Index

Absolute discounting, 130	Art retrieval models, 111
Abstractive text summarization, 318, 321–	Aspect opinion analysis, 325–326
324	Associations, word. See Word association
Access modes, 73–76	mining
Accuracy in search engine evaluation, 168	Authority pages in web searches, 202, 207
Ad hoc information needs, 8–9	Automatic evaluation in text clustering, 294
Ad hoc retrieval, 75–76	AVA (all-vs-all) method, 313
Add-1 smoothing, 130, 464	Average-link document clustering, 282
Adjacency matrices, 207–208	Average precision
Advertising, opinion mining for, 393	ranked lists evaluation, 175, 177–180
Agglomerative clustering, 277, 280–282, 290	search engine evaluation, 184
Aggregating	Axiomatic thinking, 88
opinions, 393	
scores, 234	Background models
All-vs-all (AVA) method, 313	mining topics from text, 345-351
Ambiguity	mixture model estimation, 351-353
full structure parsing, 43	PLSA, 370-372
LARA, 406	Background words
NLP, 40-41, 44	mixture models, 141, 351-353
one-vs-all method, 313	PLSA, 368-369, 372
text retrieval vs. database retrieval, 80	Bag-of-words
topics, 335, 337	frequency analysis, 69
Analyzers in MeTA toolkit, 61–64, 453	paradigmatic relations, 256
analyzers::filters namespace, 64	text information systems, 10
analyzers::tokenizers namespace, 64	text representation, 88-90
Anaphora resolution in natural language	vector space model, 93, 109
processing, 41	web searches, 215
Anchor text in web searches, 201	Bar-Hillel report, 42
Architecture	Baseline accuracy in text categorization, 314
GFS, 194-195	Bayes, Thomas, 25
META toolkit, 60–61	Bayes' rule
unified systems, 452–453	EM algorithm, 361-363, 373-374

Bayes' rule (continued)	Bitwise compression, 159–160
formula, 25–26	Blind feedback, 133, 135
LDA, 383	Block compression, 161–162
Bayesian inference	Block world project, 42
EM algorithm, 361–362	BM25 model
PLSA, 379, 382	description, 88
Bayesian parameter estimation	document clustering, 279
formula, 458	document length normalization, 108-109
overfitting problem, 28–30	link analysis, 201
unigram language model, 341, 359	Okapi, 89, 108
Bayesian smoothing, 125	popularity, 90
Bayesian statistics	probabilistic retrieval models, 111
binomial estimation and beta distribu-	BM25-F model, 109
tion, 457-459	BM25 score
Dirichlet distribution, 461-463	paradigmatic relations, 258–261
LDA, 382	syntagmatic relations, 270
multinomial distribution, 460-461	web search ranking, 210
multinomial parameters, 463-464	BM25 TF transformation
Naive Bayes algorithm, 309–312	description, 104-105
pseudo counts, smoothing, and setting	paradigmatic relations, 258–259
hyperparameters, 459–460	BM25+ model, 88, 110
Berkeley study, 3	Breadth-first crawler searches, 193
Bernoulli distribution, 26	Breakeven point precision, 189
Beta distribution, 457-459	Brown clustering, 278, 288–291
Beta-gamma threshold learning, 227-228	Browsing
Bias, clustering, 276	multimode interactive access, 76-78
Big text data, 5-6	pull access mode, 73-75
Bigram language model	support for, 445
abstractive summarization, 323	text information systems, 9
Brown clustering, 290	web searches, 214
Bigrams	word associations, 252
frequency analysis, 68	Business intelligence
sentiment classification, 394-395	opinion mining, 393
text categorization, 305	text data analysis, 243
words tokenizers, 149	
Binary classification	C++ language, 16, 58
content-based recommendation, 223	Caching
text categorization, 303	DBLRU, 164-165
Binary hidden variables in EM algorithm,	LRU, 163-164
362–364, 366, 368, 467	MeTA toolkit, 60
Binary logistic regression, 397	search engine implementation, 148,
Binomial distribution, 26-27	162-165
Binomial estimation, 457-459	Categories
Bit vector representation, 93-97	categorical distributions, 460–461

sentiment classification, 394, 396–397	vector space retrieval models, 99, 109
text information systems, 11–12	Compact clusters, 281
Causal topic mining, 433–437	Compare operator, 450, 452
Centroid vectors, 136–137	Complete data for EM algorithm, 467–468
Centroids in document clustering, 282–284	Complete data for EM algorithm, 467–468 Complete-link document clustering, 281–
CG (cumulative gain) in NDCG, 181–182	282
=	
character_tokenizer tokenizer, 61	Component models
Citations, 202	background language models, 345, 347–350
Classes	
Brown clustering, 289	CPLSA, 421
categories, 11–12	description, 143
sentiment, 393–396	EM algorithm, 359
Classification	mixture models, 355–356, 358–359
machine learning, 34–36	PLSA, 370–373
NLP, 43–44	Compression
Classifiers in text categorization, 302–303	bitwise, 159–160
classify command, 57	block, 161–162
Cleaning HTML files, 218–219	overview, 158–159
Clickthroughs	search engines, 148
probabilistic retrieval model, 111–113	text representation, 48–49
web searches, 201	Compression ratio, 160–161
Clustering bias, 276	Concepts in vector space model, 92
Clusters and clustering	Conceptual framework in text information
joint analysis, 416	systems, 10–13
sentiment classification, 395	Conditional entropy
text. See Text clustering	information theory, 33
Coherence in text clustering, 294–295	syntagmatic relations, 261–264, 270
Coin flips, binomial distribution for, 26–27	Conditional probabilities
Cold start problem, 230	Bayes' rule, 25–26
Collaborative filtering, 221, 229–233	overview, 23–25
Collapsed Gibbs sampling, 383	Configuration files, 57–58
Collect function, 197	Confusion matrices, 314–315
Collection language model	Constraints in PLSA, 373
KL-divergence, 474	Content analysis modules, 10-11
smoothing methods, 121-126	Content-based filtering, 221–229
Common form of retrieval models, 88-90	Content in opinion mining, 390-392
Common sense knowledge in NLP, 40	Context
Common words	Brown clustering, 290
background language model, 346-347,	non-text data, 249
350-351	opinion mining, 390-392
feedback, 141, 143	paradigmatic relations, 253-258
filtering, 54	social networks as, 428-433
mixture models, 352-353, 355-356	syntagmatic relations, 261–262
unigram language model, 345–346	text mining, 417-419

