

Evaluation in Information Retrieval

Reading:
Textbook, Chapter 8

April 15, 2010

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Written HW 2 to be assigned on Tuesday.

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Example: Google vs. Yahoo vs. Bing

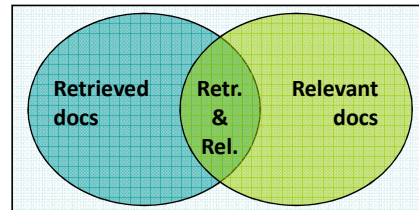
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How to evaluate the results of a search engine or
to compare different search engines?

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Evaluation: Metrics

- Two basics:



$$\text{Recall} = \frac{\text{\# documents retrieved and relevant}}{\text{\# documents relevant}}$$

$$\text{Precision} = \frac{\text{\# documents retrieved and relevant}}{\text{\# documents retrieved}}$$

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Definitions

- “True positive” (retrieved and relevant)
- “False positive” (retrieved and not relevant)
- “True negative” (not retrieved and not relevant)
- “False negative” (not retrieved and relevant)

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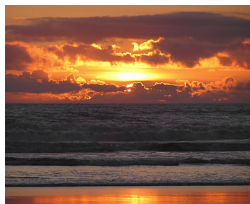
Examples in Classification Applications



Classified as "ocean"
True positive



Classified as "ocean"
False positive



Classified as "not ocean"
False negative



Classified as "not ocean"
True negative

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Boolean search ("relevant"/ "nonrelevant") evaluation measures

- Precision

$$P = \frac{TP}{TP + FP} = \frac{\text{relevant and retrieved documents}}{\text{all retrieved documents}}$$

- Recall

$$R = \frac{TP}{TP + FN} = \frac{\text{relevant and retrieved documents}}{\text{all relevant documents}}$$

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Examples

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- In what cases would we care more about precision?
- In what cases would we care more about recall?

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Precision-Recall Curve

- For search engines, we have more than just “relevant / nonrelevant” information for each document

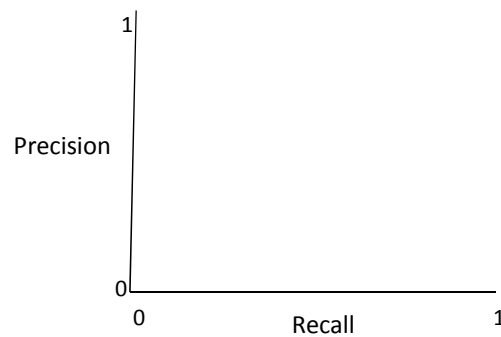
We also have “rank”.

- Can define the k top ranked documents as “relevant”.
- Can plot precision versus recall as we vary k , to see how they trade off against each other.

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Precision-Recall Curve

Recall	Precision
0%	
10%	
20%	
30%	
40%	
50%	
60%	
70%	
80%	
90%	
100%	



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Interpolated precision

For any recall level r , plot maximum precision at any equal or higher recall level $r' \geq r$

- This smoothes out “sawtooth” shape of graph
- Justification: “almost anyone would be prepared to look at a few more documents if it would increase the percentage of the viewed set that were relevant”.

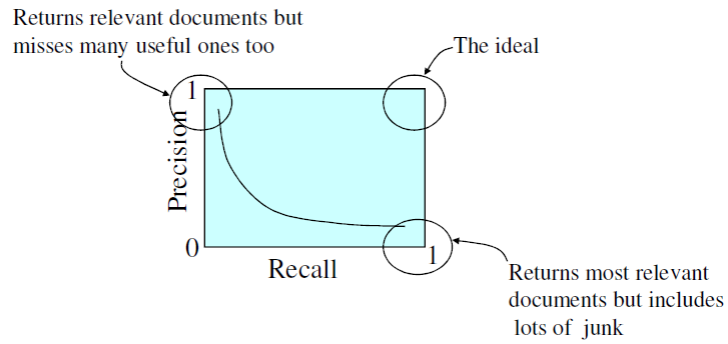
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Plotting recall and precision

- Single query performance not necessarily representative of system
 - Compute recall and precision for multiple queries
 - Average the interpolated values at each recall level

