Time-Aware Chi-squared for Document Filtering over Time

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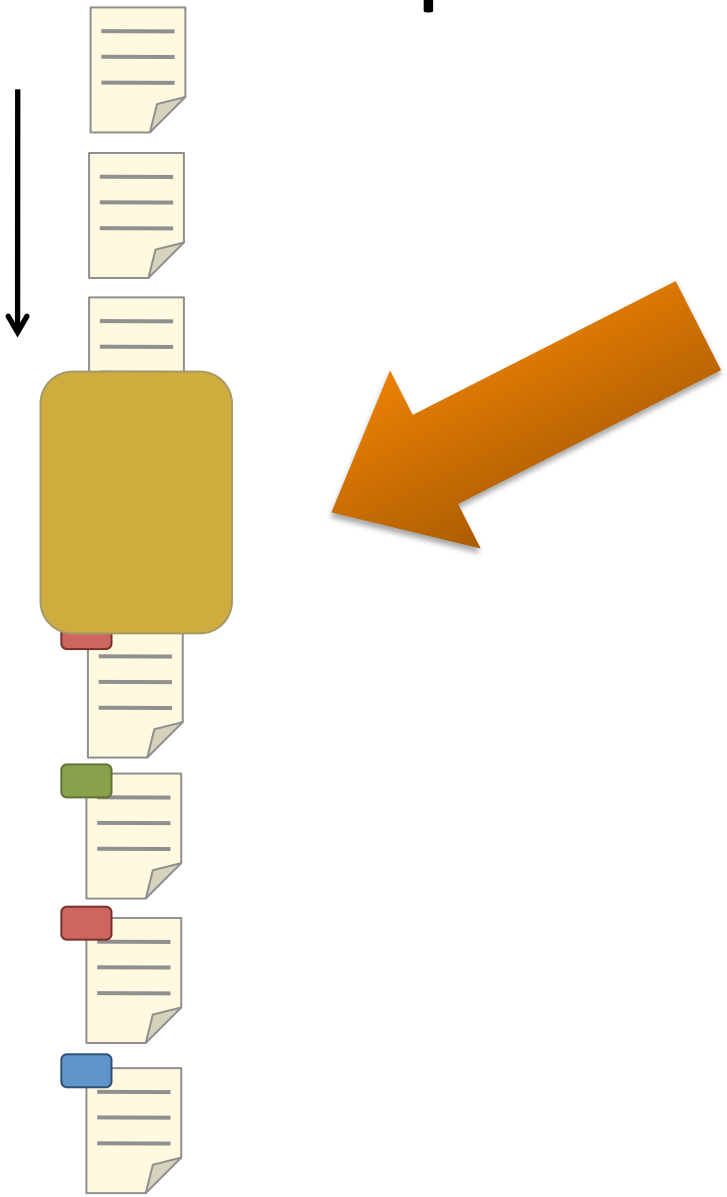
TREC 2013
Thursday, November 21 2013
Gaithersburg, United States