Context (continued)	Data mining
time series, 433–439	joint analysis, 413–415
Context variables in topic analysis, 330	probabilistic retrieval model algorithms,
Contextual Probabilistic Latent Semantic	117
Analysis (CPLSA), 419–428	text data analysis, 245–246
Continuous distributions	Data types in text analysis, 449–450
Bayesian parameter estimation, 28	Data-User-Service Triangle, 213–214
description, 22	Database retrieval, 80–82
Co-occurrences in mutual information,	DBLRU (Double Barrel Least-Recently Used)
267–268	caches, 164–165
Corpus input formats in MeTA toolkit,	DCG (discounted cumulative gain), 182-
60-61	183
corpusname.dat file, 60	Decision boundaries for linear classifiers,
corpusname.dat.gz file, 60	311-312
corpusname.dat.labels file, 60	Decision modules in content-based
corpusname.dat.labels.gz file, 60	filtering, 225
Correlations	Decision support, opinion mining for, 393
mutual information, 270	Deep analysis in natural language
syntagmatic relations, 253–254	processing, 43–45
text-based forecasting, 248	Delta bitwise compression, 160
time series context, 437	Dendrograms, 280–281
Cosine similarity	Denial of service from crawlers, 193
document clustering, 279–280	Dependency parsers, 323
extractive summarization, 321	Dependent random variables, 25
text summarization, 325	Design philosophy, META, 58–59
vector measurement, 222, 232	Development sets for text categorization,
Coverage	314
CPLSA, 420-422, 425-426	Dirichlet distribution, 461-463
LDA, 380-381	Dirichlet prior smoothing
topic analysis, 332–333	KL-divergence, 475
CPLSA (Contextual Probabilistic Latent	probabilistic retrieval models, 125–127
Semantic Analysis), 419–428	Disaster response, 243–244
Cranfield evaluation methodology, 168–170	Discounted cumulative gain (DCG), 182-183
Crawlers	Discourse analysis in NLP, 40
domains, 218	Discrete distributions
dynamic content, 217	Bayesian parameter estimation, 29
languages for, 216–217	description, 22
web searches, 192–194	Discriminative classifiers, 302
Cross validation in text categorization, 314	Distances in clusters, 281
Cumulative gain (CG) in NDCG, 181-182	Distinguishing categories, 301–302
Current technology, 5	Divergence-from-randomness models, 87,
	111
Data-driven social science research, opinion	Divisive clustering, 277
mining for, 393	Document-at-a-time ranking, 155

Document clustering, 277	Eliza project, 42, 44-45
agglomerative hierarchical, 280–282	EM algorithm. See Expectation-
<i>K</i> -means, 282–284	maximization (EM) algorithm
overview, 279–280	Email counts, 3
Document frequency	Emotion analysis, 394
bag-of-words representation, 89	Empirically defined problems, 82
vector space model, 99–100	Enron email dataset, 326
Document IDs	Entity-relation re-creation, 47
compression, 158-159	Entropy
inverted indexes, 152	information theory, 31–33
tokenizers, 149	KL-divergence, 139, 474
Document language model, 118–123	mutual information, 264–265
Document length	PMI, 288
bag-of-words representation, 89	skewed distributions, 158
vector space model, 105–108	syntagmatic relations, 261–264, 270
Documents	Evaluation, search engine. See Search
filters, 155–156	engine evaluation
ranking vs. selecting, 82–84	Events
tokenizing, 148–150	CPLSA, 426-427
vectors, 92–96	probability, 21–23
views in multimode interactive access, 77	Exhaustivity in sentiment classification, 396
Domains, crawling, 218	Expectation-maximization (EM) algorithm
Dot products	CPLSA, 422
document length normalization, 109	general procedure, 469–471
linear classifiers, 311	incomplete vs. complete data, 467-468
paradigmatic relations, 257–258	<i>K</i> -means, 282–283
vector space model, 93-95, 98	KL-divergence, 476
Double Barrel Least-Recently Used (DBLRU)	lower bound of likelihood, 468–469
caches, 164–165	MAP estimate, 378-379
Dynamic coefficient interpolation in	mining topics from text, 359-368
smoothing methods, 125	mixture unigram language model, 466
Dynamically generated content and	MLE, 466-467
crawlers, 217	network supervised topic models, 431
	overview, 465-466
E step in EM algorithm, 362–368, 373–377,	PLSA, 373-377
465, 469	Expected overlap of words in paradigmatic
E-discovery (electronic discovery), 326	relations, 257–258
Edit features in text categorization, 306	Expected value in Beta distribution, 458
Effectiveness in search engine evaluation,	Exploration-exploitation tradeoff in
168	content-based filtering, 227
Efficiency	Extractive summarization, 318-321
database data retrieval, 81–82	
search engine evaluation, 168	F measure
Electronic discovery (E-discovery), 326	ranked lists evaluation, 179

