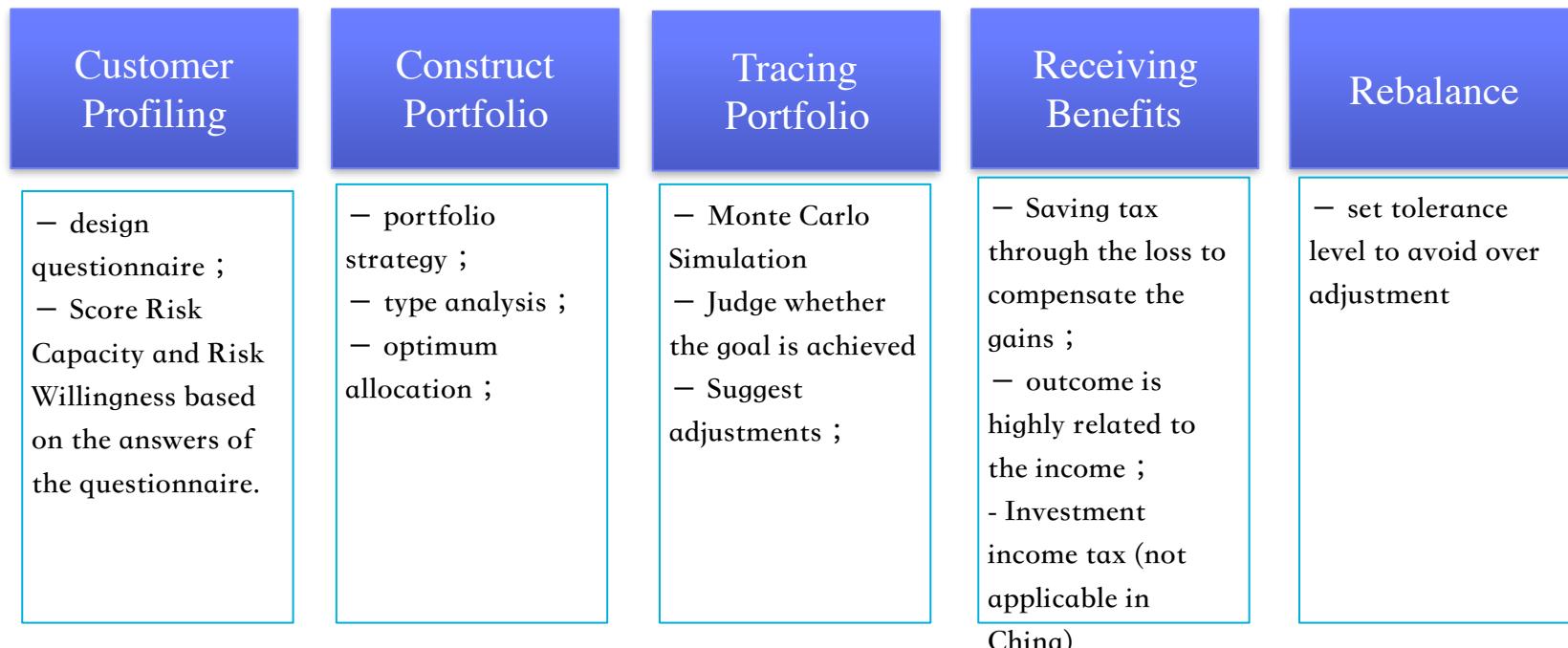
Disclosure

Expenses are represented as an asset-weighted average percentage of managed assets for mutual funds and a simple average for managers on Wealthfront. [Learn More](#)

- Low entry requirement :** min investment value USD \$500.
- Low fee :**
 - Zero annual fee, if account is lower than \$10K.
 - 0.25% fee is charged for the part of asset amount that is larger than \$10K.
 - No agent fee
 - Based on Wealthfront, in average, each user only needs to pay 0.12% fee.

