20 NEWS GROUP CLASSIFICATION

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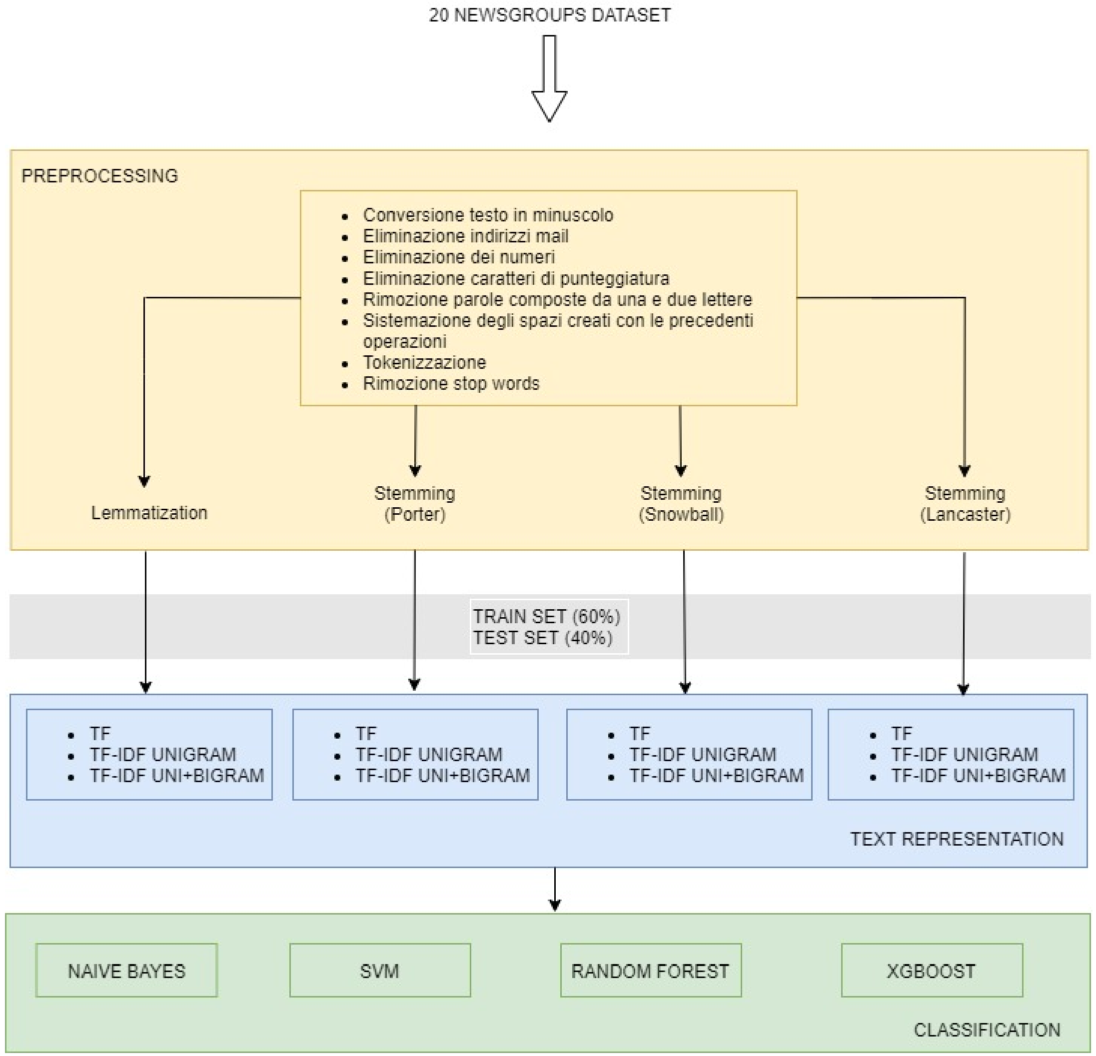
PIPELINE



