evaluating information retrieval systems

kth

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gavagai & kth

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gavagai & kth
language technology applied to information retrieval

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language technology applied to information retrieval

text styles and variation in text use

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language technology applied to information retrieval

text styles and variation in text use

interactive information retrieval

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language technology applied to information retrieval

text styles and variation in text use

interactive information retrieval

large scale text analysis

Gavagai

continuous evaluation is the most important vehicle for successful technology development continuous evaluation is the most important vehicle for successful technology development

this requires reliable and valid testing

(reliability
and
validity?)

we want to develop our system to be better

we want to develop our system to be better

use stoplists?

we want to develop our system to be better

use stoplists?

lemmatisation?

we want to develop our system to be better

use stoplists?

lemmatisation?

thesauri?

we want to develop our system to be better

use stoplists?

lemmatisation?

thesauri?

query expansion?

we want to develop our system to be better

use stoplists?

lemmatisation?

thesauri?

query expansion?

user modelling?

we want to develop our system to be better

use stoplists?

lemmatisation?

thesauri?

query expansion?

user modelling?

plan inference?

we want to develop our system to be better

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lemmatisation?

thesauri?

query expansion?

user modelling?

plan inference?

positional modelling?

we want to develop our system to be better

use stoplists?

lemmatisation?

thesauri?

query expansion?

user modelling?

plan inference?

positional modelling?

genre analysis?

we want to develop our system to be better

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lemmatisation?

thesauri?

query expansion?

user modelling?

plan inference?

positional modelling?

genre analysis?

measures of reliability and authority?

better information access is about making the user happy

better information access is about making the user happy

who are our users here?

better information access is about making the user happy

who are our users here?
what makes them happy?

three-way optimisation:

three-way optimisation:

three-way optimisation:

price-quality-timeliness

here, we'll mostly discuss quality

what is quality in an information system?

what is quality in an information system?

usefulness and effectiveness for task

what is quality in an information system?

usefulness and effectiveness for task

appealing presentation

what is quality in an information system?

usefulness and effectiveness for task

appealing presentation

authority and trustworthiness and sourceability

what is quality in an information system?

usefulness and effectiveness for task

appealing presentation

authority and trustworthiness and sourceability

relevance and truthfulness

what is quality in an information system?

usefulness and effectiveness for task

appealing presentation

authority and trustworthiness and sourceability

relevance and truthfulness

reusability and cost

what is quality in an information system?

usefulness and effectiveness for task

appealing presentation

authority and trustworthiness and sourceability

relevance and truthfulness

reusability and cost

happiness, trust, and satisfaction!

we'll focus on relevance

the target concept of relevance

the target concept of relevance

in everyday language:

a function of task, collection characteristics, user preferences and background, situation, tool, temporal constraints, and untold other factors

the target concept of relevance

in everyday language:

a function of task, collection characteristics, user preferences and background, situation, tool, temporal constraints, and untold other factors

in information retrieval research:

a (binary) relation between query and document, disregarding everything contextual

	relevant	non-relevant
delivered	true positives	false positives
not delivered	false negatives	true negatives

	relevant	non-relevant
delivered	true positives (good)	false positives
not delivered	false negatives	true negatives

	relevant	non-relevant
delivered	true positives (good)	false positives
not delivered	false negatives	true negatives (uninteresting)

	relevant	non-relevant
delivered	true positives (good)	false positives (errors)
not delivered	false negatives	true negatives (uninteresting)

	relevant	non-relevant
delivered	true positives (good)	false positives (errors)
not delivered	false negatives (misses)	true negatives (uninteresting)

accuracy = (tp+tn)/(tp+tn+fp+fn)

$$\text{accuracy} = (tp+tn)/(tp+tn+fp+fn)$$

= (good + uninteresting)/all docs

= correct labels/all docs

precision = tp/(tp+fp)

precision = tp/(tp+fp)

= good/delivered

recall = tp/(tp+fn)

(täckning)

= good/relevant

= good/(good + miss)

5 min exercise

retrieve and assess relevance of top ten

compare two queries and two search engines was this easy?

the practice of evaluation

use gold standards / ground truth

lock down the notion of relevance

create test collections

define shared tasks

locking down the notion of relevance

TREC, US, 1992 -

CLEF, EU, 1999 -

NTCIR, Japan, 1999 -

FIRE, India, 2008 -

plus many similar in ML, NLP etc

```
<top>
<num> C041 </num>
<EN-title> Pesticides in Baby Food </EN-title>
<EN-desc> Find reports on pesticides in baby food. </EN-desc>
<EN-narr> Relevant documents give information on the discovery of pesticides in baby food. They report on different brands, supermarkets, and companies selling baby food which contains pesticides. They also discuss measures against the contamination of baby food by pesticides. </EN-narr>
</top>
```

```
41 0 LA010594-0107 0
41 0 LA010594-0111 0
41 0 LA042794-0167 1
41 0 LA050694-0309 0
41 0 LA050894-0105 1
```

```
<DOC> <DOCNO> LA042794-0167 </DOCNO>
<SOURCE> <P>  Los Angeles Times  </P>
</SOURCE> <DATE> <P> April 27, 1994,
Wednesday, Home Edition  </P> </DATE>
<TEXT> ...
... Concerns have risen in recent years
over the ingestion of pesticide-treated
food by children, whose smaller body
weights may make their exposure
riskier. ...
</TEXT> </DOC>
```

imposing power on any observable variable creates bias!

