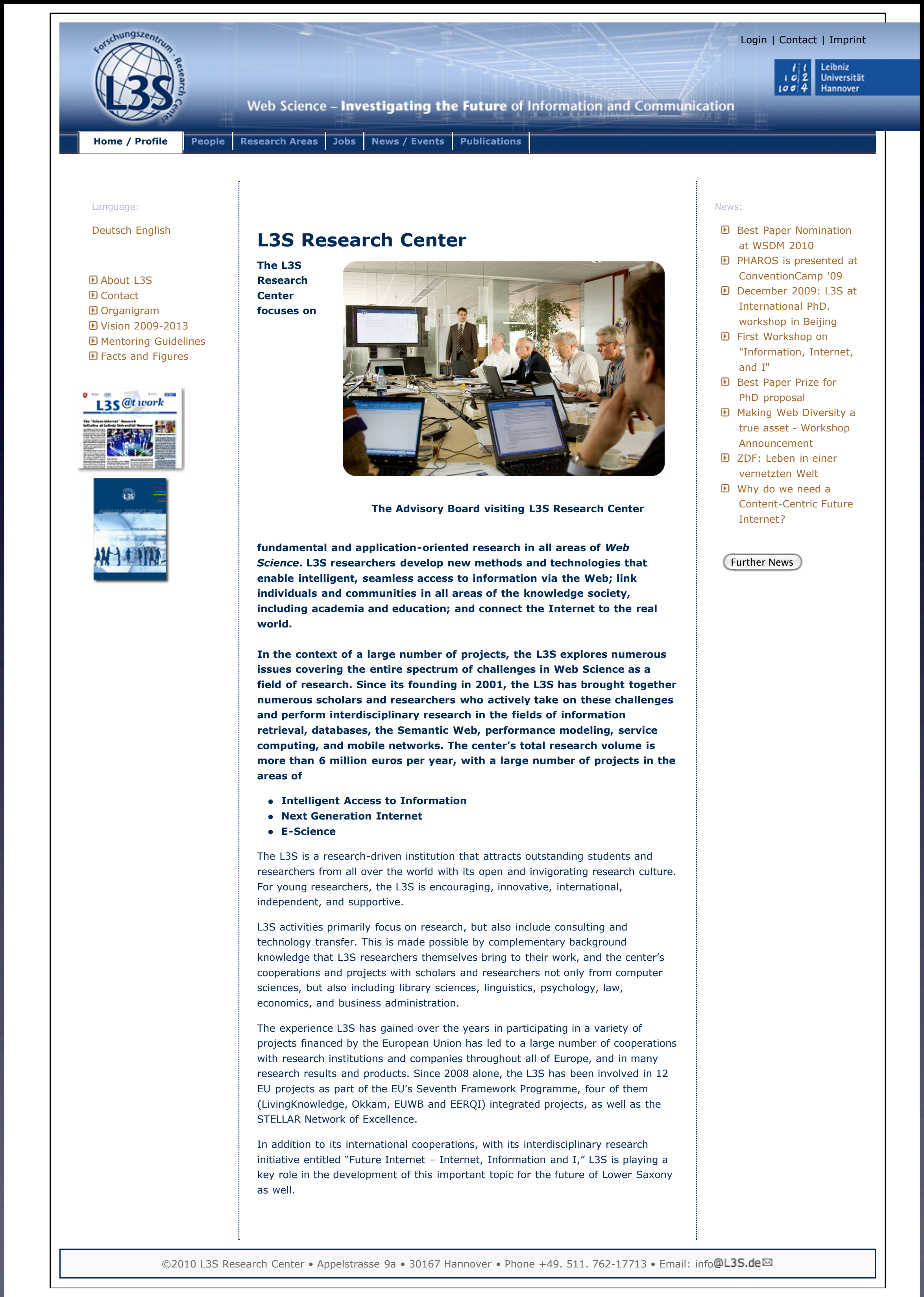
***Christian Kohlschütter**, Peter Fankhauser, Wolfgang Nejdl*

Boilerplate Detection using Shallow Text Features

Forschungszentrum · Research Center
L3S

KNOWLEDGE • INFORMATION • LEARNING

Boilerplate Text



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Web Science – **Investigating the Future** of Information and Communication

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- Contact
- Organigram
- Vision 2009-2013
- Mentoring Guidelines
- Facts and Figures

L3S Research Center

The L3S Research Center focuses on

The Advisory Board visiting L3S Research Center

fundamental and application-oriented research in all areas of *Web Science*. L3S researchers develop new methods and technologies that enable intelligent, seamless access to information via the Web; link individuals and communities in all areas of the knowledge society, including academia and education; and connect the Internet to the real world.

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- **Intelligent Access to Information**
- **Next Generation Internet**
- **E-Science**

The L3S is a research-driven institution that attracts outstanding students and researchers from all over the world with its open and invigorating research culture. For young researchers, the L3S is encouraging, innovative, international, independent, and supportive.

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News:

- Best Paper Nomination at WSDM 2010
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- December 2009: L3S at International PhD. workshop in Beijing
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- Best Paper Prize for PhD proposal
- Making Web Diversity a true asset - Workshop Announcement
- ZDF: Leben in einer vernetzten Welt
- Why do we need a Content-Centric Future Internet?

Further News

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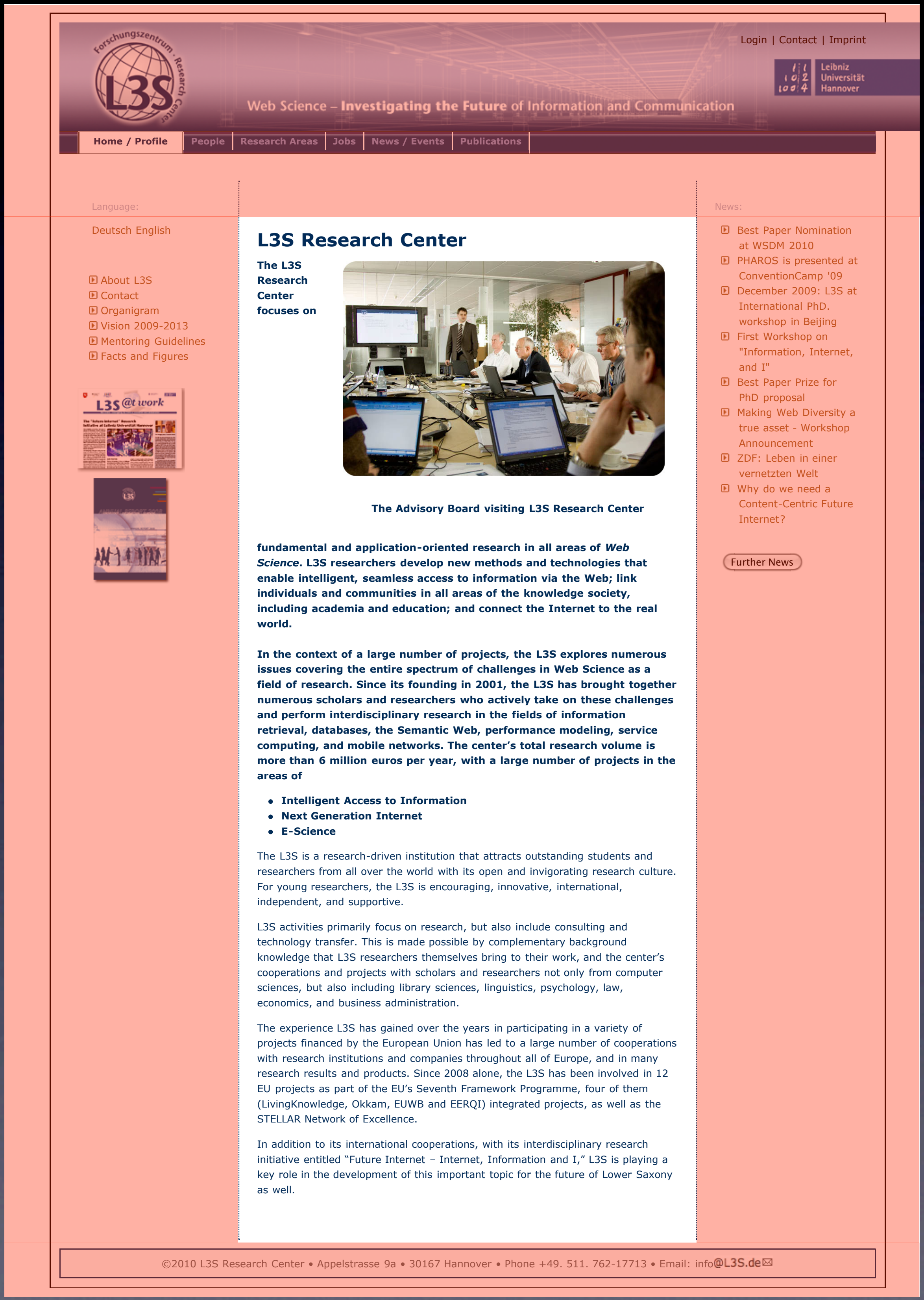

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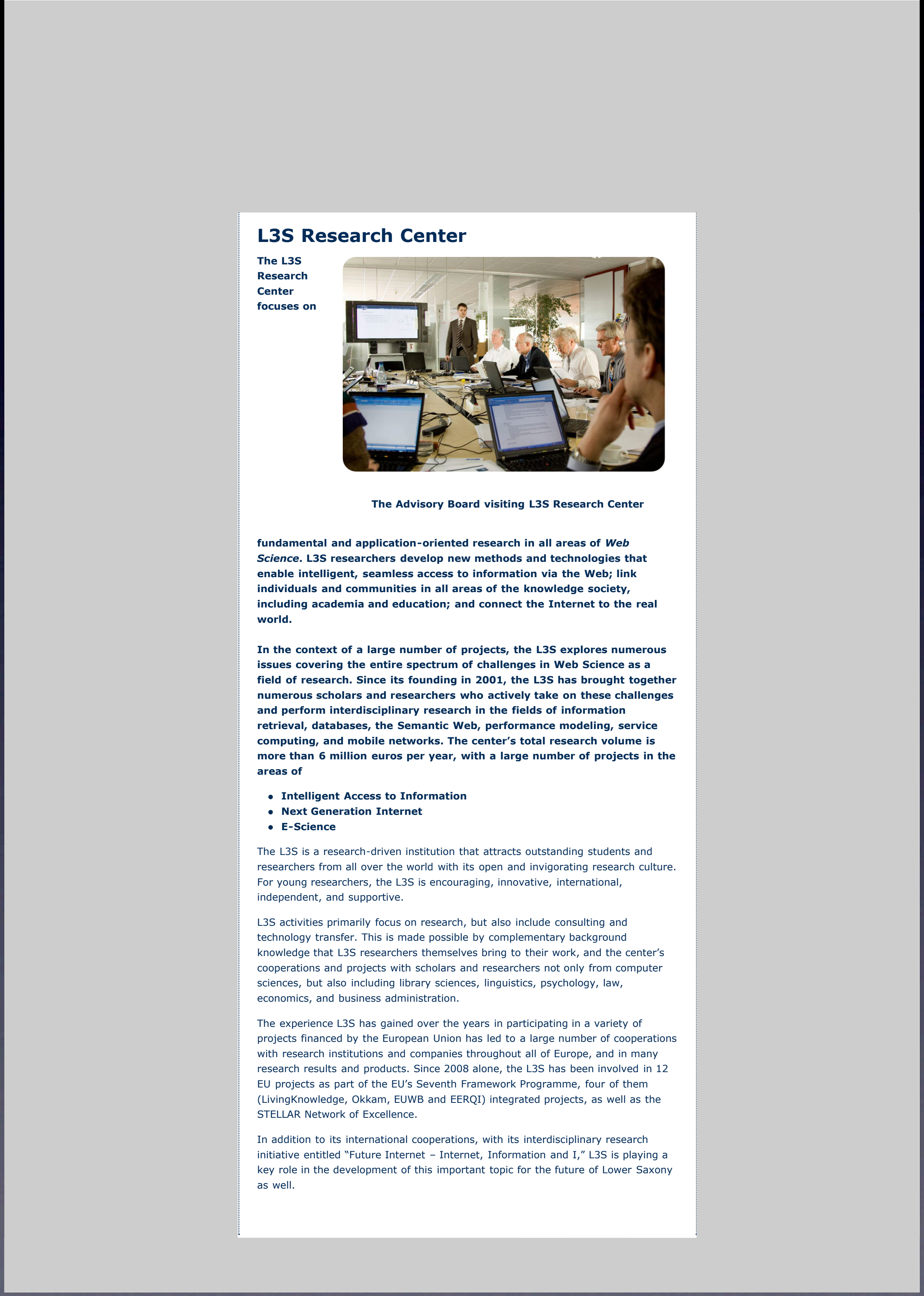

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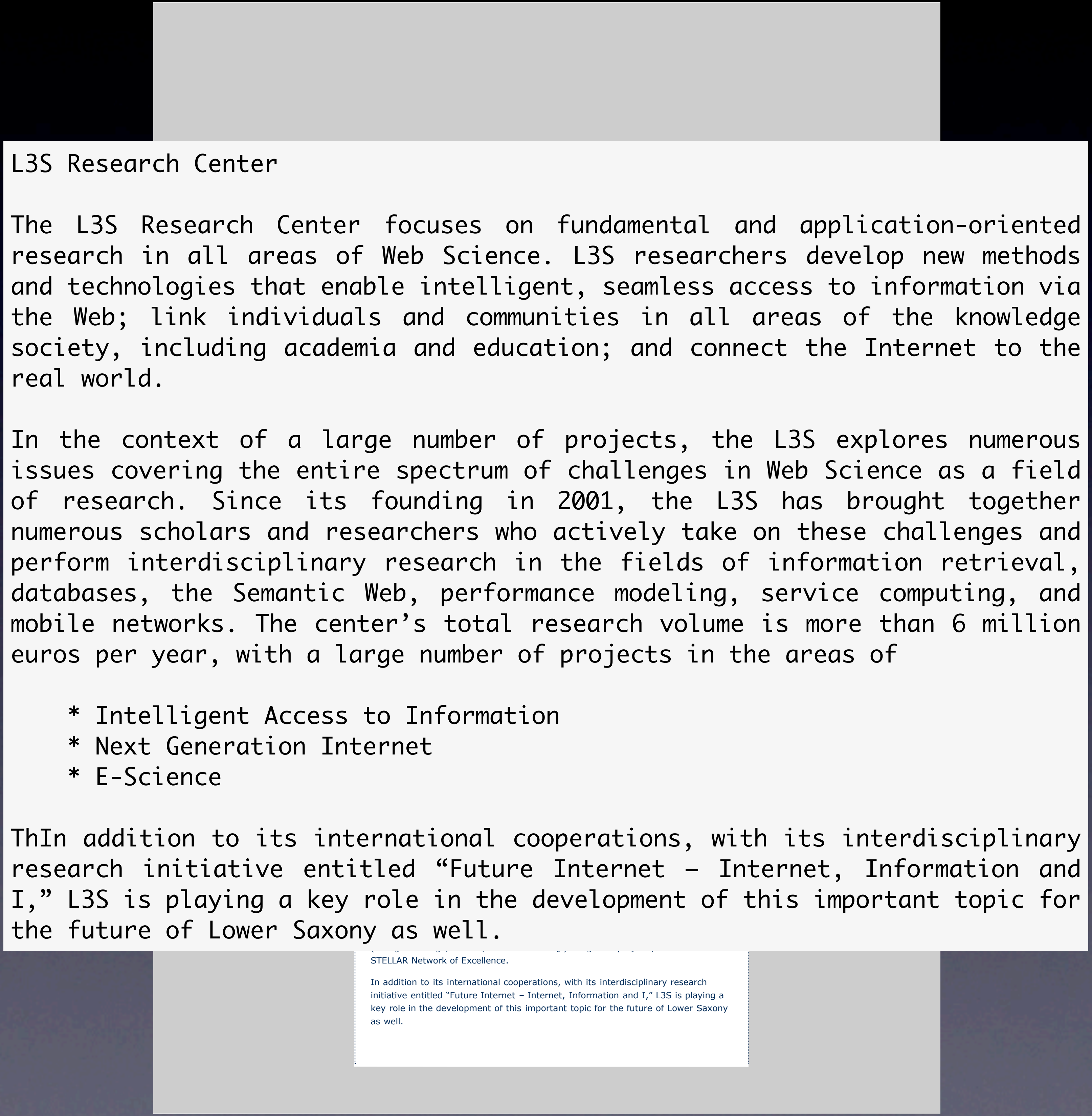

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STELLAR Network of Excellence.