CLIN24
Friday, January 17 2014
Leiden

Topic Filtering over Time



Classifier

Multinomial Naive Bayes classifier with feature selection

- Evolving topics
- Online learning

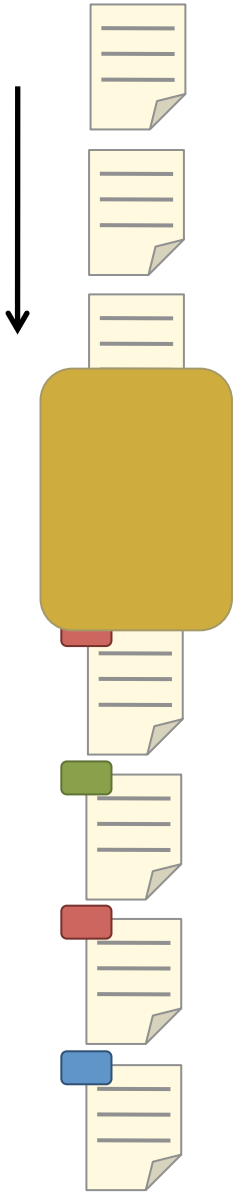
Feature selection with χ^2

Contingency table

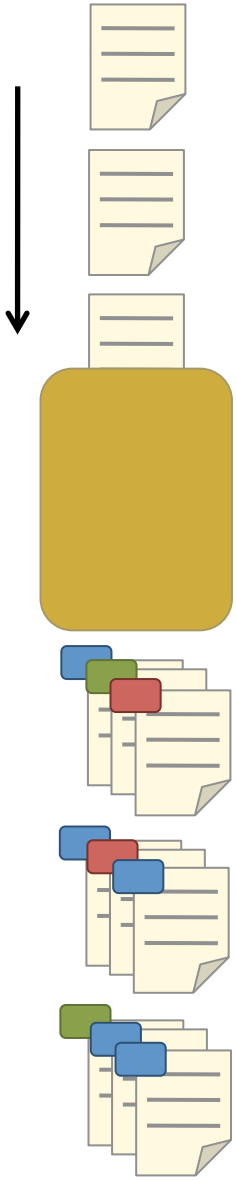
	w	¬w	
c	a	b	C
¬c	c	d	¬C
	W	¬W	N

$$\chi^2 = \frac{N(ad - bc)^2}{C \cdot \neg C \cdot \neg W \cdot W}$$

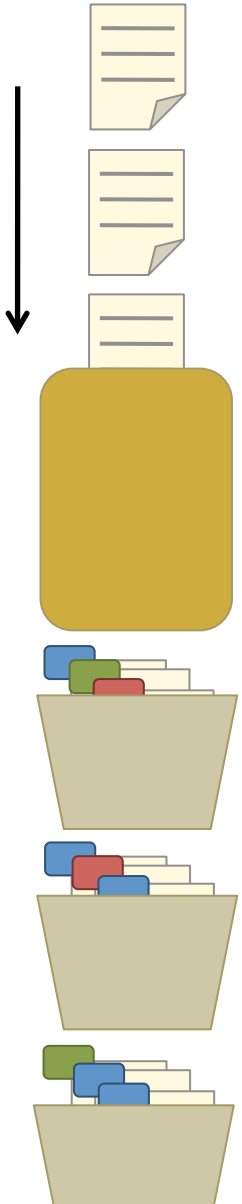
χ^2 over time



χ^2 over time

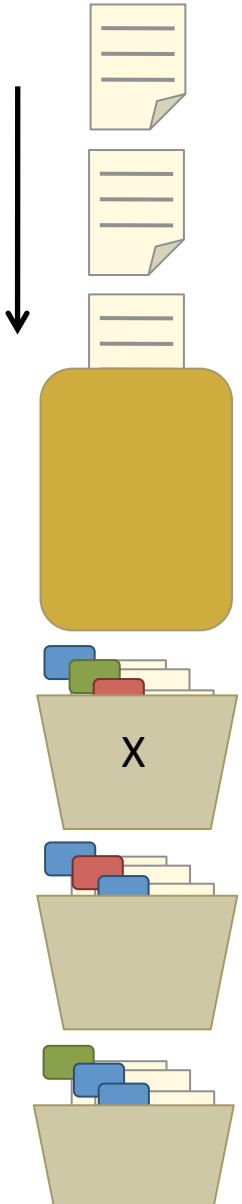


χ^2 over time



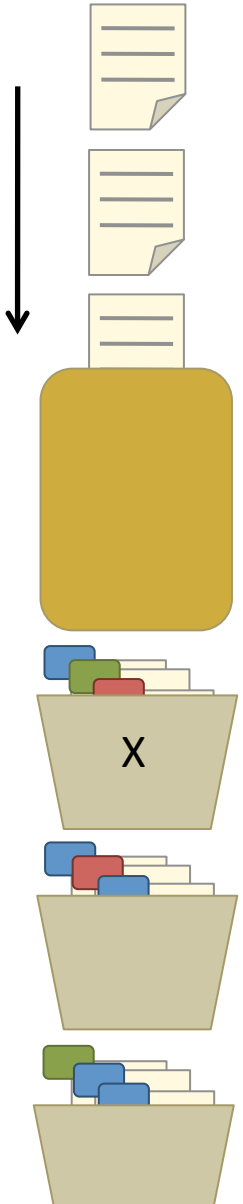
Time batches

χ^2 over time



	w	¬w	
c	a_x	b_x	C_x
¬c	c_x	d_x	$¬C_x$
	W_x	$¬W_x$	N_x

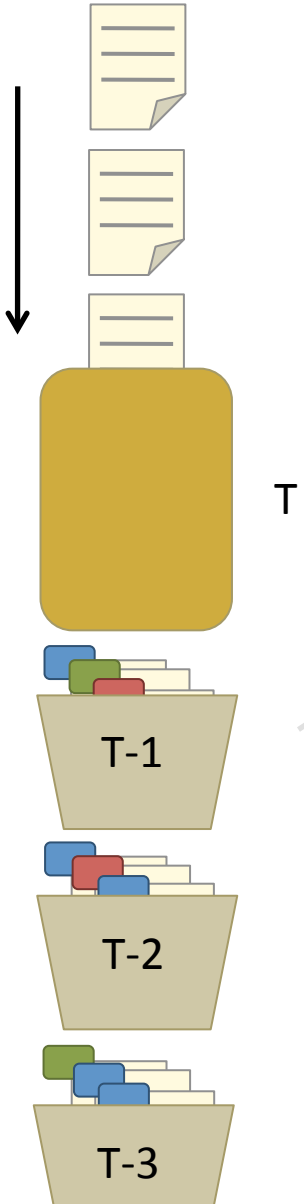
χ^2 over time



	w	¬w	
c	a_x	b_x	C_x
¬c	c_x	d_x	$\neg C_x$
	W_x	$\neg W_x$	N_x

$$\chi^2_x = \frac{N_x(a_x d_x - b_x c_x)^2}{C_x \cdot \neg C_x \cdot \neg W_x \cdot W_x}$$

