Overview of FinNum-2

Numeral Attachment in Financial Tweets

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Outline

- Motivation

- Dataset

- Task Setting

- Participants

- Methods & Results

- Discussion

- FinNum-3: Investor's and Manager's Fine-grained Claim Detection

Motivation

Numerals on Social Trading Platforms

Apr 26th, 1:39 am

$TSLA 256 Break-out thru 50 & 200- DMA (197-230) upper head res (274-279) Short squeeze in progress Nr term obj: 310 Stop loss:239

Bullish

Apr 12th, 7:02 pm

$AAPL support identified $198.8 ... next move to $215

Bullish   5

Apr 12th, 7:02 pm

$TVIX making a new 52 week low.

Bearish   4

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FinNum-1

$TSLA **256** Break-out thru **50** &

200- DMA (**197**-**230**) upper head res

(**274**-**279**) Short squeeze in progress
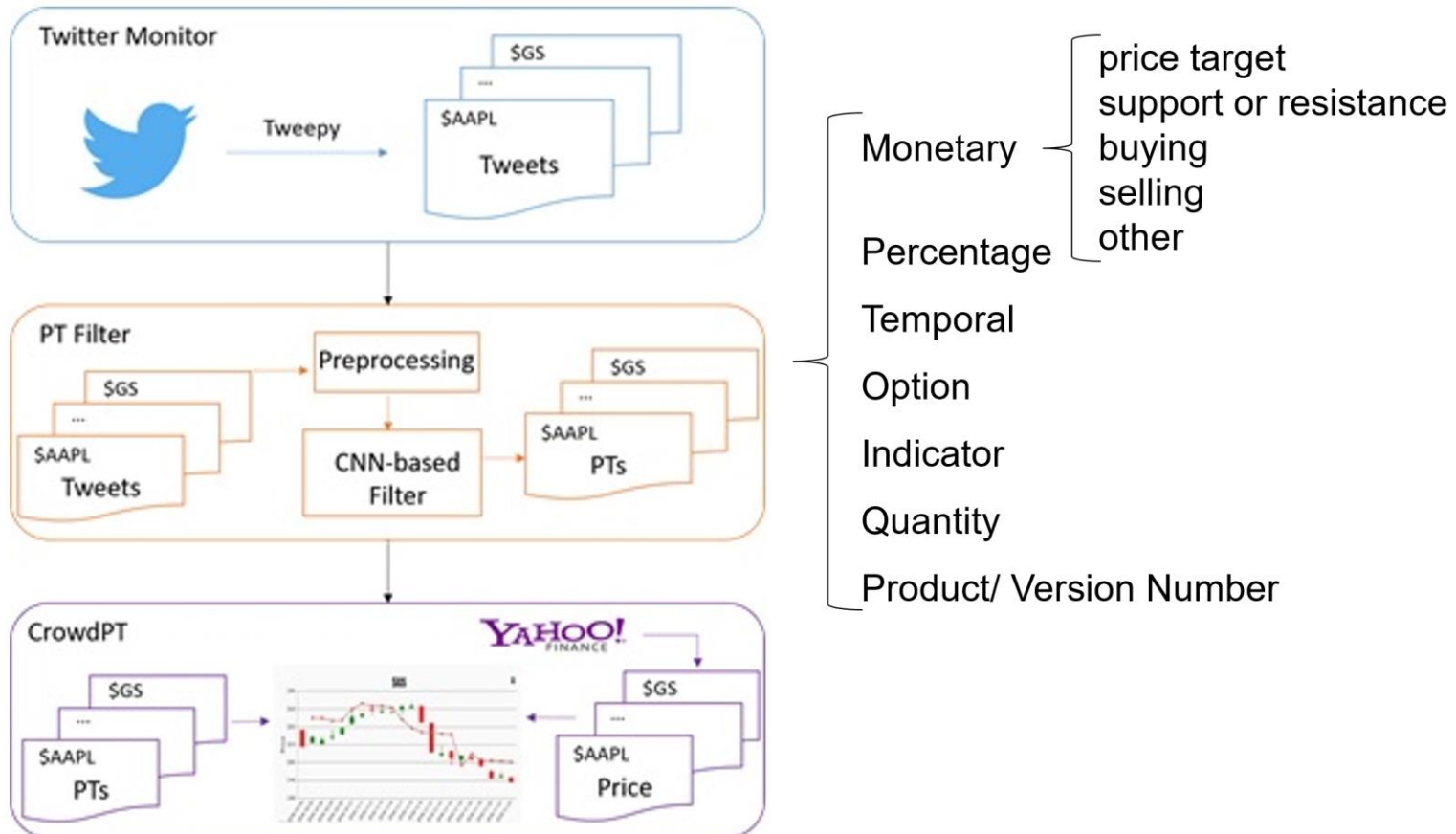
Nr term obj: **310** Stop loss:**239**.