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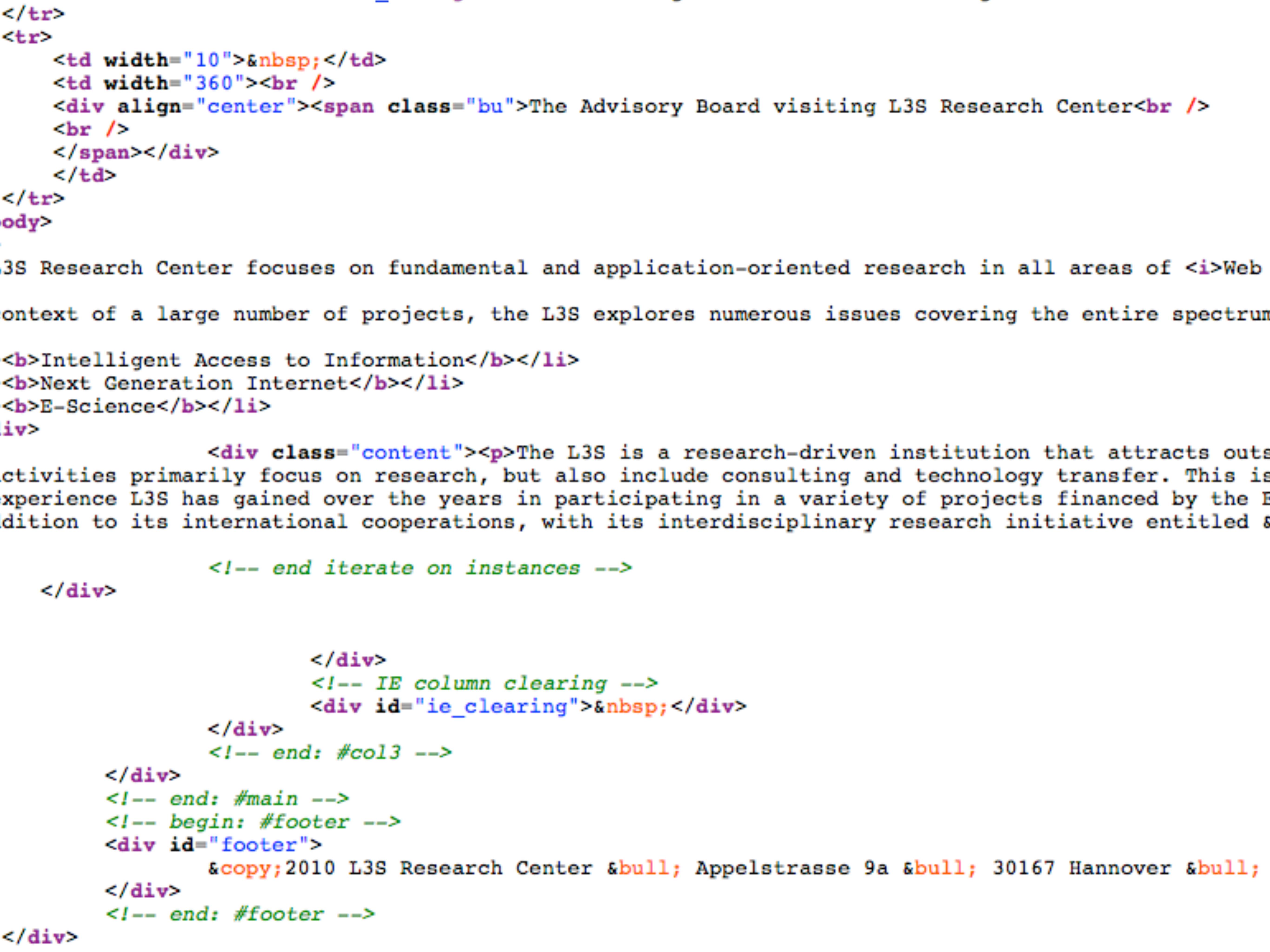

```
</tr>
<tr>
    <td width="10">&nbsp;</td>
    <td width="360"><br />
    <div align="center"><span class="bu">The Advisory Board visiting L3S Research Center<br />
    <br />
    </span></div>
    </td>
</tr>
ody>

3S Research Center focuses on fundamental and application-oriented research in all areas of <i>Web

ontext of a large number of projects, the L3S explores numerous issues covering the entire spectrum

<b>Intelligent Access to Information</b></li>
<b>Next Generation Internet</b></li>
<b>E-Science</b></li>
iv>
                <div class="content"><p>The L3S is a research-driven institution that attracts outs
ctivities primarily focus on research, but also include consulting and technology transfer. This is
xperience L3S has gained over the years in participating in a variety of projects financed by the E
dition to its international cooperations, with its interdisciplinary research initiative entitled &

                <!-- end iterate on instances -->
   </div>


                        </div>
                        <!-- IE column clearing -->
                        <div id="ie_clearing">&nbsp;</div>
                </div>
                <!-- end: #col3 -->
        </div>
        <!-- end: #main -->
        <!-- begin: #footer -->
        <div id="footer">
                &copy;2010 L3S Research Center &bull; Appelstrasse 9a &bull; 30167 Hannover &bull;
        </div>
        <!-- end: #footer -->
</div>
```

Existing Approaches

- Machine Learning vs. Heuristics
- Site-specific Solutions
  (Rule-based Scraping, DOM, Text, Link Graph)
- Vision-based models
- Tokens, N-Grams
- Shallow Text Features
- Context

```
<h2>Hello World!</h2><p>This is a <a href="x">test</a>. <br>
```

Shallow Text Features

- Examine Document at Text Block Level
  - Numbers: Words, Tokens contained in block
  - Average Lengths: Tokens, Sentences
  - Ratios: Uppercased words, full stops
  - Classes: Block-level HTML tags <P>, <H*n*>, <DIV>
  - Densities: Link Density (Anchor Text Percentage), **Text Density**

Text Density

Kohlschütter/Nejdl [CIKM2008]
Kohlschütter [WWW2009]

Wrap text at a fixed line width (e.g. 80 chars)

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communities in all areas of the knowledge society,

$$\rho(b) = \frac{\text{\# tokens in b}}{\text{\# wrapped lines in b}}$$

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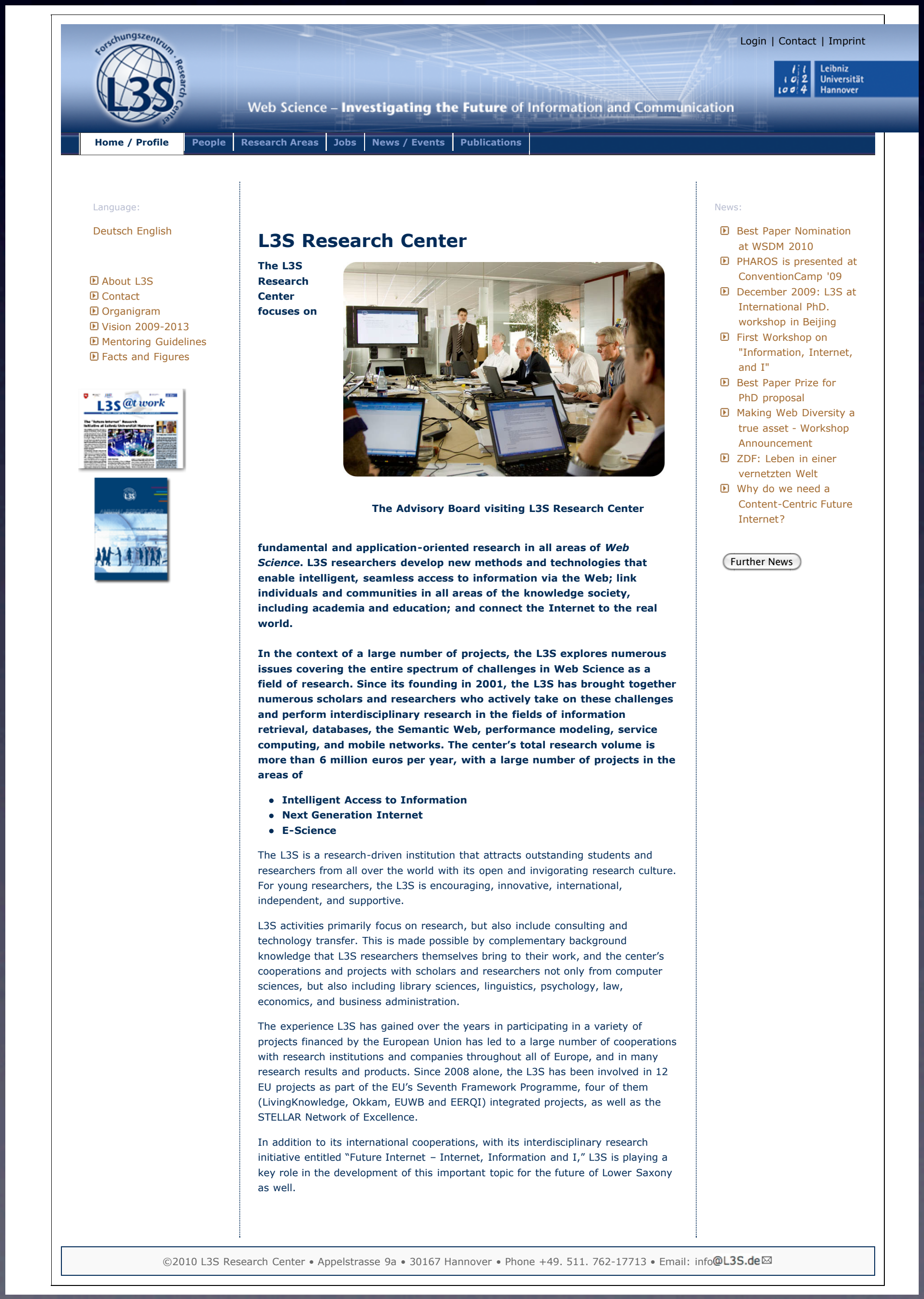

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Contextual Features

- Intra-Document:
  - Relative/Absolute Position of Block
  - Features of the previous/next block
- Inter-Document
  - Text Block Frequency

Experiments

1. Classification Accuracy?

   Decision Trees, SVM, 10-fold cross validation, F-Measure/ROC AuC, ...

2. Main Content Extraction

   Compare to BTE (Finn et al., 2001) and n-grams (Pasternack et al., 2009)
   In Paper also: Victor (Spousta et al., 2008), NCleaner (Evert, 2008)

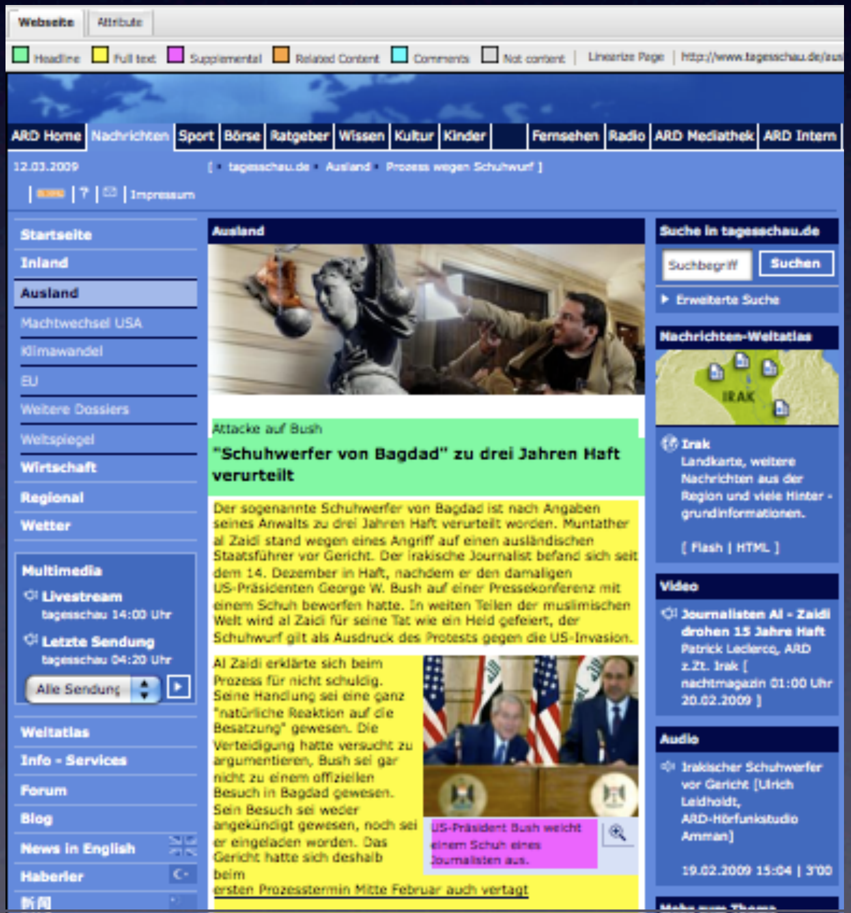
3. Ranking Improvement?

   Precision@10, NDCG@10

   50 top-k TREC-Queries for BLOGS06 (3M docs)

GoogleNews Dataset

- L3S-GN1
  621 news articles from 408 web sites, randomly sampled from a 254,000 pages crawl of English Google News over 4 months, manually assessed by L3S colleagues



Ausland

Attacke auf Bush

"Schuhwerfer von Bagdad" zu drei Jahren Haft verurteilt

Der sogenannte Schuhwerfer von Bagdad ist nach Angaben seines Anwalts zu drei Jahren Haft verurteilt worden. Muntather al Zaidi stand wegen eines Angriff auf einen ausländischen Staatsführer vor Gericht. Der irakische Journalist befand sich seit dem 14. Dezember in Haft, nachdem er den damaligen US-Präsidenten George W. Bush auf einer Pressekonferenz mit einem Schuh beworfen hatte. In weiten Teilen der muslimischen Welt wird al Zaidi für seine Tat wie ein Held gefeiert, der Schuhwurf gilt als Ausdruck des Protests gegen die US-Invasion.

Al Zaidi erklärte sich beim Prozess für nicht schuldig. Seine Handlung sei eine ganz "natürliche Reaktion auf die Besatzung" gewesen. Die Verteidigung hatte versucht zu argumentieren, Bush sei gar nicht zu einem offiziellen Besuch in Bagdad gewesen. Sein Besuch sei weder angekündigt gewesen, noch sei er eingeladen worden. Das Gericht hatte sich deshalb beim ersten Prozesstermin Mitte Februar auch vertagt

US-Präsident Bush weicht einem Schuh eines Journalisten aus.

