



Sentiment-Driven Financial Intelligence

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Agenda

- Introduction
- Financial Intelligence
- Behavioral Approach
- Key Takeaways
- Questions

Digital Reasoning

Trusted Cognitive Computing For A Better World



Machine Learning
platform that
understands
human
communication



National Security
Financial Services
Health Analytics
Data Science



Nashville
Washington
New York
London



Goldman Sachs
Credit Suisse
In-Q-Tel
Silver Lake
(individuals)

 **accenture**

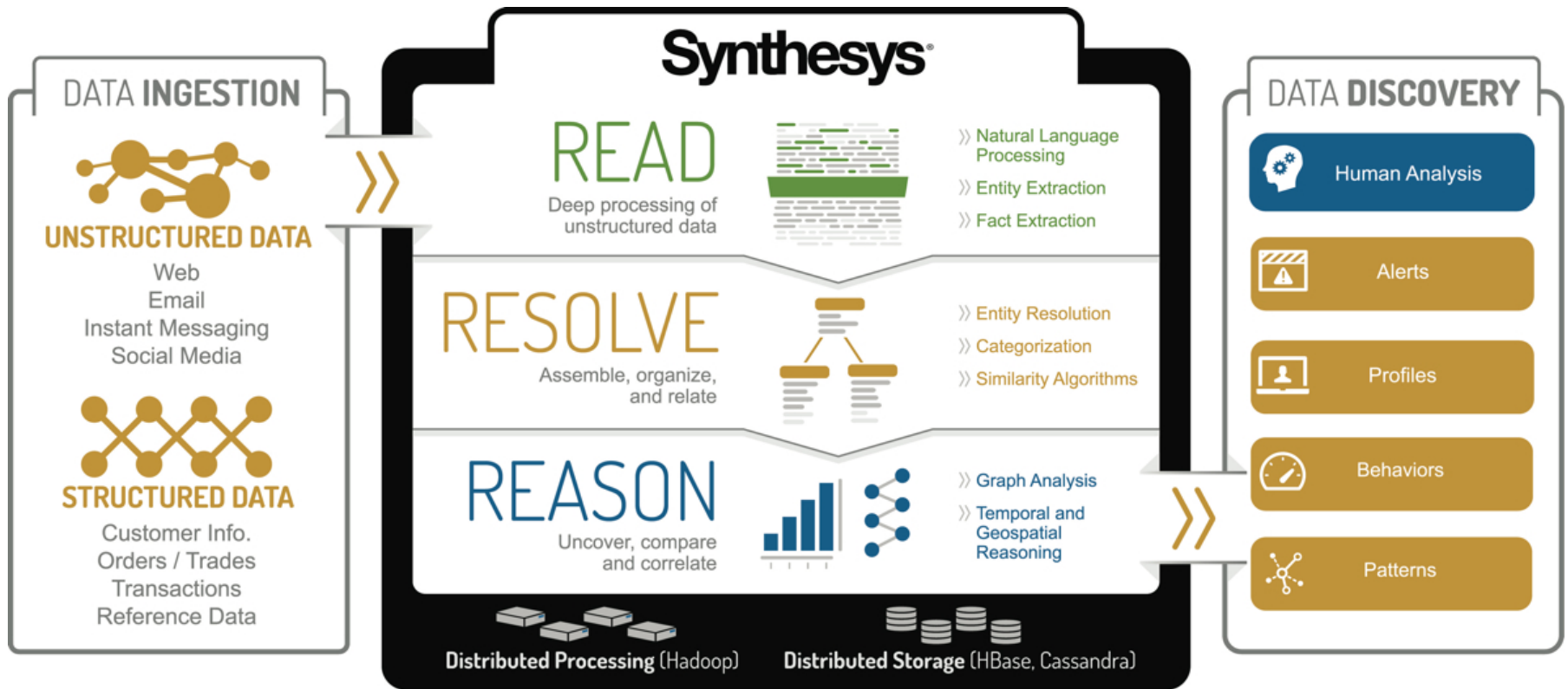
cloudera[®]
Ask Bigger Questions

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 **amazon**
web services[™]

Digital Reasoning Platform

- Scalable platform designed to analyze human communications



What is Financial Intelligence?

