singularitydao

Sentiment and Cognitive Distortions Mining in Social Media

Mukul Vishvas, Ali Raheman, Anton Kolonin, Igors Fridkins, Ikram Ansari, Juan Pinzon, Alice Ho (Based on work done at SingularutyDAO and Autonio Foundation)

mukul.vishwas@singularitydao.ai anton@singularitynet.io

Sentiment and Cognitive Distortions Mining in Social Media

- GOAL: Analysis of social media sentiment (polarity) and cognitive distortions for the purpose of crypto market prediction.
 - Collecting social media feeds from about 77 feeds on Twitter and Reddit, then computing about 19 metrics for them around the clock.
 - **Using prior work** "Historical language records reveal a surge of cognitive distortions in recent decades" for cognitive distortions mining model. <u>https://doi.org/10.1073/pnas.2102068881</u>
 - Exploring different open source sentiment analysis solutions and choosing Aigents[®]
 model because of its Interpretable nature, Its more practical to use and easy to adjust model
 performance with domain-specific corpus.
 - Papers are published: <u>https://arxiv.org/pdf/2204.10185</u> and <u>https://arxiv.org/pdf/2204.12928</u>
 - Analyzing the potential causal connection between different metrics and the price movement.



Cognitive Distortions, Cognitive-Behavioral Schema (CBS)

- Text mining model based on 'n-grams' (lexemes)
- Examples:
 - Catastrophizing: Exaggerating the importance of negative events (will fail, will go wrong..)
 - Fortune-telling: Making predictions, usually negative ones, about the future (I will not, we will not...)
 - Mindreading: Believing you know what others are thinking (everyone knows, everyone thinks...)

12 COMMON COGNITIVE DISTORTIONS



Mind reading When you assume you know what others are thinking or feeling



Negative focus When you ignore the positive aspects and only see the negative ones



Catastrophizing When you expect the worst case scenario to happen to you



Labeling When you label yourself or someone negatively such as 'I'm a loser'



Should-thinking

When you have rules or expectations how things or people should be/act



Personalization When you feel personally responsible or guilty for things you can't control



Overgeneralizing When a single negative event occurs and you believe it is a pattern



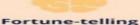
Owning the truth When you are certain you are right and your opinion is the truth



Emotional reasoning When you believe that how you feel is evidence or reflects reality



Just-world thinking When you assume that everything in the world will be balanced fairly



When you think the future is set in stone and the outcome is sure



Control fallacy When you assume you

can control everything that happens in your life



singularity dao

Aigents®

- Aigents[®] is an "interpretable" model based on "n-grams" (lexemes), available as part of <u>https://github.com/aigents/aigents-java</u> distribution, and written in Java.
- It is based on positive and negative dictionaries of words and lexemes (n-grams) and has over 8,200 negative and 3,800 positive n-grams.
- The "priority on order" feature helps the model to get a more reliable sentiment score.
 https://github.com/aigents/aigents-java/blob/master/src/main/java/net/webstructo



Aigents[®] Sentiment metrics

Example	Positive (P)	Negative (N)	Seniment (P+N)	Contradictive SQRT(P*N)
The weather is good.	1	0	1	0
The movie was bad.	0	-1	-1	0
Honestly, I don't like Crypto stuff but I am happy that it makes me richer.	1	-1	0	1

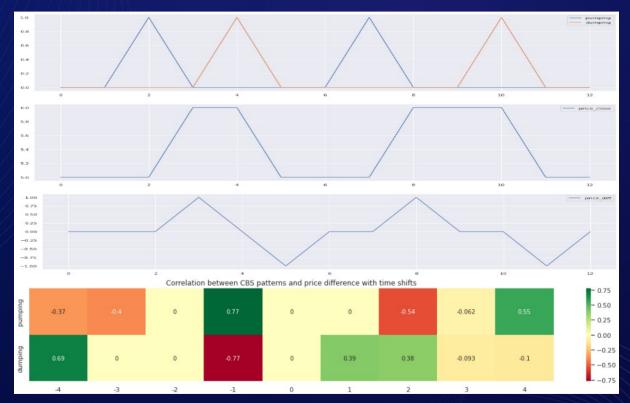


Aigents[®] Priority on order

- Aigents[®] is a **'n-gram'** (lexemes) based algorithm.
- In the 'Priority on order' method precedence is given for n-grams with higher order "n". For example if tetragram ["not a bad thing"] matched then lower 'n-grams' like ['bad thing'], ['not'] and ['bad'] inside of it are discarded.
- Using this method resolves the negation problem (not good, not bad).