25 tokens 9 numbers 6 meanings

We

- propose **fine-grained numeral taxonomy** for financial social media data
- attempt to **leverage the numeral opinions made by the crowd** to mine **additional information** for trading

Category	Subcategory	Train	Dev.	Test	Total	Ratio
Monetary		2467	261	459	3187	35.94%
	money	589	52	95	736	8.30%
	quote	792	89	152	1033	11.65%
	change	143	8	25	176	1.98%
	buy price	319	36	60	415	4.68%
	sell price	103	10	22	135	1.52%
	forecast	270	33	52	355	4.00%
	stop loss	25	4	6	35	0.39%
	support or resistance	226	29	47	302	3.41%
Percentage		838	105	170	1113	12.55%
	relative	585	70	112	767	8.65%
	absolute	253	35	58	346	3.90%
Option		169	11	22	202	2.28%
	exercise price	113	5	14	132	1.49%
	maturity date	56	6	8	70	0.79%
Indicator		167	22	27	216	2.44%
Temporal		2364	253	401	3018	34.03%
	date	2079	223	351	2653	29.92%
	time	285	30	50	365	4.12%
Quantity		741	87	154	982	11.07%
Product/Version		114	14	22	150	1.69%
		6860	753	1255	8868	100.00%

Application Scenario

Twitter Monitor → Tweepy → $GS ... $AAPL Tweets

PT Filter: $GS ... $AAPL Tweets → Preprocessing → CNN-based Filter → $GS ... $AAPL PTs

CrowdPT: $GS ... $AAPL PTs → YAHOO! FINANCE ← $GS ... $AAPL Price

Monetary
— price target
— support or resistance
— buying
— selling
— other

Percentage

Temporal

Option

Indicator

Quantity

Product/ Version Number

Chen, Chung-Chi, Hen-Hsen Huang, and Hsin-Hsi Chen. "Crowd View: Converting Investors' Opinions into Indicators." *IJCAI*. 2019.

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FinNum-2

- **Example**

Attached

$NE, last time oil was over **$65** you were close to **$8**

Not Attached

Attached   **Attached**

Guess who sold off about **$800** million in **$MDLZ** after losing about **$1** billion on **$VRX**???

Not Attached

- **NumAttach 1.0**

Cashtag: Multi 38%, Single 62%

Numeral: Single 30%, Multi 70%

Chen, Chung-Chi, Hen-Hsen Huang, and Hsin-Hsi Chen. "Numeral attachment with auxiliary tasks." *Proceedings of the 42nd International ACM SIGIR Conference on Research and Development in Information Retrieval*. 2019.
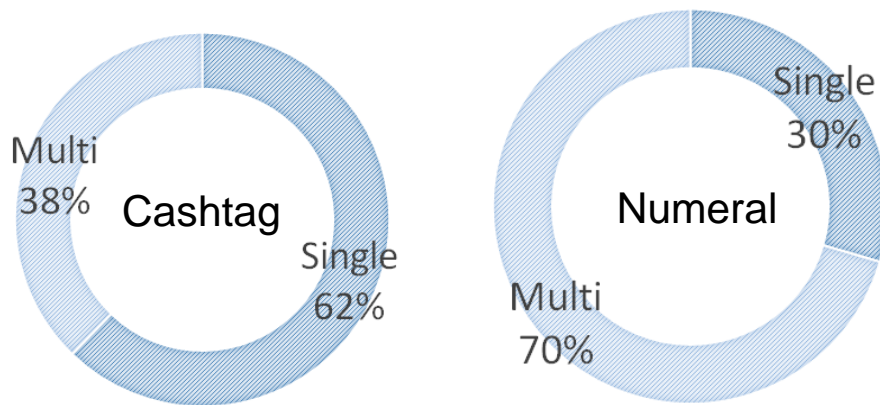
NumAttach 2.0
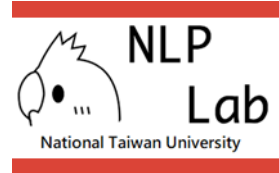
Corpus Creation & Statistics

- Data is collected from StockTwits.
- Three experts were involved in the annotating process.