imposing power on any observable variable creates bias!

risky!

risk 1: blocks creativity - what happened with e.g. context?

risk 2: overtraining

(partial remedy: crossvalidation)

risk 3: variation across queries greater than variation across systems

(partial remedy: more queries in test set)

example problem: sentiment polarity

And the sound quality - my God!

And the sound quality - my God!

Raymond left no room for error on his recordings and it shows.

And the sound quality - my God!

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Definitely one of the better tracks on the album.

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Wow, could have been a expansion pack.

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I loved The Spy Who Came In From The Cold but the movie is a bit dated in a way the book never will be.

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I am unsure about the feasibility of this knitting pattern.

I love the Samsung B2710 but I would not recommend it to my colleagues.

I don't know if I should call her up – I liked her when I met her last weekend.

This is true.

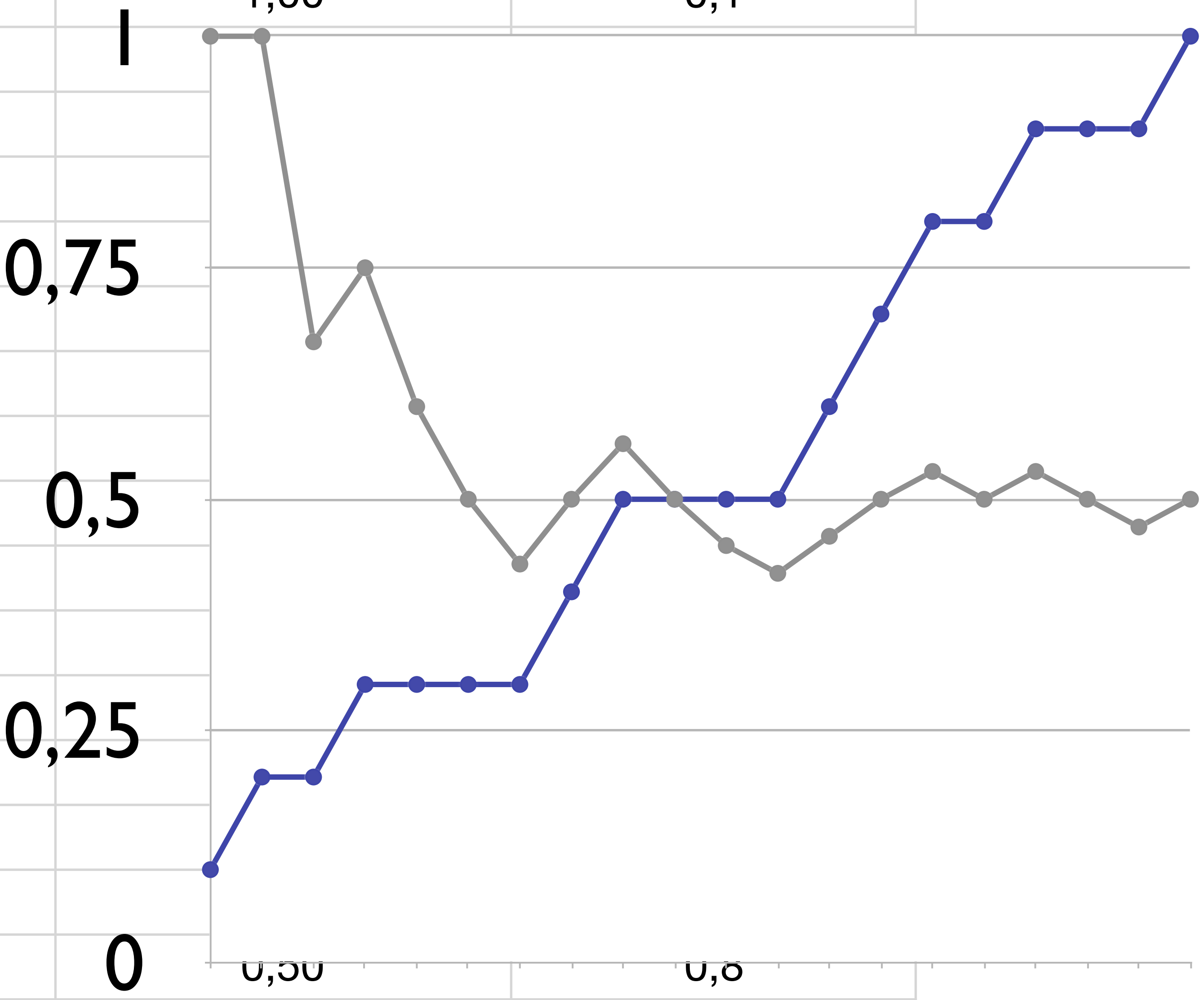
but let's assume we can swing it

first: we will now focus on ranked retrieval

precision and recall combined

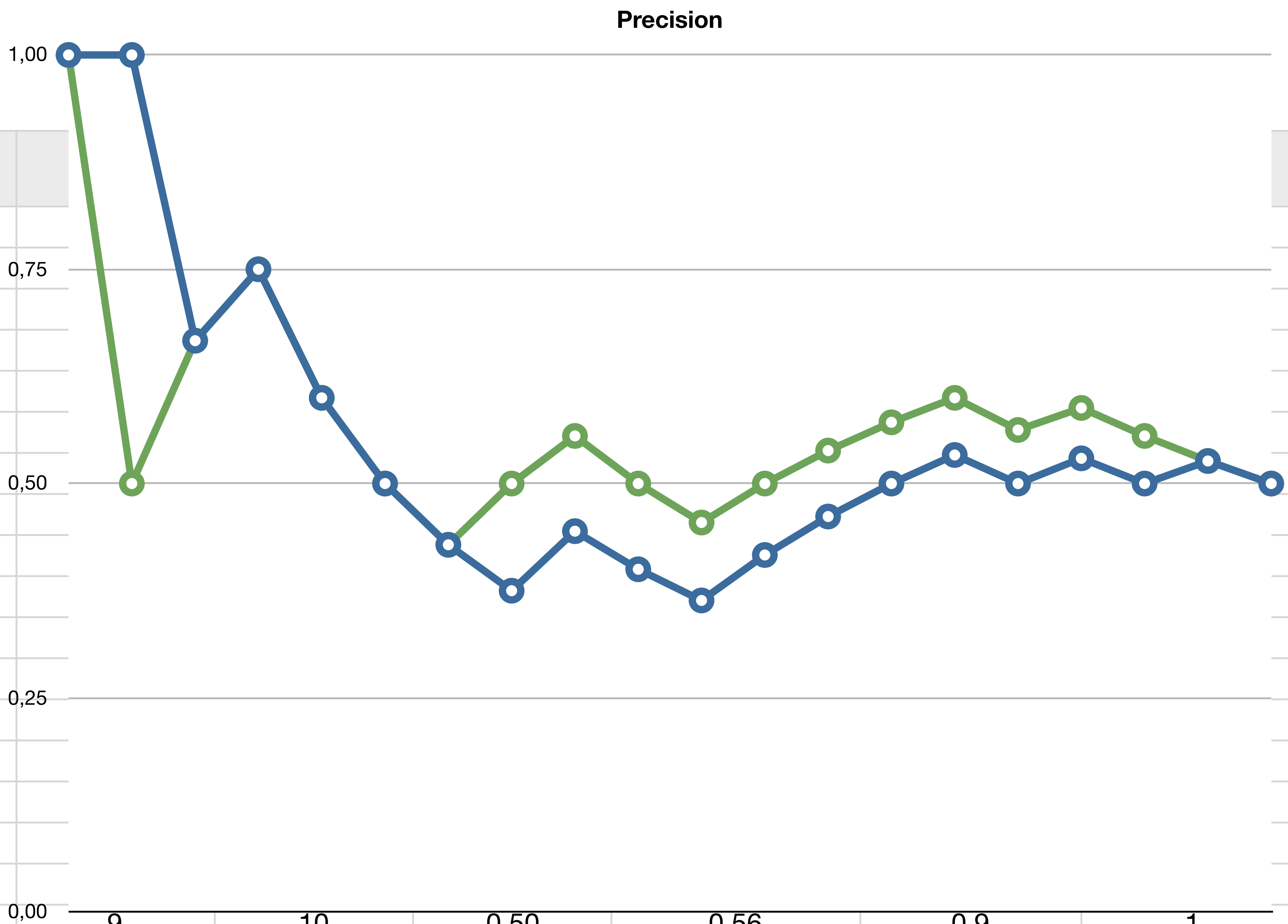
relevant?	tp	precision = tp/(tp+fp)	recall = tp/(tp+fn)
1	1	1,00	0,1
1	2	1,00	0,2
0	2	0,67	0,2
1	3	0,75	0,3
0	3	0,60	0,3
0	3	0,50	0,3
0	3	0,43	0,3
1	4	0,50	0,4
1	5	0,56	0,5
0	5	0,50	0,5
0	5	0,45	0,5
0	5	0,42	0,5
1	6	0,46	0,6
1	7	0,50	0,7
1	8	0,53	0,8
0	8	0,50	0,8
1	9	0,53	0,9
0	9	0,50	0,9
0	9	0,47	0,9
1	10	0,50	1

relevant?	tp	precision = tp/(tp+fp)	recall = tp/(tp+fn)
1	1	1,00	0,1
1	2		
0	2		
1	3		
0	3		
0	3		
0	3		
1	4		
1	5		
0	5		
0	5		
0	5		
1	6		
1	7		
1	8		
0	8	0,50	0,8
1	9	0,53	0,9
0	9	0,50	0,9
0	9	0,47	0,9
1	10	0,50	1