Mining Causal Connections Between Social Media Metrics and Price Movement

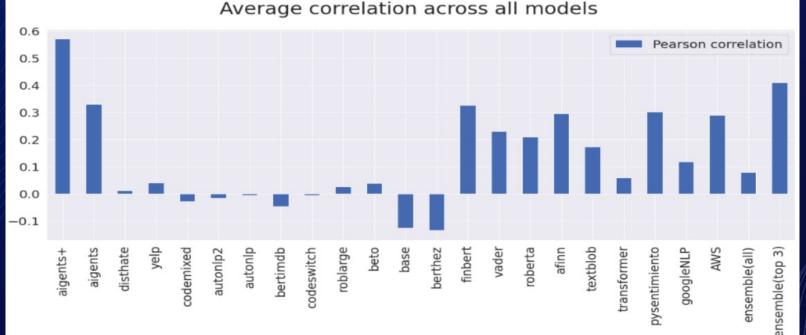


singularity dao

Aug 2022

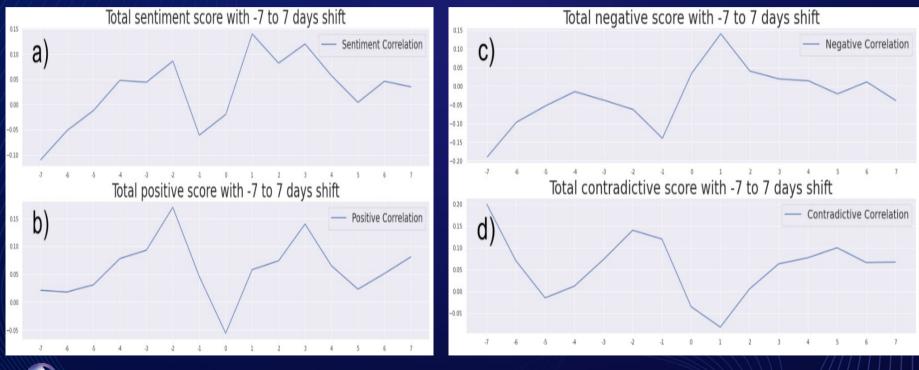
Results: Finding the best sentiment analysis model

- Below is the Pearson correlation between outputs provided by different models and manual sentiment markup in the test corpus, the Aigents® model outperformed all others.
- Aigents®+ model is the extended version of the Aigents® baseline one, we have added crypto domain-specific lexemes to it.



Results: Causal connections between Sentiment and BTC/USD price difference

Temporal correlation analysis for different sentiment metrics with mutual Pearson correlation computed between
 the daily Bitcoin price difference (derivative) and respective metrics over six months from July to December 2021.

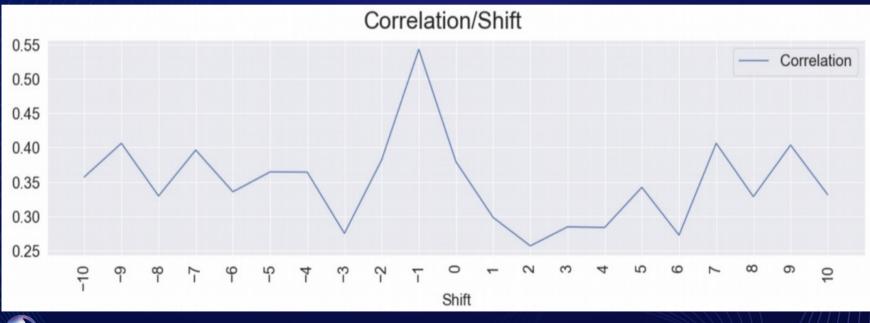


singularitydao

Aug 2022

Results: Causal connections between Compound Indicator and BTC/USDT Price difference

- Temporal correlation analysis for different sentiment metrics (Channel weight included) with mutual Pearson correlation computed between the daily Bitcoin price difference (derivative) and compound sentiment indicator (built on combination of Channel and metric weights, maximising the overall correlation value)
- $Y(I,d) = \Sigma X(c,m,d) * P(I,c,m) * W(c)$