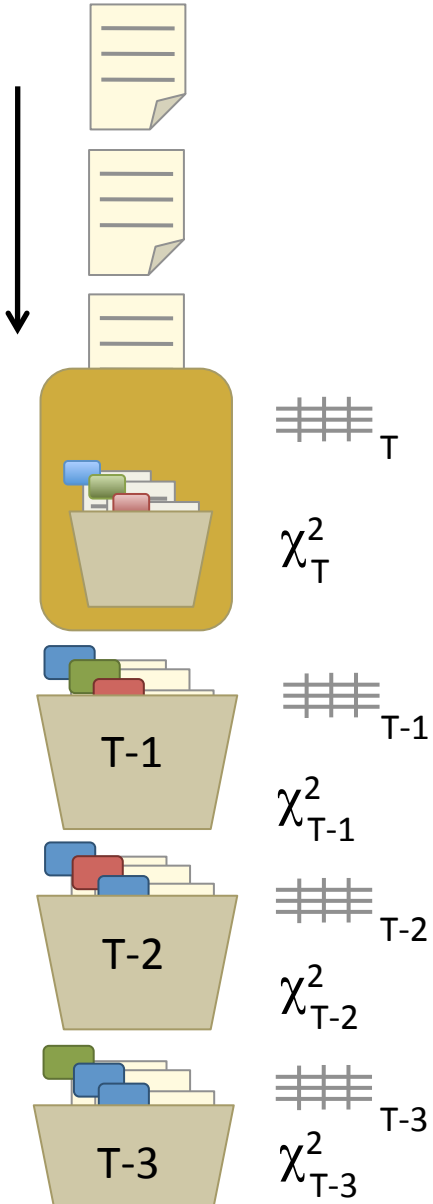
χ^2 over time



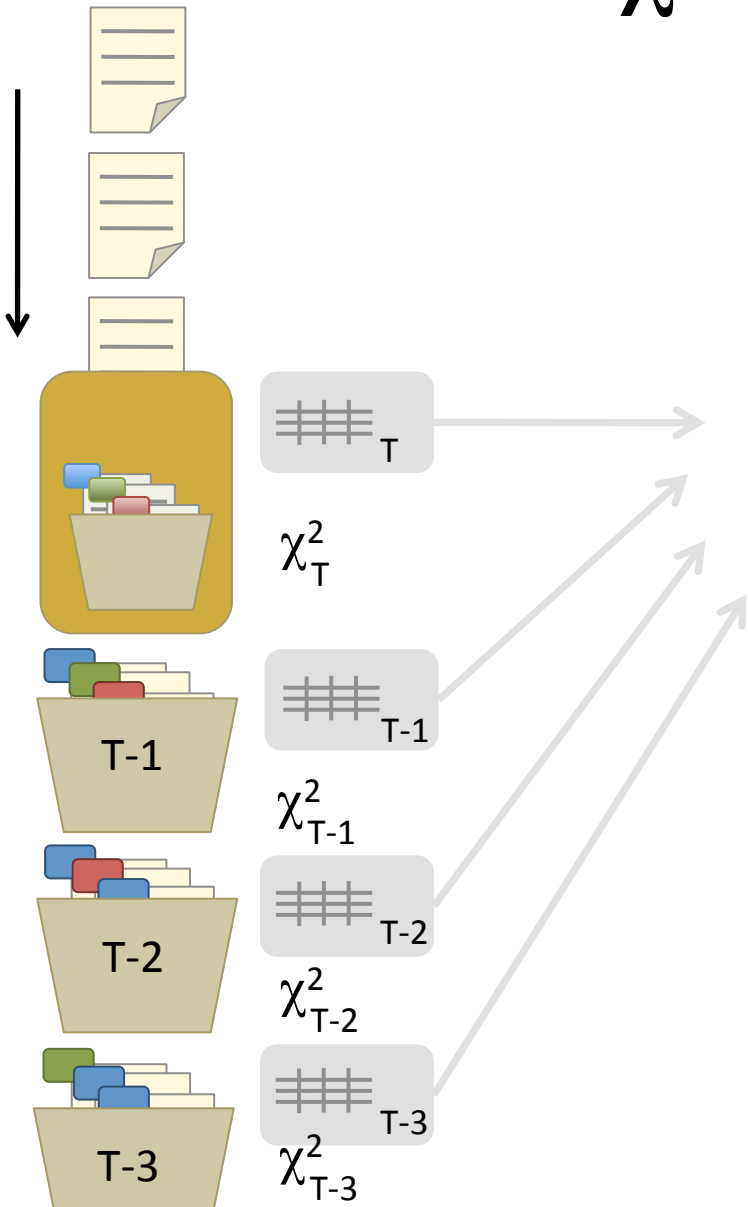
	w	¬w	
c	a_{T-1}	b_{T-1}	C_{T-1}
¬c	c_{T-1}	d_{T-1}	$\neg C_{T-1}$
	W_{T-1}	$\neg W_{T-1}$	N_{T-1}

$$\chi^2_{T-1} = \frac{N_{T-1}(a_{T-1}d