



Using machine learning to predict temporal orientation of search engines' queries in the Temporalia challenge

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CODE & RESOURCES

To aid replicability of this work, the **source code**, **datasets**, and the machine learning pre-trained **models** have been made publicly



Temporal information extraction plays a crucial role in many Natural Language Processing tasks. Research in **Information Retrieval** has lead to the idea of using temporal information to improve IR systems' accuracy by guessing the temporal intent of user's queries and filtering the results accordingly.

We want to build a system which is able to predict the temporal orientation of a user's query. Temporal intents are the following: **recency**, **past**, **future and atemporal**.

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available online.

Image: Contemporalia TQIC project × Image: Contemporalia TQIC project ×

Temporalia: Temporal Query Intent Classification (TQIC)

This project is part of the NTCIR-11 Temporalia challenge, Temporal Query Intent Classification: predicting the temporal orientation of search engine user queries: present, past, future and atemporal. We propose to tackle the task as a machine learning classification problem.

For example, the temporal orientation of a query like weather in Manchester is present, whereas for weather forecast Manchester it's future. Some queries refer to the past (e.g. when did galileo born?), whereas some other don't have a temporal orientation (e.g. sunday times, fairchild dancer lyrics).

Download 🖂

Source code

The source code is hosted by GitHub

Machine learning playroom

The pipeline uses a CRFs model for the identification phase. You can use one of the following pre-trained models, depending on the training set:

Training and test setThe first 100 instances are the training set, the rest (300) is the official benchmark test set.(ARFF format)Size: 96.498Kb; MD5: ad0e42312b7b3be6e3c638d1cc45f432 , downloadTraining and test setThe first 100 instances are the training set, the rest (300) is the official benchmark test set.(CSV format)Size: 78.127Kb; MD5: 6721a82d8d87f7b86c05569ed881adc9 , download

Related publications

Using machine learning to predict temporal orientation of search engines' queries in the Temporalia challenge M. Filannino, G. Nenadic Proceedings of the Sixth International Workshop on Evaluating Information Access (EVIA 2014) a Satellite Workshop of the NTCIR-11 Conference — paper, review, demo, source code.

URL: http://www.cs.man.ac.uk/~filannim/projects/temporalia/

METHODS: LOW-SPARSITY ATTRIBUTES

We approached the problem as a machine learning supervised classification task in 4 classes (Recency, Past, Future, Atemporal).

We focussed on designing attributes with minimal sparsity. Some of them make use of a temporal expression extraction system, ManTIME[1], to capture queries' temporality with respect to their submission time.



The models have been trained by using the official NTCIR-11 Temporalia **training set**, which contains 100 queries along with time of submission and temporal class.

SVM with polynomial kernel (for the minimal, and intermediate runs) and Random Forests (for the full run) models have been used.

We submitted **3 runs**, each one using a different combination of attributes (see the table).