F measure (continued)	Frequency transformation in paradigmatic
set retrieval evaluation, 172-173	relations, 258–259
<i>F</i> -test for time series context, 437	Full structure parsing, 43
F ₁ score	
text categorization, 314	G-means algorithm, 294
text summarization, 324	Gain in search engine evaluation, 181–183
Fault tolerance in Google File System,	Gamma bitwise compression, 160
195	Gamma function, 457
Feature generation for tokenizers, 150	Gaussian distribution, 22, 404–405
Features for text categorization, 304-307	General EM algorithm, 431
Feedback	Generation-based text summarization, 318
content-based filtering, 225	Generative classifiers, 309
KL-divergence, 475–476	Generative models
language models, 138–144	background language model, 346-347,
overview, 133-135	349
search engines, 147, 157-158	CPLSA, 419, 421
vector space model, 135-138	description, 30, 36, 50
web searches, 201	LARA, 403, 405-406
Feedback documents in unigram language	LDA, 381
model, 466	log-likelihood functions, 343-344, 384
Feelings. See Sentiment analysis	mining topics from text, 347
fetch_docs function, 154	<i>n</i> -gram models, 289
file_corpus input format, 60	network supervised topic models, 428-
Files in Google File System, 194–195	430
Filter chains for tokenization, 61-64	PLSA, 370-371, 380
Filters	topics, 338–340
content-based, 221–229	unigram language model, 341
documents, 155-156	Geographical networks, 428
recommender systems. See Recom-	Geometric mean average precision (gMAP),
mender systems	179
text information systems, 11	GFS (Google File System), 194–195
unigram language models, 54	Gibbs sampling, 383
Focused crawling, 193	Google File System (GFS), 194–195
forward_index indexes, 60-61	Google PageRank, 202–206
Forward indexes	Grammar learning, 252
description, 153	Grammatical parse trees, 305–307
k-nearest neighbors algorithm, 308	Granger test, 434, 437
Frame of reference encoding, 162	Graph mining, 49
Frequency and frequency counts	gz_corpus input format, 60
bag-of-words representation, 89–90	
MapReduce, 197	Hidden variables
META analyses, 68–70	EM algorithm, 362-364, 366, 368, 373-
term, 97–98	376, 465, 467
vector space model, 99–100	LARA, 403

Inverse document frequency (IDF)	retrieval, 473-474
(continued)	Knowledge acquisition in text information
vector space model, 99-101	systems, 8–9
Inverse user frequency (IUF), 232	Knowledge discovery in text summarization,
inverted_index indexes, 60	326
Inverted index chunks, 156–157	Knowledge Graph, 215
Inverted indexes	Knowledge provenance in unified systems,
compression, 158	447
k-nearest neighbors algorithm, 308	Known item searches in ranked lists
MapReduce, 198-199	evaluation, 179
search engines, 150-153	Kolmogorov axioms, 22-23
IR (information retrieval) systems, 6	Kullback-Leibler divergence retrieval
evaluation metrics, 324-325	model. See KL-divergence
implementation. See Search engine	
implementation	Lagrange Multiplier approach
text data access, 79	EM algorithm, 467, 470
Iterative algorithms for PageRank, 205–206	unigram language model, 344
Iterative Causal Topic Modeling, 434–435	Language models
IUF (inverse user frequency), 232	feedback in, 138–144
	in probabilistic retrieval model, 87, 111,
Jaccard similarity, 280	117
Jelinek-Mercer smoothing, 123–126	Latent Aspect Rating Analysis (LARA),
Joint analysis of text and structured data,	400-409
413	Latent Dirichlet Allocation (LDA), 377-
contextual text mining, 417-419	383
CPLSA, 419-428	Latent Rating Regression, 402–405
introduction, 413-415	Lazy learners in text categorization, 302
social networks as context, 428-433	Learners
time series context, 433-439	search engines, 147
Joint distributions for mutual information,	text categorization, 302
266-268	Learning modules in content-based
Joint probabilities, 23–25	filtering, 224–225
	Least-Recently Used (LRU) caches, 163–164
K-means document clustering, 282–284	length_filter filter, 61
K-nearest neighbors (k-NN) algorithm,	Length normalization
307-309	document length, 105-108
Kernel trick for linear classifiers, 312	query likelihood retrieval model, 122
Key-value pairs in MapReduce, 195–198	Lexical analysis in NLP, 39–40
KL-divergence	Lexicons for inverted indexes, 150–152
Dirichlet prior smoothing, 475	LIBLINEAR algorithm, 58
EM algorithm, 468	libsvm_analyzer analyzer, 62
feedback, 139–140	libsvm_corpus file, 61
mutual information, 266	LIBSVM package, 58, 64
query model, 475–476	Lifelong learning in web searches, 213