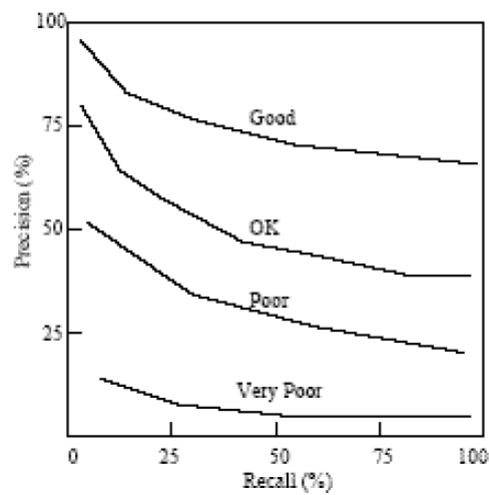
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Trade-off between Recall and Precision



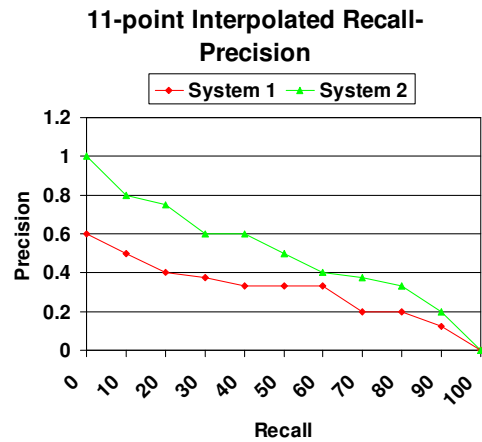
From: www.cs.utexas.edu/~mooney/ir-course/slides/Evaluation.ppt

Precision / Recall Curves



Which system is better?

Recall level	Average interpolated precision	
	System 1	System 2
0	0.6	1.0
10	0.5	0.8
20	0.4	0.75
30	0.375	0.6
40	0.33	0.6
50	0.33	0.5
60	0.33	0.4
70	0.2	0.375
80	0.2	0.33
90	0.125	0.2
100	0.0	0.0

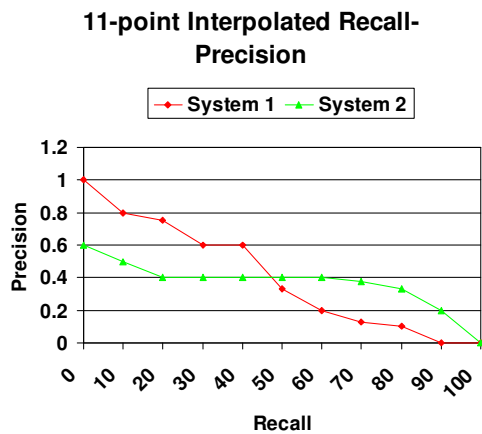


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Which system is better?

Recall level	Average interpolated precision	
	System 1	System 2
0	1.0	0.6
10	0.8	0.5
20	0.75	0.4
30	0.6	0.4
40	0.6	0.4
50	0.33	0.4
60	0.2	0.4
70	0.125	0.375
80	0.1	0.33
90	0.0	0.2
100	0.0	0.0



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Mean average precision (MAP)

- Calculate average (uninterpolated) precision of top k documents
- Average this over a set of queries Q

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R-precision

- Suppose we have a set of known relevant documents Rel .
- Calculate precision for top $|Rel|$ documents retrieved.
- *and*
- Also called “break-even point”: Value at which P and R are equal.
 - Suppose r of the $|Rel|$ documents retrieved are actually relevant.
 - Then: $P = r / |Rel|$
 - But: $R = r / |Rel|$

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F-measure: Weighted harmonic mean of precision and recall

F-measure

$$F_{\beta=1} = \frac{2PR}{P+R}$$

More generally:

$$F_{\beta} = \frac{(\beta^2 + 1)PR}{\beta^2 P + R}, \beta \in [0, \infty]$$

Idea: Avoid getting high score on mean by simply retrieving all documents (i.e., all are “relevant”).

E.g., what would happen if all documents are retrieved under arithmetic versus harmonic mean of P and R?

Examples of F-measure.

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Receiver Operating Characteristic (ROC) Curves

- Alternative to precision/recall curves
- Shows tradeoff between true positive rate and false positive rate.

True positive rate = $TP/(TP + FN)$ (“sensitivity”)

False positive rate = $FP/(TN + FP)$

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Example ROC curve

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How to obtain ground truth for judging
relevance?

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System quality and user utility

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