

TOWARDS BUILDING A KNOWLEDGE BASE OF MONETARY TRANSACTIONS FROM A NEWS COLLECTION



JAN R. BENETKA

Norwegian University
of Science and Technology



KRISZTIAN BALOG

University of Stavanger



KJETIL NØRVÅG

Norwegian University
of Science and Technology

I. MOTIVATION

Amazon Acquires Whole Foods for \$13.7 Billion

By Madison Malone Kircher



REVIEWS NEWS VIDEO HOW TO SMART HOME CARS DEALS DOWNLOAD

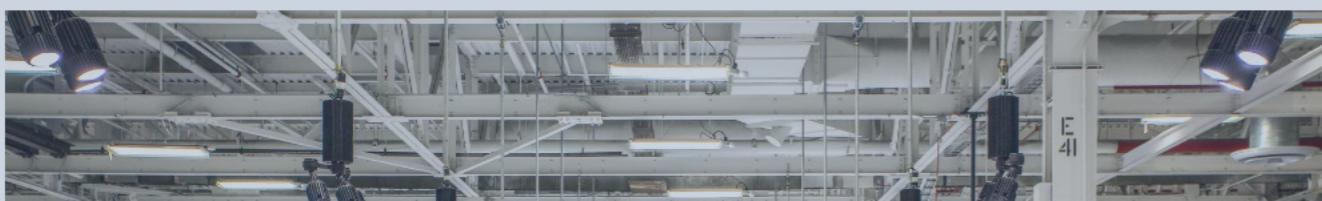
Google closes \$3.2 billion purchase of Nest

The acquisition brings with it the Learning Thermostat and the Protect smoke and CO detector as Google looks to make its mark in the smart home.

Tesla acquires a German automation company to accelerate vehicle production

by Jordan Golson | @jlgolson | Nov 8, 2016, 7:01am EST

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BUSINESS

Google Acquires Artificial-Intelligence Company DeepMind

By Rolfe Winkler

Jan. 26, 2014 10:44 p.m. ET

I. MOTIVATION | Existing KBs

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List of mergers and acquisitions by Apple

From Wikipedia, the free encyclopedia

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Apple Inc. is an American multinational corporation that designs and manufactures consumer electronics and software products. It was established in Cupertino, California, on April 1, 1976, by Steve Jobs, Steve Wozniak, and Ronald Wayne.^[1] and was incorporated on January 3, 1977.^[2] The company's hardware products include the Macintosh line of personal computers, the iPod line of portable media players, the iPad line of tablets, the iPhone line of smartphones, the Apple TV line of digital media players, and the Apple Watch line of smartwatches. Apple's software products include the OS X operating system, the iOS mobile operating system, the iTunes media browser, and the iLife suite of multimedia and creativity software.^[3] As of June 2017, Apple is publicly known to have acquired 70 companies. The actual number of acquisitions is possibly larger as Apple does not reveal the majority of its acquisitions unless discovered by journals. Apple has also purchased stakes in two companies, as well as made two divestments. Apple has not released the financial details for the majority of its mergers and acquisitions.

Apple's business philosophy is to acquire small companies that can be easily integrated into existing company projects.^[4] For instance, Apple acquired Emagic and its professional music software, Logic Pro, in 2002. The acquisition was incorporated in the creation of the digital audio workstation software GarageBand, now part of the iLife software suite.^[4]

The company made its first acquisition on March 2, 1988, with its purchase of Network Innovations. In its two divestments, both of which were during the 1990s, parts of the company were sold to other companies. In 2013, Apple acquired thirteen companies—more than it has in any other year so far. Apple's largest acquisition was that of Beats Electronics in August 2014 for US\$3 billion.^[5] Of the companies Apple has acquired, 49 were based in the United States.