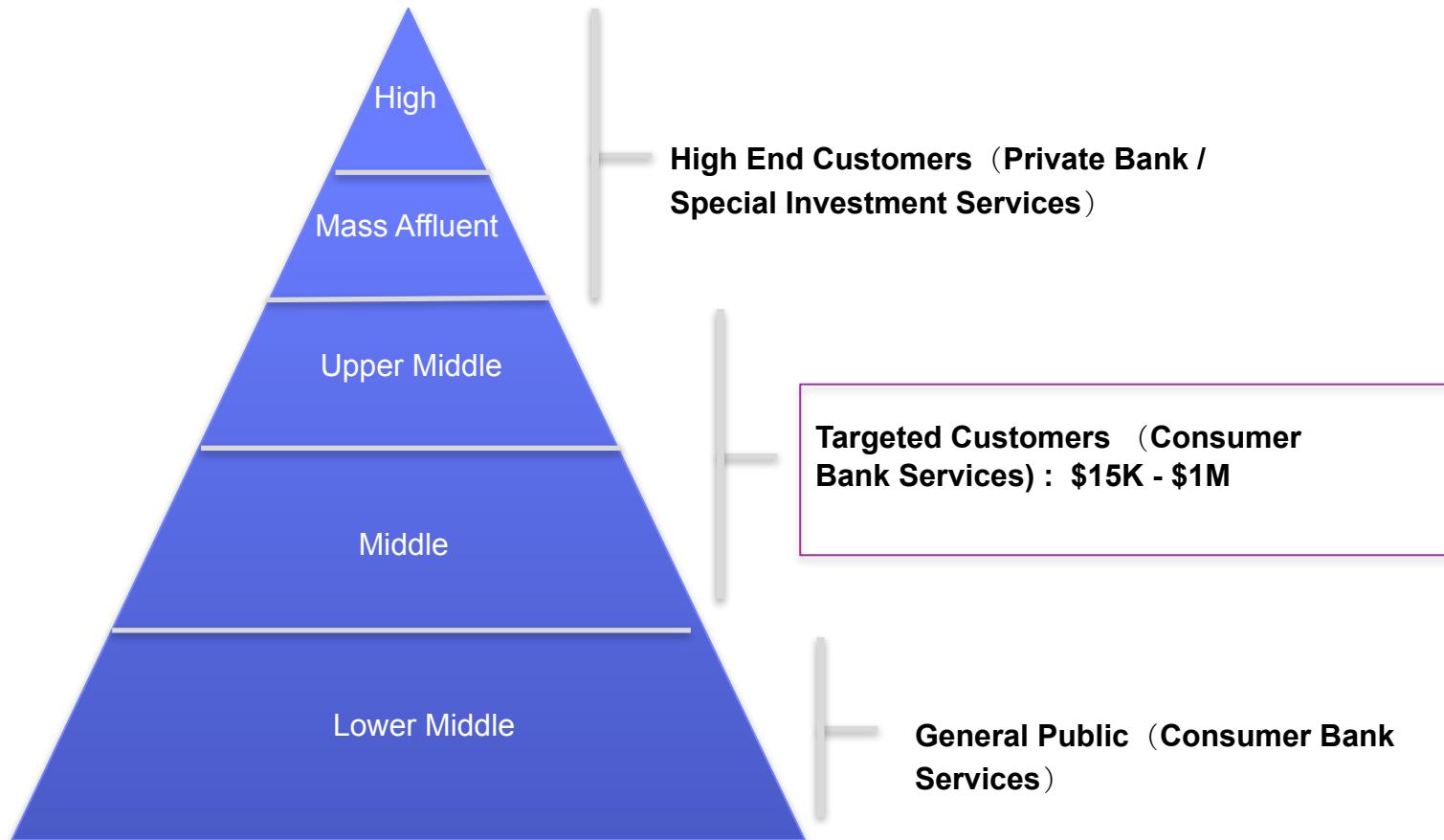
Typical Steps of Robo-Advisory

Most of the robo-advisor platform is built based on the modern investment portfolio theory, using Exchange Trade Funds (ETFs) to build portfolio.



Based on a survey of Wells Fargo, in US, there is only 16% of population in their 20s and 30s are willing to interact with investment consultants. The remaining people prefer to use these types of AI consultant.

Robo Advisor Customer Analysis



Four Steps to use Big Data Cognitive Analysis for Robo-Advisor

Investment Market Analysis	Dynamically Know Your Customer	Optimized Personalized Investment Strategy	Precise Bank-Customer Interaction
<ul style="list-style-type: none"> Analyze the market performance of various kinds of funds Analyze domestic and international financial and economic changes and how they may impact CPI, PPI, or GDP. Use Machine Learning and Deep Learning, based on historical economic numbers, find out how factors impact financial markets. <p><u>Data</u></p> <ul style="list-style-type: none"> Product Data Market Data Historical Economic Data Industry-related Data 	<ul style="list-style-type: none"> Customer Profiling, e.g, based on IPQ (Individual Profile Questionnaire), Feedback, Risk Capacity and Risk Willingness Understand what the customer really wants based on their past behaviors interacting with bank <p><u>Data</u></p> <ul style="list-style-type: none"> Customer Data Behavior Data / Interaction Data 	<ul style="list-style-type: none"> Strategy computation and optimization based on personal history Demonstrate / Simulate 'what ifs' when the portfolio has different allocation. Explainability of 'what ifs' to customer to the customer. <p><u>Data</u></p> <ul style="list-style-type: none"> Customer Data Market Data 	<ul style="list-style-type: none"> Create and predict customer interaction strategy, including when, method, content to interact with customer – to achieve max customer and bank benefit. <p><u>Data</u></p> <ul style="list-style-type: none"> Customer Data Interaction Data Else?

Example: Major Wealth Management



Hundreds of products/campaigns Combinations with incompatibilities

How much of each product/campaign ?



Nightly batch run, select over 1.2M



To which customers?

Several millions of customers

Telesales, Mail, email, Office, etc...

Done through which channel?



Experts doing what-if to improve process

**When?
Select actions for the next days**



- Using customer past investment transactions under different market conditions, determine customer risk taking sentiment in real time on daily basis. Is customer panicking type or double down?
- Assess customer financial strength in taking aggressive investment position.
- Suggest portfolio adjustment at a rate that matches customer investment change rate