_{T-1} - b_{T-1}c_{T-1})^2}{C_{T-1} \cdot \neg C_{T-1} \cdot \neg W_{T-1} \cdot W_{T-1}}$$

χ^2 over time



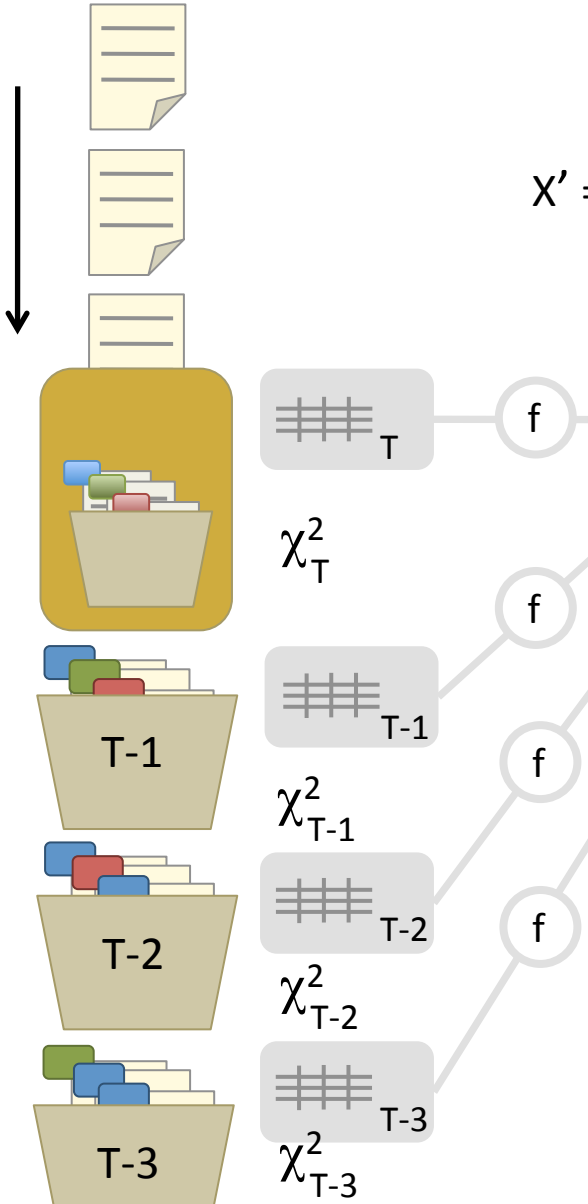
χ^2 over time



Weighted contingencies

	w’	¬w’	
c’	a’	b’	C’
¬c’	c’	d’	¬C’
	W’	¬W’	N’