	Attached	Not Attached	Sum
Train	5,827	1,360	7,187
Development	850	194	1,044
Test	1,721	388	2,109
Sum	8,398	1,942	10,340

# of	Cashtag	Numeral
1	44.77%	26.20%
2	26.56%	28.33%
3	10.64%	17.87%
4	5.90%	10.11%
5	3.43%	6.03%
6	2.40%	3.43%
7	1.54%	3.37%
8	0.98%	1.05%
9	0.88%	2.13%
> 10	2.91%	1.48%

Distribution

- NumAttach2.0

	Single-cashtag	Multi-cashtag
Single-numeral	1,282 (12.40%)	1,427 (13.80%)
Multi-numeral	3,347 (32.37%)	4,284 (41.43%)

- Attached/Not Attached

	Single-cashtag	Multi-cashtag
Single-numeral	1,204/78	1,017/410
Multi-numeral	3,071/276	3,106/1,178

Task Setting

Task Formulation & Evaluation

- Given
  - A tweet
  - The position of target numeral
  - The position of target cashtag

- Output
  - Attached or Not Attached
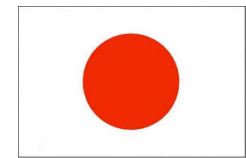
- Evaluation
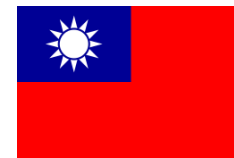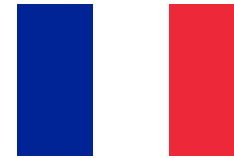 - Macro-averaged F-score

Participants

13 Teams including 15 Institutions from 7 Countries

Individual Researcher

Methods & Results

Results

Team	Method	Dev.	Test
Baseline - 1	Majority	44.88	44.93
CYUT-1	-	48.64	48.02
WUST	SVM	82.91	54.43
BTBCH-1	-	100.00	57.19
BTBCH-2	-	99.68	58.00
TMUNLP-3	BERT-CNN + Dep.	87.34	58.40
TMUNLP-2	BERT-BiLSTM + Dep.	85.17	59.77
IIITH-1	-	96.16	62.81
Baseline - 2	Caps-m	79.27	63.37
IIITH-3	-	93.99	64.16
TMUNLP-1	BERT-BiLSTM	87.02	64.76
MIG-1	BERT-BiLSTM + CW	84.46	68.27
MIG-3	BERT + CW	90.69	68.37
TLR-2	RoBERTa	87.81	68.64
MIG-2	BERT-BiLSTM + CW	85.77	68.72
IIITH-2	-	96.23	71.11
TLR-1	BERT	88.26	71.41
CYUT-2	RoBERTa	95.99	71.90
TLR-3	Ensemble	88.87	**73.95**

Correct Rate

- Distribution of correct rate

Correct Rate	# of Instance	%
0.00%	107	5.07%
5.56%	46	2.18%
11.11%	43	2.04%
16.67%	32	1.52%
22.22%	15	0.71%
27.78%	10	0.47%
33.33%	17	0.81%
38.89%	18	0.85%
44.44%	8	0.38%
50.00%	23	1.09%
55.56%	13	0.62%
61.11%	17	0.81%
66.67%	24	1.14%
72.22%	38	1.80%
77.78%	33	1.56%
83.33%	110	5.22%
88.89%	216	10.24%
94.44%	1339	63.49%

- Averaged correct rate on different kinds of in-stances

	Single-cashtag	Multi-cashtag
Single-numeral	79.78%	55.17%
Multi-numeral	81.68%	67.46%

- Attached/**Not Attached** of instances with correct rate lower than 20%

	Single-cashtag	Multi-cashtag
Single-numeral	0/64	0/10
Multi-numeral	0/152	0/2

Error Analysis – Not Attached Cases

- **Informal Writing Style**
  - $IMUC head banging against the ceiling. Matter of time **b4** she breaks wide open!

- **Need Price for Inference**
  - $JWN millennials will not spend $250 for jeans at Nordstrom.

- **Attached to Not-Cashtag entity**
  - $GLD VIX under 10? Markets will sell in Oct, Bonds stink.

- **Ambiguous**
  - Already in Q4, $BOX is set to execute a record number of big deals

FinNum-3 –
Investor's and Manager's Fine-grained
Claim Detection

Motivation

- FinNum-1 & FinNum-2 Social Media

- FinNum-3 ➜ Formal Documents

- Argument mining in finance

- Over **58.47%** of sentences in analysis report contain at least one numeral

- Investors always make a claim **with an estimation**
  - **(X) We estimate that the sales may growth**
  - **(O) We estimate that the sales growth rate may exceed 40%**

- The importance of fine-grained claims and the numerals.
  - We estimate that the sales growth rate may exceed 5%
  - We estimate that the sales growth rate may exceed 40%