Contents [hide]
1 Acquisitions
2 Stakes
3 Divestitures
4 See also
5 Notes
6 References
7 External links

Acquisitions [edit]

Number	Date	Company	Business	Country	Value (USD)	References	Derived products
86	May 13, 2017	Lattice Data	Artificial intelligence	United States	US\$200,000,000	[108]	
85	May 9, 2017	Beddit	Sleep tracking hardware	Finland	—	[107]	iOS
84	March 23, 2017	Workflow	Automation and scripting app	United States	—	[105][106]	iOS
83	December 1, 2016	Indoor.io	Indoor mapping and navigation	Finland	—	[104]	Maps
82	September 22, 2016	Tuplejump	Machine learning	India	—	[102][103]	Siri, CoreML, HealthKit

crunchbase

Apple

Overview Timeline Contributors

TOP CONTRIBUTORS

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CONTRIBUTE

Acquisitions (87) UPDATE

Date	Acquired	Amount
May 14, 2017	Lattice	\$200M in Cash
May 9, 2017	Beddit	Unknown
Mar 23, 2017	Workflow	Unknown
Feb 19, 2017	RealFace	\$2M (terms undisclosed)
Dec 1, 2016	indoor.io	Unknown
Sep 23, 2016	tuplejump	Unknown
Aug 22, 2016	Gliimpse	\$200M in Cash
Aug 5, 2016	Turi	Unknown
Feb 3, 2016	LegbaCore	Unknown
Jan 29, 2016	Flyby Media	Unknown
Jan 28, 2016	LearnSprout	Unknown
Jan 7, 2016	Emotient	Unknown
Nov 24, 2015	faceshift	\$18.2M (terms undisclosed)
Oct 5, 2015	Perceptio	Unknown
Oct 2, 2015	VocalIQ	Unknown
Sep 15, 2015	Mapsense	\$25M (terms undisclosed)
Jun 26, 2015	Privaris	Unknown
May 28, 2015	Metaio	Unknown
May 18, 2015	Coherent Navigation	Unknown

I. MOTIVATION | KBP Tool

Subject: **Oracle** A

Financial event: **acquisition** B

Find events

Counterpart	Event attributes				Link	Insert
	Confidence	Year	Value	Snipet		
PeopleSoft C	82.8%	2004	USD 10 300 000 000	...Oracle finally acquired PeopleSoft for...	NYT	<input checked="" type="checkbox"/>
Siebel Systems	78.9%	2004	USD 7 7	oft last year ...	NYT	<input type="checkbox"/>
Hyperion Solutions	75.3%	2007	USD 20	chase ...	NYT	<input type="checkbox"/>
Reteck	66.7%	2005	USD 1 5	n cash.	NYT	<input type="checkbox"/>
	56%	2004	USD 11	Oracle's ...	NYT	<input type="checkbox"/>

A Boom in Merger Activity E

In December 2004, after a battle for control that grew nasty, Oracle finally acquired PeopleSoft for about \$10.3 billion, becoming the second-largest maker of business-management software.

I. MOTIVATION | Outline

- ▶ Define how we represent monetary transaction.
- ▶ Describe the extraction pipeline.
- ▶ Show how we select one 'best' instance of information.
- ▶ Describe the dataset and evaluation.
- ▶ Present results & analysis.
- ▶ Wrap up.

II. REPRESENTATION OF MONETARY TRANSACTION

Monetary transaction quintuple:

(<subject>, <predicate>, <object>, monetary value, date)

II. REPRESENTATION OF MONETARY TRANSACTION

Monetary transaction quintuple:

(<subject>, <predicate>, <object>, monetary value, date)

II. REPRESENTATION OF MONETARY TRANSACTION | < subject / object >

- ▶ Entities: economic subjects.
- ▶ Knowledge bases: [DBpedia](#), [Freebase](#), and [CrunchBase](#).
- ▶ 989K unique entities / 1.35M unique surface forms

ID:	Skype
Surface forms:	{Skype, Skype Technologies, Skype Limited}
URIs:	{< dbpedia:Skype_Technologies >, < crunchbase:org/skype-technologies > < crunchbase:org/skype >, < freebase:m/026wfg >, < freebase:m/06whf7 >}