Enhanced customer view

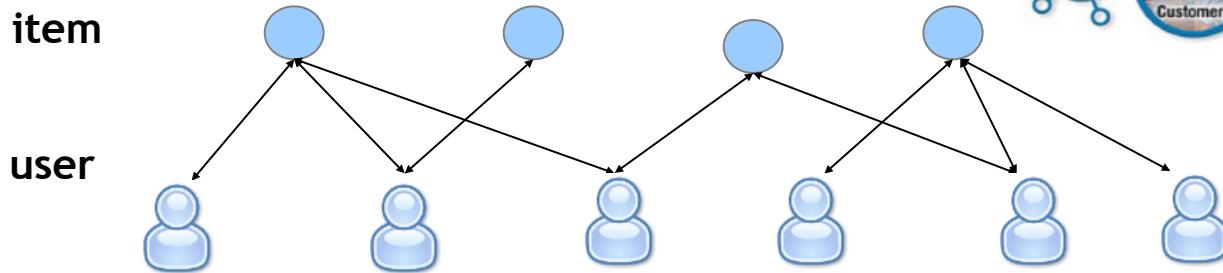
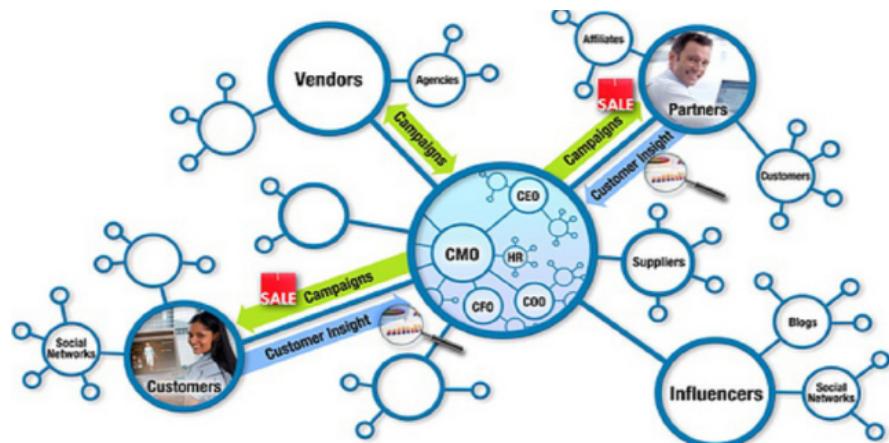
Recommendation



The screenshot shows the Amazon.com homepage with a search bar and navigation links. A message at the top says, "Hello, Ching Yung Lin. We have recommendations for you. (If you're not Ching Yung Lin, click here.) Make this". On the left, there's a sidebar with "Your Favorites" (Books, Software) and "Featured Stores" (Apparel & Accessories, Beauty, DVD's TV Central). The main content area is titled "Recommended for you" and lists three items:

- Spikes [Reprint]** Paperback by Fred Rieke
- Spiking Neuron Models** Paperback by Wulfram Gerstner
- Methods In Neuronal Modeling - 2nd Edition** Hardcover by Christof Koch

Each item has a link to "Why is this recommended to me?" and a "See more Recommendations" button.



Graph Visualizations

[Communities](#)
[Graph Search](#)
[Network Info Flow](#)
[Bayesian Networks](#)
[Centralities](#)
[Graph Query](#)
[Shortest Paths](#)
[Latent Net](#)
[Ego Net Features](#)
[Graph Matching](#)
[Graph Sampling](#)
[Markov Networks](#)

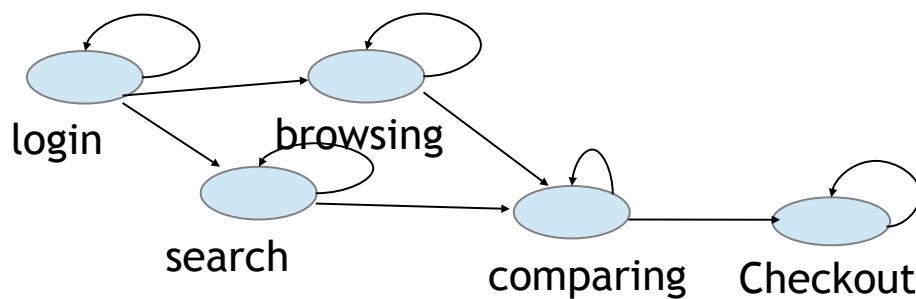
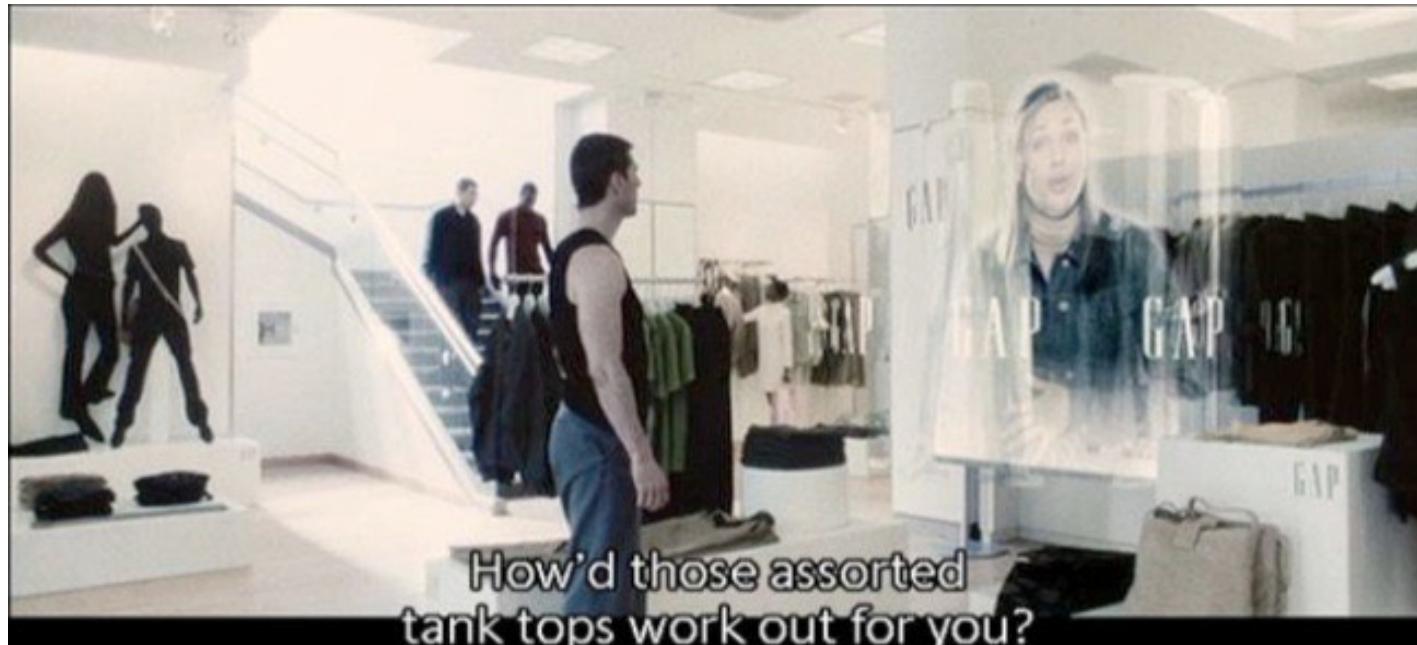
Middleware and Database