Likelihood and likelihood function	LRU (Least-Recently Used) caches, 163-164
background language model, 349-351	Lucene search engine toolkit, 64
EM algorithm, 362-363, 367-368, 376,	
465-469	M step
LARA, 405	EM algorithm, 361-368, 373-377, 465,
LDA, 378, 381-382	469-470
marginal, 28	MAP estimate, 379
mixture model behavior, 354-357	network supervised topic models, 431
MLE, 27	Machine-generated data, 6
network supervised topic models, 428-	Machine learning
431	overview, 34-36
PLSA, 372-374	sentiment classification methods, 396
unigram language model, 342–344	statistical, 10
line_corpus input format, 60	text categorization, 301
Linear classifiers in text categorization,	web search algorithms, 201
311-313	web search ranking, 208–212
Linear interpolation in Jelinek-Mercer	Machine translation, 42, 44–45
smoothing, 124	Magazine output, 3
Linearly separable data points in linear	Manual evaluation for text clustering, 294
classifiers, 312	map function, 195–198
Link analysis	MAP (Maximum a Posteriori) estimate
HITS, 206–208	Bayesian parameter estimation, 29
overview, 200-202	LARA, 404–405
PageRank, 202–206	PLSA, 378-379
list_filter filter, 62	word association mining, 271-273
Local maxima, 360, 363, 367–368, 465	MAP (mean average precision), 178–180
Log-likelihood function	Map Reduce paradigm, 157
EM algorithm, 365-366, 466-467	MapReduce framework, 194–200
feedback, 142–143	Maps in multimode interactive access,
unigram language model, 343–344	76–77
Logarithm transformation, 103–104	Marginal probabilities
Logarithms in probabilistic retrieval model,	Bayesian parameter estimation, 29
118, 122	mutual information, 267
Logic-based approach in NLP, 42	Market research, opinion mining for, 393
Logical predicates in NLP, 49–50	Massung, Sean, biography, 490
Logistic regression in sentiment classifica-	Matrices
tion, 396–400	adjacency, 207–208
Long-range jumps in multimode interactive	PageRank, 204–208
access, 77	text categorization, 314–315
Long-term needs in push access mode, 75	transition, 204
Low-level lexical features in text categoriza-	Matrix multiplication in PageRank, 205
tion, 305	Maximal marginal relevance (MMR)
Lower bound of likelihood in EM algorithm,	reranking
468-469	extractive summarization, 320–321

Maximal marginal relevance (MMR)	setting up, 59-60
reranking (continued)	text categorization, 314–315
topic analysis, 333	tokenization, 61–64
Maximization algorithm for document	as unified system, 453–455
clustering, 282	Metadata
Maximum a Posteriori (MAP) estimate	classification algorithms, 307
Bayesian parameter estimation, 29	contextual text mining, 417
LARA, 404–405	networks from, 428
PLSA, 378–379	text data analysis, 249
word association mining, 271–273	topic analysis, 330
Maximum likelihood estimation (MLE)	Mining
background language model, 346, 350	contextual, 417–419
Brown clustering, 289	demand for, 4–5
Dirichlet prior smoothing, 125–126	graph, 49
EM algorithm, 359–368, 466–467	joint analysis, 413–419
feedback, 141–143	opinion. See Opinion mining; Sentiment
generative models, 339	analysis
Jelinek-Mercer smoothing, 124	probabilistic retrieval model, 117
KL-divergence, 475–476	tasks, 246–250
LARA, 404	toolkits, 64
LDA, 382	topic analysis, 330–331
mixture model behavior, 354–359	word association. See Word association
mixture model estimation, 352–353	mining
multinomial distribution, 463	Mining topics from text, 340
mutual information, 268–269	background language model, 345–351
overview, 27–28	expectation-maximization, 359–368
PLSA, 372–373, 378	joint analysis, 416
query likelihood retrieval model, 118–119	mixture model behavior, 353–359
term clustering, 286	mixture model estimation, 351–353
unigram language models, 52–53, 341–	unigram language model, 341–345
345	Mixture models
web search ranking, 210	behavior, 353–359
Mean average precision (MAP), 178–180	EM algorithm, 466
Mean reciprocal rank (MRR), 180	estimation, 351–353
Measurements in search engine evaluation,	feedback, 140–142, 157
168	mining topics from text, 346–351
Memory-based approach in collaborative	MLE. See Maximum likelihood estimation
filtering, 230	(MLE)
MeTA toolkit	MMR (maximal marginal relevance)
architecture, 60-61	reranking
classification algorithms, 307	extractive summarization, 320–321
design philosophy, 58–59	topic analysis, 333
exercises, 65–70	Model-based clustering algorithms, 276–
overview, 57–58	277
related toolkits, 64–65	Model files for META toolkit, 59
,	,

Modification in NLP, 41 text information systems, 43-45 Modules in content-based filtering, 224-226 text representation, 46-50 Navigating maps in multimode interactive MRR (mean reciprocal rank), 180 Multiclass classification access, 77 linear classifiers, 313 Navigational queries, 200 NDCG (normalized discounted cumulative text categorization, 303 Multi-level judgments in search engine gain), 181-183 evaluation, 180–183 NDCG@k score, 189 Multimode interactive access, 76-78 Nearest-centroid classifiers, 309 Multinomial distributions Negative feedback documents, 136-138 Bayesian estimate, 463-464 Negative feelings, 390-394 generalized, 460-461 NetPLSA model, 430-433 LDA, 380 Network supervised topic models, 428-433 Multinomial parameters in Bayesian Neural language model, 291-294 estimate, 463-464 News summaries, 317 Multiple-level sentiment analysis, 397-398 Newspaper output, 3 Multiple occurrences in vector space model, ngram_pos_analyzer analyzer, 62 103-104 ngram_word_analyzer analyzer, 62 Multiple queries in ranked lists evaluation, NLP. See Natural language processing (NLP) 178-180 NLTK toolkit, 64 Multivariate Gaussian distribution, 404-405 no_evict_cache caches, 60 Mutual information Nodes in word associations, 252 information theory, 33-34 Non-text data syntagmatic relations, 264-271 context, 249 text clustering, 278 predictive analysis, 249 vs. text, 244-246 n-fold cross validation, 314 Normalization *n*-gram language models document length, 105-108 abstractive summarization, 322-323 PageRank, 206 frequency analysis, 68-69 query likelihood retrieval model, 122 sentiment classification, 394-395 term clustering, 286 term clustering, 288-291 topic analysis, 333 vector space model, 109 Normalized discounted cumulative gain Naive Bayes algorithm, 309-312 (NDCG), 181-183 Named entity recognition, 323 Normalized ratings in collaborative Natural language, mining knowledge about, filtering, 230-231 Normalized similarity algorithm, 279 Natural language generation in text summarization, 323-324 Objective statements vs. subjective, 389-390 Observed world, mining knowledge about, Natural language processing (NLP) history and state of the art, 42-43 247-248 pipeline, 306-307 Observers, mining knowledge about, 248 sentiment classification, 395 Office documents, 3 statistical language models, 50-54 Okapi BM25 model, 89, 108 tasks, 39-41 One-vs-all (OVA) method, 313