20 NEWSGROUPS DATASET
PREPROCESSING
Conversione testo in minuscolo
Eliminazione indirizzi mail
Eliminazione dei numeri
Eliminazione caratteri di punteggiatura
Rimozione parole composte da una e due lettere
Sistemazione degli spazi creati con le precedenti operazioni
Tokenizzazione
Rimozione stop words
Lemmatization
Stemming (Porter)
Stemming (Snowball)
Stemming (Lancaster)
TRAIN SET (60%)
TEST SET (40%)
TF
TF-IDF UNIGRAM
TF-IDF UNI+BIGRAM
TF
TF-IDF UNIGRAM
TF-IDF UNI+BIGRAM
TF
TF-IDF UNIGRAM
TF-IDF UNI+BIGRAM
TF
TF-IDF UNIGRAM
TF-IDF UNI+BIGRAM
TEXT REPRESENTATION
NAIVE BAYES
SVM
RANDOM FOREST
XGBOOST
CLASSIFICATION

DATASET *20 NEWSGROUPS*

19997 documenti divisi in 20 newsgroups:

1. alt.atheism
2. comp.graphics
3. comp.os.ms-windows.misc
4. comp.sys.ibm.pc.hardware
5. comp.sys.mac.hardware
6. comp.windows.x
7. misc.forsale
8. rec.autos
9. rec.motorcycles
10. rec.sport.baseball
11. rec.sport.hockey
12. sci.crypt
13. sci.electronics
14. sci.med
15. sci.space
16. soc.religion.christian
17. talk.politics.guns
18. talk.politics.mideast
19. talk.politics.misc
20. talk.religion.misc

PREPROCESSING

- Conversione testo in minuscolo
- Eliminazione indirizzi mail
- Eliminazione dei numeri
- Eliminazione caratteri di punteggiatura
- Rimozione parole composte da una e due lettere
- Sistemazione degli spazi creati con le precedenti operazioni
- Tokenizzazione
- Rimozione Stop Words
- Lemmatization
- Stemming: Porter, Snowball, Lancaster

Dataset diviso in Training set (60%) e Test set (40%)

TEXT REPRESENTATION

- **Term Frequency (TF)**: la Term Frequency tft,d del termine t nel doumento d è definito come il numero di volte che t si verifica in d

- **Term Frequency-Inverse Document Frequency (TF-IDF)**: il peso tf-idf di un termine è il prodotto del suo peso tf e del suo peso idf
  - Unigram
  - Unigram + Bigram

Matrici costruite per:

- Dati lemmatizzati
- Dati stemmatizzati (Porter)
- Dati stemmatizzati (Snowball)
- Dati stemmatizzati (Lancaster)

→ 24 Matrici (12 Train + 12 Test)

TEXT CLASSIFICATION

- Multinomial NB
- SVM
- Random Forest
- XGBOOST

MULTINOMIAL NAIVE BAYES

	TRAIN (cross validation)		TEST	
	Accuracy	Time	Accuracy	Time
TF + LEM	0.86	395 ms	0.87	119 ms
TF + STEM (Porter)	0.85	320 ms	0.86	207 ms
TF + STEM (Snowball)	0.85	319 ms	0.86	96.4 ms
TF + STEM (Lancaster)	0.85	304 ms	0.85	99.5 ms
TF-IDF + LEM	0.86	228 ms	0.87	76.8 ms
TF-IDF + STEM (Porter)	0.85	220 ms	0.86	72.9 ms
TF-IDF + STEM (Snowball)	0.85	211 ms	0.86	78.7 ms
TF-IDF + STEM (Lancaster)	0.85	245 ms	0.86	95.2 ms
TF-IDF (bigram) + LEM	0.86	235 ms	0.87	84.2 ms
TF-IDF (bigram) + STEM (Porter)	0.86	250 ms	0.87	84.6 ms
TF-IDF (bigram) + STEM (Snowball)	0.86	240 ms	0.87	82 ms
TF-IDF (bigram) + STEM (Lancaster)	0.86	244 ms	0.86	86.2 ms

SUPPORT VECTOR MACHINE (SVM)