relevant?	relevant?	tp	tp	precision	precision	recall	recall
1	1	1	1	1,00	1,00	0,1	0,1
1	0	2	1	1,00	0,50	0,2	0,1
0	1	2	2	0,67	0,67	0,2	0,2
1	1	3	3	0,75	0,75	0,3	0,3
0	0	3	3	0,60	0,60	0,3	0,3
0	0	3	3	0,50	0,50	0,3	0,3
0	0	3	3	0,43	0,43	0,3	0,3
0	1	3	4	0,38	0,50	0,3	0,4
1	1	4	5	0,44	0,56	0,4	0,5
0	0	4	5	0,40	0,50	0,4	0,5
0	0	4	5	0,36	0,45	0,4	0,5
1	1	5	6	0,42	0,50	0,5	0,6
1	1	6	7	0,46	0,54	0,6	0,7
1	1	7	8	0,50	0,57	0,7	0,8
1	1	8	9	0,53	0,60	0,8	0,9
0	0	8	9	0,50	0,56	0,8	0,9
1	1	9	10	0,53	0,59	0,9	1
0	0	9	10	0,50	0,56	0,9	1
1	0	10	10	0,53	0,53	1	1
0	0	10	10	0,50	0,50	1	1

relevant?	relevant?						
1	1						
1	0						
0	1						
1	1						
0	0						
0	0						
0	0						
0	1						
1	1						
0	0						
0	0						
1	1						
1	1						
1	1						
1	1						
0	0						
1	1						
0	0	9	10	0,50	0,56	0,9	1
1	0	10	10	0,53	0,53	1	1
0	0	10	10	0,50	0,50	1	1



a curve is fine, but a scalar would be simpler

F-score

harmonic mean of precision and recall

$F_1 = 2PR / (P + R)$

you will not be able to avoid the F-score

(8.5; 8.6)

map

average precision at the rank of each retrieved document

(8.8)

map

relevant?	relevant?	map	map
1	1	1,000	1,000
1	0	1,000	0,500
0	1	0,667	
1	1		0,750
0	0	0,600	0,600
0	0		
0	0		
0	1		
1	1		0,556
0	0	0,400	0,500
0	0		
1	1		
1	1	0,462	0,538
1	1	0,500	0,571
1	1	0,533	0,600
0	0	0,500	0,563
1	1		
0	0	0,500	0,556
1	0		
0	0	0,500	
		0,666	**0,673**

average precision at the rank of each retrieved document

(8.8)

11-pt interpolated precision

1. precision at recall level r is the highest precision for every recall level ≥ r
2. compute this for r = 0.0, 0.1 ... 0.9, 1.0
3. equivalent of smoothing recall-precision curve

(8.7)

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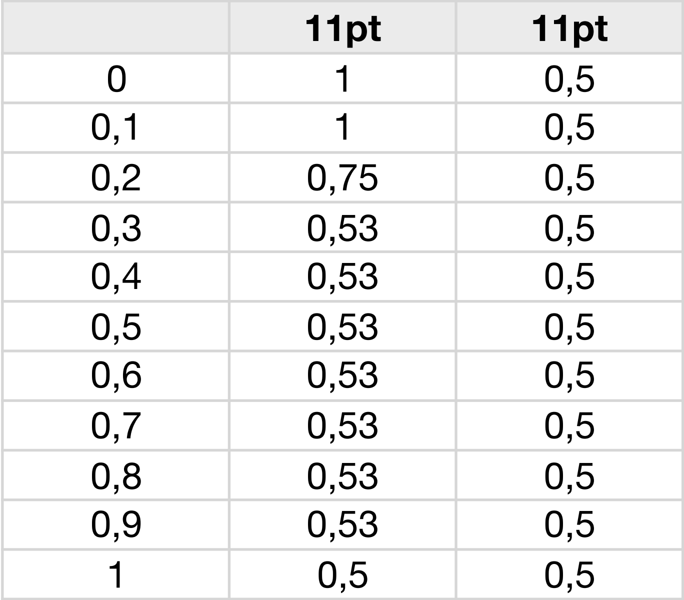
(8.7)



	11pt	11pt
0	1	0,5
0,1	1	0,5
0,2	0,75	0,5
0,3	0,53	0,5
0,4	0,53	0,5
0,5	0,53	0,5
0,6	0,53	0,5
0,7	0,53	0,5
0,8	0,53	0,5
0,9	0,53	0,5
1	0,5	0,5