Customer Behavior Sequence Analysis

Markov
Network

Latent
Network

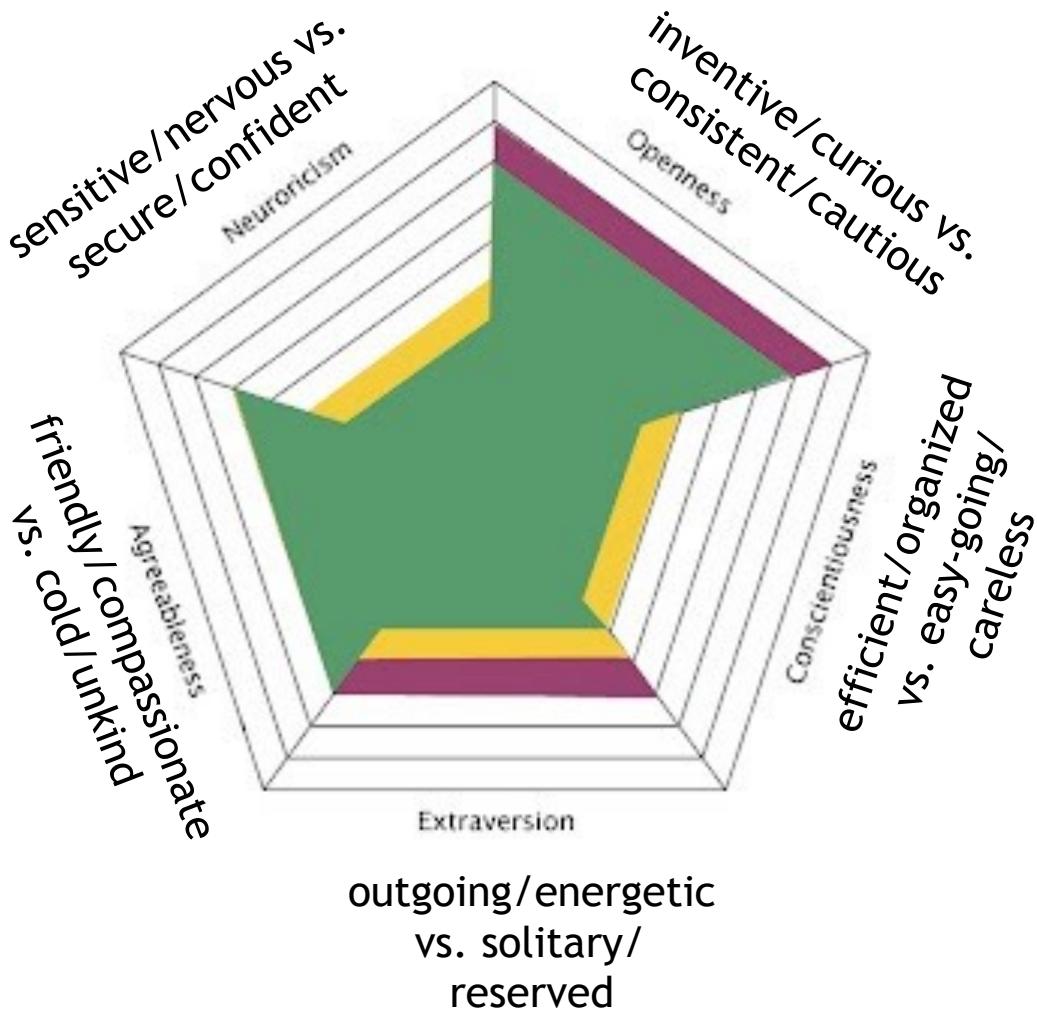
Bayesian
Network



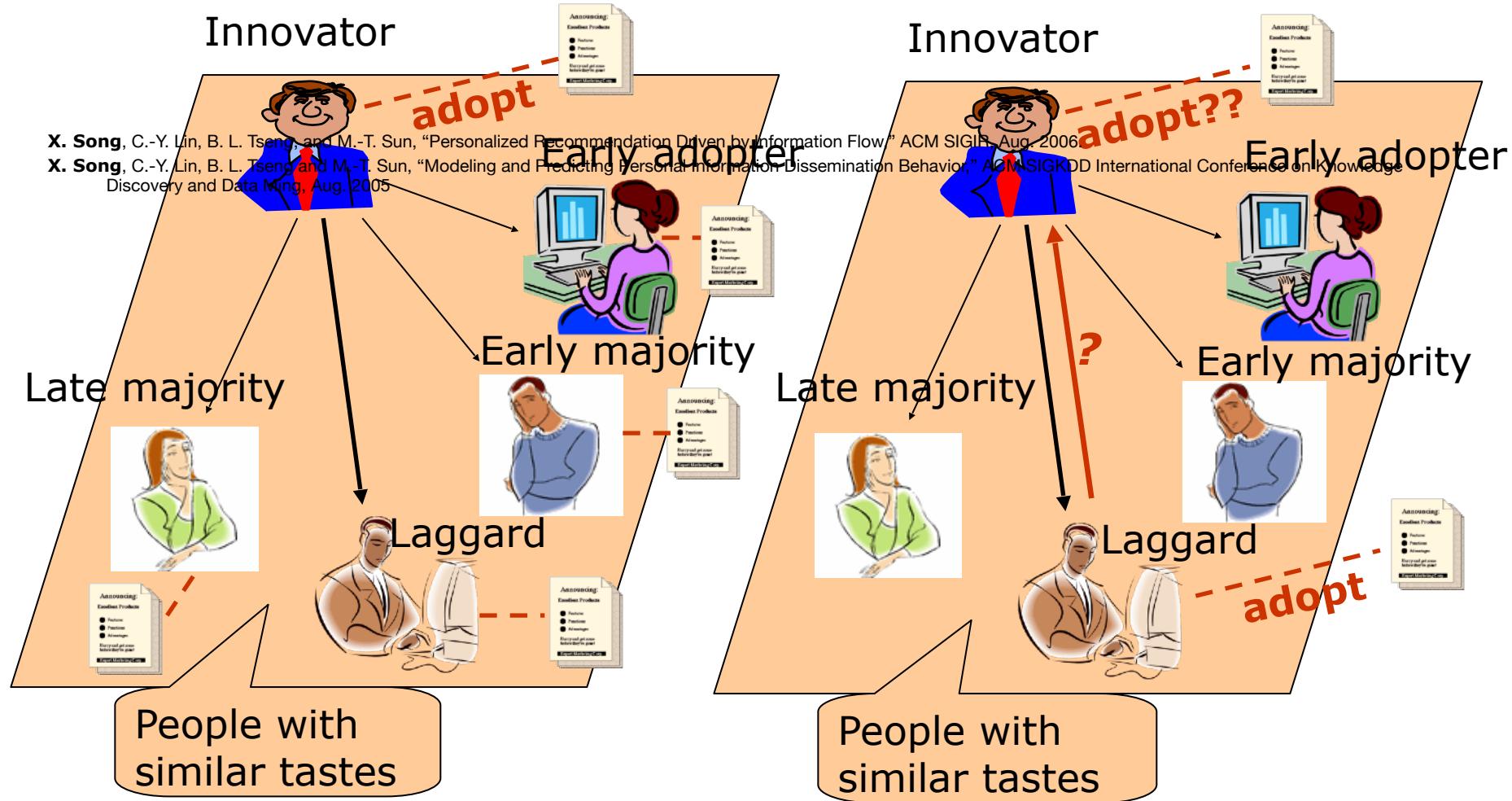
- Behavior Pattern Detection
- Help Needed Detection

Deriving Personality

Big5 Personality (OCEAN)



Recommendation Driven by Influence Flow



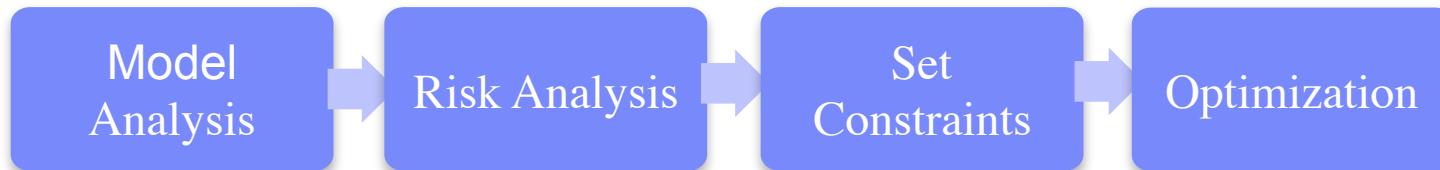
Influence is not symmetric!