Irak
Landkarte, weitere Nachrichten aus der Region und viele Hinter - grundinformationen.
[Flash | HTML]

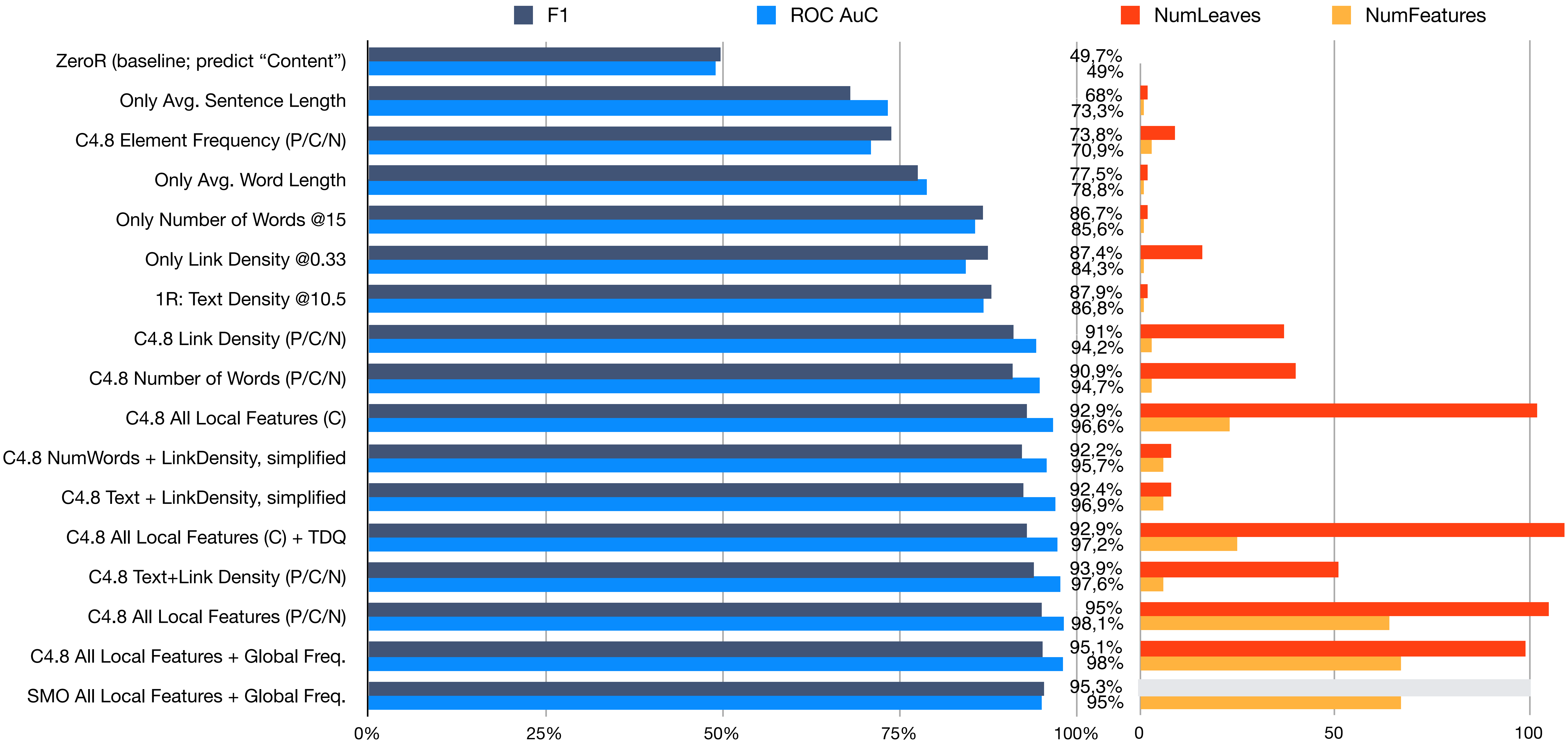
Journalisten Al - Zaidi drohen 15 Jahre Haft
Patrick Leclercq, ARD z.Zt. Irak [nachtmagazin 01:00 Uhr 20.02.2009]

Irakischer Schuhwerfer vor Gericht [Ulrich Leidholdt, ARD-Hörfunkstudio Amman]
19.02.2009 15:04 | 3'00

Class	# Blocks	# Words	# Tokens
Total	72662	520483	644021
Boilerplate	79%	35%	46%
Any Content	21%	65%	54%
Headline	1%	1%	1%
Article Full-text	12%	51%	42%
Supplemental	3%	3%	2%
User Comments	1%	1%	1%
Related Content	4%	9%	8%

Classification Accuracy

Block-Level (weighted by number of words)



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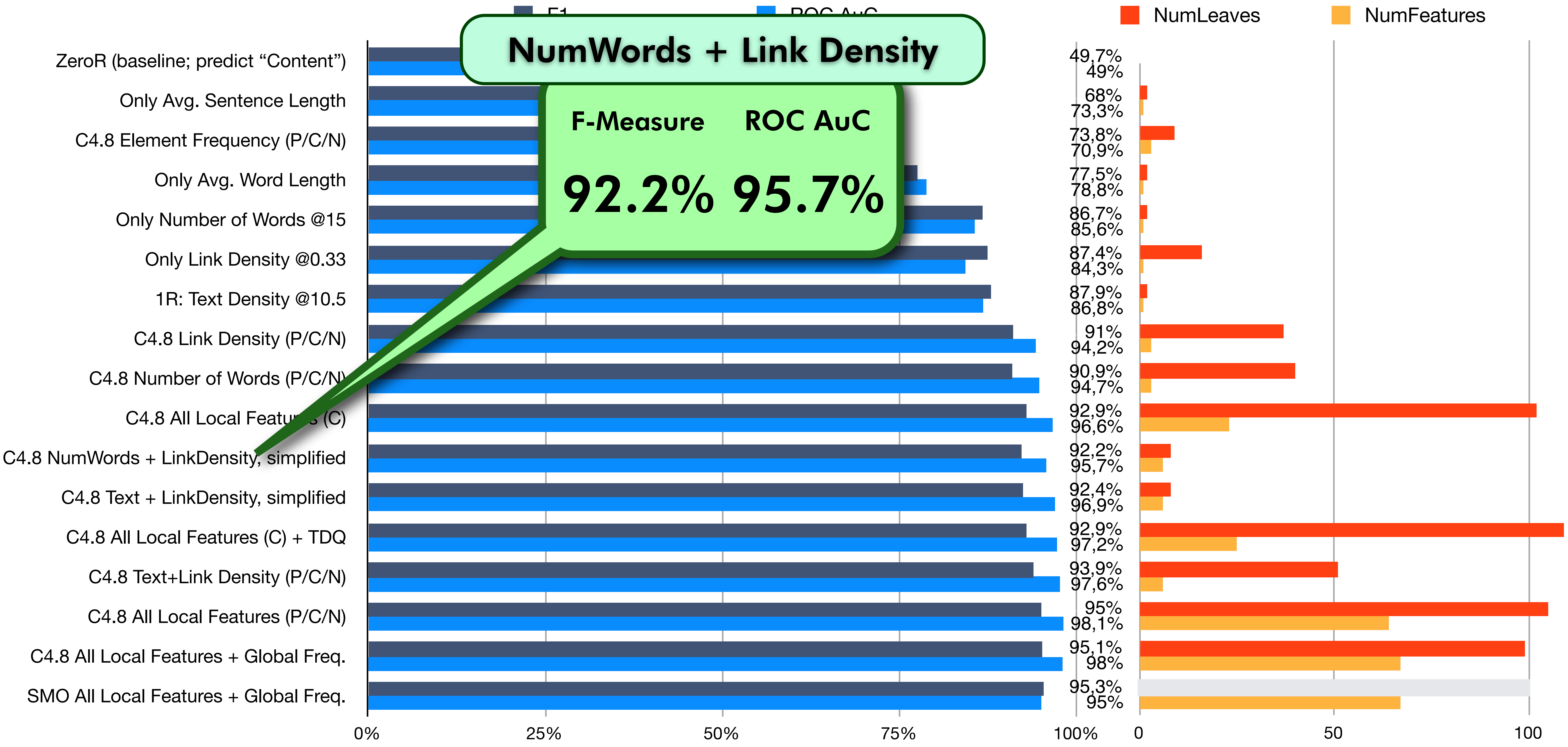


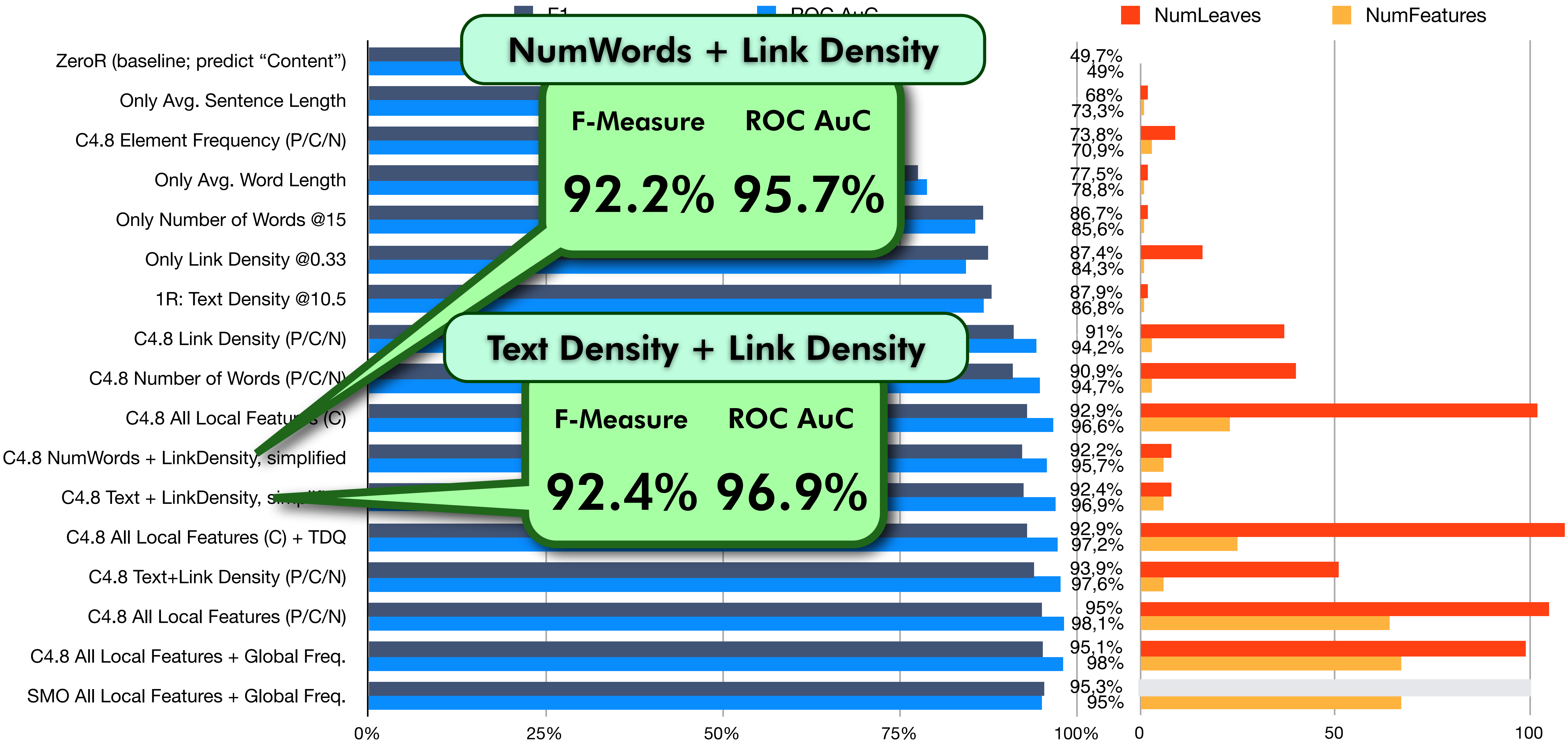
NumWords + Link Density

F-Measure ROC AuC

92.2% 95.7%

Classification Accuracy

Block-Level (weighted by number of words)



NumWords + Link Density

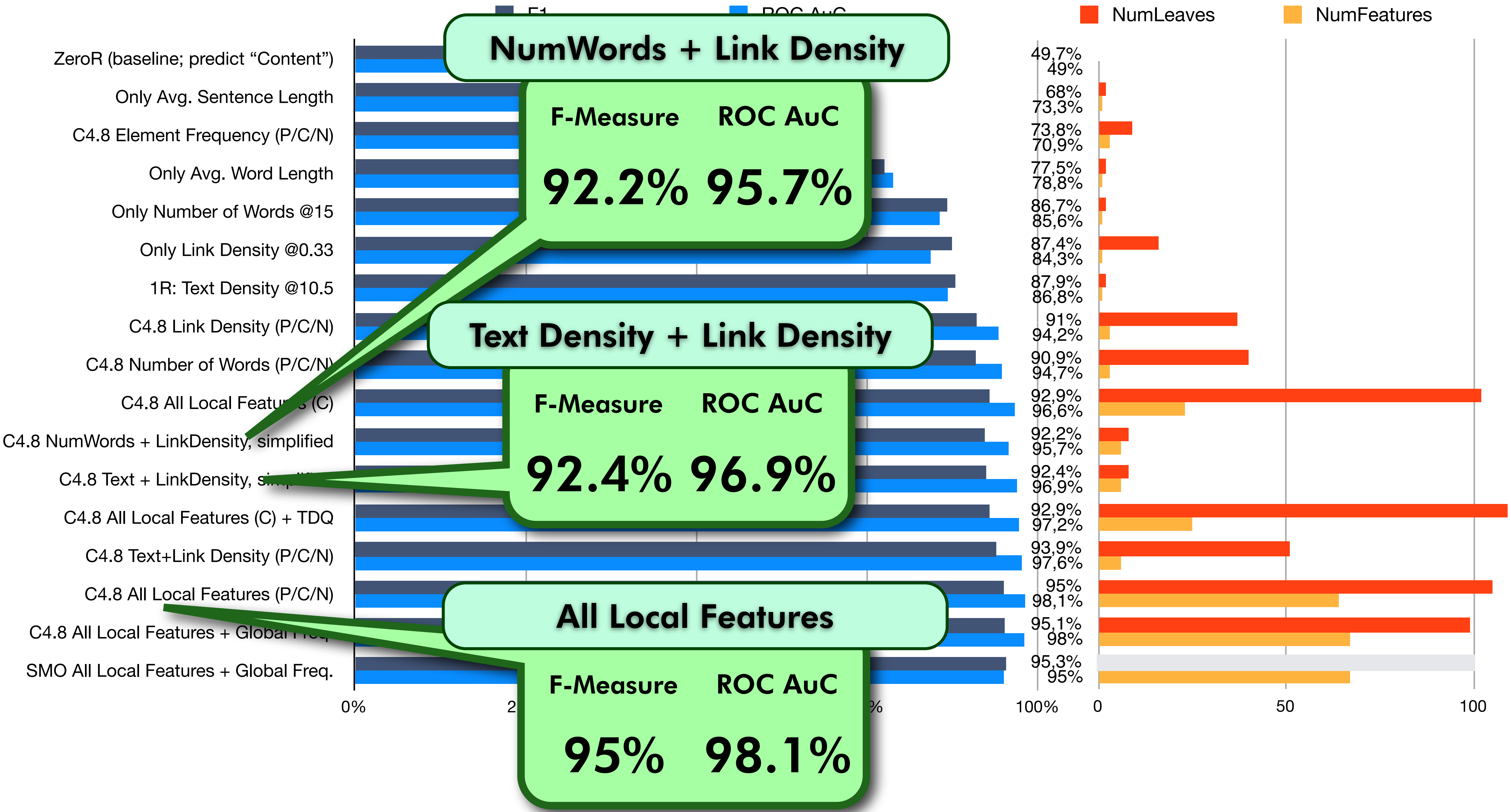
F-Measure	ROC AuC
92.2%	95.7%

Text Density + Link Density

F-Measure	ROC AuC
92.4%	96.9%

Classification Accuracy

Block-Level (weighted by number of words)