Predict client interests and behavior from communications and interactions

Customer
Insight

Extract key market themes and monitor risk metrics from structured and unstructured data

Market
Intelligence

Uncover investment opportunities through insights derived from public and private data

Investment
Research

Monitor AML, SAR, misconduct, manipulation and unauthorized trading, trade reconstruction

Risk &
Compliance

Customer Insight

- Goal: leverage client communications to predict client preferences and behavior, extract client holdings
 - CRM data, emails, documents, phone calls, chat
- Example:
 - Banking chat mining:

>>>>05/06/2014 23:17:09 JSMITH, SMITH, JAMES, BANK 1 has joined the room

Financial Product Bid/Offer Financial Product Bid/Offer Financial Benchmark
spot MYR* opened 2.2690/10* (unch from NY) spot KRW* opened 1028.6 (1027.5/28 NY close).

>>>> Financial Entity HGRUBER, GRUBER, HANS, BANK 1 Says: Financial Benchmark
models/gamma types* have been buying USDJPY since the NKY open.*

Financial Benchmark Financial Model N, ESTEBAN, BANK 1 Says: Financial Benchmark Bid/Offer
CNY fix - our NEER model* forecasting 6.1523, pretty much in line with market expectation of 6.1530 spot CNY FIX* 70/90*

>>>>05/07/2014 01:17:26 ELADRON Financial Benchmark 1 Says:
does anyone have a 4pm London* for me?

>>>>05/07/2014 01:17:26 DB BARKER, BANK 2 Says:
I have a 200000000 USDJPY.*

Risk & Compliance

- Goal: Monitor AML, SAR, misconduct, manipulation and unauthorized trading, trade reconstruction



FX Rate Manipulation

- Reveal collusion and market manipulation
 - "Quid-pro-quo" exchanges
- Clustered Bid/Ask quotes
- Order execution around the benchmark



Unauthorized Trading

- Identify trading abuse
 - Deal related language
- Abusive/dirty references
- Improper placement and execution



Wall Cross Violations

- Uncover insider trading
- M & A terminology
 - Personal trade execution
- Discussing Companies on Restricted list



Conduct Risk / Anti-Bribery

- Email from/to sensitive countries
- Bribery & gift language
 - Presence of attachments
- Deal related language & order execution



Anti-Money Laundering

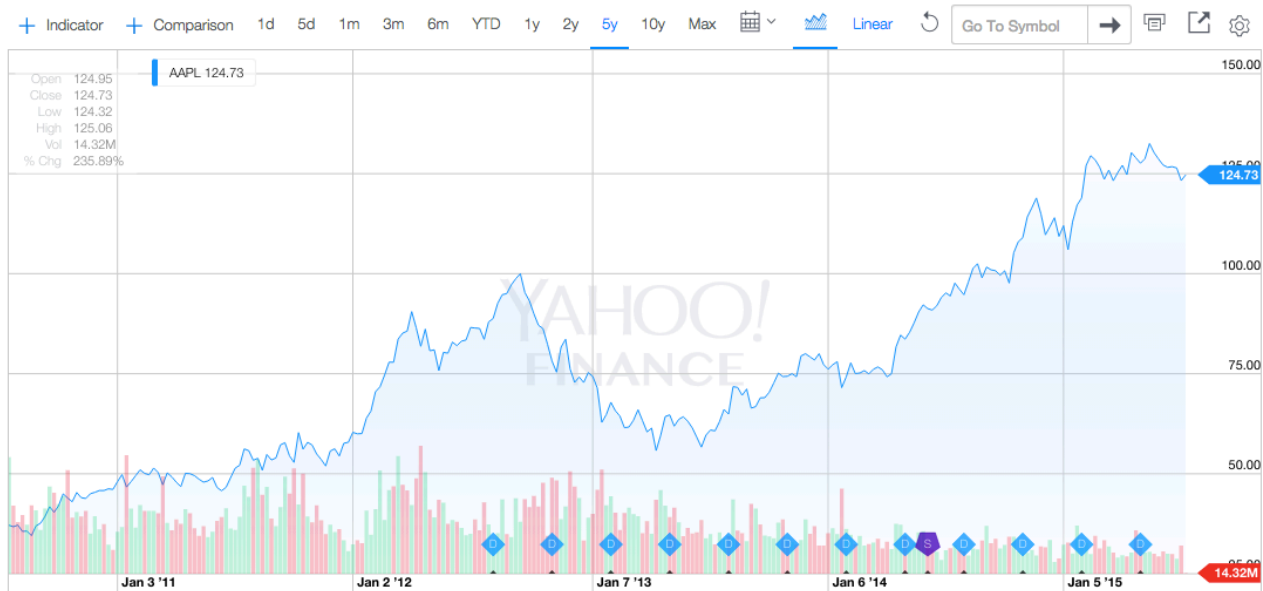
- Use public information to enhance KYC profiles
 - Email to/from economically sanctioned countries
- Deal related language & order execution
- Analyze wire instruction fields for hidden risks



Electronic Communications Surveillance

Useful Analyst Sentiment?