χ^2 over time



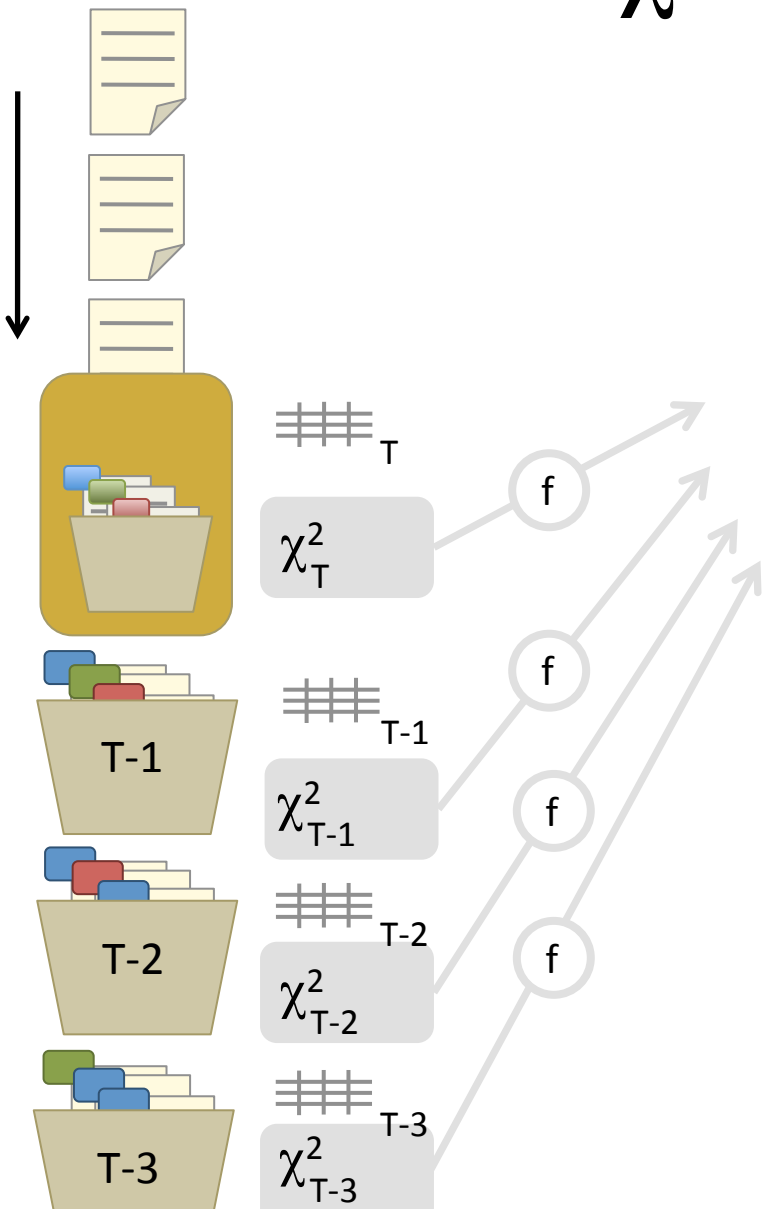
Weighted contingencies

$$X' = \sum_{t=0}^{T} f(T - t) \cdot X_t$$

	w	¬w	
c	a'	b'	C'
¬c	c'	d'	¬C'
	W'	¬W'	N'

