



Text Classification using Weka

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What is Weka?



- Workbench for machine learning and data mining
- Supports a large number of ML approaches
- Developed by the ML group at the University of Waikato (NZ)
- Implemented in Java
- Open Source software under GNU GPL
- <http://www.cs.waikato.ac.nz/~ml/weka/index.html>





- Corresponds to database table or spreadsheet
- Collection of examples
 - attributes with values
- Represented as ARFF file
 - ARFF: attribute-relation file format
 - header with attribute types
 - nominal → finite set of strings
 - numeric
 - string
 - date
 - example instances as comma-separated list of attribute values

ARFF Example



```
@relation golf_weather
```

```
@attribute outlook {sunny, overcast, rainy}
```

```
@attribute temperature numeric
```

```
@attribute humidity numeric
```

```
@attribute windy {true, false}
```

```
@attribute playGolf {yes, no}
```

```
@data
```

sunny,	29,	85,	false,	no
sunny,	27,	90,	true,	no
overcast,	28,	86,	false,	yes
rainy,	21,	96,	false,	yes
rainy,	20,	80,	false,	yes
rainy,	18,	70,	true,	no
overcast,	17,	65,	true,	yes
sunny,	22,	95,	false,	no
sunny,	21,	70,	false,	yes
rainy,	21,	80,	false,	yes
sunny,	24,	70,	true,	yes
overcast,	22,	90,	true,	yes
overcast,	27,	75,	false,	yes
rainy,	22,	91,	true,	no

J48 Decision Tree



```
> java weka.classifiers.trees.J48 -t weather.arff -i
```

J48 pruned tree

outlook = sunny

| humidity <= 75: yes (2.0)

| humidity > 75: no (3.0)

outlook = overcast: yes (4.0)

outlook = rainy

| windy = true: no (2.0)

| windy = false: yes (3.0)

Number of Leaves : 5

Size of the tree : 8

Vector-Based Text Classification



- Document features as numeric Weka attributes
- Feature weight as attribute values
- Document class as last Weka attribute
- Example instances as feature vectors followed by document class



- Classes: 12 languages
 - German (de) Italian (it)
 - Catalan (ca) Norwegian (no)
 - Finnish (fi) Danish (dk)
 - Sorbian (sb) Swedish (sv)
 - French (fr) English (en)
 - Estonian (et) Dutch (nl)
- <http://corpora.uni-leipzig.de/download.html>
- Features: character 2-grams



- Training data: 1000 sentences per language
 - train.arff
- Test data: 500 sentences per language
 - test.arff
- Features selection using corpus frequency ≥ 4
 - 4764 total features, 1845 filtered \rightarrow 2919 features left
- Feature weight: tf.idf

Language Identification ARFF File



```
...
@attribute 'Ru' numeric
@attribute 'Ry' numeric
@attribute 'Rà' numeric
@attribute 'Rä' numeric
@attribute 'Rå' numeric
@attribute 'Ré' numeric
...
@attribute lang {de,it,ca,no,fi,dk,sb,sv,fr,en,et,nl}

@data
...
0,0,14.2323,0,0,7.456, ..., de
...
```

Language Identification Results



```
> java weka.classifiers.functions.SMO -t train.arff -T test.arff
```

```
=== Error on test data ===
```

```
Correctly Classified Instances      5703           95.05 %
Incorrectly Classified Instances    297           4.95 %
...
Total Number of Instances          6000
```

```
=== Confusion Matrix ===
```

	a	b	c	d	e	f	g	h	i	j	k	l	<-- classified as
497	0	0	2	0	0	1	0	0	0	0	0	0	a = de
0	490	6	0	0	1	0	0	2	1	0	0	0	b = it
0	8	486	1	0	1	0	1	2	1	0	0	0	c = ca
9	3	1	431	1	43	0	8	1	2	0	1	1	d = no
1	1	0	2	492	0	0	3	0	0	1	0	0	e = fi
4	1	1	84	0	402	0	5	0	1	0	2	2	f = dk
3	4	1	2	0	1	483	1	1	0	4	0	0	g = sb
4	1	4	15	0	5	0	468	1	1	1	0	0	h = sv
0	2	2	0	0	0	0	0	492	2	0	2	2	i = fr
1	2	6	2	0	0	0	1	3	485	0	0	0	j = en
1	0	1	0	2	0	0	0	0	0	496	0	0	k = et
4	1	1	1	0	2	0	0	6	4	0	481	0	l = nl

Language Identification Results



```
> java weka.classifiers.bayes.NaiveBayes -t train.arff -T test.arff
```

```
=== Error on test data ===
```

Correctly Classified Instances	5514	91.9	%
Incorrectly Classified Instances	486	8.1	%
...			
Total Number of Instances	6000		

```
=== Confusion Matrix ===
```

	a	b	c	d	e	f	g	h	i	j	k	l	<-- classified as
a	479	0	1	3	0	0	3	3	0	3	0	8	a = de
b	0	479	5	4	0	1	6	1	0	4	0	0	b = it
c	9	6	445	3	0	0	5	6	8	6	0	12	c = ca
d	12	0	3	388	0	72	1	17	0	2	0	5	d = no
e	2	1	0	2	487	0	0	4	0	0	3	1	e = fi
f	4	1	2	73	1	393	0	8	0	9	1	8	f = dk
g	3	0	0	1	1	1	492	0	0	1	1	0	g = sb
h	6	0	0	11	1	10	0	461	0	8	0	3	h = sv
i	3	0	13	5	0	0	2	1	453	4	0	19	i = fr
j	3	0	1	4	0	2	3	2	0	464	0	21	j = en
k	1	0	0	1	1	0	2	1	1	2	489	2	k = et
l	7	0	0	1	0	0	1	1	2	4	0	484	l = nl