NumWords + Link Density

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Text Density + Link Density

F-Measure ROC AuC

92.4% 96.9%

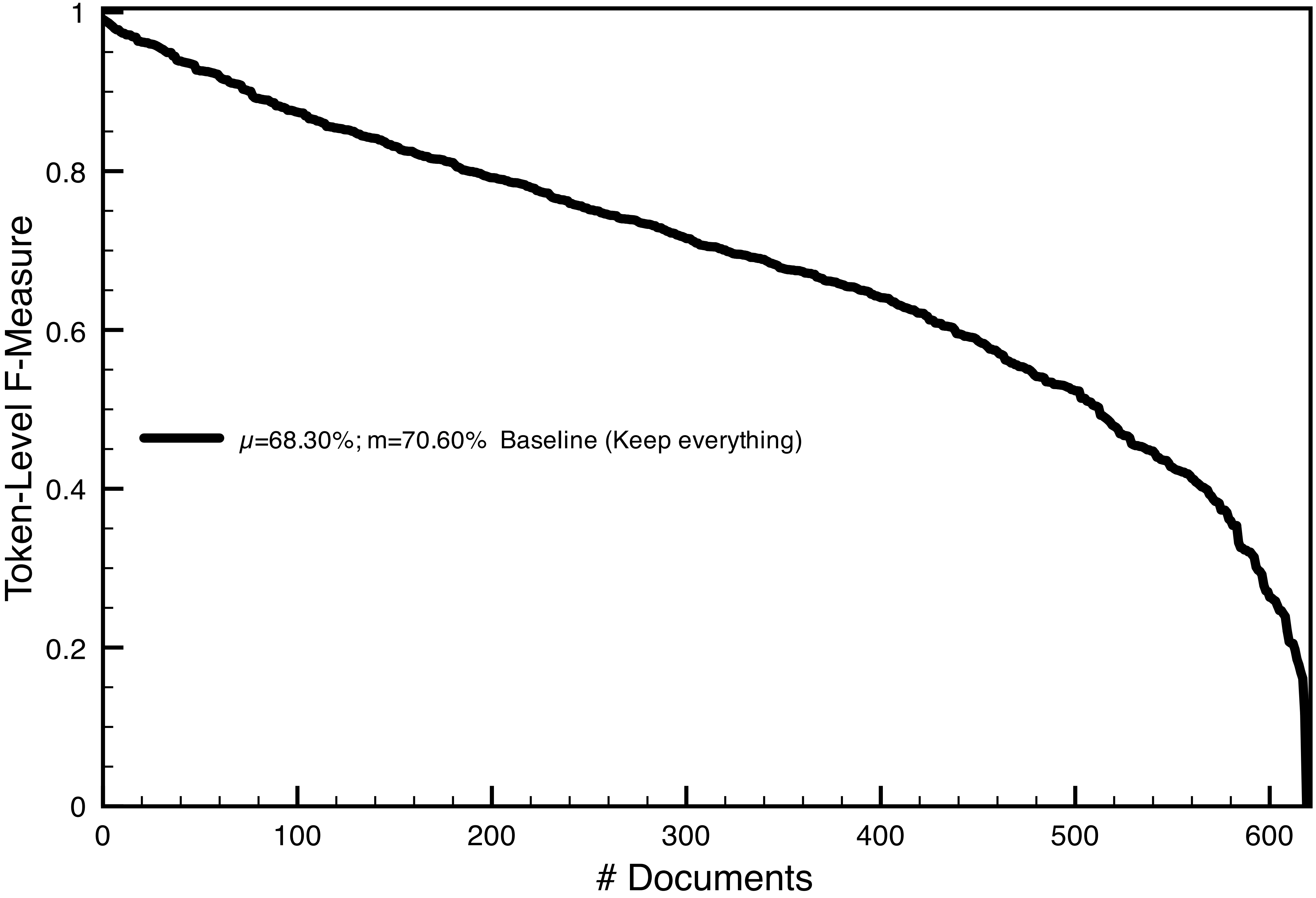
All Local Features

F-Measure ROC AuC

95% 98.1%

"Main Content" Extraction

"*Main Content*" *Extraction*



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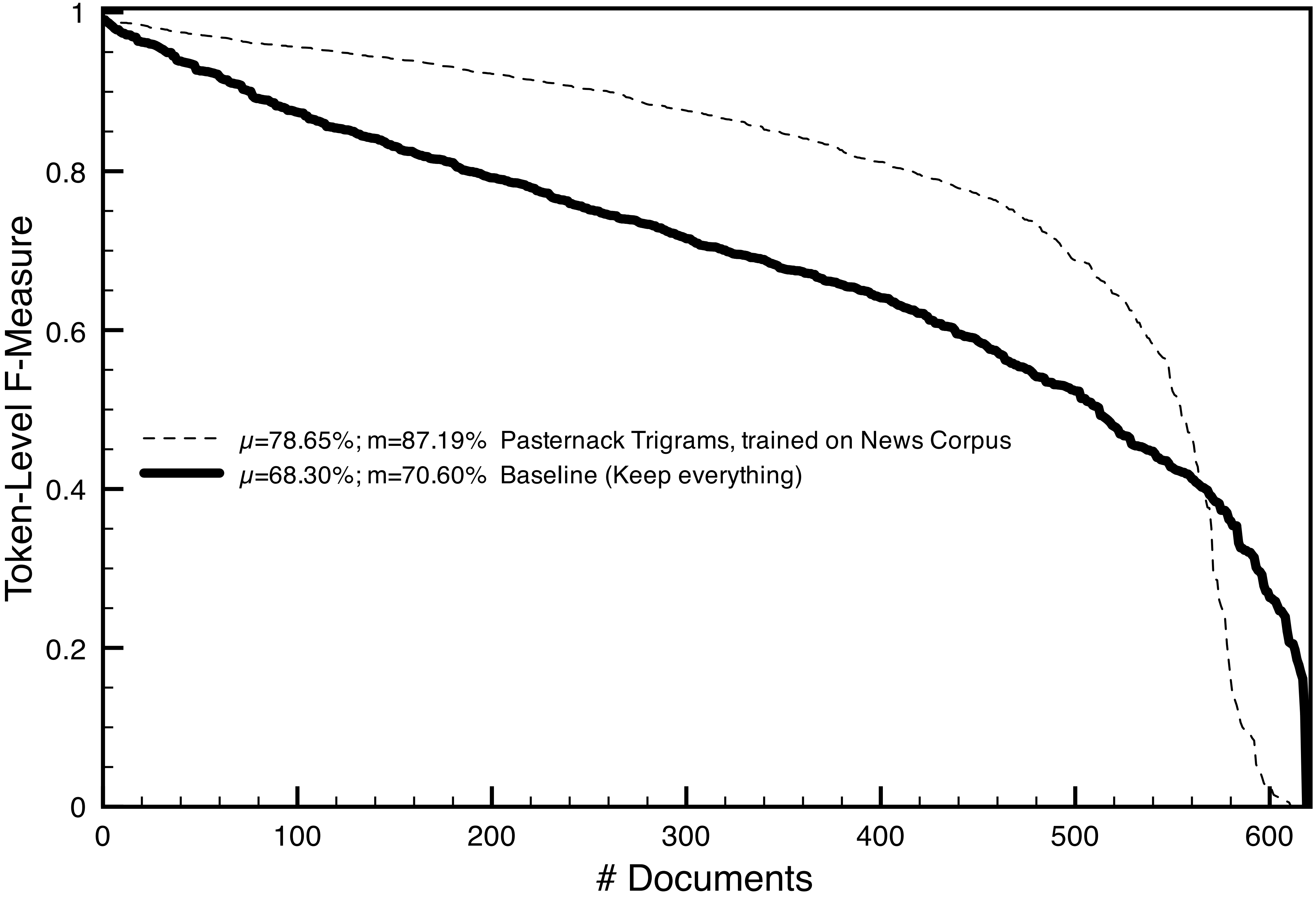

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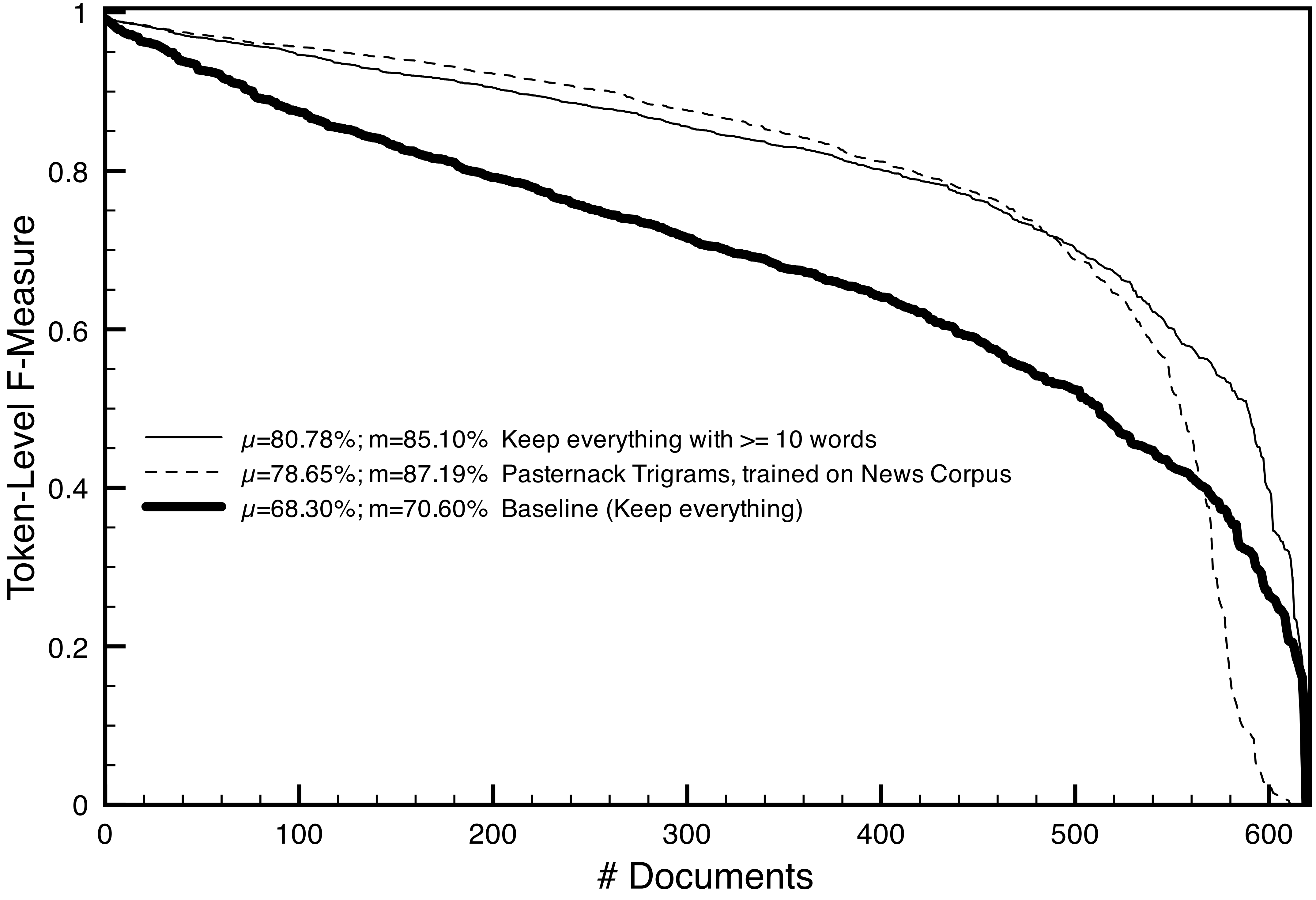

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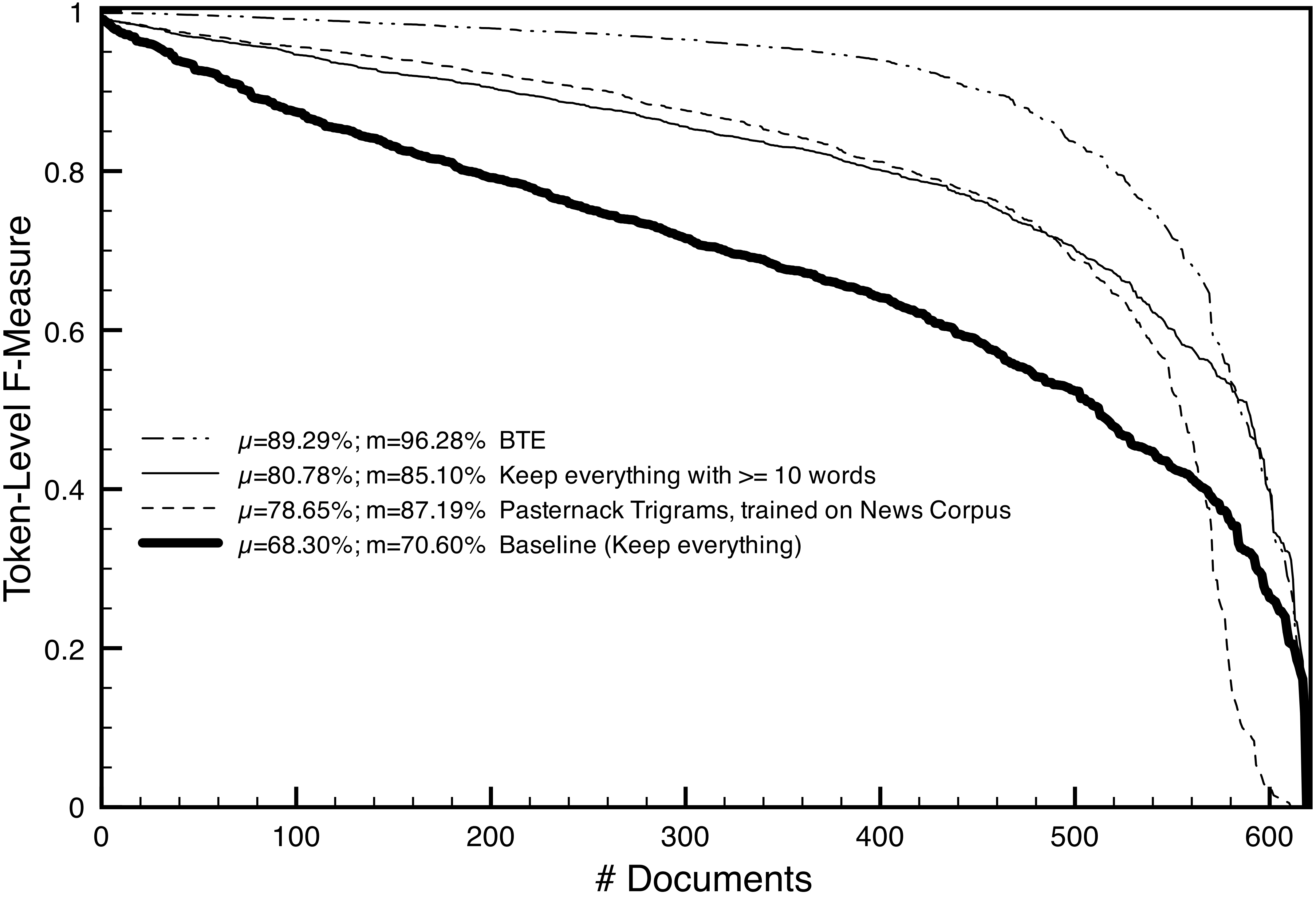