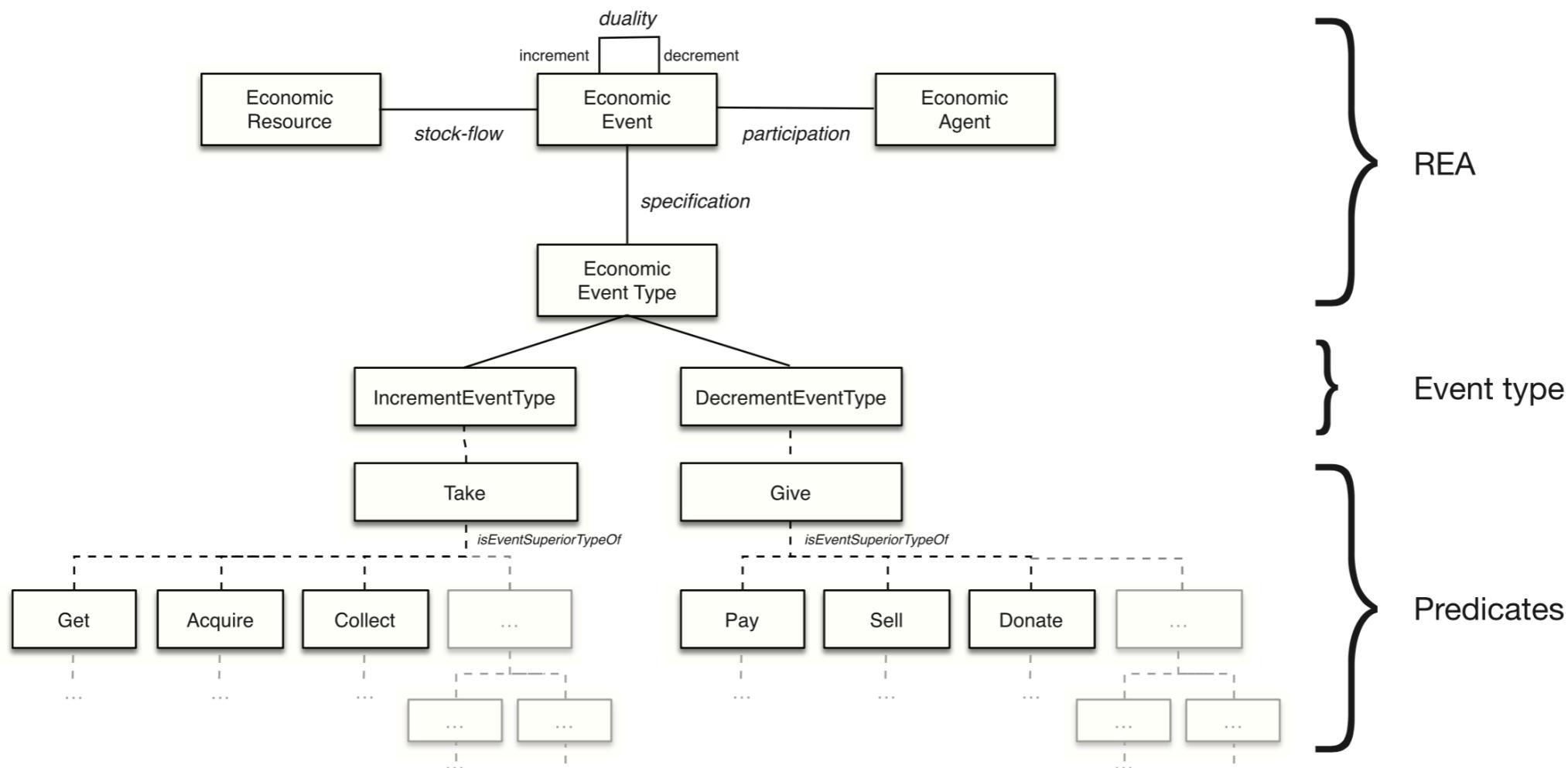
II. REPRESENTATION OF MONETARY TRANSACTION

Monetary transaction quintuple:

(<subject>, <predicate>, <object>, monetary value, date)

II. REPRESENTATION OF MONETARY TRANSACTION | < predicate >

- ▶ Purpose-built ontology of transaction types



II. REPRESENTATION OF MONETARY TRANSACTION

Monetary transaction quintuple:

(<subject>, <predicate>, <object>, monetary value, date)