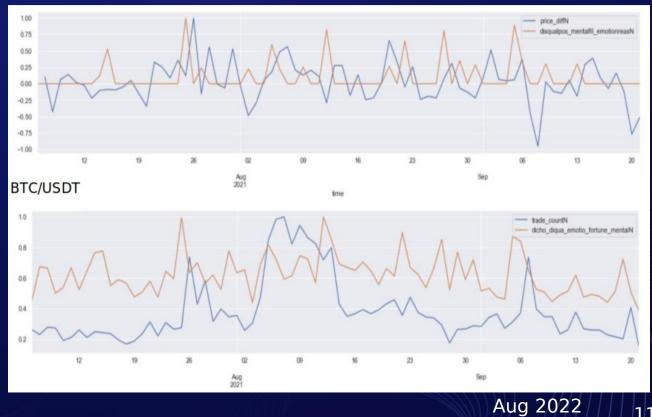


Aug 2022

Results: Causal connections between Sentiment and BTC/USD Price Moves and Volume

Cognitive Distortion vs Price Move

Cognitive Distortion vs Trade Count





CBS patterns vs. Market Dynamics (Price difference)

Tracking overall Twitter and Reddit cognitive distortions as a predictor for BTC/USD price difference

Correlation between CBS patterns and price difference with time shifts (days)												ys)	- 0.4				
catastrophizing	0.022	-0.056	-0.055	-0.084	-0.083	0.0073	0.0089	0.0077	-0.088	-0.068	0.037	0.013	-0.035	0.084	0.062		- 0.4
dichotoreasoning	0.018	-0.064	-0.049	0.0059	0.04	0.031	0.059	0.055	0.056	-0.018	0.052	0.12	0.18	0.089	0.082		
disqualpositive	0.077	-0.00084	-0.028	-0.11	0.018	-0.05	-0.0044	0.06	-0.025	0.064	0.1	-0.045	-0.035	0.003	0.048		- 0.3
emotionreasoning	0.00087	0.068	0.028	-0.014	-0.11	0.0091	-0.012	-0.026	-0.008	0.092	0.032	0.023	-0.11	-0.03	0.088		
fortunetelling	-0.091	0.0002	-0.031	0.043	-0.081	-0.016	0.097	0.02	-0.054	0.044	0.0053	0.086	0.065	0.064	0.094		- 0.2
labeling	0.063	0.037	-0.081	-0.16	-0.032	0.029	-0.028	0.0033	-0.043	-0.051	-0.027	0.052	-0.0021	0.029	0.06		
magnification	-0.046	-0.087	0.051	0.015	0.032	0.036	-0.0058	-0.017	-0.033	-0.048	0.05	0.053	0.13	0.083	0.022		
mentalfiltering	-0.00065	0.0034	-0.061	-0.048	-0.062	-0.014	0.041	-0.0021	0.12	0.17	0.19	-0.021	-0.081	0.0092	0.062		- 0.1
mindreading	-0.079	-0.047	-0.11	-0.057	-0.083	-0.041	-0.056	-0.075	-0.022	0.0079	-0.078	-0.031	-0.03	0.038	0.046		
overgeneralizing	0.1	0.14	0.099	0.027	0.024	0.083	0.088	0.074	0.024	-0.0023	-0.03	0.026	0.088	-0.044	0.024		- 0.0
personalizing	0.028	-0.023	-0.042	0.06	0.011	-0.051	-0.0097	0.034	0.074	0.019	-0.12	-0.12	0.0065	0.022	0.083		
shouldment	0.17	0.064	-0.06	-0.0026	-0.026	-0.02	0.046	0.049	-0.019	-0.042	-0.096	0.0044	0.066	0.073	0.14		0.1
exclusivereasoning	0.072	-0.022	-0.08	-0.025	0.024	0.038	0.045	0.041	0.06	-0.029	0.031	0.079	0.069	0.048	0.051		
negativereasoning	0.044	-0.00039	0.052	-0.038	0.0058	0.13	0.0049	-0.055	-0.11	-0.066	-0.086	-0.082	-0.096	-0.12	-0.086		
mentalfilteringplus	-0.022	-0.023	-0.1	-0.044	-0.036	-0.043	0.0037	-0.043	0.0044	0.017	0.088	0.0017	-0.001	-0.093	0.025	1	0.2
catastro_disqualpos_mentalfil_emotionreas	0.047	0.0087	-0.056	-0.13	-0.12	-0.023	0.017	0.018	0.0032	0.13	0.18	-0.014	-0.13	0.03	0.13		
disqualpos_mentalfil_emotionreas	0.042	0.041	-0.034	-0.098	-0.092	-0.03	0.014	0.016	0.052	0.19	0.18	-0.023	-0.13	-0.011	0.11		0.3
dicho_disqua_emotio_fortune_mental	-0.001	0.031	-0.048	-0.068	-0.11	-0.031	0.059	0.028	0.028	0.18	0.17	0.026	-0.072	0.026	0.15		
cbs	0.048	0.015	-0.088	-0.096	-0.12	-0.0088	0.055	0.025	-0.0082	0.088	0.082	-0.0041	-0.033	0.033	0.18		0.4
2	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7		-0.4