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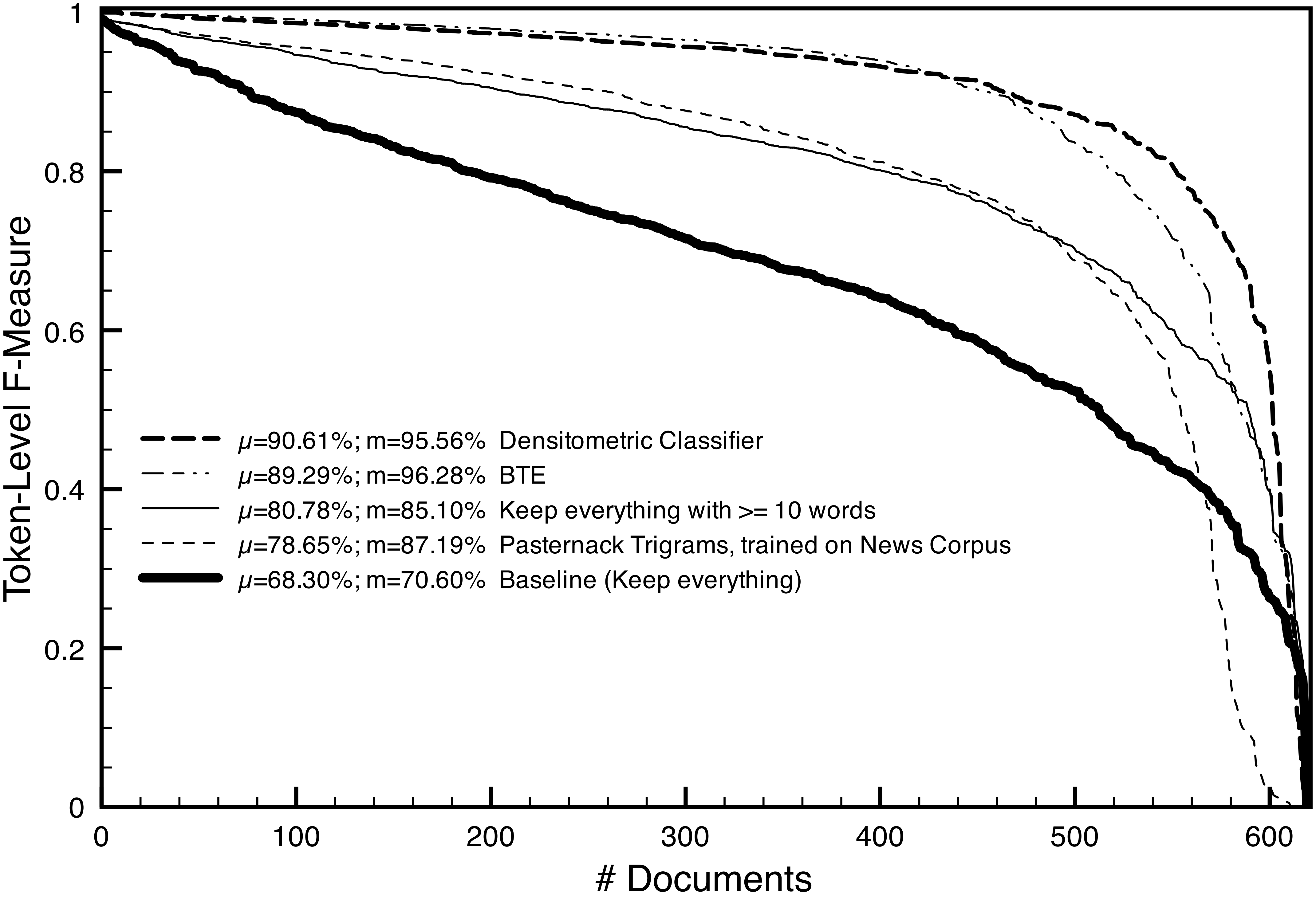

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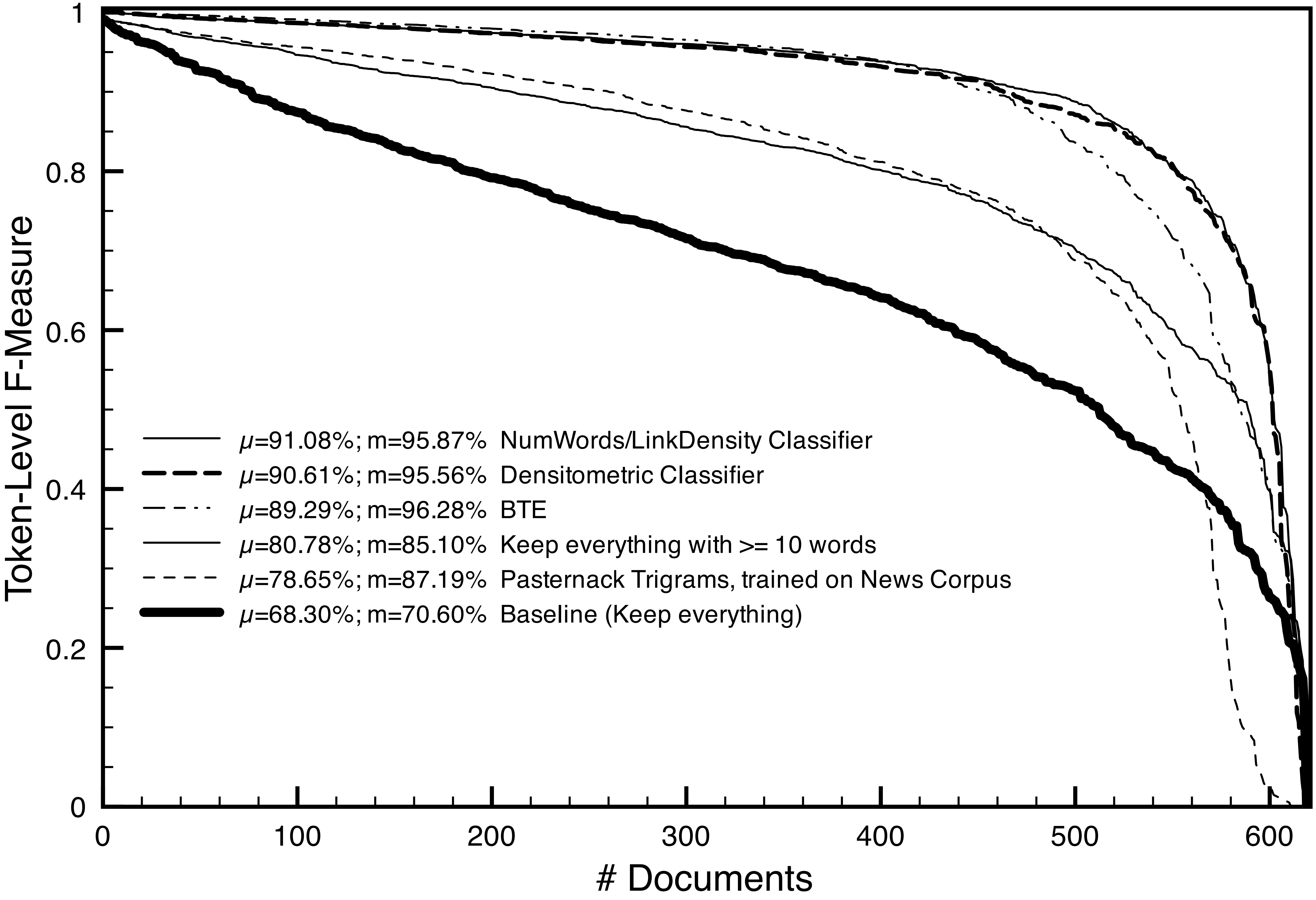

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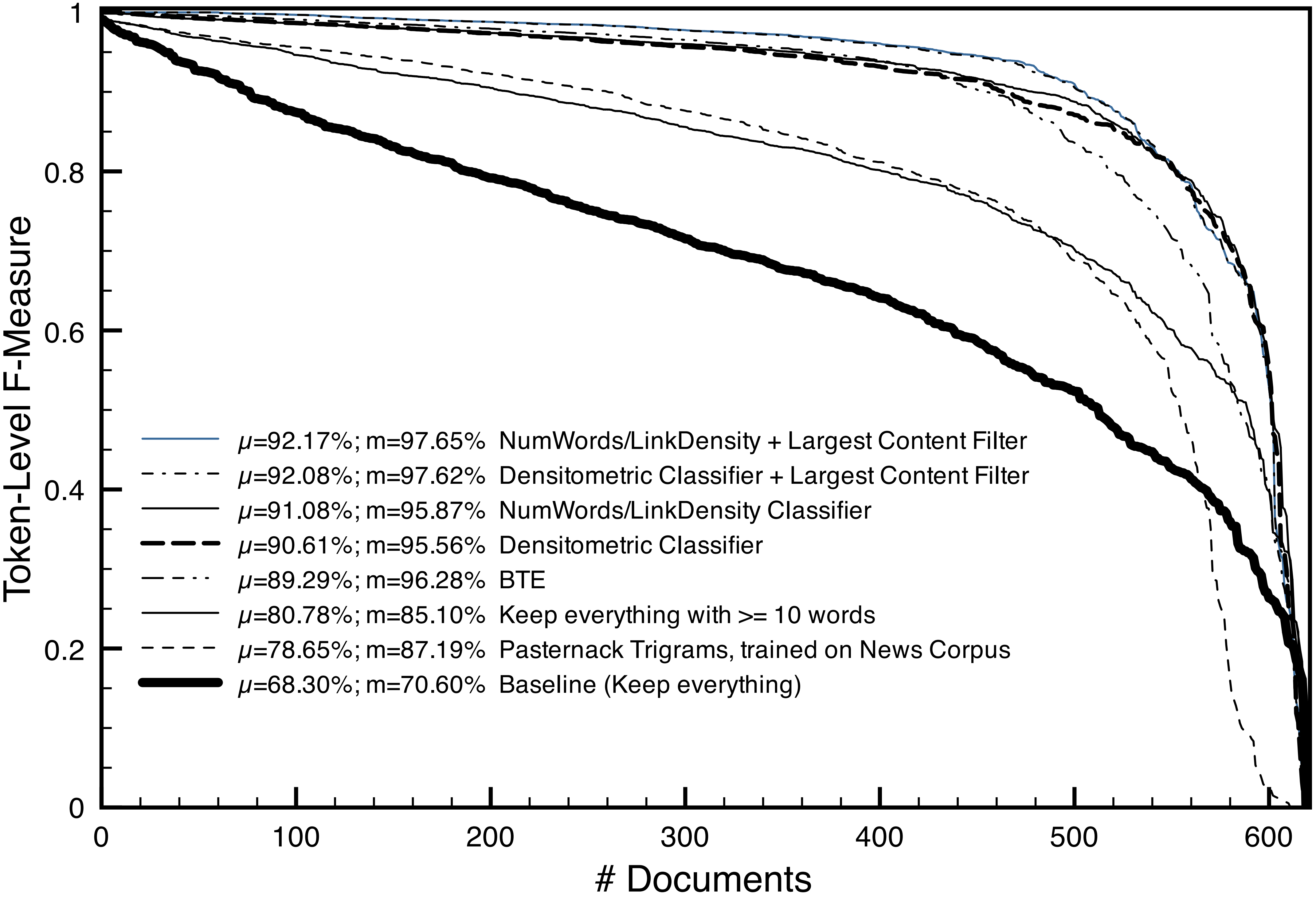