Optimized Personal Investment Strategy

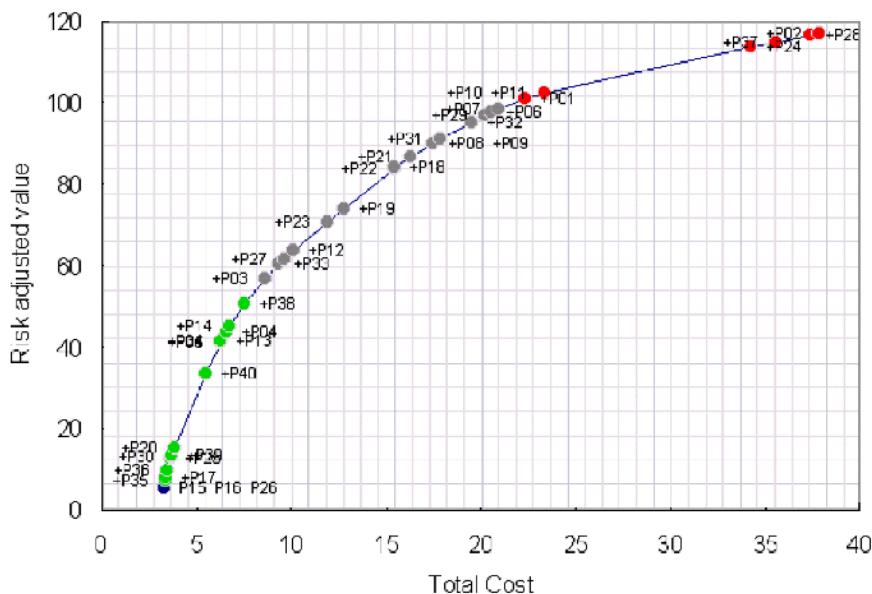
- Project customer existing portfolio performance over a time period vs. suggested adjustment projected performance over the same period.
 - Show past historical similarity and simulated projection.
- Portfolio adjustment should include both conservative and aggressive bias and let the customer choose change or no change to his portfolio.
- Give customer the decision making power to make portfolio adjustment using our personalized recommendation.

Robo-Advisory Techniques suggests better combination

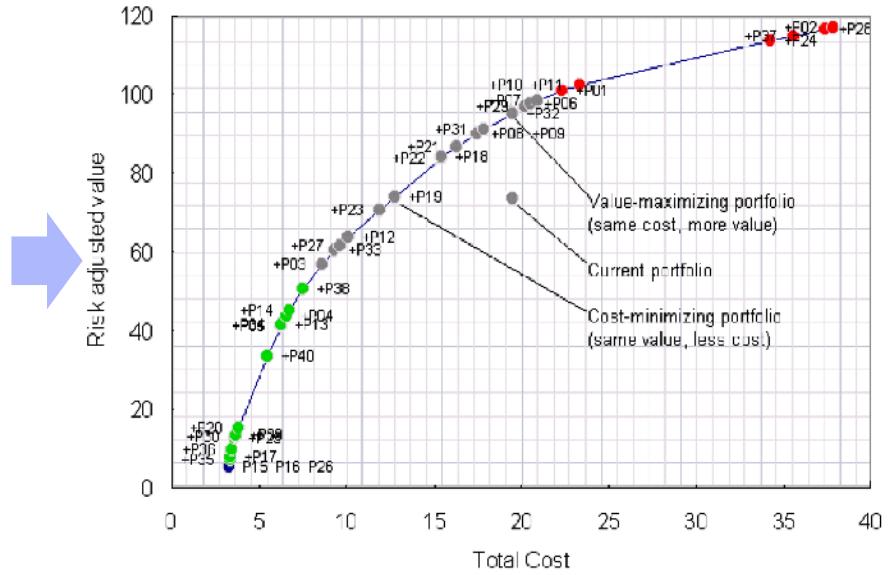
Constrained optimized model



Risk-Profit chart



Optimized outcome



Optimization is about Resource efficiency/utilization and allocation

Resources	Choices to make
Capital	Invest, allocate
People	Hire, assign, schedule
Equipment	Acquire, schedule, locate
Facilities	Locate, size, schedule, maintain
Vehicles	Acquire, route, schedule, deliver, maintain
Material/Product	Acquire, allocate, produce, deliver, maintain

- **Planning and scheduling activities**
 - Which are subject to complex operating constraints (e.g. limited resources, large volume of data, complex manufacturing or design processes)
 - With multiple business objectives to reduce time, cost, or increase KPI's such as productivity
- **While enabling**
 - Adjustment of changes in operating environment
 - What-if analysis

Keywords:

- minimize, maximize,
- how many/how much, which, when/where
- decide/choose, plan, schedule, assign, route, source, maintain, locate, trade-off