“The stable outlook reflects our expectations that Apple will continue to maintain and defend its **strong** market position in mobile devices and tablets despite seeing an **contraction** in its addressable market.”



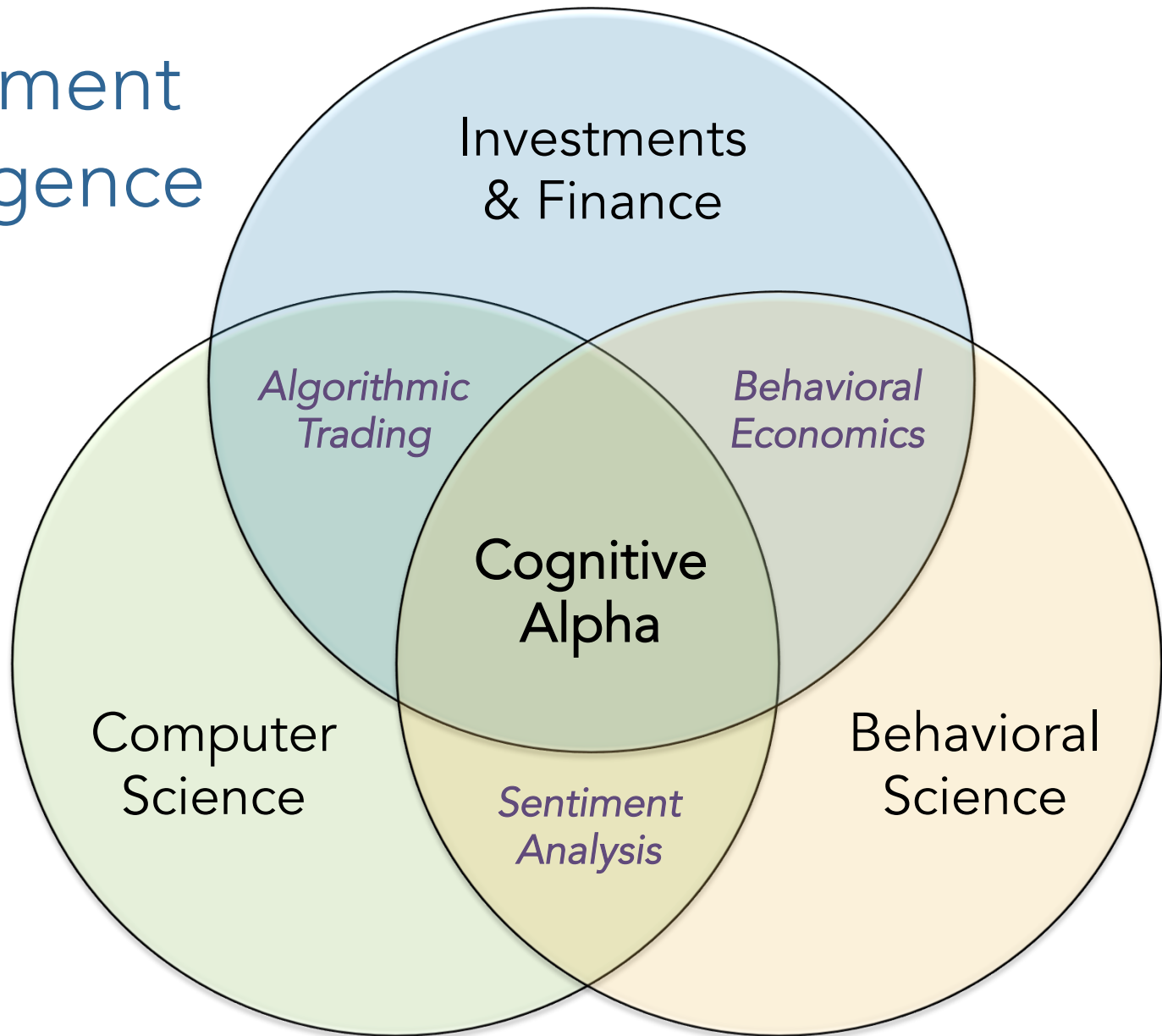
Source: Yahoo

Investment Intelligence

Alpha: the active return above that of a passive benchmark

- Goal: identify persistent sources of alpha through sentiment analysis
- Key is “persistent” as sentiment is widely viewed as transitory and unstable over long-term
- Current approaches incorporate emotional, affect psychology and intent models that aggregate individual sentiment to identify short-term group trends
- Incorporate models of investor behavior?