$$\chi^2 = \frac{N'(a'd' - b'c')^2}{C' \cdot \neg C' \cdot \neg W' \cdot W'}$$

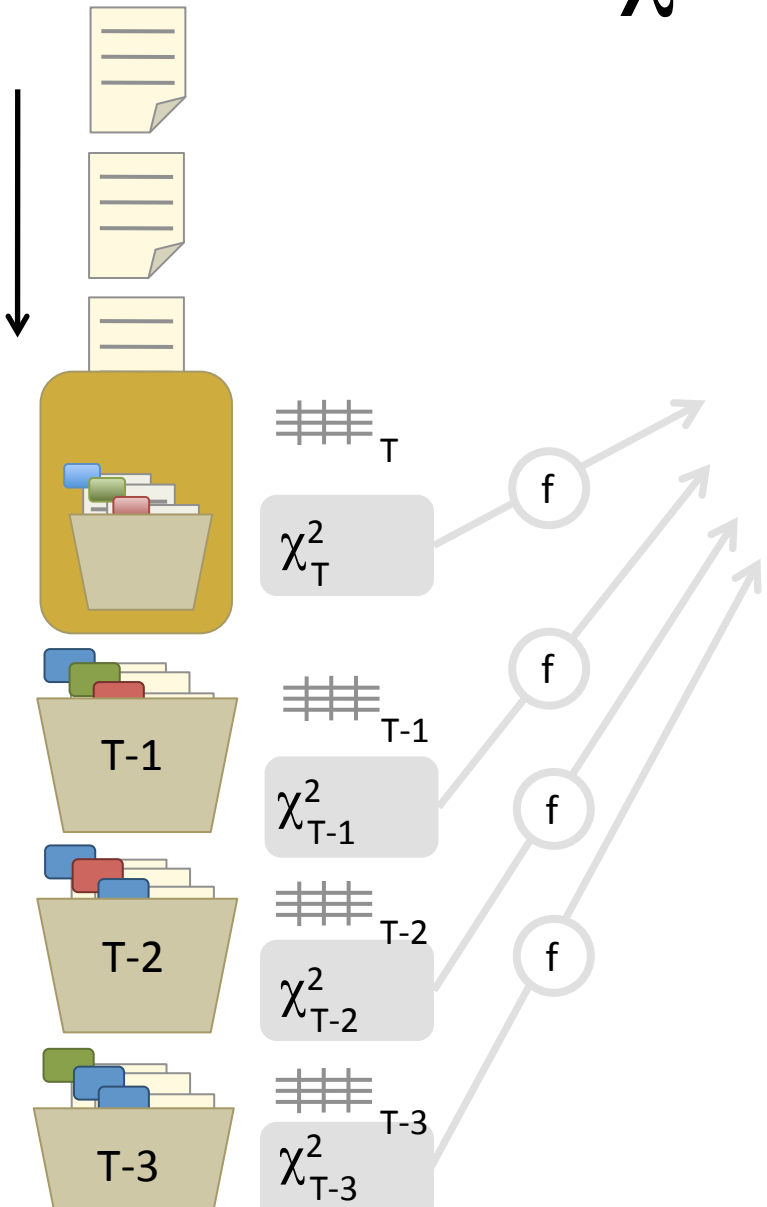
χ^2 over time



Weighted χ^2 values

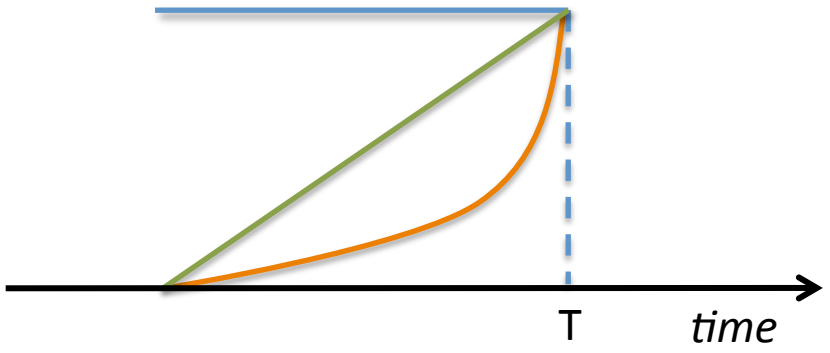
$$\chi^2 = \sum_{t=0}^{T} f(T-t) \cdot \chi^2_t$$

χ^2 over time



Weighted χ^2 values

$$\chi^2 = \sum_{t=0}^{T} f(T-t)\cdot\chi^2_t$$



f(·) = decay function

Experimental setup

- Difference between weighted contigencies and weighted χ^2 values
- Various bucket sizes
- Different decay functions

Difference between two approaches

Weighted contingencies

- Losing distribution of terms per time period
- Better χ^2 estimates
- Might have drag effect
- Can handle small buckets

Weighted χ^2 values

- Preserving saliency information over time
- Less data to work from
- Can adapt quicker
- Suffers from small bucket size

Future work

- Find out which examples to learn from
- Support ‘garbage’ class
- Adaptive feature space

Publications

Tom Kenter, David Graus, Edgar Meij, and Maarten de Rijke. 2013. **Time-aware chi-squared for document filtering over time**. In Proceedings of the SIGIR 2013 Workshop on Time-aware Information Access.

http://ilps.science.uva.nl/sites/ilps.science.uva.nl/files/TimeAwareChiSquared.pdf

Full SIGIR 2013 TAIA workshop proceedings:

http://research.microsoft.com/en-us/people/milads/taia2013.proceedings.final.pdf

TREC KBA CCR 2013 notebook paper:

To be published