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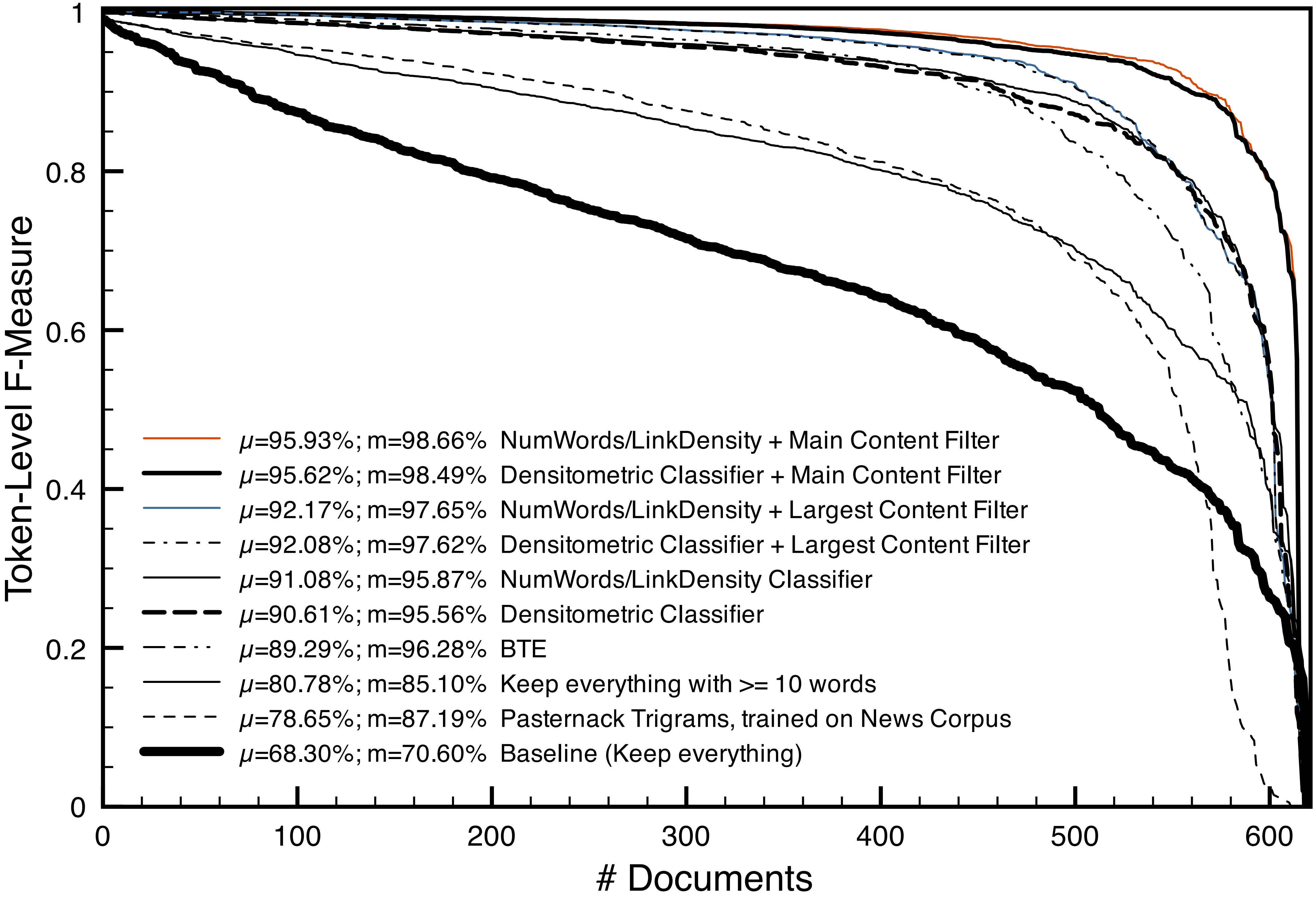
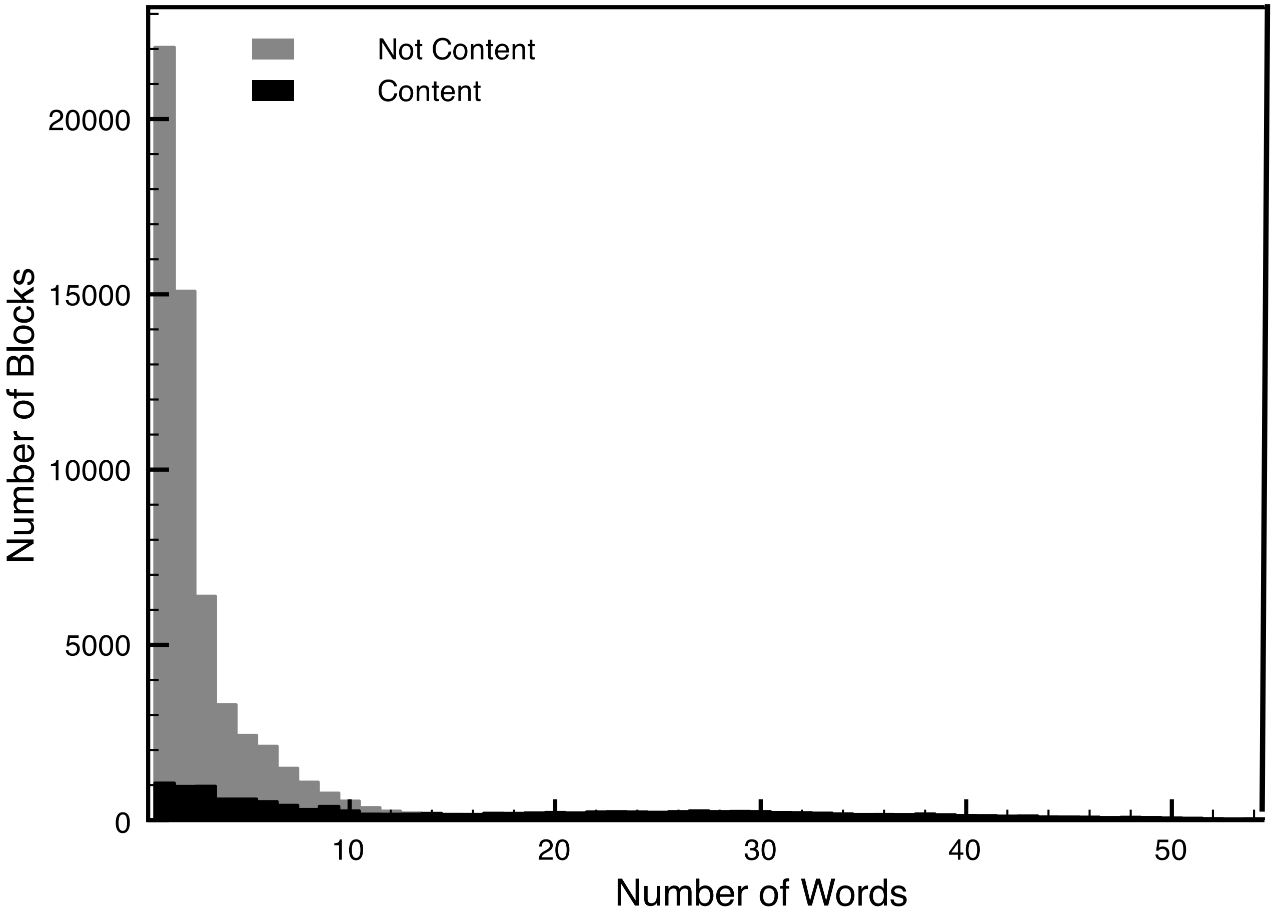
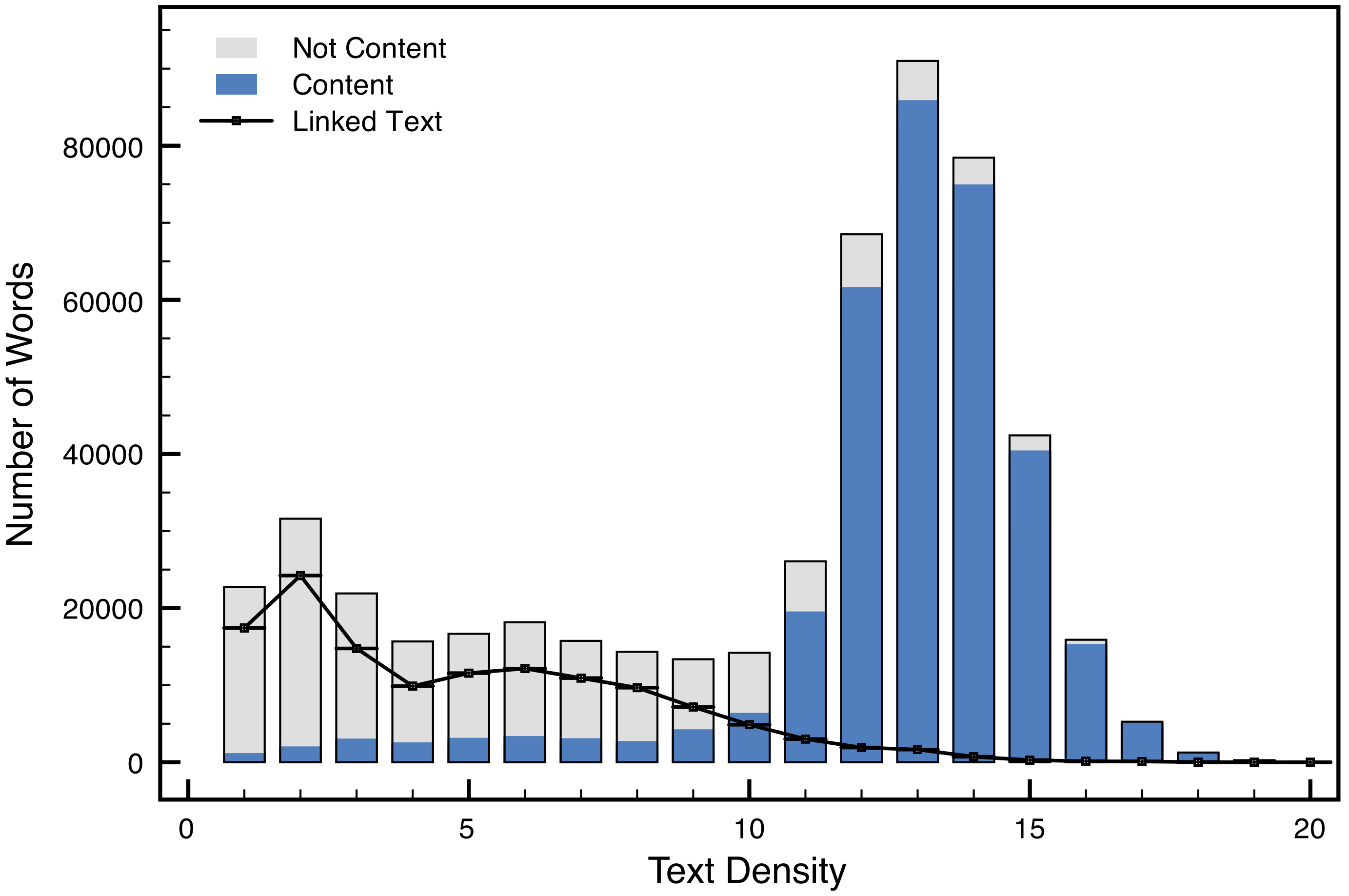


Number of Words



Text Density



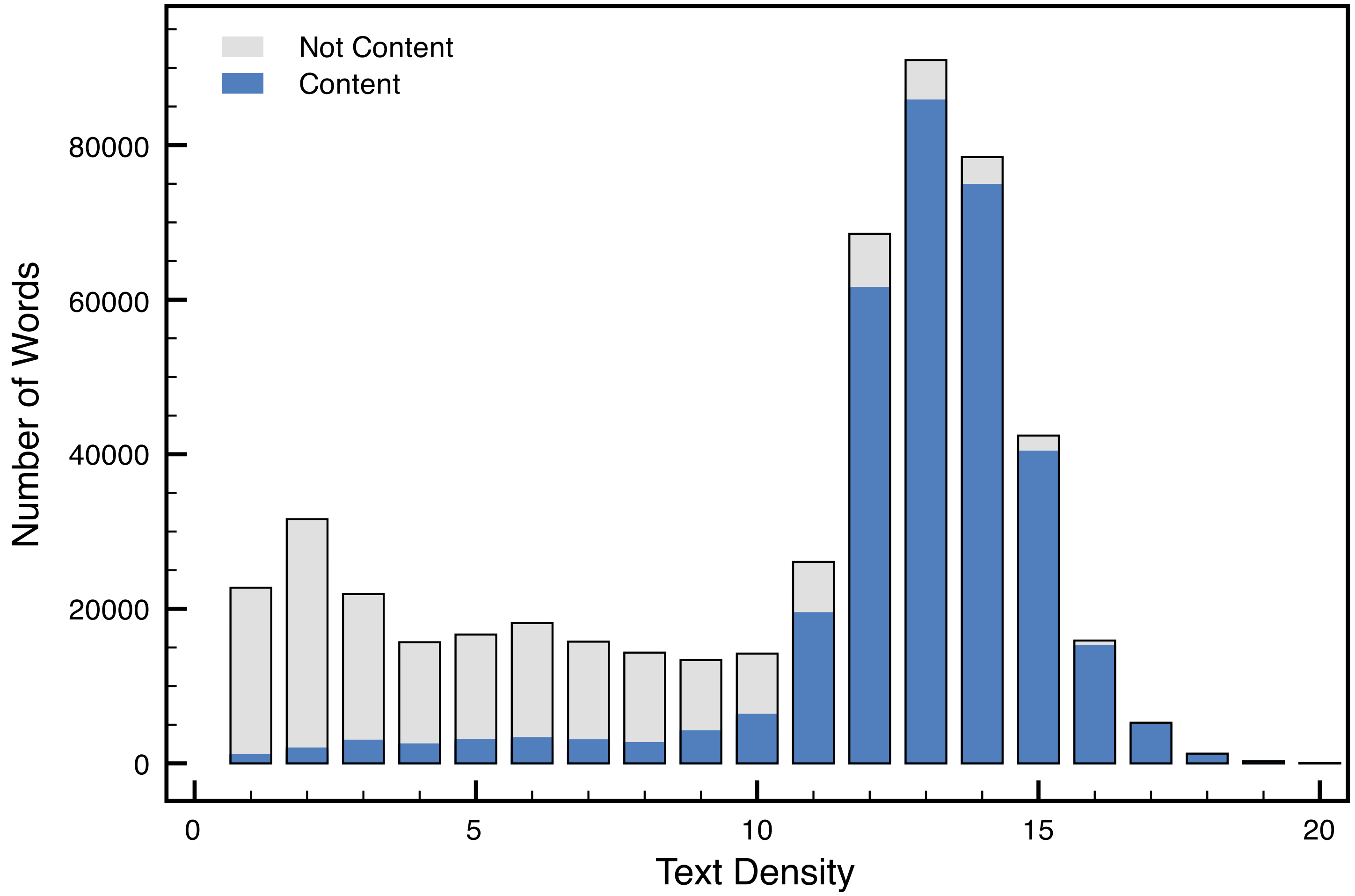
NumWords + Link Density

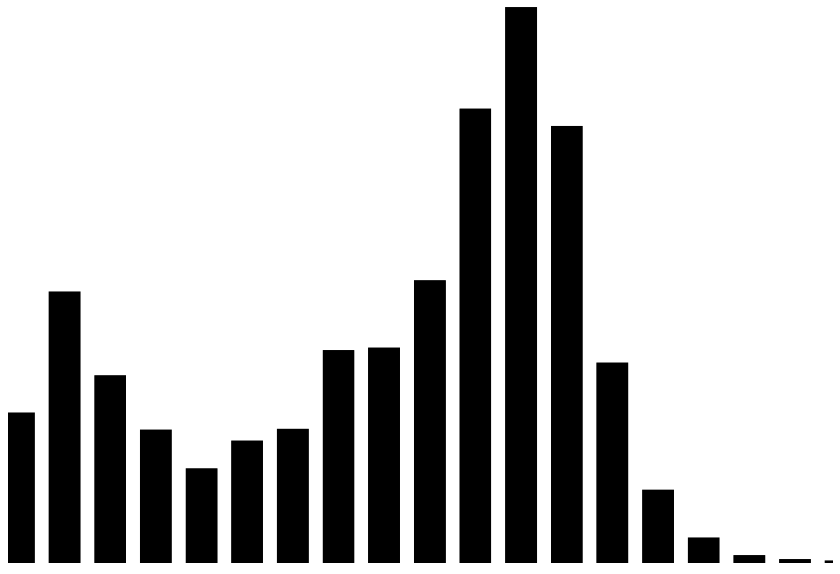
```
curr_linkDensity <= 0.333333
| prev_linkDensity <= 0.555556
| | curr_numWords <= 16
| | | next_numWords <= 15
| | | | prev_numWords <= 4: BOILERPLATE
| | | | prev_numWords > 4: CONTENT
| | | next_numWords > 15: CONTENT
| | curr_numWords > 16: CONTENT
| prev_linkDensity > 0.555556
| | curr_numWords <= 40
| | | next_numWords <= 17: BOILERPLATE
| | | next_numWords > 17: CONTENT
| | curr_numWords > 40: CONTENT
curr_linkDensity > 0.333333: BOILERPLATE
```

Text Density + Link Density

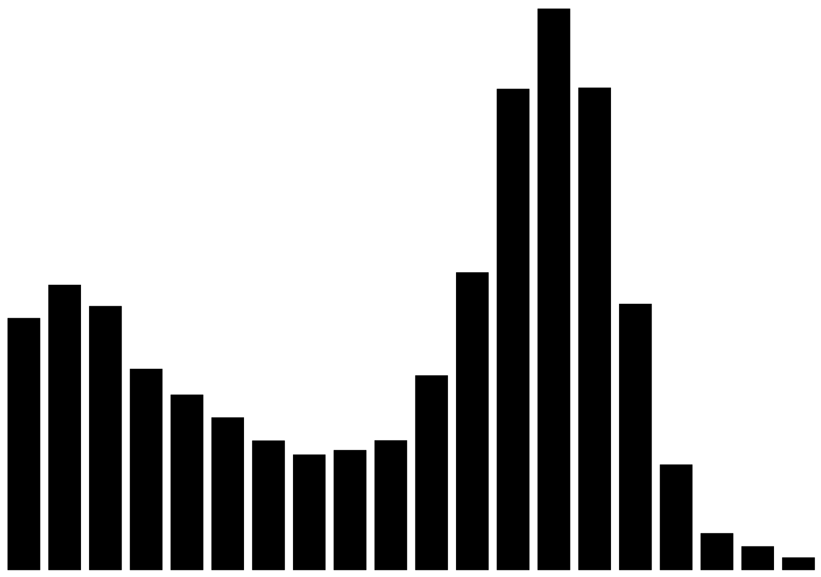
```
curr_linkDensity <= 0.333333
| prev_linkDensity <= 0.555556
| | curr_textDensity <= 9
| | | next_textDensity <= 10
| | | | prev_textDensity <= 4: BOILERPLATE
| | | | prev_textDensity > 4: CONTENT
| | | next_textDensity > 10: CONTENT
| | curr_textDensity > 9
| | | next_textDensity = 0: BOILERPLATE
| | | next_textDensity > 0: CONTENT
| prev_linkDensity > 0.555556
| | next_textDensity <= 11: BOILERPLATE
| | next_textDensity > 11: CONTENT
curr_linkDensity > 0.333333: BOILERPLATE
```

GoogleNews L3S-GN1

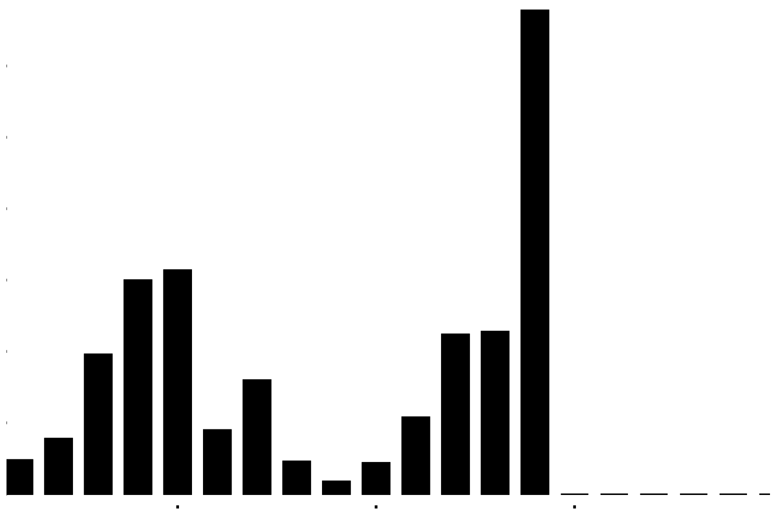




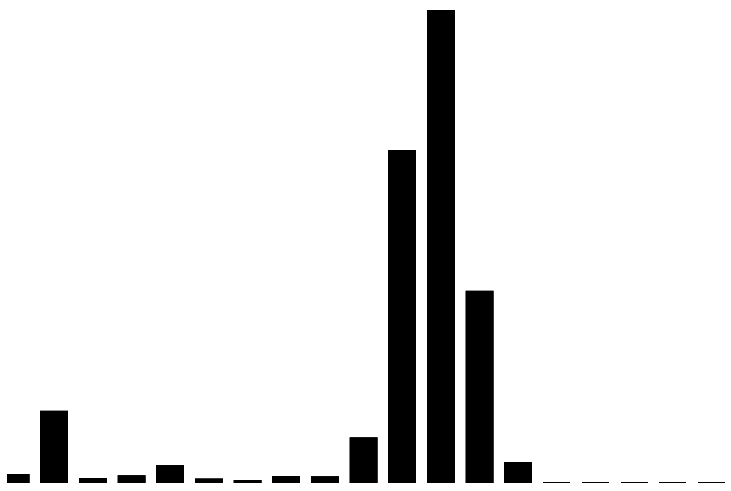
Webspam-UK 2007 Ham (356K)