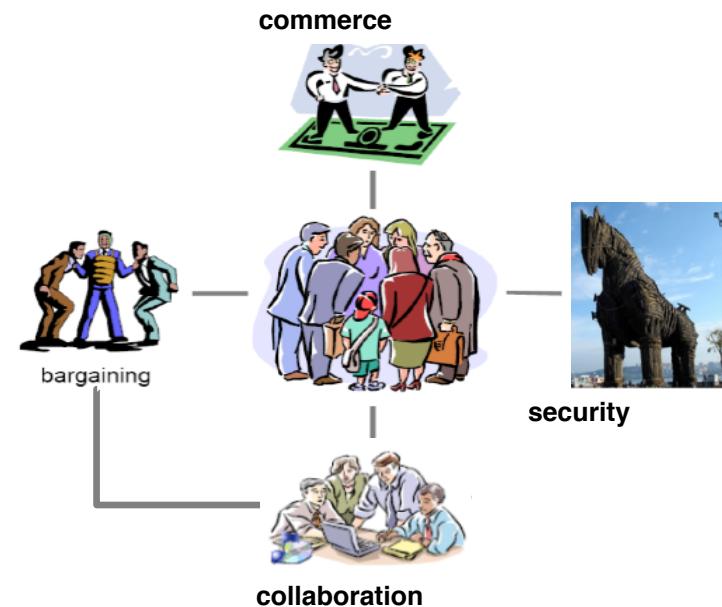
Portfolio Optimization

- **Issue:** Portfolio holders and managers seek maximum return from assets while limiting risks of adverse outcomes.
 - Classical formulation by Markowitz has become enriched by several factors.
 - Competitive advantage and client preferences lead fund managers to tailor portfolios to specific regional, sectoral, and other diverse preferences.
 - Novel assets have risk characteristics very different from standard stocks and bonds.
- **Scope:** Thousands of assets, hundreds of sectors, hundreds of regions. Rebalancing frequency (daily, weekly,...)
- **Decisions:** Amount of fund allocated to each asset
- **Objectives:** Minimize risk as measured by variance of portfolio return, etc
- **Requirements:**
 - Expected return at least achieves target
 - Total funds invested does not exceed amount available
 - Total funds invested per sector and/or region does not exceed limit
 - Limits on leverage

Task 4. Bank-Customer Interaction Strategy

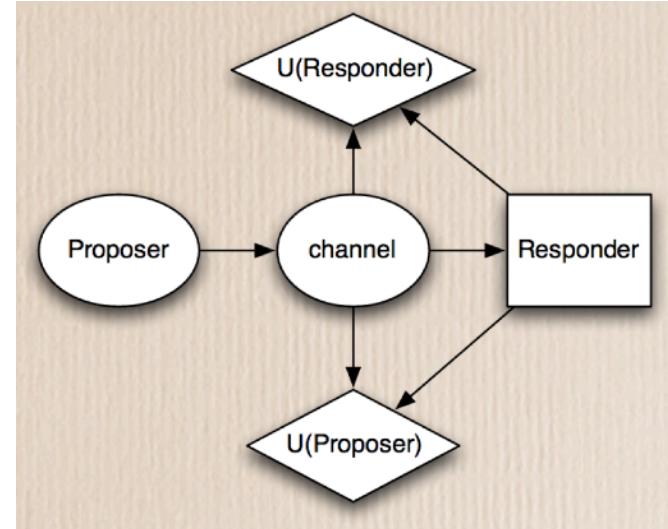
Bank-Customer Interaction Strategy

- Customers may not immediately accept a personalized investment strategy.
- Customers profile may contain insufficient data (e.g. new customers) to fully capture their risk profile.
- Customers may have their own investment strategy ideas they want to pursue.
- Customers desired investment characteristics may be impossible to achieve
- Customers may be willing to accept higher risk strategies than they believe.
- A personalized investment strategy may involve a number of investment stages.
 - What order should these stages be presented?
 - Can this order influence a customers risk profile?
- How can we model interaction with customers? As a multi-agent decision process, analyzed using game theory.



Game Theory and Decision Processes

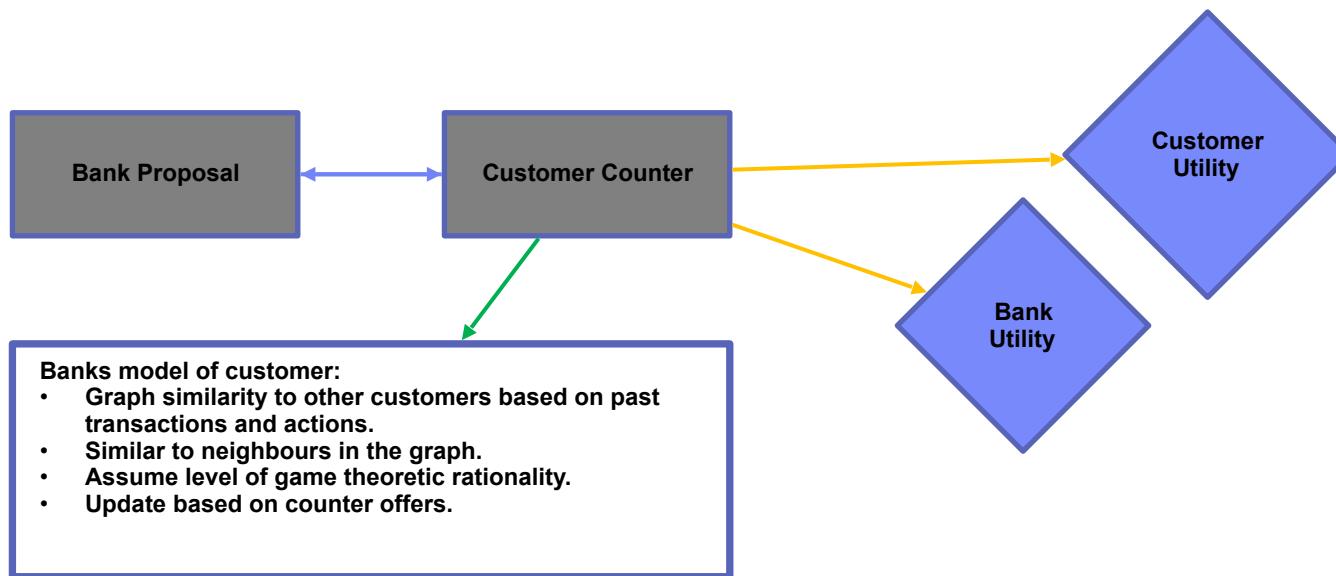
- Game theory is a system to model behavior of those in conflict, or with different goals.
- Creates predictions about individuals using assumptions of rationality (I will make the decision that is best for me).
- We can use an influence diagram to describe a game or decision process and solve it (e.g. using game theory).
- Here we have an influence diagram representing the ultimatum game between the Proposer (i.e. a bank) and a Responder (i.e. a customer).