	TRAIN (cross validation)		TEST	
	Accuracy	Time	Accuracy	Time
TF + LEM	0.75	8 min 39 s	0.78	3 min 11 s
TF + STEM (Porter)	0.75	8 min 19 s	0.78	3 min 5 s
TF + STEM (Snowball)	0.75	8 min 42 s	0.78	3 min 29 s
TF + STEM (Lancaster)	0.74	8 min 38 s	0.77	3 min 6 s
TF-IDF + LEM	0.89	12 min 10 s	0.90	4 min 47 s
TF-IDF + STEM (Porter)	0.89	12 min 44 s	0.90	4 min 23 s
TF-IDF + STEM (Snowball)	0.89	11 min 47 s	0.90	4 min 17 s
TF-IDF + STEM (Lancaster)	0.88	11 min 45 s	0.89	4 min 14 s
TF-IDF (bigram) + LEM	0.89	14 min 25 s	0.90	4 min 57 s
TF-IDF (bigram) + STEM (Porter)	0.89	14 min 12 s	0.90	5 min 3 s
TF-IDF (bigram) + STEM (Snowball)	0.89	13 min 55 s	0.90	4 min 56 s
TF-IDF (bigram) + STEM (Lancaster)	0.89	13 min 43 s	0.89	4 min 50 s

RANDOM FOREST

	TRAIN (cross validation)		TEST	
	Accuracy	Time	Accuracy	Time
TF + LEM	0.83	2 min 37 s	0.84	31.9 s
TF + STEM (Porter)	0.82	2 min 23 s	0.84	29.4 s
TF + STEM (Snowball)	0.82	2 min 21 s	0.84	29.4 s
TF + STEM (Lancaster)	0.81	2 min 13 s	0.83	28.6 s
TF-IDF + LEM	0.81	1 min 29 s	0.83	23.3 s
TF-IDF + STEM (Porter)	0.81	1 min 31 s	0.83	22.9 s
TF-IDF + STEM (Snowball)	0.81	1 min 31 s	0.82	23.2 s
TF-IDF + STEM (Lancaster)	0.80	1 min 35 s	0.82	25.1 s
TF-IDF (bigram) + LEM	0.81	1 min 34 s	0.83	25.4 s
TF-IDF (bigram) + STEM (Porter)	0.82	1 min 33 s	0.83	25.2 s
TF-IDF (bigram) + STEM (Snowball)	0.81	1 min 33 s	0.83	25.5 s
TF-IDF (bigram) + STEM (Lancaster)	0.80	1 min 35 s	0.82	25.5 s