BLOGS06 (3M)



Invidiual web page
About.com: New York City Travel

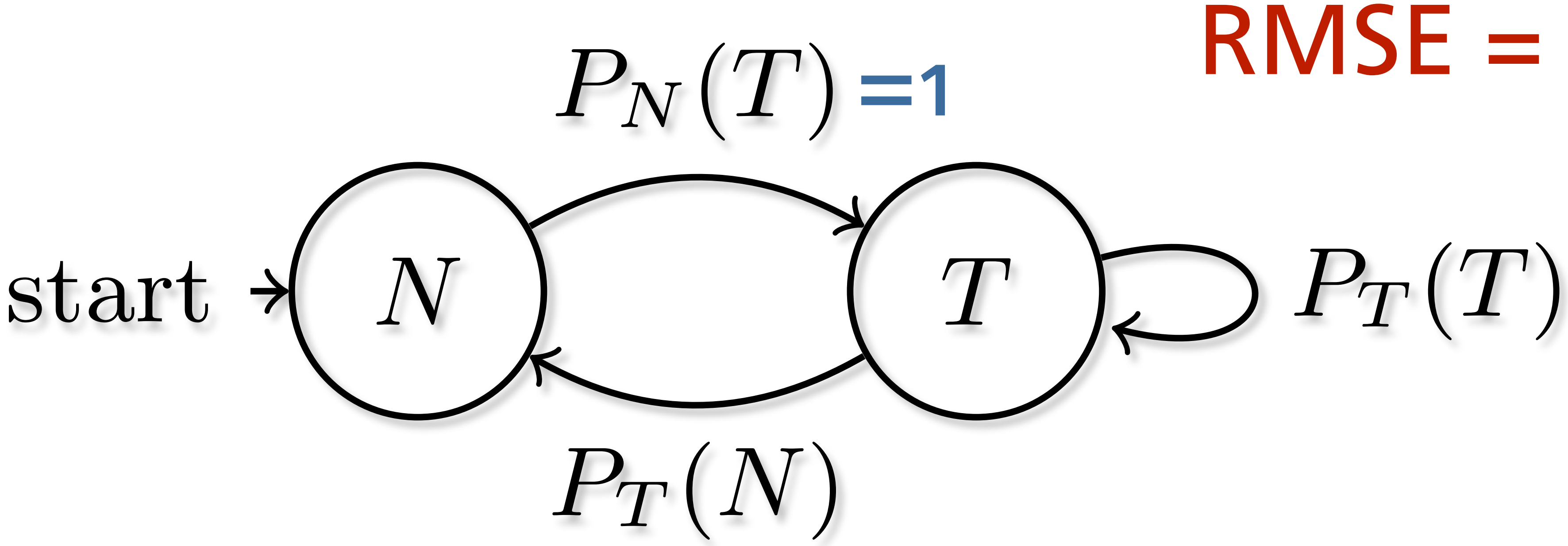


WSDM Paper
Kohlschütter, Fankhauser, Nejdl

Shannon Random Writer

R^2_{adj} = 96.7%

RMSE = 0.0046



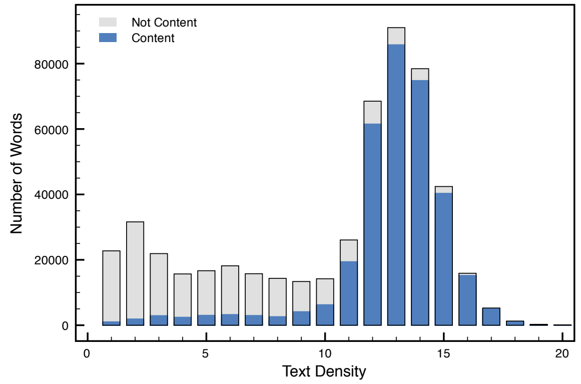
Bernoulli trial: Transition to next block is success p

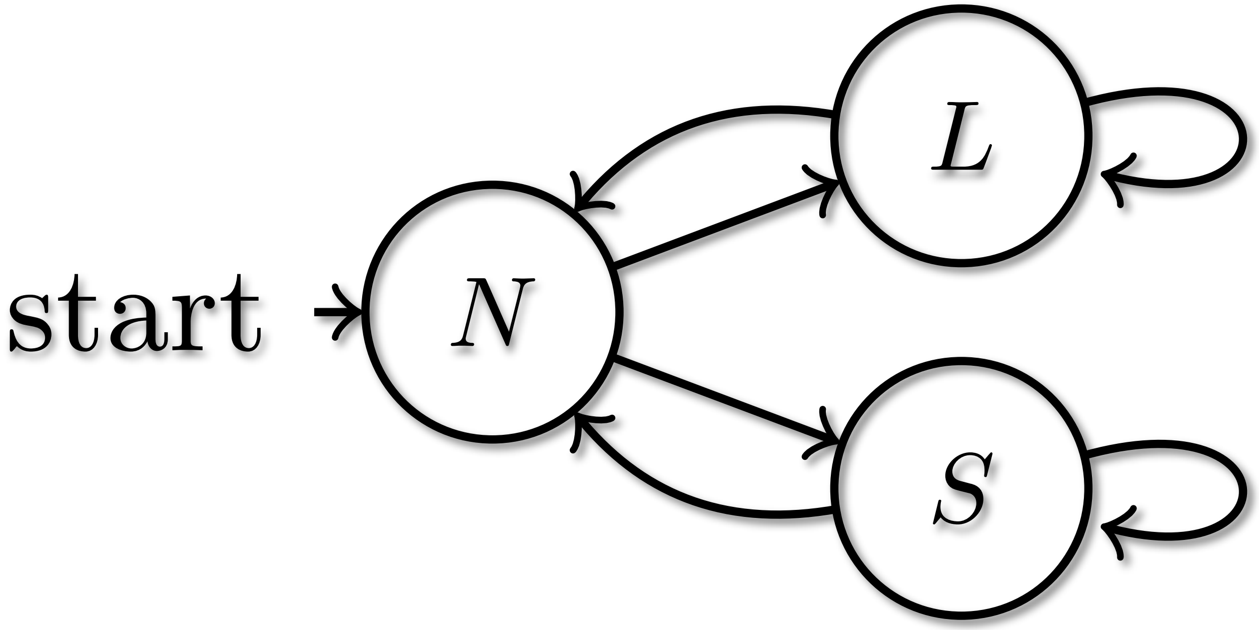
emission of another word is failure $1\text{-}p$

$$Pr(Y=k) = (1-p)^k p$$

$$Pr(Y=x) = (1-p)^{x-1} \cdot p = P_T(T)^{x-1} \cdot P_T(N)$$

Stratified Model





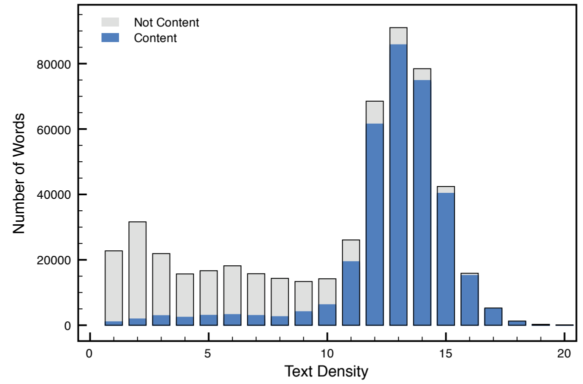
L = "Long Text"
S = "Short Text"

$$P_S(N) \gg P_L(N)$$

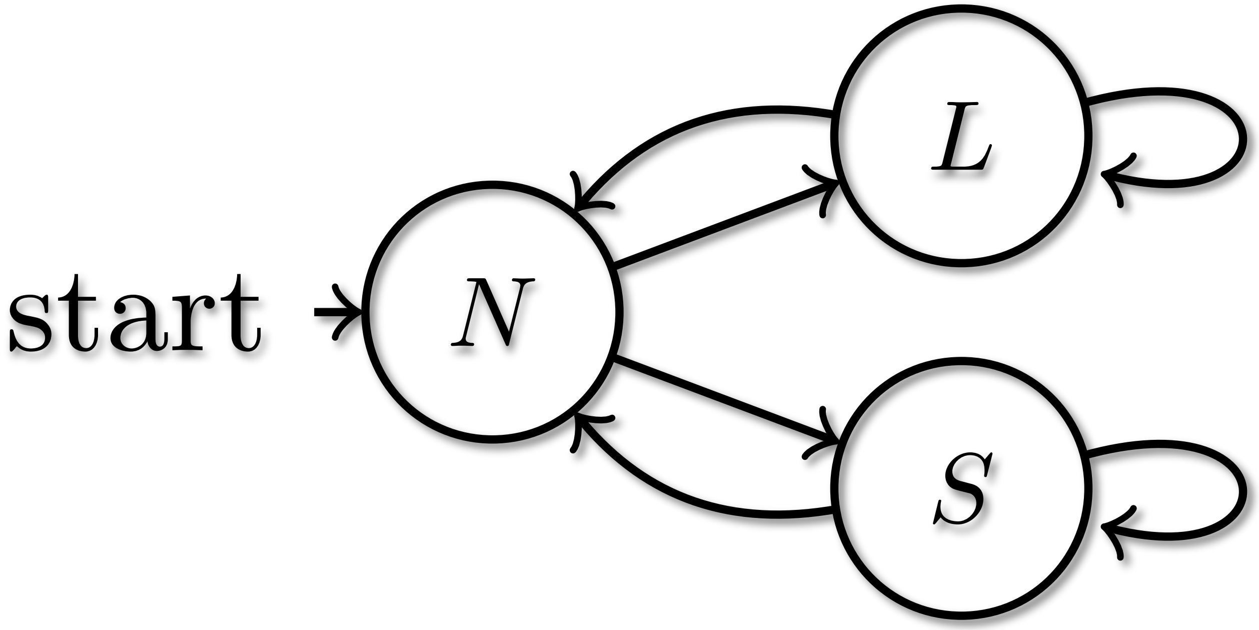
$$P_N(L) = 1 - P_N(S)$$

$$\begin{aligned} Pr(Y=x) = P_N(S)\cdot\left[P_S(S)^{x-1}\ \cdot\ P_S(N)\right]+ \\ +P_N(L)\cdot\left[P_L(L)^{x-1}\ \cdot\ P_L(N)\right] \end{aligned}$$

Stratified Model



R^2_{adj} = 98.8%
RMSE = 0.0027



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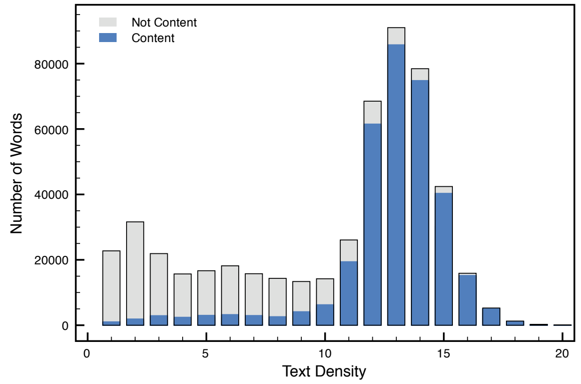
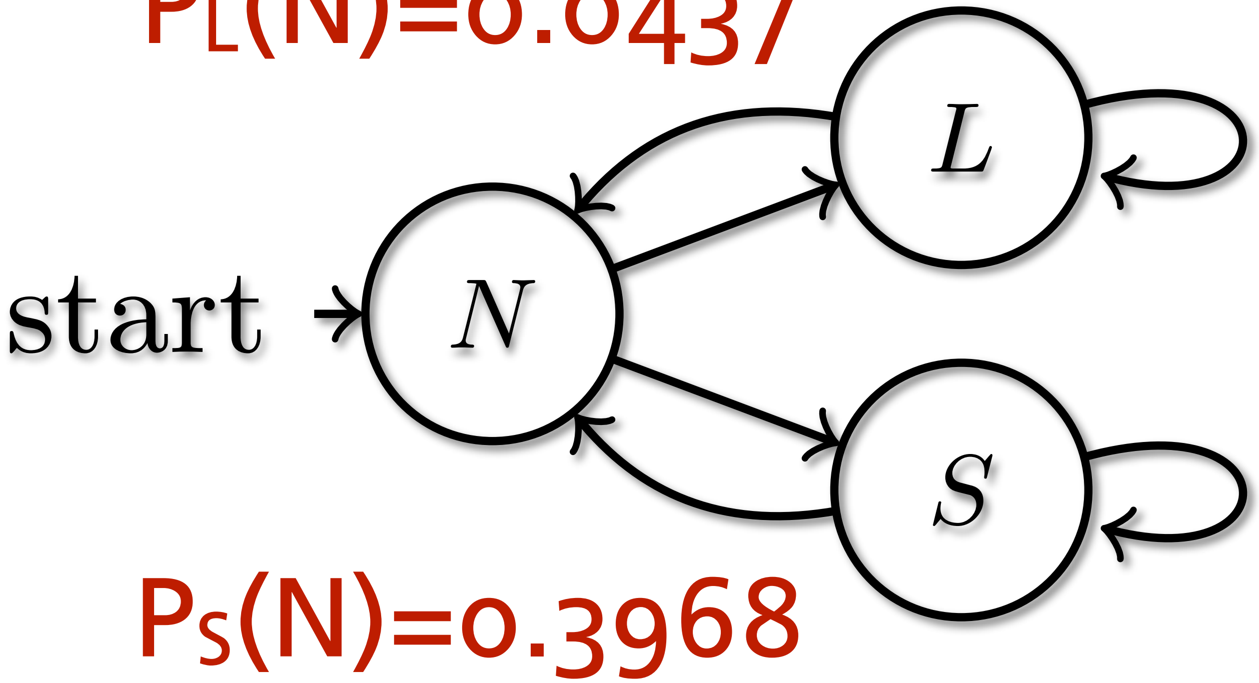
Stratified Model



1 + E = 1 + 1/p = 23.8

$P_L(N)$=0.0437



$P_S(N)$=0.3968

1 + E = 1 + 1/p = 3.52

R^2_{adj} = 98.8%

RMSE = 0.0027

L = "Long Text"

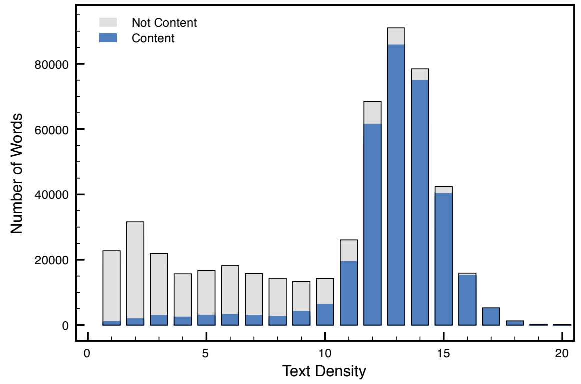
S = "Short Text"

$$P_S(N) \gg P_L(N)$$

$$P_N(L) = 1 - P_N(S)$$

$$Pr(Y = x) = P_N(S) \cdot \left[P_S(S)^{x-1} \cdot P_S(N)\right] + \\ + P_N(L) \cdot \left[P_L(L)^{x-1} \cdot P_L(N)\right]$$