Investment Intelligence



Traditional vs. Behavioral Economics

Empirical evidence diverges greatly from classic theory

Traditional

- Perfect rationality
- Expected utility theory
 - Risk aversion
- Efficient market hypothesis
- CAPM and APT

Behavioral

- Bounded rationality
- Prospect theory
 - Loss aversion
- Adaptive market hypothesis
- Behavioral Asset Pricing
- Market anomalies

Why do market anomalies exist?

Drivers of Anomalies

Cognitive Biases

- Conservatism
 - Overweight Bayesian priors
- Confirmation
 - Selection bias
- Gambler's Fallacy
 - Mean reversion
- Representativeness
 - Overweight recent evidence
- Availability
 - Familiarity premium

Emotional Biases

- Loss aversion
 - Pain > Gain
- Overconfidence
 - Underestimate risk
- Endowment
 - Sentimental value premium
- Status-Quo
 - Regret-aversion
- Herd behavior

Anomalies are drivers of excess return (alpha)

Studies of Market Anomalies

Year	Authors	Anomaly
1968	Ball & Brown	Earnings announcement effect
1975	Haugen & Heins	Low volatility effect
1976	Rozeff & Kinney	January effect
1977	Basu	Low P/E effect
1981	Gibbons & Hess	Monday effect
1981	Shiller	Excess volatility effect
1981	Banz	Size effect
1985	Rosenberg, Reid, Lanstein	Value effect
1987	DeBondt & Thaler	Over-reaction to bad news
1993	Jegadeesh & Titman	Momentum investing

Quantitative Behavioral Finance

- Behavioral asset pricing model:

Expected Return

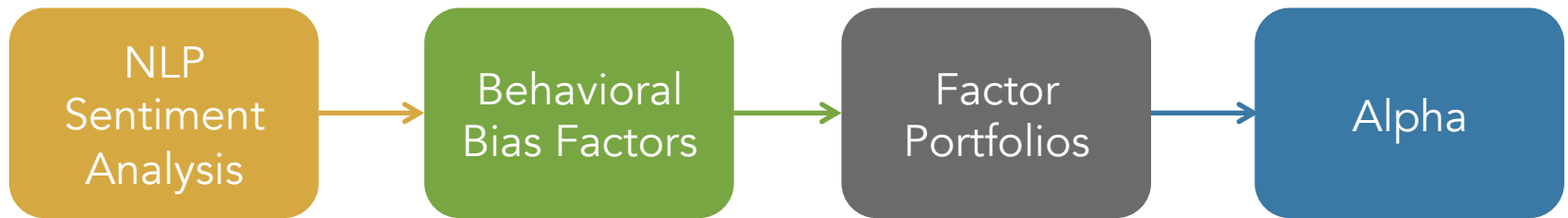
$$E[r] = r_f + \sum_{j=1}^k \beta_j (r_j - r_f) + \sum_{i=1}^m \gamma_i b_i$$

Risk-free Rate Factor Beta Risk Factor Premium Bias Sentiment Premium

CAPM APT

- This is a linear factor model that includes behavioral bias sentiment factors
- Exposure to behavioral biases given by weights γ_i