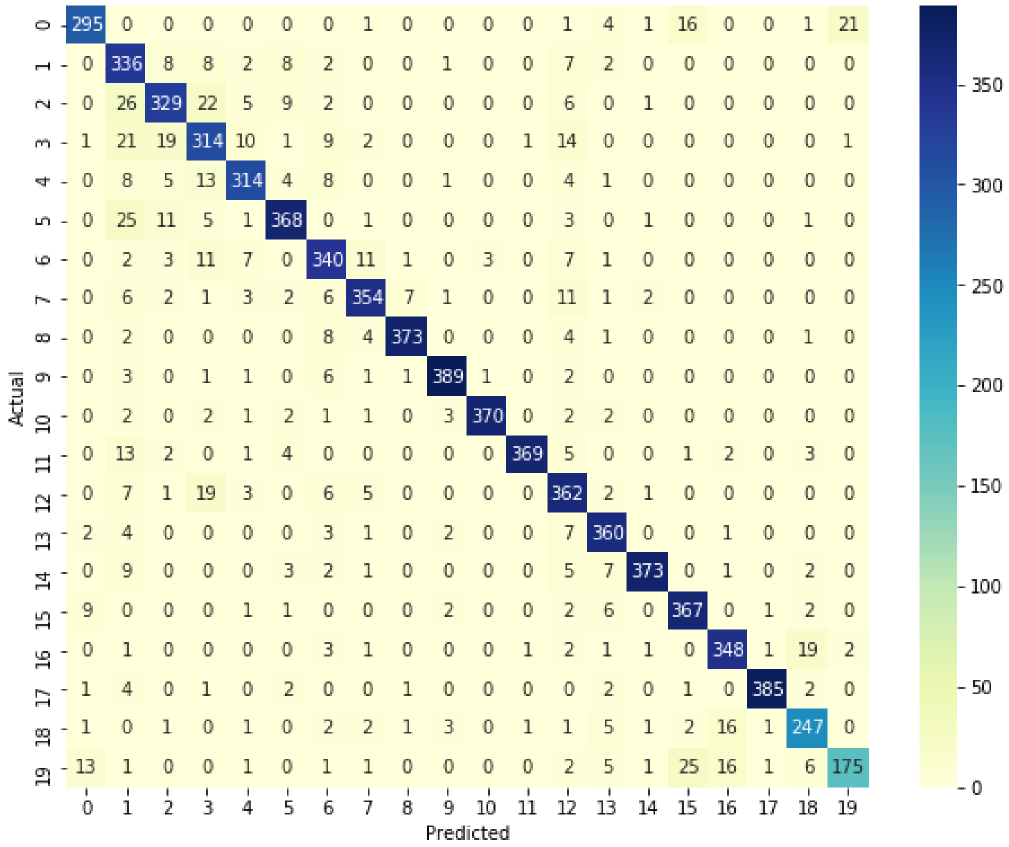
XGBOOST

	TRAIN (cross validation)		TEST	
	Accuracy	Time	Accuracy	Time
TF + LEM	0.80	16 min 42 s	0.80	3 min 34 s
TF + STEM (Porter)	0.80	14 min 14 s	0.79	3 min 3 s
TF + STEM (Snowball)	0.80	13 min 38 s	0.79	2 min 56 s
TF + STEM (Lancaster)	0.79	12 min 36 s	0.79	2 min 45 s
TF-IDF + LEM	0.79	13 min 54 s	0.79	3 min 25 s
TF-IDF + STEM (Porter)	0.79	14 min 26 s	0.79	3 min 27 s
TF-IDF + STEM (Snowball)	0.79	14 min 16 s	0.79	3 min 27 s
TF-IDF + STEM (Lancaster)	0.78	14 min 1 s	0.78	3 min 25 s
TF-IDF (bigram) + LEM	0.79	15 min 26 s	0.80	3 min 50 s
TF-IDF (bigram) + STEM (Porter)	0.80	15 min 45 s	0.80	3 min 51 s
TF-IDF (bigram) + STEM (Snowball)	0.79	15 min 47 s	0.80	3 min 55 s
TF-IDF (bigram) + STEM (Lancaster)	0.79	16 min 10 s	0.79	3 min 59 s

CONCLUSIONI

Il modello migliore in termini di *Recall*, *Precision* ed *F1-score* risulta essere ***Support Vector Machine*** nelle rappresentazioni tf-idf

	precision	recall	f1-score	support
0	0.92	0.87	0.89	340
1	0.71	0.90	0.80	374
2	0.86	0.82	0.84	400
3	0.79	0.80	0.79	393
4	0.89	0.88	0.89	358
5	0.91	0.88	0.90	416
6	0.85	0.88	0.87	386
7	0.92	0.89	0.91	396
8	0.97	0.95	0.96	393
9	0.97	0.96	0.96	405
10	0.99	0.96	0.97	386
11	0.99	0.92	0.96	400
12	0.81	0.89	0.85	406
13	0.90	0.95	0.92	380
14	0.98	0.93	0.95	403
15	0.89	0.94	0.91	391
16	0.91	0.92	0.91	380
17	0.99	0.96	0.98	399
18	0.87	0.87	0.87	285
19	0.88	0.71	0.78	248
accuracy			0.90	7539
macro avg	0.90	0.89	0.90	7539
weighted avg	0.90	0.90	0.90	7539



GRAZIE PER L'ATTENZIONE