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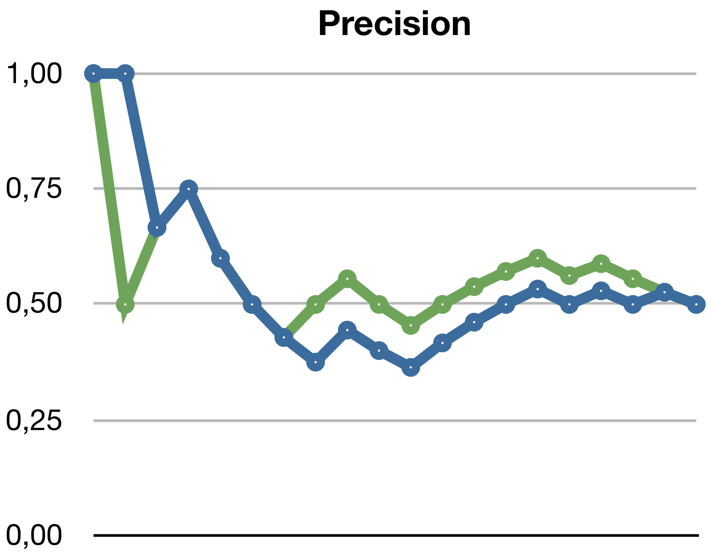
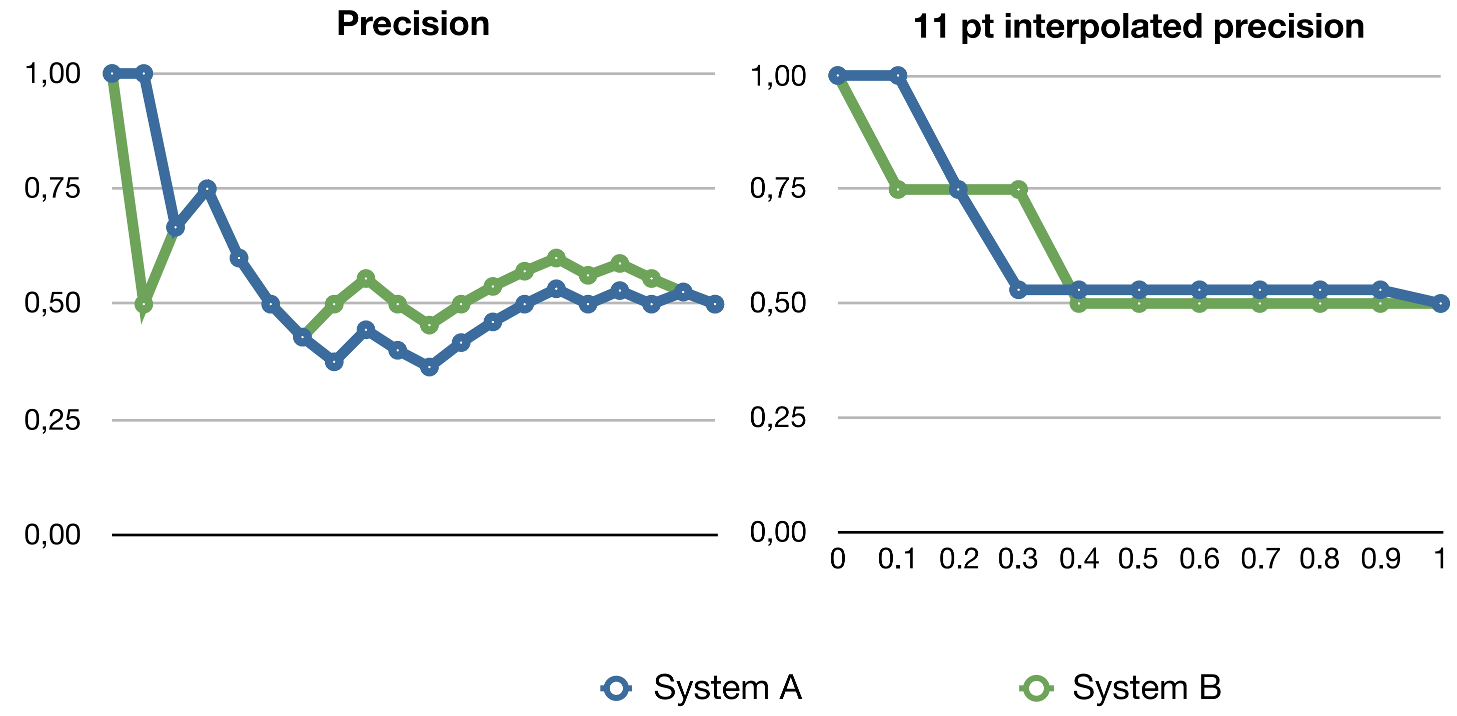


(8.7)

	11pt	11pt
0	1	0,5
0,1	1	0,5
0,2	0,75	0,5
0,3	0,53	0,5
0,4	0,53	0,5
0,5	0,53	0,5
0,6	0,53	0,5
0,7	0,53	0,5
0,8	0,53	0,5
0,9	0,53	0,5
1	0,5	0,5

11-pt interpolated precision

1. precision at recall level r is the highest precision for every recall level ≥ r
2. compute this for r = 0.0, 0.1 ... 0.9, 1.0
3. equivalent of smoothing recall-precision curve