Operators in text analysis systems, 448–452	network supervised topic models, 429
Opinion analysis in text summarization,	PLSA, 372–373, 379–380
325–326	probabilistic models, 30–31
Opinion holders, 390–392	ranking, 209–211
Opinion mining	statistical language models, 51–52
evaluation, 409–410	topic analysis, 338–339
LARA, 400-409	unigram language models, 52
overview, 389–392	Parsing
sentiment classification. See Sentiment	META toolkit, 67–68
analysis	NLP, 43
Opinion summarization, 318	web content, 216
Optimization in web searches, 191	Part-of-speech (POS) tags
Ordinal regression, 394, 396–400	META toolkit, 67
Organization in text information systems, 8	NLP, 47
OVA (one-vs-all) method, 313	sentiment classification, 395
Over-constrained queries, 84	Partitioning
Overfitting problem	Brown clustering, 289
Bayesian parameter estimation, 28, 30	extractive summarization, 319–320
sentiment classification, 395	text data, 417–419
vector space model, 138	Patterns
Overlap of words in paradigmatic relations,	contextual text mining, 417–419
257–258	CPLSA, 425–426
20, 200	joint analysis, 417
<i>p</i> -values in search engine evaluation,	NLP, 45
185–186	sentiment classification, 395
PageRank technique, 202–206	Pdf (probability density function)
Paradigmatic relations	Beta distribution, 457
Brown clustering, 290	Dirichlet distribution, 461
discovering, 252–260	multinomial distribution, 461
overview, 251–252	Pearson correlation
Parallel crawling, 193	collaborative filtering, 222, 231–232
Parallel indexing and searching, 192	time series context, 437
Parameters	Perceptron classifiers, 312–313
background language model, 350-351	Personalization in web searches, 212, 215
Bayesian parameter estimation, 28–30,	Personalized PageRank, 206
341, 359, 458, 463–464	Perspective in text data analysis, 246–247
Beta distribution, 458–460	Pivoted length normalization, 89, 107–108
Dirichlet distribution, 461–463	PL2 model, 90
EM algorithm, 363, 465	PLSA (probabilistic latent semantic
feedback, 142–144	analysis)
LARA, 404–405	CPLSA, 419–428
LDA, 380-381	extension, 377-383
mixture model estimation, 352	overview, 368-377
MLE. See Maximum likelihood	Pointwise Mutual Information (PMI), 278,
estimation (MLE)	287-288

Polarity analysis in sentiment classification,	Bayesian parameter estimation, 28–30
394	binomial distribution, 26-27
Policy design, opinion mining for, 393	EM algorithm, 362–366
Pooling in search engine evaluation, 186-	joint and conditional probabilities, 23-25
187	KL-divergence, 474
Porter2 English Stemmer, 66–67	LARA, 403
porter2_stemmer filter, 62	maximum likelihood parameter
POS (part-of-speech) tags	estimation, 27–28
META toolkit, 67	mixture model behavior, 354-358
NLP, 47	mutual information, 266-270
sentiment classification, 395	Naive Bayes algorithm, 310
Positive feelings, 390–394	PageRank, 202–206
Posterior distribution, 28	paradigmatic relations, 257–258
Posterior probability in Bayesian parameter	PLSA, 368-377, 380
estimation, 29	probabilistic models and applications,
Postings files for inverted indexes, 150–152	30-31
Power iteration for PageRank, 205	syntagmatic relations, 262-263
Practitioners reader category, 17	term clustering, 286–289
Pragmatic analysis in NLP, 39-40	topics, 336-339
Precision	unigram language model, 342–344
search engine evaluation, 184	web search ranking, 209–211
set retrieval evaluation, 170–178	Probability density function (pdf)
Precision-recall curves in ranked lists	Beta distribution, 457
evaluation, 174–176	Dirichlet distribution, 461
Predictive analysis for non-text data, 249	multinomial distribution, 461
Predictors features in joint analysis, 413-	Probability distributions
416	overview, 21–23
Presupposition in NLP, 41	statistical language models, 50-54
Prior probability in Bayesian parameter	Probability ranking principle, 84
estimation, 29	Probability space, 21–23
Probabilistic inference, 88	Producer-initiated recommendations, 75
Probabilistic latent semantic analysis	Product reviews in opinion mining, 391-392
(PLSA)	profile command, 65-66
CPLSA, 419-428	Properties
extension, 377–383	inferring knowledge about, 248
overview, 368-377	text categorization for, 300
Probabilistic retrieval models	Proximity heuristics for inverted indexes,
description, 87–88	151
overview, 110–112	Pseudo counts
query likelihood retrieval model, 114–118	Bayesian statistics, 459–460
Probability and statistics	LDA, 381
abstractive summarization, 322	multinomial distribution, 463
background language model, 346–349	PLSA, 379, 381
basics, 21–23	smoothing techniques, 128, 286
Bayes' rule, 25–26	Pseudo data in LDA, 378