NumClaim

- **Chinese** financial **analysis reports (investor)**
- The annotators work in the financial industry (bank's treasury department and hedge fund)
- The Cohen's kappa agreements between the experts are 88.31%
- 5,144 instances: 23.78% "In-claim" and 76.22% "Out-of-claim"

Sentence	Label
We estimate that the sales growth rate may exceed **40%**.	In-claim
Professional audio/visual products account for **20%**.	Out-of-claim

In-claim		Out-of-claim	
estimate	2.86	lower/higher than	-1.37
price target	2.80	cause	-1.37
downgrade	2.58	last year	-1.26
upgrade	1.55	influence	-1.25

- The Cohen's kappa agreements between the experts are 89.55%

Category	Subcategory	In-claim	Out-of-claim	Sum
Monetary	price	42	33	75
	money	506	368	874
	change	3	15	18
Percentage	absolute	208	500	708
	relative	408	402	810
Temporal	date	0	2,134	2,134
	time	0	3	3
Quantity	absolute	55	219	274
	relative	0	4	4
Product Number		1	135	136
Ranking		0	3	3
Other		0	105	105
Total		1,223	3,921	5,144

Chung-Chi Chen, Hen-Hsen Huang, Yow-Ting Shiue, and Hsin-Hsi Chen. 2018. Numeral understanding in financial tweets for fine-grained crowd-based forecasting. In *IEEE/WIC/ACM International Conference on Web Intelligence*

Statistics

Dataset	NumClaim	CRC [13]	PE [12]
Language	Chinese	Chinese	English
Source	Analysis Report	Hotel Review	Persuasive Essay
# Word	42,594	21,848	97,420
# Numeral	5,144	67	111

	NumClaim	CRC
# hard words	**31.95**	18.28
# negative words	0.14	**0.60**
# synonym	0.28	**1.49**
Noun phrase modifier ratio	0.29	**0.38**
Noun phrase ratio	**31.79**	26.62
# transition words	**4.86**	1.62

[12] Steffen Eger, Johannes Daxenberger, and Iryna Gurevych. 2017. Neural End-to-End Learning for Computational Argumentation Mining. In ACL
[13] Steffen Eger, Johannes Daxenberger, Christian Stab, and Iryna Gurevych. 2018.Cross-lingual Argumentation Mining: Machine Translation (and a bit of Projection) is All You Need!. In COLING.

Experimental Results

- Encoding: BERT

- Baseline: CNN, BiGRU, CapsNet

- Metrics: Macro-F1

- Class Weight (CW)

- Numeral Encoder

  - Represent the digit (0-9) and the decimal point as a 11-dimension tensor, and concatenate it with a tensor for the inter-numeral position information.

- Joint Learning with Category Classification Task (CG)

Architecture	CNN	BiGRU	CapsNet
Baseline	76.15%	77.97%	77.93%
+ CW	77.26%	78.29%	78.68%
+ CW & NE (CNN)	78.19%	79.06%	80.91%
+ CW & NE (CNN) & CG	81.35%	81.65%	**82.62%**

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FinNum-3

- Manager's and Investor's Fine-grained Claim Detection
  - **Chinese** financial analysis reports (**investor**)
  - **English** earnings conference call (**manager**)

- Information in NumClaim 2.0
  - Given
    - Target numeral
    - Context of Target numeral
  - Model Output
    - Category of target numeral (FinNum-1)
    - In-claim or out-of-claim (FinNum-3)

Earnings Conference Call

- Modeling Financial Analysts' Decision Making
  - Keith, Katherine, and Amanda Stent. "Modeling Financial Analysts' Decision Making via the Pragmatics and Semantics of Earnings Calls." *ACL-2019*.

- Risk Forecasting
  - Ye, Zhen, Yu Qin, and Wei Xu. "Financial Risk Prediction with Multi-Round Q&A Attention Network." IJCAI-2020.
  - Sawhney, Ramit, et al. "VolTAGE: Volatility Forecasting via Text-Audio Fusion with Graph Convolution Networks for Earnings Calls." *EMNLP*-2020.
  - Qin, Yu, and Yi Yang. "What you say and how you say it matters: Predicting financial risk using verbal and vocal cues." *ACL-2019*
  - Yang, Linyi, et al. "HTML: Hierarchical Transformer-based Multi-task Learning for Volatility Prediction." *Proceedings of The Web Conference 2020*.
  - Li, Jiazheng, et al. "MAEC: A Multimodal Aligned Earnings Conference Call Dataset for Financial Risk Prediction." *CIKM*-2020.

Related Events

- FinTech on the Web Workshop (FinWeb-2021)

  - The Web Conference 2021

  - https://finweb.nlpfin.com

Feel free to contact us if you have any questions.

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