(8.7)

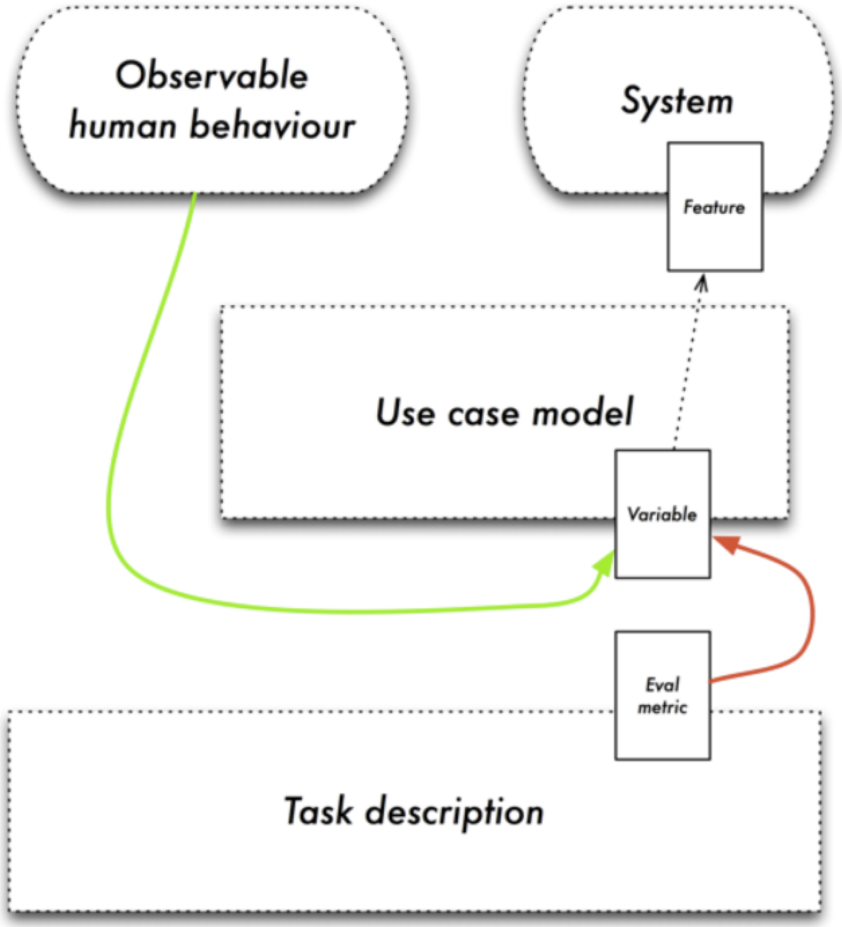
	11pt	11pt
0	1	0,5
0,1	1	0,5
0,2	0,75	0,5
0,3	0,53	0,5
0,4	0,53	0,5
0,5	0,53	0,5
0,6	0,53	0,5
0,7	0,53	0,5
0,8	0,53	0,5
0,9	0,53	0,5
1	0,5	0,5

back to usefulness for task

modelling usage:

1.87 wds / q

use case as a modelling framework



(don't worry, we'll probably return to this next time) p@N

assumes that N is a sensible number

relevant?	relevant?	tp	tp	precision	precision
1	1	1	1	1,00	1,00
1	0	2	1	1,00	0,50
0	1	2	2	0,67	0,67
1	1	3	3	0,75	0,75
0	0	3	3	0,60	0,60
0	0	3	3	0,50	0,50
0	0	3	3	0,43	0,43
0	1	3	4	0,38	0,50
1	1	4	5	0,44	0,56
0	0	4	5	**0,40**	**0,50**
0	0	4	5	0,36	0,45
1	1	5	6	0,42	0,50
1	1	6	7	0,46	0,54
1	1	7	8	0,50	0,57
1	1	8	9	0,53	0,60
0	0	8	9	0,50	0,56
1	1	9	10	0,53	0,59
0	0	9	10	0,50	0,56
1	0	10	10	0,53	0,53
0	0	10	10	**0,50**	**0,50**

relevant?	relevant?	tp	tp	precision	precision
1	1	1	1	1,00	1,00
1	0	2	1	1,00	0,50
0	1	2	2	0,67	0,67
1	1	3	3	0,75	0,75
0	0	3	3	0,60	0,60
0	0	3	3	0,50	0,50
0	0	3	3	0,43	0,43
0	1	3	4	0,38	0,50
1	1	4	5	0,44	0,56
0	0	4	5	**0,40**	**0,50**
0	0	4	5	0,36	0,45
1	1	5	6	0,42	0,50
1	1	6	7	0,46	0,54
1	1	7	8	0,50	0,57
1	1	8	9	0,53	0,60
0	0	8	9	0,50	0,56
1	1	9	10	0,53	0,59
0	0	9	10	0,50	0,56
1	0	10	10	0,53	0,53
0	0	10	10	**0,50**	**0,50**