Pseudo feedback, 133, 135, 142, 157–158 Pseudo-segments for mutual information,	Rankers for search engines, 147 Ranking
269–270	extractive summarization, 320
Pull access mode, 8–9, 73–76	probabilistic retrieval model. See
Push access mode, 8–9, 73–76	Probabilistic retrieval models
Python language	vs. selection, 82–84
cleaning HTML files, 218	text analysis operator, 450–451
crawlers, 217	text data access, 78
crawlers, 217	vector space model. See Vector space (VS)
O function 465 460 471	retrieval models
Q-function, 465, 469–471	
Queries	web searches, 201, 208–212
multimode interactive access, 77	Ratings
navigational, 200	collaborative filtering, 230–231
text information systems, 9	LARA, 400–409
text retrieval vs. database retrieval, 80	sentiment classification, 396–399
Query expansion	Real world properties, inferring knowledge
vector space model, 135	about, 248
word associations, 252	Realization in abstractive summarization,
Query likelihood retrieval model, 90, 113	324
document language model, 118–123	Recall in set retrieval evaluation, 170–178
feedback, 139	Reciprocal ranks, 179–180
KL-divergence, 475–476	Recommendations in text information
overview, 114-118	systems, 11
smoothing methods, 123–128	Recommender systems
Query vectors, 92–98, 135–137	collaborative filtering, 229–233
	content-based recommendation, 222-
Random access decoding in compression,	229
158	evaluating, 233–235
Random numbers in abstractive summa-	overview, 221–222
rization, 322	reduce function, 198
Random observations in search engine	Redundancy
evaluation, 186	MMR reranking, 333
Random surfers in PageRank, 202-204	text summarization, 320-321, 324
Random variables	vector space retrieval models, 92
Bayesian parameter estimation, 28	Regression
dependent, 25	LARA, 402-405
entropy of, 158, 262-263, 270	machine learning, 34–35
information theory, 31-34	sentiment classification, 394, 396-400
PMI, 287	text categorization, 303-304
probabilistic retrieval models, 87, 111,	web search ranking, 209-211
113	Regularizers in network supervised topic
probability distributions, 22	models, 429–431
Ranked lists evaluation	Relevance and relevance judgments
multiple queries, 178–180	Cranfield evaluation methodology,
overview, 174–178	168-169

description, 133	Scikit Learn toolkit, 64
document ranking, 83	score_term function, 154
document selection, 83	Scorers
extractive summarization, 321	document-at-a-time ranking, 155
probabilistic retrieval models, 110-112	filtering documents, 155–156
search engine evaluation, 181–184,	index sharding, 156–157
186-187	search engines, 147, 153-157
set retrieval evaluation, 171–172	term-at-a-time ranking, 154–155
text data access, 79	Scoring functions
vector space model, 92	KL-divergence, 474
web search ranking, 209–211	topic analysis, 332
Relevant text data, 5–6	SDI (selective dissemination of informa-
Relevant word counts in EM algorithm,	tion), 75
364-365, 376-377	Search engine evaluation
Repeated crawling, 193	Cranfield evaluation methodology,
Representative documents in search engine	168-170
evaluation, 183	measurements, 168
reset command, 57–59	multi-level judgments, 180–183
Retrieval models	practical issues, 183-186
common form, 88-90	purpose, 167–168
overview, 87-88	ranked lists, 174–180
probabilistic. See Probabilistic retrieval	set retrieval, 170–173
models	Search engine implementation
vector space. See Vector space (VS)	caching, 162–165
retrieval models	compression, 158–162
Reviews	feedback implementation, 157–158
LARA, 400-409	indexes, 150–153
opinion mining, 391–392	overview, 147-148
sentiment classification, 394	scorers, 153–157
text summarization, 318	tokenizers, 148-150
RMSE (root-mean squared error), 233	Search engine queries
robots.txt file, 193	pull access mode, 74-75
Rocchio feedback	text data access, 78-79
forward indexes, 157	Search engine toolkits, 64
vector space model, 135–138	Searches
Root-mean squared error (RMSE), 233	text information systems, 11
Ruby language	web. <i>See</i> Web searches
cleaning html files, 218–219	Segmentation in LARA, 405
crawlers, 217	Select operator, 449–451, 455
Rule-based text categorization, 301	Selection
	vs. ranking, 82–84
Scalability in web searches, 191–192	text data access, 78
Scanning inverted indexes, 152	Selection-based text summarization, 318
Scientific research, text data analysis for,	Selective dissemination of information
243	(SDI), 75