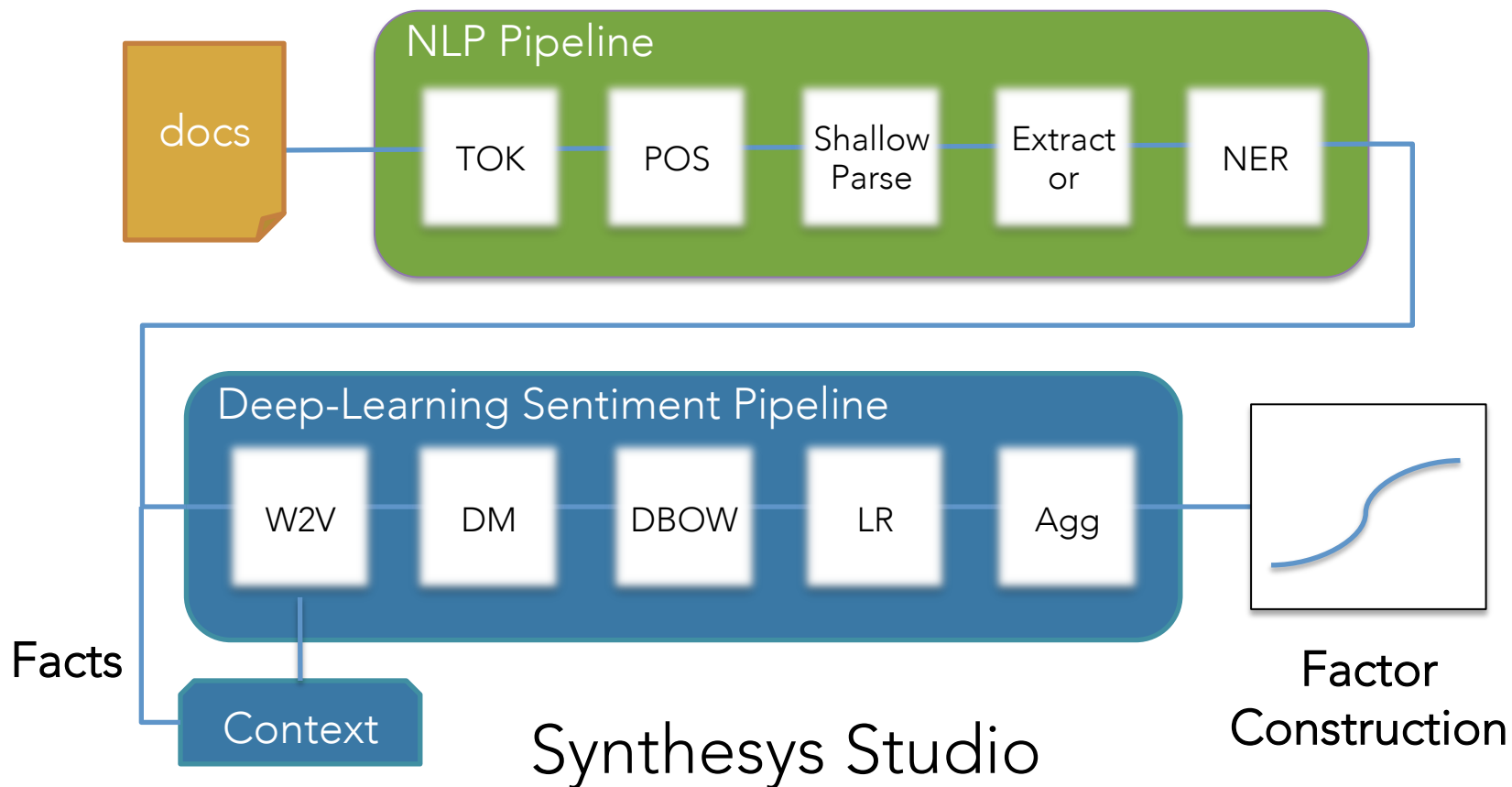
In Search of Alpha



1. Context-based sentiment analysis to extract features of behavioral biases observed in investor commentary
2. Combine these features with structured data to formulate behavioral bias factors
3. Use the factors to fit regression models for asset returns
4. Construct factor portfolios to monetize market anomalies by overweight/underweight exposure to specific behavioral biases

Our Methodology at Digital Reasoning

- Data: public and private investor commentary



Some Results

Standard Fama-French model (MKT, SMB, HML) regression with two behavioral factors (UMO, ITF): ^{Sun 2014}

	Factor Premium	Standard Deviation	P-value	Sharpe Ratio	Corr. Vs. MKT
MKT	0.47	4.66	0.0262	0.10	1.00
SMB	0.19	3.16	0.1942	0.06	0.28
HML	0.42	3.04	0.0022	0.14	-0.33
UMO	0.32	1.57	0.0001	0.20	-0.12
ITF	0.91	3.06	0.0001	0.30	-0.50

Key Takeaways

- Intersection between sentiment analysis and behavioral economics is opening up new opportunities for investment alpha generation
- DR's context-based sentiment analysis methodology is useful for extracting behavioral bias features from public and private data
- Behavioral bias feature extraction yields factor portfolios that can take advantage of anomalies manifested from these biases
- Open research field

Final Words

- We at Digital Reasoning are actively exploring neural embedding and deep learning methods to enhance feature extraction of behavioral biases
- Toolbox: Synthesys Studio
 - Text analytics
 - Model training
 - Open platform
 - Q4 2015 release
 - Freeware