II. REPRESENTATION OF MONETARY TRANSACTION | monetary value, date

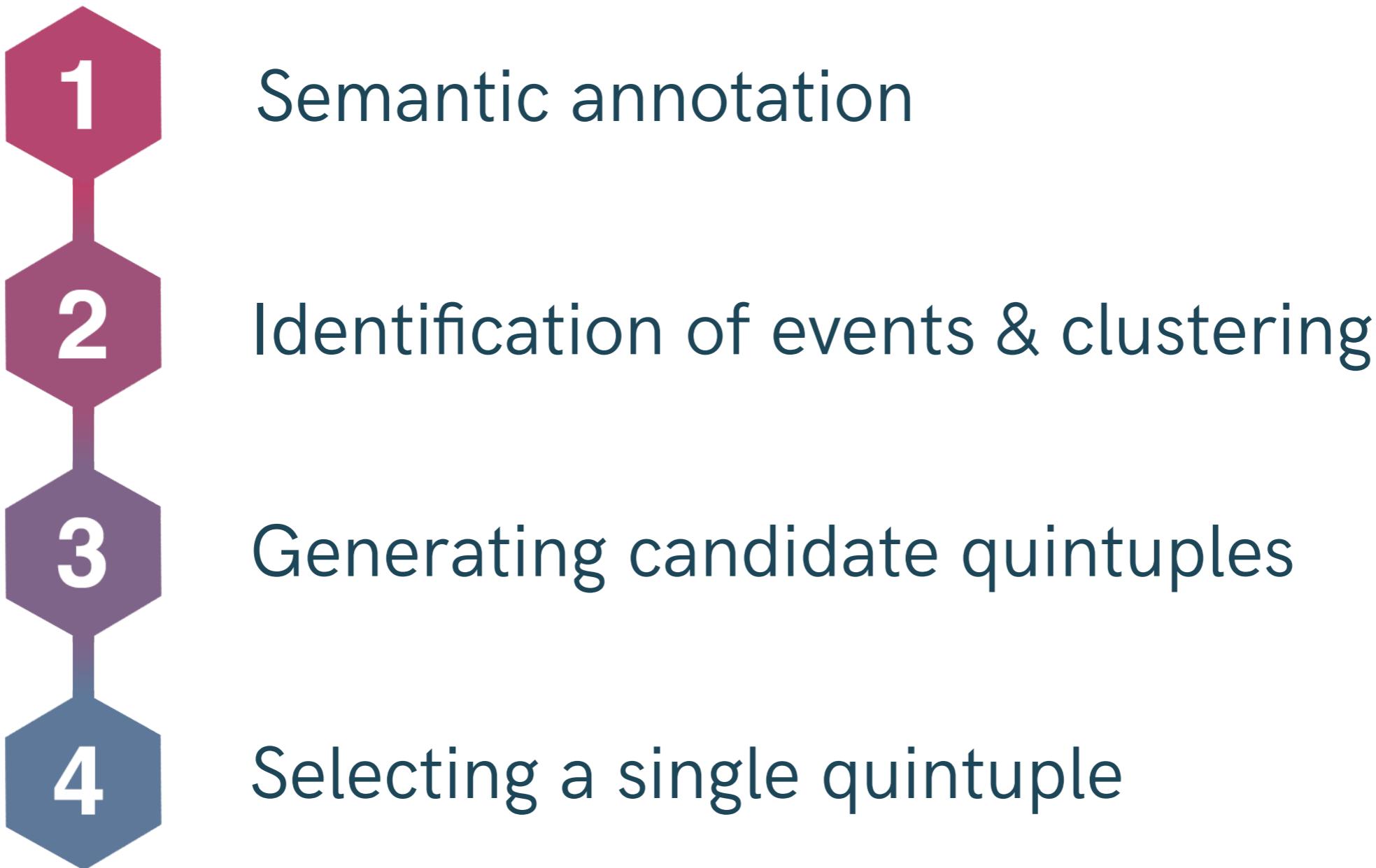
Monetary value

- Tuple consisting of a numerical value and a currency identifier

Date

- Each event has at least one date (date of publication).
- Absolute (e.g., 6/7/2015) or relative (e.g., 'two days ago')
- Tool: SUTime

III. EXTRACTION PIPELINE



III. EXTRACTION PIPELINE

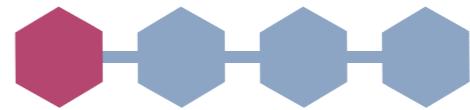


Semantic annotation

Published: June 16, 2017

Amazon acquired Whole Foods Market today for \$13.7B.

III. EXTRACTION PIPELINE



Semantic annotation

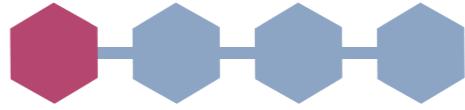
Published: June 16, 2017

Amazon acquired Whole Foods Market today for \$13.7B.

<e:amazon>

<e:whole_foods_market>

III. EXTRACTION PIPELINE



Semantic annotation

Published: June 16, 2017

Amazon acquired Whole Foods Market today for \$13.7B.

