A System for the Support of Experiments in Text Classification

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Presentation outline

1. Motivation & Background
2. System Description
3. Evaluation
4. Conclusions & Future work

Motivation

- "All of the **biggest technological inventions** created by man - the airplane, the automobile, the computer - says little about his intelligence, but **speaks volumes about** his **laziness.** " — Mark Kennedy

- "Efficiency is intelligent laziness." — David Dunham

- "**Progress** isn't made by early risers. It's **made by lazy men** trying to find easier ways to do something." — Robert A. Heinlein

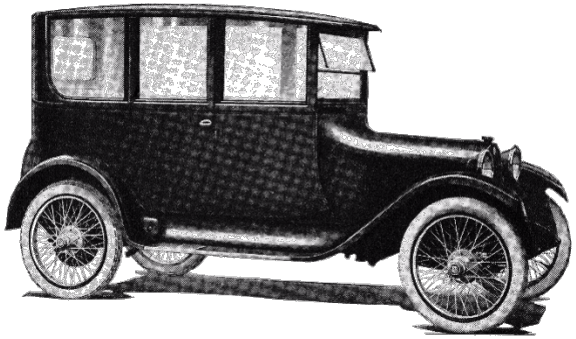
- "I don't think necessity is the mother of invention. **Invention . . . arises** directly from idleness, possibly also from laziness. **To save oneself trouble.**"

  — Agatha Christie, *An Autobiography*

- "Laziness is the first step towards efficiency." — Patrick Bennett

Motivation

- History of technology evolution is based on laziness.
  "Where else can we save ourselves trouble?"



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Automation – the keyword "What else can we automate?"

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Automation – the keyword "What else can we automate?"

Motivation

Research process

- **creative part** (preparing descriptions of research background, literature review, discussion and detailed analysis of the results of experiments)
- **non-creative part** (laboriously preparing data for experiments, conducting the evaluation experiments, step-by-step manually changing feature sets to train and test classifiers, from the experiment results preparing tables, graphs, or descriptions of the results for the use in technical reports and scientific papers)

Non-creative part of everyday research drill - laborious because requires the most of researcher's focus and precision

Motivation

People usually automate the non-creative part (laborious), and not the creative part (pleasant)

- Automated calculation process, but not what we use the calculations for
- Automated buying the drink but not drinking it
- Automated going to the theatre, but not watching the show

Non-creative - Laborious for us – easy for computers

Creative – pleasant for us - difficult for computers

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Let's try to automate this !

System Description

1. Prepare data for experiment
2. Conduct experiment under conditions selected by user
3. Summarize results and prepare materials for a paper

System Description

- **User input**
- Text classification and analysis tasks.
- At present - up to two datasets (binary classification, spam/not-spam, or positive/negative, etc.)
- The user needs to prepare two separate files with sentences.
- The rest is done “with one click”.

System Description

- **Experiment Setup Preparation Module**
- Launch: one command

```
$ bash main.sh
```

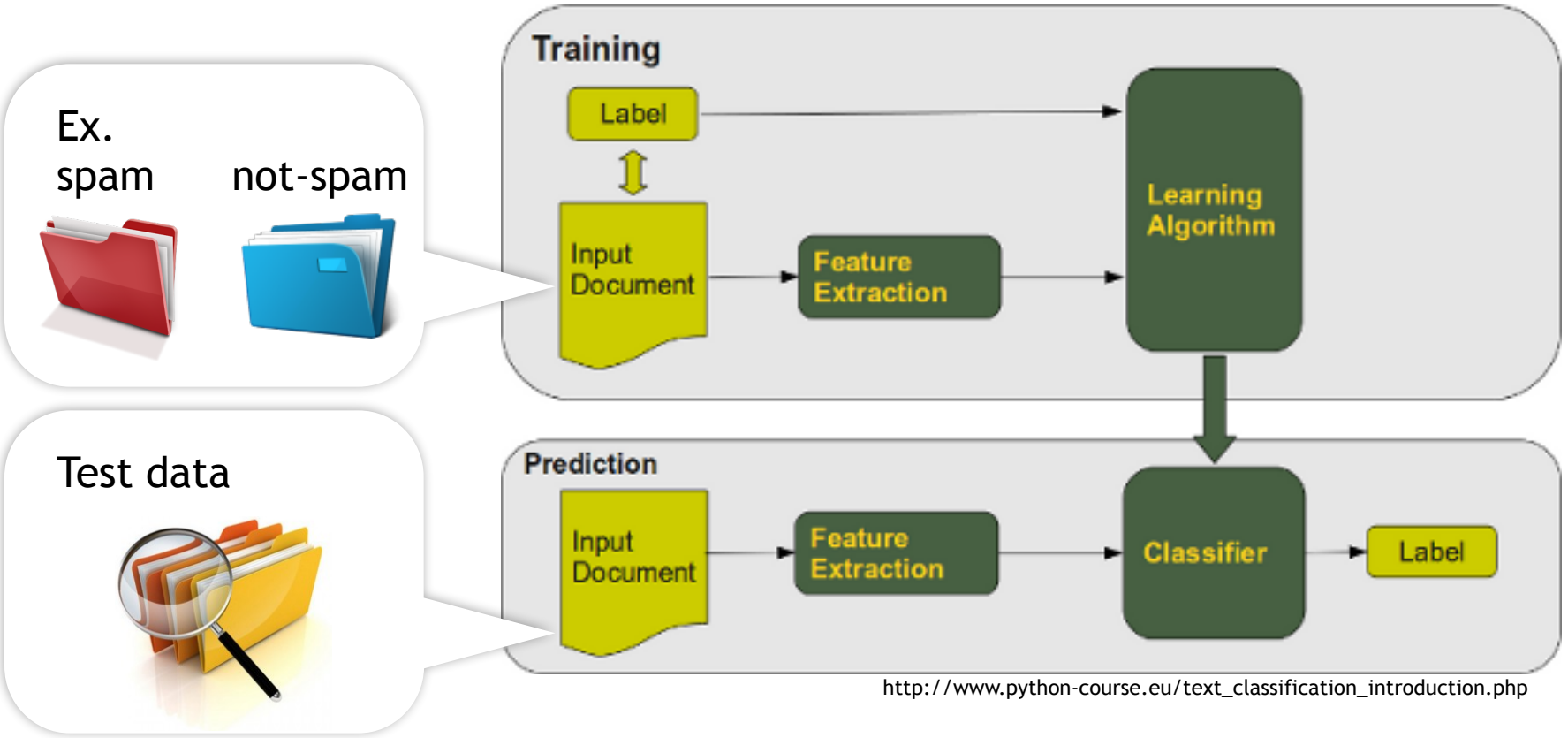
- Options
- n-fold cross validation by adding parameter