Semantic analysis in NLP, 39–40, 43, 47	Bayesian statistics, 459–460
Semantically related terms in clustering,	KL-divergence, 474–475
187, 285–287	maximum likelihood estimation, 119-
Sensors	128
humans as, 244–246	multinomial distribution, 463–464
joint analysis, 413–415	
· ·	Naive Bayes algorithm, 310
opinion mining. See Opinion mining	unigram language models, 53
Sentence vectors in extractive summariza-	Social media in text data analysis, 243
tion, 319	Social networks as context, 428–433
Sentiment analysis, 389	Social science research, opinion mining for,
classification, 393–396	393
evaluation, 409–410	Soft rules in text categorization, 301
NLP, 43	Spam in web searches, 191–192
ordinal regression, 396–400	Sparse Beta, 459
text categorization, 304	Sparse data in Naive Bayes algorithm,
Separation in text clustering, 294–295	309-311
Sequences of words in NLP, 46–47	Sparse priors in Dirichlet distribution,
Set retrieval evaluation	461-462
description, 170	Spatiotemporal patterns in CPLSA, 425–426
F measure, 172–173	Specificity in sentiment classification, 396
precision and recall, 170–173	Speech acts in NLP, 47–48
Shadow analysis in NLP, 48	Speech recognition
Shallow analysis in NLP, 43–45	applications, 42
Short-range walks in multimode interactive	statistical language models, 51
access, 77	Spiders for web searches, 192–194
Short-term needs in pull access mode, 75	Split counts in EM algorithm, 374–375
Sign tests in search engine evaluation, 185	Split operator for text analysis, 449–452, 455
Signed-rank tests in search engine	Stanford NLP toolkit, 64
evaluation, 185	State-of-the-art support vector machines
Significance tests in search engine	(SVM) classifiers, 311–312
evaluation, 183–186	Statistical language models
Similarity algorithm for clustering, 276	NLP, 45
Similarity in clustering	overview, 50-54
Similarity functions and measures	Statistical machine learning
extractive summarization, 319, 321	NLP, 42-43
paradigmatic relations, 256–259	text information systems, 10
vector space model, 92, 109	Statistical significance tests in search
description, 277	engine evaluation, 183–186
document clustering, 279–281	Statistics. See Probability and statistics
term clustering, 285	Stemmed words in vector space model, 109
Single-link document clustering, 281–282	Stemming process in MeTA toolkit, 66-67
Skip-gram neural language model, 292–293	Sticky phrases in Brown clustering, 291
sLDA (supervised LDA), 387	Stop word removal
Smoothing techniques	feedback, 141
Add-1, 130, 464	frequency analysis, 69
, ,	I v v /

MeTA toolkit, 62, 66	Targets in opinion mining, 390–392
mixture models, 352	Temporal trends in CPLSA, 424–425
vector space model, 99, 109	Term-at-a-time ranking, 154–155
Story understanding, 42	Term clustering, 278
Structured data	<i>n</i> -gram class language models, 288–291
databases, 80	neural language model, 291–294
joint analysis with text. See Joint analysis	overview, 284–285
of text and structured data	Pointwise Mutual Information, 287–288
Student reader category, 16	semantically related terms, 285–287
Stylistic analysis in NLP, 49	Term frequency (TF)
Subjective sensors	bag-of-words representation, 89
humans as, 244–246	vector space model, 97–98
opinion mining. See Opinion mining	Term IDs
Subjective statements vs. objective, 389–390	inverted indexes, 151-152
Sublinear transformation	tokenizers, 149–150
term frequency, 258-259	Term vectors, 92
vector space model, 103-104	Terms, topics as, 332–335
Summarization. See Text summarization	Terrier search engine toolkit, 64
Supervised LDA (sLDA), 387	Test collections in Cranfield evaluation
Supervised machine learning, 34	methodology, 168–169
SVM (state-of-the-art support vector	Testing data
machines) classifiers, 311–312	machine learning, 35
Symbolic approach in NLP, 42	text categorization, 303
Symmetric Beta, 459	Text
Symmetric probabilities in information	joint analysis with structured data. See
theory, 32	Joint analysis of text and structured
Symmetry in document clustering, 279–280	data
Synonyms	mining. See Mining; Mining topics from
vector space model, 92	text
word association, 252	usefulness, 3–4
Syntactic ambiguity in NLP, 41	Text annotation. See Text categorization
Syntactic analysis in NLP, 39–40, 47	Text-based prediction, 300
Syntactic structures in NLP, 49	Text categorization
SyntacticDiff method, 306	classification algorithms overview, 307
Syntagmatic relations, 251–252	evaluation, 313–315
Brown clustering, 290–291	features, 304–307
discovering, 253–254, 260–264	introduction, 299-301
mutual information, 264–271	<i>k</i> -nearest neighbors algorithm, 307–309
System architecture in unified systems,	linear classifiers, 311–313
452–453	machine learning, 35
	methods, 300–302
Tags, POS	Naive Bayes, 309–311
META toolkit, 67	problem, 302–304
NLP, 47	TD- 1 -11110
sentiment classification, 395	Text clustering, 12 document, 279–284