Input Attribute description	Sparsity	Example	runs		
		Input (query/time) \rightarrow attribute value	minimal	intermediate	full
Is it a Wikipedia page title?	2	New York Times" → YES		\checkmark	\checkmark
Does it contain a temporal expression?	2	"june 2013 movies" → 'YES'	\checkmark	\checkmark	\checkmark
Submission's term	3	"Feb 28, 2013 GMT+0" → 'B'			\checkmark
Submission's trimester	4	"Aug 26, 2013 GMT+0" → 'M2'			\checkmark
Timing	4	"Movies 2012", "Feb 28, 2013 GMT+0" → 'past'	\checkmark	\checkmark	\checkmark
Most frequent trigger class	5	"peso dollar exchange rate" → 'present'	\checkmark		\checkmark
Wh type	5	"how did hitler die" \rightarrow 'how'		\checkmark	\checkmark
Most frequent TempoWordNet class	5	"current stock prices" → 'present'			\checkmark
Most frequent POS tag tense	7	"what is stop kony 2012" → 'VBZ'	\checkmark	\checkmark	\checkmark
Most frequent coarse-grained POS tag	8	"kony 2012 fake" → 'N'		\checkmark	\checkmark
Trigger classes footprint	11	"what was I thinking lyrics" \rightarrow 'past-atemporal"	\checkmark	\checkmark	\checkmark
Temporal Δ between submission and query	16	"father's day 2010", "Feb 28, 2013 GMT+0" → 36.0		\checkmark	\checkmark
Tenses footprint	18	"when does fall start" → 'VBZ-VB'		\checkmark	\checkmark
Ordered TempoWordNet classes	18	"the last song" \rightarrow 'past-future-present-atemporal"			\checkmark
Most frequent fine-grained POS tag	21	"kony 2012 fake" → 'NN'		\checkmark	\checkmark
Coarse-grained POS tag ordered footprint	119	"when is labour day" \rightarrow 'N-W-V'			\checkmark
Fine-grained POS tag ordered footprint	202	"when is labour day" → 'NN-WRB-VBZ'			\checkmark
Coarse-grained POS tag footprint	204	"when is labour day" \rightarrow 'W-V-N-N'			\checkmark
Fine-grained POS tag footprint	265	"when is labour day" \rightarrow 'WRB-VBZ-NN-NN'			\checkmark
	 Is it a Wikipedia page title? Does it contain a temporal expression? Submission's term Submission's trimester Timing Most frequent trigger class Wh type Most frequent TempoWordNet class Most frequent POS tag tense Most frequent coarse-grained POS tag Trigger classes footprint Temporal Δ between submission and query Tenses footprint Ordered TempoWordNet classes Most frequent fine-grained POS tag Coarse-grained POS tag ordered footprint Fine-grained POS tag footprint 	Is it a Wikipedia page title?2Does it contain a temporal expression?2Submission's term3Submission's trimester4Timing44Most frequent trigger class5Wh type55Most frequent TempoWordNet class55Most frequent POS tag tense7Most frequent coarse-grained POS tag8Trigger classes footprint11Temporal Δ between submission and query16Tenses footprint18Ordered TempoWordNet classes18Most frequent fine-grained POS tag21Coarse-grained POS tag ordered footprint119Fine-grained POS tag footprint202Coarse-grained POS tag footprint204	Attribute descriptionSparsityInput (query/time) \rightarrow attribute valueIs it a Wikipedia page title?2New York Times" \rightarrow YESDoes it contain a temporal expression?2"june 2013 movies" \rightarrow YES'Submission's term3"Feb 28, 2013 GMT+0" \rightarrow 'B'Submission's trimester4"Aug 26, 2013 GMT+0" \rightarrow 'M2'Timing4"Movies 2012", "Feb 28, 2013 GMT+0" \rightarrow 'past'Most frequent trigger class5"peso dollar exchange rate" \rightarrow 'present'Wh type5"how did hitler die" \rightarrow 'how'Most frequent TempoWordNet class5"current stock prices" \rightarrow 'present'Most frequent POS tag tense7"what is stop kony 2012" \rightarrow 'VBZ'Most frequent coarse-grained POS tag8"kony 2012 fake" \rightarrow 'N'Trigger classes footprint11"what was I thinking lyrics" \rightarrow 'past-atemporal'Temporal Δ between submission and query Tenses footprint6"father's day 2010", "Feb 28, 2013 GMT+0" \rightarrow 36.0Most frequent fine-grained POS tag18"the last song" \rightarrow 'past-future-present-atemporal'Most frequent fine-grained POS tag21"kony 2012 fake" \rightarrow 'NN'Coarse-grained POS tag ordered footprint119"when is labour day" \rightarrow 'N-W-V'Fine-grained POS tag footprint202"when is labour day" \rightarrow 'NN-WRB-VBZ'Coarse-grained POS tag footprint204"when is labour day" \rightarrow 'NN-W-N-N'	Attribute descriptionSparsityInput (query/time) → attribute valueminimalIs it a Wikipedia page title?2New York Times" → YES✓Does it contain a temporal expression?2"june 2013 movies" → 'YES'✓Submission's term3"Feb 28, 2013 GMT+0" → 'B'✓Submission's trimester4"Aug 26, 2013 GMT+0" → 'M2'✓Timing4"Movies 2012", "Feb 28, 2013 GMT+0" → 'past'✓Most frequent trigger class5"peso dollar exchange rate" → 'present'✓Wh type5"how did hitler die" → 'how'✓Most frequent TempoWordNet class5"current stock prices" → 'present'✓Most frequent OS tag tense7"what is stop kony 2012" → 'VBZ'✓Most frequent coarse-grained POS tag8"kony 2012 fake" → 'N'✓Trigger classes footprint11"what was I thinking lyrics" → 'past-atemporal'✓Temporal Δ between submission and query16"father's day 2010", "Feb 28, 2013 GMT+0" → 36.0✓Tenses footprint18"when does fall start" → 'VBZ-VB'✓Ordered TempoWordNet classes18"the last song" → 'past-future-present-atemporal'✓Most frequent fine-grained POS tag21"kony 2012 fake" → 'NN'✓Coarse-grained POS tag ordered footprint119"when is labour day" → 'N-W-V'✓Fine-grained POS tag ordered footprint202"when is labour day" → 'N-W-V'✓Fine-grained POS tag footprint204"when is labour day" → 'N-V-N-N'<	Attribute descriptionSparsityLxmmpt Input (query/time) \rightarrow attribute valueminimalintermediateIs it a Wikipedia page title?2New York Times" \rightarrow YESImage: Constraint a temporal expression?2"june 2013 movies" \rightarrow 'YES'Image: Constraint a temporal expression?Does it contain a temporal expression?2"june 2013 movies" \rightarrow 'YES'Image: Constraint a temporal expression?Image: Constraint a temporal expression?Submission's term3"Feb 28, 2013 GMT+0" \rightarrow 'B'Image: Constraint a temporal expression?Image: Constraint a temporal expression?Submission's term3"Feb 28, 2013 GMT+0" \rightarrow 'M2'Image: Constraint a temporal expression?Image: Constraint a temporal expression?Submission's term4"Movies 2012", "Feb 28, 2013 GMT+0" \rightarrow 'past'Image: Constraint a temporal expression?Image: Constraint a temporal expression?Submission's term4"Movies 2012", "Feb 28, 2013 GMT+0" \rightarrow 'past'Image: Constraint a temporal expression?Image: Constraint a temporal expression?Most frequent trigger class5"peso dollar exchange rate" \rightarrow 'present'Image: Constraint a temporal expression?Image: Constraint expression?Most frequent POS tag tense7"what is stop kony 2012" \rightarrow 'VBZ'Image: Constraint expression?Image: Constraint expression?Most frequent tempoWordNet classe8"kony 2012 fake" \rightarrow 'N'Image: Constraint expression?Image: Constraint expression?Temporal Δ between submission and query16"father's day 2010", "Feb 28, 2013 GMT+0" \rightarrow 36.0Image: Constraint expression?<