P@10

cumulative gain measures

measure gain at rank p

introducing graded relevance values

CG: simple cumulative gain at rank p

sum of relevance scores for all documents with rank ≤ p

CG: simple cumulative gain at rank p

sum of relevance scores for all documents with rank ≤ p

CG: simple cumulative gain at rank p

sum of relevance scores for all documents with rank ≤ p

relevant?	relevant?	CG	CG
3	3	3	3
2	0	5	3
0	0	5	3
0	2	5	5
1	2	6	7
2	1	8	8
3	1	11	9
1	3	12	12
0	0	12	12

CG: simple cumulative gain at rank p

sum of relevance scores for all documents with rank ≤ p

relevant?	relevant?	CG	CG
3	3	3	3
2	0	5	3
0	0	5	3
0	2	5	5
1	2	6	7
2	1	8	8
3	1	11	9
1	3	12	12
0	0	12	12

non-binary relevance!

CG: simple cumulative gain at rank p

sum of relevance scores for all documents with rank ≤ p

relevant?	relevant?	CG	CG
3	3	3	3
2	0	5	3
0	0	5	3
0	2	5	5
1	2	6	7
2	1	8	8
3	1	11	9
1	3	12	12
0	0	12	12

$$\mathrm{CG_p} = \sum_{i=1}^{p} rel_i$$

non-binary relevance!

CG: simple cumulative gain at rank p

sum of relevance scores for all documents with rank ≤ p

CG: simple cumulative gain at rank p

sum of relevance scores for all documents with rank ≤ p

DCG: discounted cumulative gain at rank p

penalise relevant documents if delivered late

CG: simple cumulative gain at rank p

sum of relevance scores for all documents with rank ≤ p

DCG: discounted cumulative gain at rank p

penalise relevant documents if delivered late

CG: simple cumulative gain at rank p

sum of relevance scores for all documents with rank ≤ p

DCG: discounted cumulative gain at rank p

penalise relevant documents if delivered late

p	relevant?	relevant?	CG	CG	DCG	DCG
1	3	3	3	3	3,00	3,00
2	2	0	5	3	5,00	3,00
3	0	0	5	3	5,00	3,00
4	0	2	5	5	5,00	3,00
5	1	2	6	7	5,43	3,43
6	2	1	8	8	6,20	4,20
7	3	1	11	9	7,27	5,27
8	1	3	12	12	7,61	5,61
9	0	0	12	12	7,61	5,61

CG: simple cumulative gain at rank p

sum of relevance scores for all documents with rank ≤ p

DCG: discounted cumulative gain at rank p

penalise relevant documents if delivered late

p	relevant?	relevant?	CG	CG	DCG	DCG
1	3	3	3	3	3,00	3,00
2	2	0	5	3	5,00	3,00
3	0	0	5	3	5,00	3,00
4	0	2	5	5	5,00	3,00
5	1	2	6	7	5,43	3,43
6	2	1	8	8	6,20	4,20
7	3	1	11	9	7,27	5,27
8	1	3	12	12	7,61	5,61
9	0	0	12	12	7,61	5,61

$$\mathrm{DCG_p} = rel_1 + \sum_{i=2}^{p} \frac{rel_i}{\log_2(i)}$$

CG: simple cumulative gain at rank p

sum of relevance scores for all documents with rank ≤ p

CG: simple cumulative gain at rank p

sum of relevance scores for all documents with rank $\leq p$

DCG: discounted cumulative gain at rank p

penalise relevant documents if delivered late

CG: simple cumulative gain at rank p

sum of relevance scores for all documents with rank ≤ p

DCG: discounted cumulative gain at rank p

penalise relevant documents if delivered late

nDCG: normalized discounted cumulative gain at rank p

compared to perfect system

CG: simple cumulative gain at rank p

sum of relevance scores for all documents with rank ≤ p

DCG: discounted cumulative gain at rank p

penalise relevant documents if delivered late

nDCG: normalized discounted cumulative gain at rank p

compared to perfect system

CG: simple cumulative gain at rank p

sum of relevance scores for all documents with rank ≤ p

DCG: discounted cumulative gain at rank p

penalise relevant documents if delivered late

nDCG: normalized discounted cumulative gain at rank p

compared to perfect system

p	relevant?	relevant?	CG	CG	DCG	DCG	Ideal system	IDCG	nDCG	nDCG
1	3	3	3	3	3,00	3,00	3	3,00	1,00	1,00
2	2	0	5	3	5,00	3,00	3	6,00	0,83	0,50
3	0	0	5	3	5,00	3,00	2	7,26	0,69	0,41
4	0	2	5	5	5,00	3,00	2	8,26	0,61	0,36
5	1	2	6	7	5,43	3,43	1	8,69	0,62	0,39
6	2	1	8	8	6,20	4,20	1	9,08	0,68	0,46
7	3	1	11	9	7,27	5,27	0	9,08	0,80	0,58
8	1	3	12	12	7,61	5,61	0	9,08	0,84	0,62
9	0	0	12	12	7,61	5,61	0	9,08	0,84	0,62

take home message

you should understand

take home message

you should understand

evaluation and systematic testing

take home message

you should understand

evaluation and systematic testing

(the thing to do, whatever you do)

take home message

you should understand

evaluation and systematic testing

(the thing to do, whatever you do)

precision and recall

take home message

you should understand

evaluation and systematic testing

(the thing to do, whatever you do)

precision and recall

various measures based on p & r

take home message

you should understand

evaluation and systematic testing

(the thing to do, whatever you do)

precision and recall

various measures based on p & r

perils of averages

take home message

you should understand

evaluation and systematic testing

(the thing to do, whatever you do)