Text clustering (continued)	vector space model, 97–98
evaluation, 294–296	TF-IDF weighting
overview, 275–276	Dirichlet prior smoothing, 128
techniques, 277–279	probabilistic retrieval model, 122–123
term, 284–294	topic analysis, 333
Text data access, 73	vector space model, 100–103
access modes, 73-76	TF transformation, 102–105
document selection vs. document	TF weighting, 125–126
ranking, 82–84	Themes in CPLSA, 420–422
multimode interactive, 76–78	Therapist application, 44–45
text retrieval vs. database retrieval, 80–82	Thesaurus discovery in NLP, 49
text retrieval overview, 78–80	Threshold settings in content-based
Text data analysis overview, 241–242	filtering, 222, 224–227
applications, 242–244	Tight clusters, 281
humans as subjective sensors, 244–246	Time series context in topic analysis,
operators, 448–452	433-439
text information systems, 8	TISs (text information systems)
text mining tasks, 246–250	conceptual framework, 10–13
Text data understanding. See Natural	functions, 7–10
language processing (NLP)	NLP, 43-45
Text information systems (TISs)	Tokenization
conceptual framework, 10–13	META toolkit, 61–64, 453
functions, 7–10	search engines, 147–150
NLP, 43–45	Topic analysis
Text management and analysis in unified	evaluation, 383–384
systems. See Unified systems	LDA, 377–383
Text organization in text information	mining topics from text. See Mining
systems, 8	topics from text. See Willing
Text representation in NLP, 46–50	model summary, 384–385
Text retrieval (TR)	overview, 329–331
vs. database retrieval, 80–82	
	PLSA, 368–377 social networks as context, 428–433
demand for, 4–5	text information systems, 12
overview, 78–80	· · · · · · · · · · · · · · · · · · ·
Text summarization, 12	time series context, 433–439
abstractive, 321–324	topics as terms, 332–335
applications, 325–326	topics as word distributions, 335–340
evaluation, 324–325	Topic coherence in time series context, 436
extractive, 319–321	Topic coverage
overview, 317–318	CPLSA, 420–422, 425–426
techniques, 318	LDA, 380–381
TextObject data type operators, 449, 454	Topic maps in multimode interactive
TextObjectSequence data type operators,	access, 76–77
449, 454	TopicExtraction operator, 450
TF (term frequency)	TR (text retrieval)
bag-of-words representation, 89	vs. database retrieval, 80–82

demand for, 4–5	Unimodel Beta, 459
overview, 78-80	Union operator, 449–450
Training and training data	University of California Berkeley study, 3
classification algorithms, 307-309	Unseen words
collaborative filtering, 229–230	document language model, 119–120,
content-based recommendation, 227-	122-123
228	KL-divergence, 474
linear classifiers, 311–313	Naive Bayes algorithm, 310–311
machine learning, 34–36	smoothing, 124, 285-287
Naive Bayes, 309–310	statistical language models, 52
NLP, 42–43, 45	Unstructured text access, 80
ordinal regression, 398–399	Unsupervised clustering algorithms, 275,
text categorization, 299–303, 311–314	278
web search ranking, 209–210, 212	Unsupervised machine learning, 34, 36
Transformations	URLs and crawlers, 193
frequency, 258-259	Usability in search engine evaluation, 168
vector space model, 103-104	Utility
Transition matrices in PageRank, 204	content-based filtering, 224–228
Translation, machine, 42, 44–45	text clustering, 294
TREC filtering tasks, 228	
tree_analyzer analyzer, 62	Valence scoring, 411
Trends in web searches, 215–216	Variable byte encoding, 161
Trigrams in frequency analysis, 69	Variables
Twitter searches, 83	context, 330
Two-component mixture model, 356	contextual text mining, 419
	CPLSA, 422
Unary bitwise compression, 159–160	EM algorithm, 362-364, 366, 368, 373-
Under-constrained queries, 84	376, 465, 467
Unified systems	LARA, 403
MeTA as, 453–455	random. See Random variables
overview, 445-448	vByte encoding, 161
system architecture, 452–453	Vector space (VS) retrieval models, 87
text analysis operators, 448–452	bit vector representation, 94-97
Uniform priors in Dirichlet distribution,	content-based filtering, 225–226
461	document length normalization, 105-108
Unigram language models, 51–54	feedback, 135-138
EM algorithm, 466	improved instantiation, 97-102
LDA, 381	improvement possibilities, 108-110
mining topics from text, 341-345	instantiation, 93–95
PLSA, 370	overview, 90-92
Unigrams	paradigmatic relations, 256–258
abstractive summarization, 321–323	summary, 110
frequency analysis, 68	TF transformation, 102–105
sentiment classification, 394	Vectors
words tokenizers, 149	collaborative filtering, 222

Vectors (continued)	text categorization rules, 301
neural language model, 292	topics, 333, 335–336
Versions, MeTA toolkit, 59	vector space model, 92, 99-103
Vertical search engines, 212	Weka toolkit, 64
Video data mining, 245	whitespace_tokenizer command, 149
Views	Whitespace tokenizers, 149
CPLSA, 420-422	Wilcoxon signed-rank test, 185
multimode interactive access, 77	Word association mining
Visualization in text information systems,	evaluation, 271–273
12-13	general idea of, 252–254
VS retrieval models. See Vector space (VS)	overview, 251–252
retrieval models	paradigmatic relations discovery, 254–260
Web searches	syntagmatic relations discovery, 260-271
crawlers, 192–194	Word counts
future of, 212–216	EM algorithm, 364-365, 376-377
indexing, 194–200	MapReduce, 195–198
link analysis, 200–208	vector space model, 103-104
overview, 191-192	Word distributions
ranking, 208–212	CPLSA, 424–425
Weighted k-nearest neighbors algorithm,	LARA, 405
309	topics as, 335–340
WeightedTextObjectSequence data type, 449	Word embedding in term clustering, 291–294
WeightedTextObjectSet data type,	Word-level ambiguity in NLP, 41
449	Word relations, 251–252
Weights	Word segmentation in NLP, 46
collaborative filtering, 231	Word sense disambiguation in NLP, 43
Dirichlet prior smoothing, 127–128	Word valence scoring, 411
document clustering, 279–280	Word vectors in text clustering, 278
LARA, 401–409	word2vec skip-gram, 293
linear classifiers, 313	WordNet ontology, 294
mutual information, 269–270	
NetPLSA model, 430	Zhai, ChengXiang, biography, 489
network supervised topic models, 431	Zipf's law
paradigmatic relations, 258–261	caching, 163
query likelihood retrieval model, 121–123	frequency analysis, 69–70