Attribute list: The attributes are ordered by sparsity (number of possible attribute-values measured in the training set).

RESULTS

The minimal run obtained the **highest accuracy** by correctly predicting the temporal orientation of 199 queries (66.33%) out of 300 in the official test set. There is no **statistically significant difference** between the minimal and intermediate model, whereas the difference between minimal and full, and intermediate and full are statistically significant. The confusion matrix for the best submitted run (minimal) highlights the major sources of **classification errors**:



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The model has been further improved, leading to a final accuracy of 72.33% (minimal fixed).

The minimal run ranked 5th among the best runs, and 11th out of the 17 submitted runs among all the submitted runs.



Challenge results: Results for each run are shown here. The accuracy is computed with respect to the NTCIR-11 Temporalia official benchmark test set. We corrected, a posteriori, some attributes.

• future vs. recency

• atemporal vs. recency

	Classified as						
	Recency	Past	Future	Atemporal			
Recency	43	0	21	11			
Past	3	60	6	6			
Future	38	0	35	2			
Atemporal	6	5	3	61			

Confusion matrix: The figures refer to the best submitted run (minimal).

[1] M. Filannino, G. Brown, and G. Nenadic. ManTIME: Temporal expression identification and normalization in the TempEval-3 challenge. In Proceedings of the Seventh International Workshop on Semantic Evaluation (SemEval 2013), pages 53–57, Atlanta, Georgia, USA, June 2013. ACL.

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