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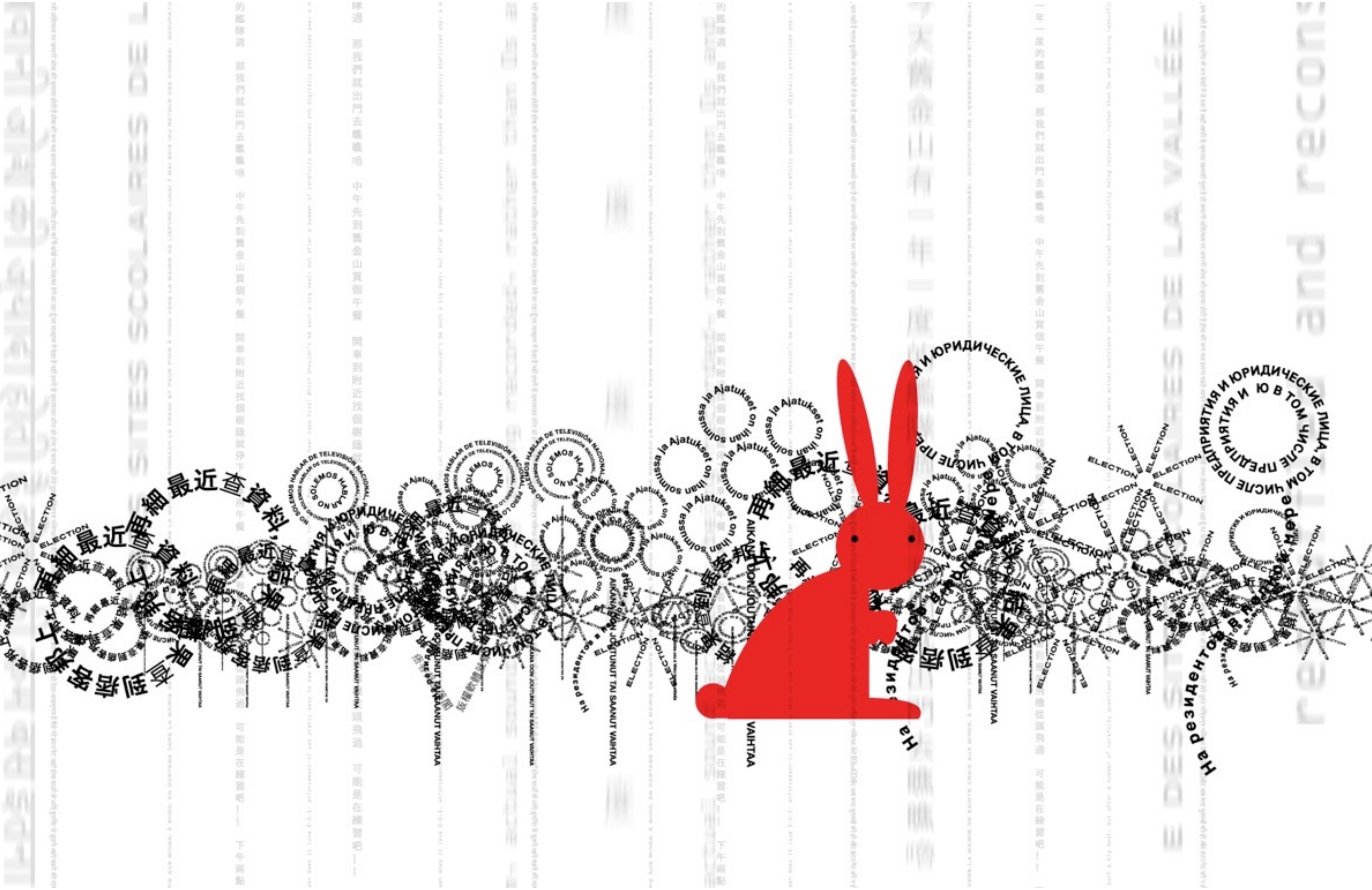
challenges to "relevance"



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ELECTION
NO SOLEMOS HABLAR DE TELEVISIÓN NACIONAL
Ajatukset on ihan solmussa ja
AIKANUT JOUTUNUT TAI SAANUT VAHTAA
И ЮРИДИЧЕСКИЕ ЛИЦА, В ТОМ ЧИСЛЕ ПРЕДПРИЯТИЯ
На резидентов
再細最近查資料