Stratified Model



$1 + E = 1 + 1/p = 23.8$

$P_L(N)=0.0437$

$R^2_{adj} = 98.8\%$

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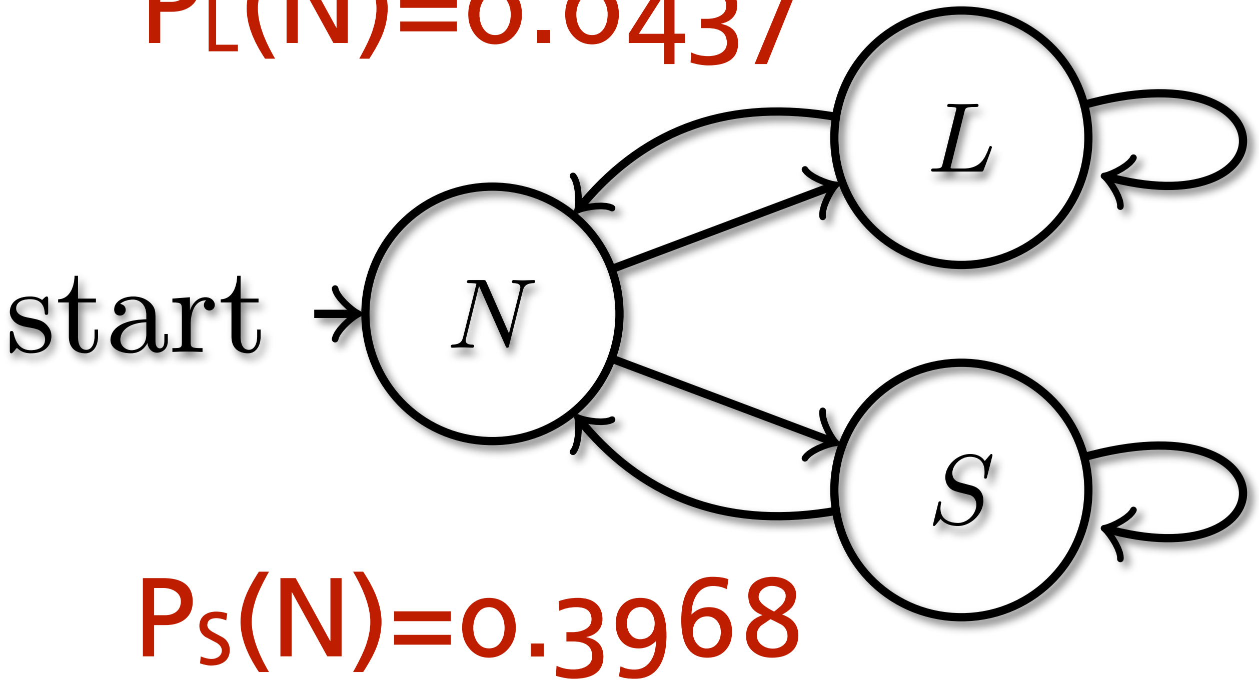


L = "Long Text"

S = "Short Text"

$$P_S(N) \gg P_L(N)$$

$$P_N(L) = 1 - P_N(S)$$

$P_S(N)=0.3968$

$1 + E = 1 + 1/p = 3.52$

$P_N(S)=76\%$

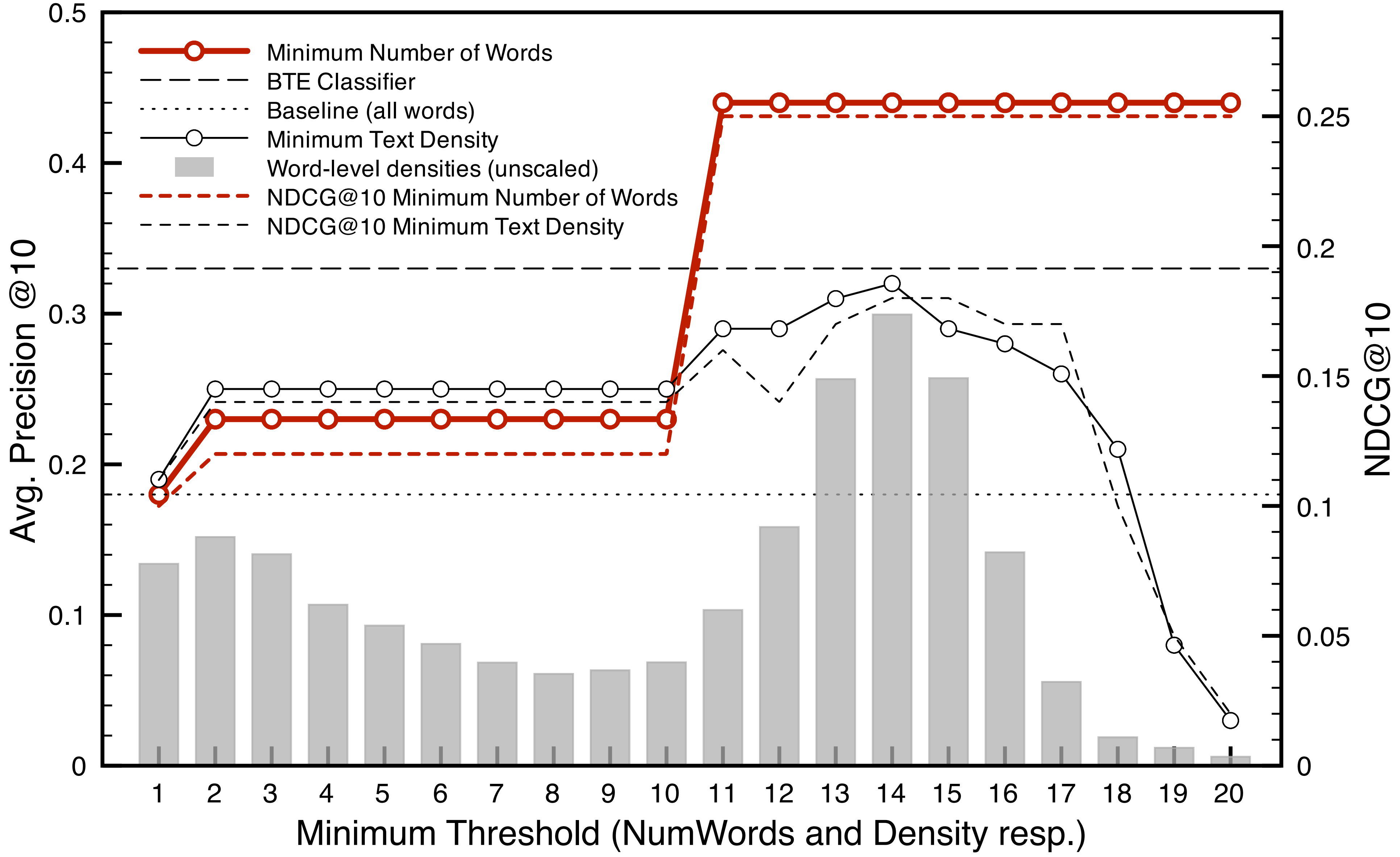
GoogleNews assessment:
79% of blocks were boilerplate

$$Pr(Y = x) = P_N(S) \cdot \left[P_S(S)^{x-1} \cdot P_S(N)\right] + \\ + P_N(L) \cdot \left[P_L(L)^{x-1} \cdot P_L(N)\right]$$

Retrieval Experiment

Baseline: P@10=0.18; NDCG@10=0.0985

BTE: P@10=0.33; NDCG@10=0.1627



50 top-k TREC queries on BLOGS06 dataset (~3M docs)

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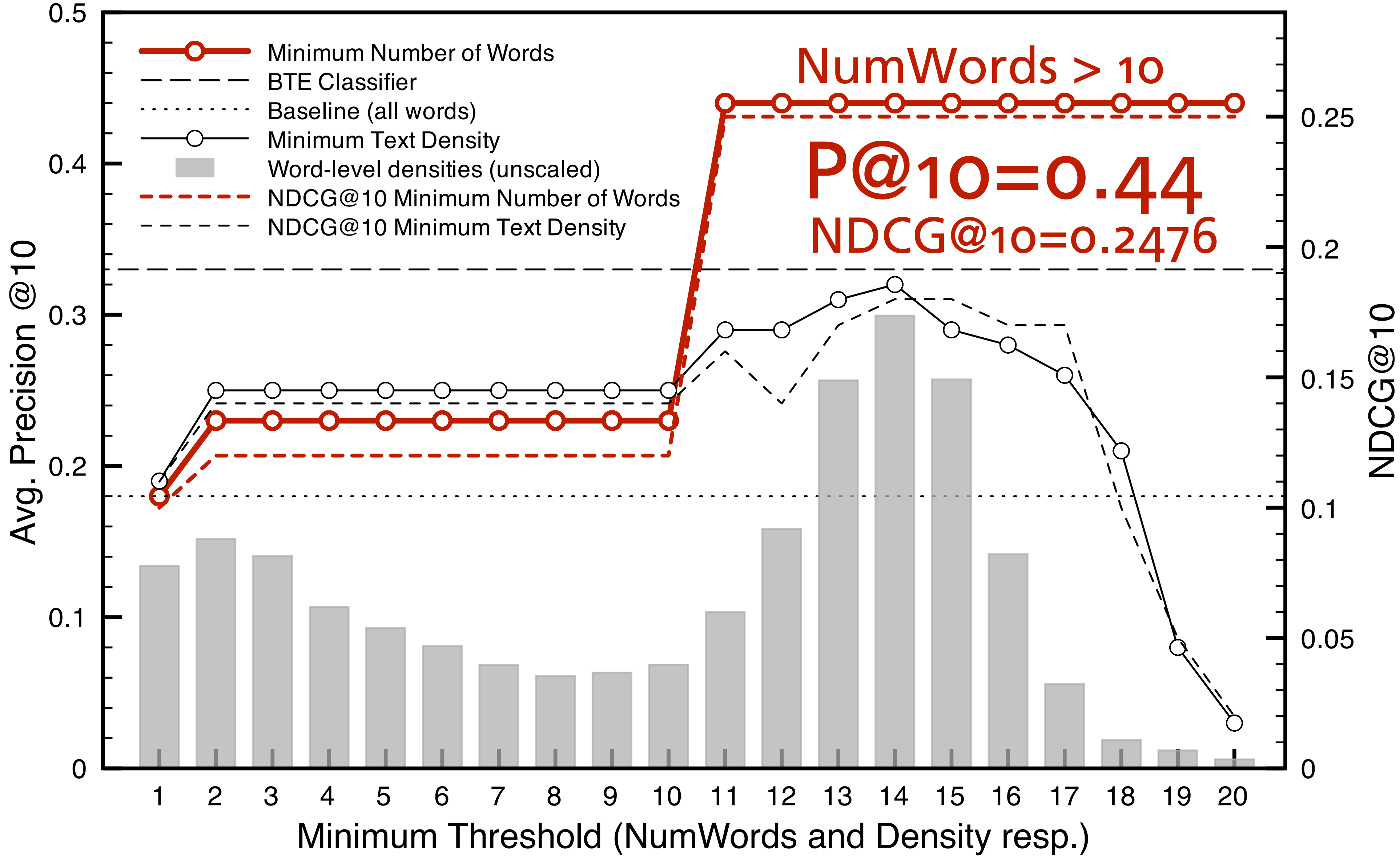
Baseline: P@10=0.18; NDCG@10=0.0985

BTE: P@10=0.33; NDCG@10=0.1627



NumWords > 10

P@10=0.44

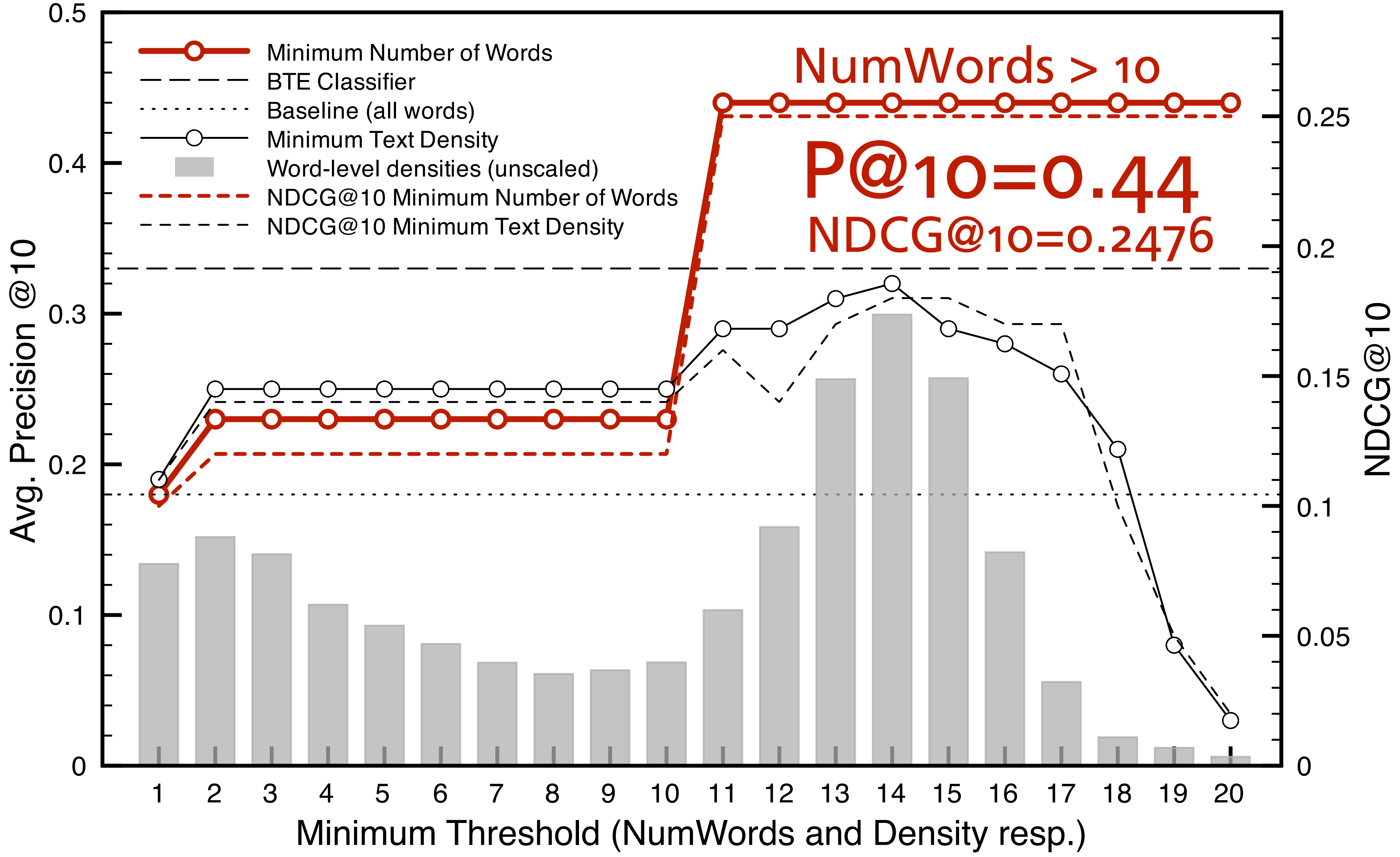
NDCG@10=0.2476

50 top-k TREC queries on BLOGS06 dataset (~3M docs)

Retrieval Experiment

Improvement over Baseline: 144%/151% P@10=0.18; NDCG@10=0.0985

Improvement over BTE: 33%/ 52% P@10=0.33; NDCG@10=0.1627



50 top-k TREC queries on BLOGS06 dataset (~3M docs)

Conclusions

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- Very high Classification/Extraction Accuracy (92-98%) at almost no cost
- Increase of Retrieval Precision (33%-151%) at almost no cost

Next Steps

- Multi-Lingual, Multi-Domain Corpora
- Further explore the relationship to Quantitative Linguistics
- Model Linking Behavior
- Use it, for free (Apache 2.0 License) http://boilerpipe.googlecode.com

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