<e:amazon> <p:acquire> <e:whole_foods_market>

III. EXTRACTION PIPELINE



Semantic annotation

Published: June 16, 2017

Amazon acquired Whole Foods Market today for \$13.7B.

<e:amazon> <p:acquire> <e:whole_foods_market> d:2017-06-16

III. EXTRACTION PIPELINE



Semantic annotation

Published: June 16, 2017

Amazon acquired Whole Foods Market today for \$13.7B.

<e:amazon> <p:acquire> <e:whole_foods_market> d:2017-06-16 v:USD:13.7B

III. EXTRACTION PIPELINE



Semantic annotation

Published: June 16, 2017

Amazon acquired Whole Foods Market today for \$13.7B.

<e:amazon> <p:acquire> <e:whole_foods_market> d:2017-06-16 v:USD:13.7B

Semantic role labeling:

Predicate: acquire.01

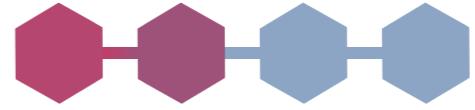
Subject: <e:amazon>

Object: <e:whole_foods_market>

Price: v:USD:13.7B

Date: d:2017-06-16

III. EXTRACTION PIPELINE

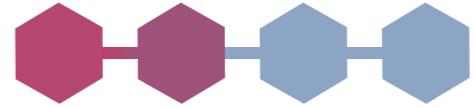


Identification of events & clustering

Economic event :

(<subject>, <predicate>, <object>)

III. EXTRACTION PIPELINE



Identification of events & clustering

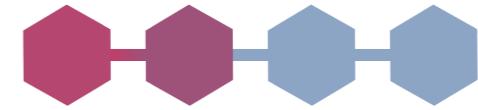
Economic event :

(<subject>, <predicate>, <object>)



(<s:amazon>, <p:acquire>, <o:whole_foods_market>)

III. EXTRACTION PIPELINE



Identification of events & clustering

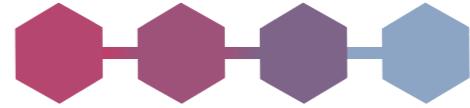
(<s:amazon>, <p:acquire>, <o:whole_foods_market>)

- *Amazon to acquire Whole Foods for \$13.7 Billion.*
- *Amazon, which said on Friday it would buy Whole Foods in a \$13.7B deal...*
- *Amazon buys Whole Foods for nearly \$14B in Cash...*

(<s:amazon>, <p:acquire>, <o:harvest.ai>)

- *Amazon quietly acquired AI security startup harvest.ai for around \$20M.*
- *Amazon Web Services, a cloud computing service offering subsidiary of Amazon.com has completed the purchase of harvest.ai...*

III. EXTRACTION PIPELINE



Generating candidate quintuples

Amazon to acquire Whole Foods for \$13.7 Billion.

(<o:amazon>, <p:acquire>, <s:whole_foods_market>, v:USD:13.7B, d:2017-06-16)

Amazon, which said on Friday it would buy Whole Foods in a \$13.7B deal...

(<o:amazon>, <p:acquire>, <s:whole_foods_market>, v:USD:13.7B, d:2017-06-16)

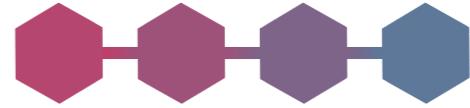
Amazon buys Whole Foods for nearly \$14B in Cash...

(<o:amazon>, <p:acquire>, <s:whole_foods_market>, v:USD:14B, d:2017-06-16)

In the online retail giant's latest expansion, Amazon has purchased organic grocery chain Whole Foods for \$13.7 billion.

(<o:amazon>, <p:acquire>, <s:whole_foods_market>, v:USD:13.7B, d:2017-06-20)

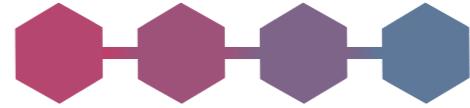
III. EXTRACTION PIPELINE



Selecting a single quintuple

- (A) First reporting
- (B) Last reporting of the event
- (C) Most frequent reporting of the event
- (D) Supervised learning approach