<http://www.eecs.harvard.edu/~gal/tutorial4perPage.pdf>

Customer and Bank Interaction Modeling

- Using influence diagrams, we can model the process of suggesting investment strategies to customers. This involves decision processes with potentially multiple interactions between a bank and each client.
- We assume that the bank and the customer each have their own financial investment characteristics that they find desirable.
- Game theoretic decision processes to settle on an investment strategy that both find acceptable, involving offers and counter offers.





AI Trader

Personal AI Traders



Anita

Graphen Artificial Intelligence Traders

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Anita avatars are earning: \$1,501.65



ANITA-324658
PER \$1,000 EARN: \$82.24



ANITA-253758
PER \$1,000 EARN: \$27.04



ANITA-247917
PER \$1,000 EARN: \$291.07



ANITA-428339
PER \$1,000 EARN: \$55.16



ANITA-164762
PER \$1,000 EARN: \$33.69



ANITA-450214
PER \$1,000 EARN: \$161.56



ANITA-247502
PER \$1,000 EARN: \$51.40



ANITA-267139
PER \$1,000 EARN: \$456.80

Personality driven AI Trader


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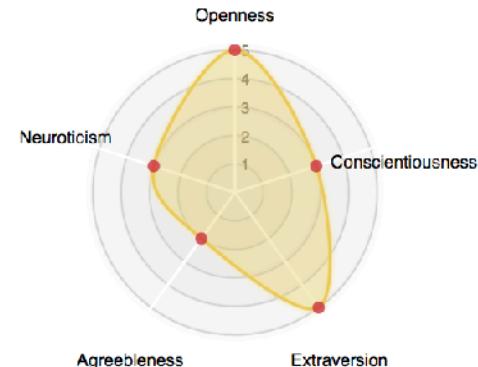

Anita 267139

-- an Adventurous AI Trader

Specialized at: EUR-USD

Knowledgeable of: Oil, Gold and Twitter

Strategy Learning Frequency at: 2.0 hours



Original: \$1,000.00, Current: \$1,404.50, Performance: Gain \$404.50



Activities

Time	Action	Cash	Unit	Balance
2017-10-12 13:45:05	Sell 50,000	\$1,404.50	0	\$1,404.50
2017-10-12 12:57:25	Buy 100,000	-\$57,792.00	50,000	\$1,386.50
2017-10-12 11:19:10	Sell 100,000	\$60,577.00	-50,000	\$1,372.00
2017-10-12 11:11:55	Buy 100,000	-\$57,822.00	50,000	\$1,366.00
2017-10-12 09:08:05	Sell 100,000	\$60,566.00	-50,000	\$1,310.00
2017-10-12 08:34:40	Buy 100,000	-\$57,935.00	50,000	\$1,287.50

Personality driven AI Trader


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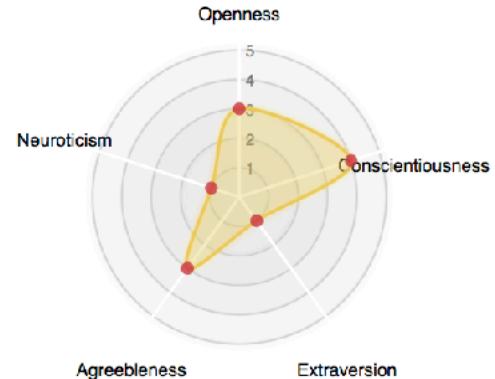

Anita 247502

-- an Independent AI Trader

Specialized at: EUR-USD

Knowledgable of: FX, Gold and Twitter

Strategy Learning Frequency at: 100.0 days



Original: \$1,000.00, Current: \$1,119.50, Performance: Gain \$119.50



Activities

Time	Action	Cash	Unit	Balance
2017-10-12 14:58:00	Buy 50,000	\$1,119.50	0	\$1,119.50
2017-10-12 13:56:35	Sell 100,000	\$60,304.00	-50,000	\$1,048.50
2017-10-12 11:51:25	Buy 100,000	\$-58,196.00	50,000	\$1,012.00
2017-10-12 10:56:10	Sell 100,000	\$60,232.00	-50,000	\$992.50
2017-10-11 16:46:45	Buy 100,000	\$-58,236.00	50,000	\$1,066.50
2017-10-11 15:13:20	Sell 100,000	\$60,382.00	-50,000	\$1,065.00

Personality Investing

- Goal

- Typical portfolio allocation focuses on risk tolerance of investors which measures their ability to take risk. While investors CAN take risk, they may not be WILLING to do so. One's persona better reflects their willingness to bear risk.

- Features

- OCEAN Personality Inference and Stock recommendation from portfolio and trading history
- Portfolio and trading history rated in 6 quantifiable aspects by Market Intelligence
- Personality driven trading style classification and suggestion
- OCEAN Personality
 - Openness
 - Conscientiousness
 - Extraversion
 - Agreeableness
 - Neuroticism
- Trader Type
 - Careful Investor - John Bogle
 - Patient Investor - Warren Buffett
 - Value Investor - Benjamin Graham
 - Etc.