CBS patterns vs. Market Dynamics (Volume)

• Tracking overall Twitter and Reddit cognitive distortions as a predictor for BTC/USD trade volume

Co	orrela	ation	betw	een	CBS	patte	erns a	and t	rade	volui	me w	ith ti	me s	hifts	(day
catastrophizing	-0.046	0.0018	0.032	-0.03	0.02	-0.045	-0.011	-0.087	-0.056	-0.0051	-0.088	0.014	-0.007	-0.013	0.016
dichotoreasoning	0.011	-0.0045	0.12	0.13	0.17	0.19	0.12	-0.00056	0.1	0.17	0.26	0.25	0.26	0.16	0.011
disqualpositive	-0.017	-0.057	0.039	-0.05	-0.05	-0.058	-0.033	-0.068	-0.013	0.004	-0.0052	-0.018	-0.087	-0.074	-0.067
emotionreasoning	0.028	-0.029	-0.047	-0.024	0.006	-0.00091	-0.048	0.066	0.013	-0.049	-0.074	-0.11	-0.021	-0.074	-0.0054
fortunetelling	-0.0041	-0.023	0.08	-0.017	0.03	-0.063	0.028	-0.05	0.011	-0.081	-0.009	-0.02	0.043	0.024	-0.017
labeling	-0.13	-0.067	0.037	0.15	-0.0064	-0.013	-0.022	-0.031	-0.053	0.027	0.04	0.09	0.052	0.017	-0.15
magnification	-0.013	-0.01	0.018	0.06	0.12	0.055	-0.056	0.0056	0.089	0.13	0.12	0.065	-0.029	-0.078	-0.048
mentalfiltering	0.087	-0.068	0.059	0.028	0.08	0.16	0.14	0.014	0.0019	-0.042	-0.024	0.055	-0.092	-0.022	-0.033
mindreading	-0.036	-0.09	0.039	0.036	0.054	0.019	-0.009	-0.1	-0.12	-0.15	-0.093	-0.038	0.056	0.042	-0.042
overgeneralizing	0.027	0.028	0.05	0.14	0.025	-0.033	-0.011	-0.099	-0.062	0.033	0.11	0.044	0.048	0.018	-0.092
personalizing	-0.047	-0.046	-0.077	-0.14	-0.015	0.049	-0.095	-0.13	-0.083	-0.0046	-0.03	0.03	0.041	-0.1	-0.028
shouldment	-0.06	-0.09	0.0047	0.092	-0.0099	-0.015	-0.033	-0.12	-0.18	-0.066	-0.011	-0.061	0.0094	-0.068	-0.17
exclusivereasoning	-0.13	-0.052	0.17	0.14	0.13	0.19	0.054	-0.11	0.0037	0.16	0.23	0.22	0.17	0.028	-0.16
negativereasoning	-0.22	-0.14	-0.03	0.016	-0.016	0.0014	-0.072	-0.12	-0.057	-0.01	0.062	-0.0065	-0.062	-0.1	-0.19
mentalfilteringplus	-0.045	-0.029	0.064	-0.053	-0.1	-0.022	0.024	-0.085	-0.072	-0.13	-0.088	-0.026	-0.15	-0.11	-0.18
cbs	-0.06	-0.12	0.078	0.0032	0.038	0.028	-0.011	-0.16	-0.1	-0.074	-0.039	0.013	-0.047	-0.12	-0.18
dicho_disqua_emotio_fortune_mental	-0.042	-0.11	0.028	-0.038	0.016	0.049	-0.031	-0.034	0.042	-0.052	-0.011	-0.033	-0.025	-0.023	-0.057
	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7



- 0.2

- 0.1

-0.0

- -0.

Challenges and Future work

- N-grams weight: Excellent > Good
- Context-aware ngrams: The wether is cold but BTC is shining (Context is about the BTC not about the wether).
- Current news agenda aware ngrams: This law will block the crypto industry, This law was passed (should be negative).
- Sarcasm: I like how these friendly senators have agreed on that law increasing the government control over crypto. (seems positive-neutral but rather negative in fact)
- Idioms.
- Non-text data.



Thank you for your attention

mukul.vishwas@singularitydao.ai anton@singularitynet.io



Aug 2022

15