III. EXTRACTION PIPELINE



Selecting a single quintuple

Supervised learning approach

- Cast the selection of the best quintuple as a regression task
- Random Forests algorithm
- Features (18)
 - (i) simple descriptive statistics (sentence and article length)
 - (ii) linguistic features (predicate tense, noun/verb predicate)
 - (iii) semantic features (related to automatic/explicit semantic annotations)
 - (iv) cross-document features considering global predicate frequency and attributes across all sentences

IV. EXPERIMENTS | Dataset

Text Corpus

- ▶ New York Times Annotated Corpus
- ▶ 1.8M news articles / 20 years (1987+)
- ▶ Annotations: automatically generated / manually assigned
- ▶ After initial parsing:
 - ▶ 2.1M sentences containing a monetary value
 - ▶ 383K sentences describing an economic event

IV. EXPERIMENTS | Test collection

Test Collection

- 30 target companies from CrunchBase
- Gold standard: what can potentially be extracted from NYTC
- Test transaction types: investments and acquisitions
- Total no. of events: 132 events in total

IV. EXPERIMENTS | Evaluation

Evaluation

- ▶ Precision, Recall, F1
- ▶ For ML: leave-one-out cross-validation
- ▶ Two parts:
 - 1) Event identification:
 $e = (s, p, o)$
 - 2) Event extraction:
 $r = (s, p, o, v, d)$

IV. EXPERIMENTS | Evaluation

Evaluation: 1) Event identification (s, p, o)

NP	SRL	ED	#events	#quintuples	P	R	F1
N	N	N	170	268	0.26	0.39	0.31
Y	N	N	185	312	0.24	0.40	0.30
N	Y	N	316	496	0.16	0.44	0.23
N	N	Y	117	194	0.37	0.38	0.38
Y	Y	Y	217	377	0.23	0.44	0.31

NP: whether noun predicates are also included for event recognition (Y) or only verbs are used (N)

SRL: whether semantic roles are enforced for monetary value and date (Y) or not (N)

ED: whether entities are required to have descriptions (Y) or not (N)

IV. EXPERIMENTS | Evaluation

Evaluation: 1) Event extraction (s, p, o, v, d)

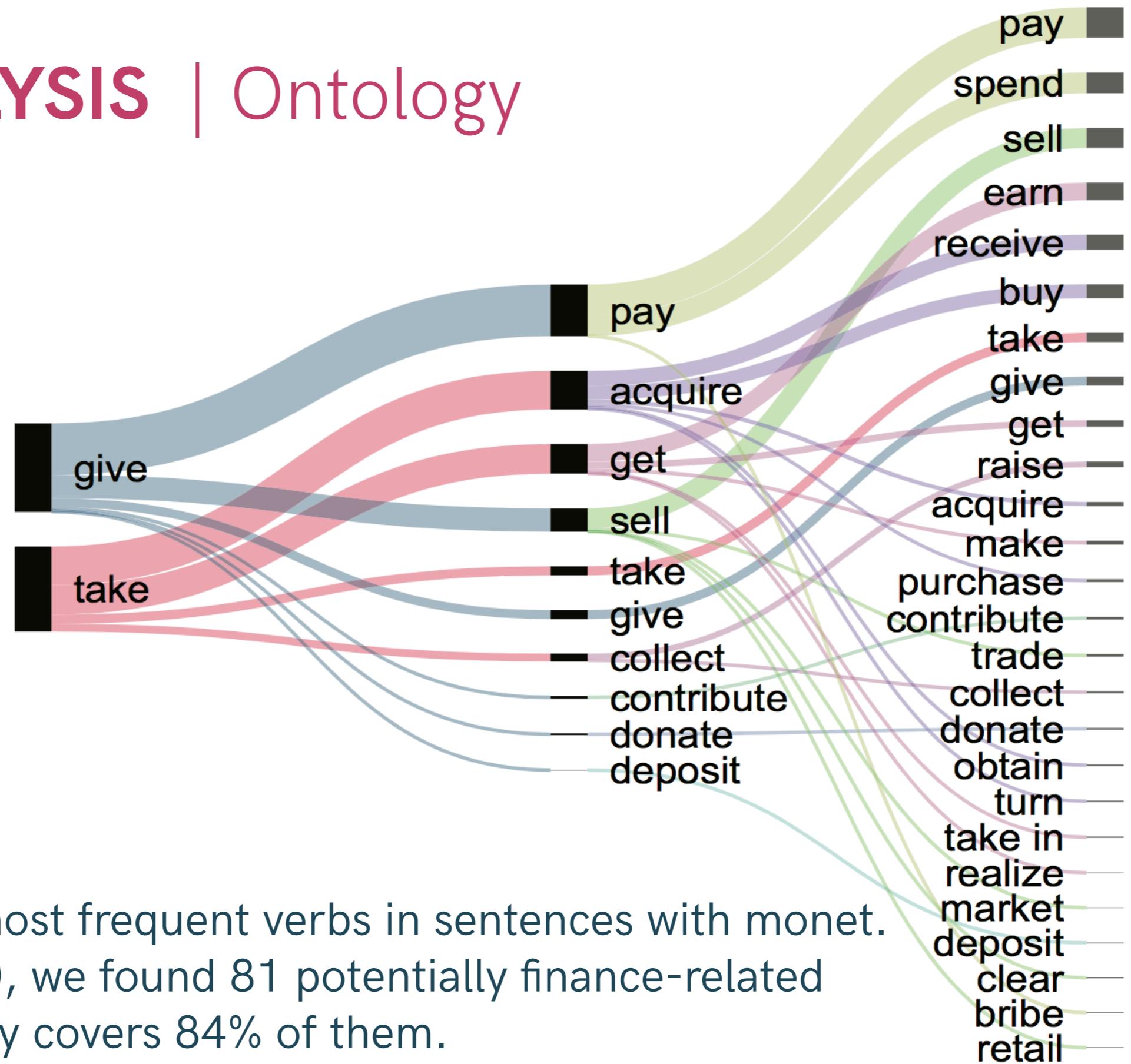
Method	Events only			Attr. strict			Attr. relaxed		
	P	R	F1	P	R	F1	P	R	F1
BL/earliest	0.23	0.44	0.31	0.18	0.34	0.23	0.22	0.42	0.29
BL/frequent	0.23	0.44	0.31	0.16	0.31	0.21	0.21	0.41	0.28
BL/latest	0.23	0.44	0.31	0.16	0.31	0.21	0.21	0.40	0.27
Our approach	0.51	0.31	0.39	0.34	0.20	0.25	0.49	0.29	0.36

Events only: arguments (value, date) are not considered

Attr. strict: financial value and event date have to match exactly

Attr. relaxed: year-granularity, 10% tolerance on monetary value

V. ANALYSIS | Ontology



- From 200 most frequent verbs in sentences with monet. value (2.1M), we found 81 potentially finance-related
- Our ontology covers 84% of them.

V. ANALYSIS | Features

Feature	Description	Type	Gini
dates_count	Quintuple # with the same date in R_e	numerical	0.1859
article_length	Length of the article	numerical	0.1447
sentence_length	Length of the sentence	numerical	0.1365
sentence_order	Sentence's position within in the article	numerical	0.1291
values_ratio	Relative freq. of the given monetary value in R_e	numerical	0.0883
correct_fin_arg	Fin. value is within the correct semantic arg.	binary	0.0636
pred_frequency	Relative freq. of the predicate in the corpus	numerical	0.0507
predicate_tense	Tense of the predicate	categorical	0.0425
object_has_cb_uri	Object has a CrunchBase URI	binary	0.0405
object_has_dbp_uri	Object has a DBpedia URI	binary	0.0237
nytc_desc_bus	Article is classified under “Business” according to the NYTC taxonomy	binary	0.0232
has_event_date	Temp. expression was found within the sentence	binary	0.0207
correct_temp_arg	Temp. value is within the correct semantic arg.	binary	0.0186
object_has_fb_uri	Object has a Freebase URI	binary	0.0156
is_noun_predicate	Predicate is expressed by a verb or a noun	binary	0.0096
subject_has_dbp_uri	Subject has a DBpedia URI	binary	0.0067
subject_has_cb_uri	Subject has a CrunchBase URI	binary	0.0000
subject_has_fb_uri	Subject has a Freebase URI	binary	0.0000

V. WRAP UP

- ▶ Task: extracting economic events from a large news corpus.
- ▶ NLP pipeline for the semantic annotation of text.
- ▶ Single structured representation for each economic event.
- ▶ Supervised learning approach with a set of innovative features.
- ▶ Our approach beats 3 intuitive baselines.
- ▶ Resources: test set, ontology (<https://github.com/benetka/kbmt>).

Apple secretly acquired a Finnish company to help it map indoor spaces

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THANK YOU

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