`$ bash main.sh 5` (5-fold cross validation, default = 10)

- parameter: `1` (test data = training data)
- parameter: `-loo` (leave-one-out)

System Description

- Text classification



http://www.python-course.eu/text_classification_introduction.php

System Description

- **Pattern List Generation Module – all n-grams**

- **Weight calculations**
- Normalized
- Awarding length
- Awarding length and occurrence
- ... (possible to add other)

$$w_j = \left(\frac{O_{pos}}{O_{pos} + O_{neg}} - 0.5\right) * 2$$

$$w_l = w_j * k$$

$$w_{lo} = w_j * k * O$$

System Description

- **Pattern List Generation Module – all n-grams**

- **Pattern list modifications**
- Original pattern list
- Erasing all ambiguous patterns,
- Erasing zero-patterns (ambiguous patterns which appear in the same number on both sides).

…
1.0000:ー
1.0000:し
1.0000:～
0.6923:よ
0.6667:だ
0.2000:に
0.2000:な
0.0182:。
0.0000:一緒 に
0.0000:ね 。
0.0000:から
0.0000:本
-0.0833:が
-0.1111:を
-0.2000:一緒
-0.6364:た 。
-1.0000:が すい た 。
-1.0000:い ます 。
-1.0000:が すい た
…

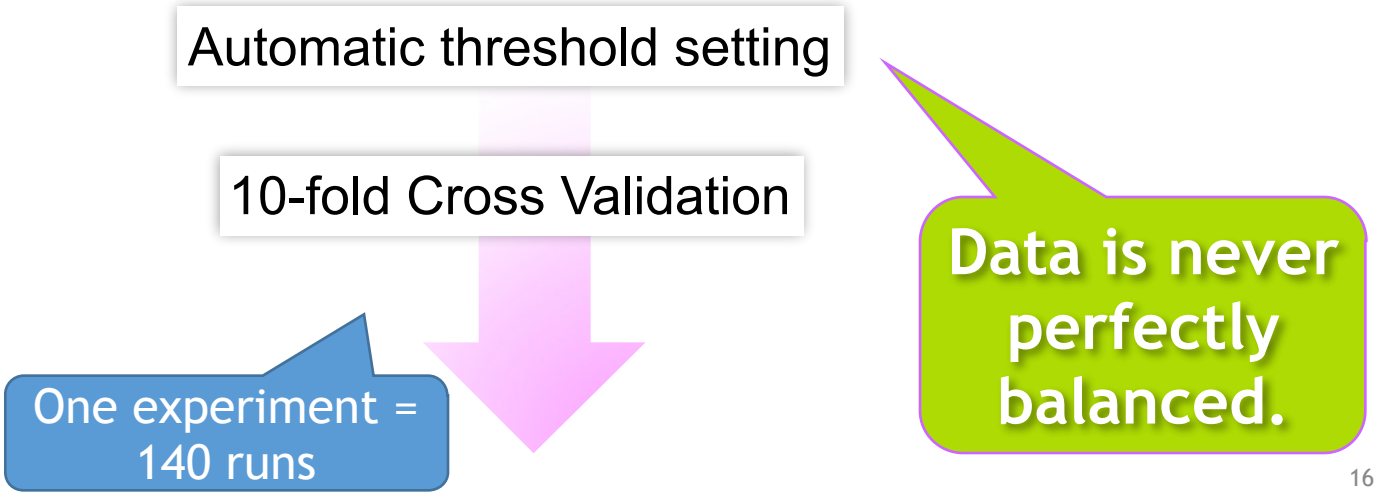
Experiment setup

Pattern List Modification

1. All patterns
2. Zero-patterns deleted
3. Ambiguous patterns deleted

Weight Calculation Modifications

1. Normalized
2. Award length
3. Award length and occurrence



System Description

- **Text Classification Module**

- Using weights of patterns calculate score for new input sentences
- Now – simple classifier

$$score = \sum w_j, (1 \geq w_j \geq -1)$$

- In future add other classifiers (kNN, NN, SVM)

System Description

- **Contingency Table Generation Module**

Predicted class \ True class	Positive	Negative	Measures
Positive	True positive *TP*	False positive *FP*	Positive predictive value (PPV) $\frac{TP}{TP+FP}$
Negative	False negative *FN*	True negative *TN*	Negative predictive value (NPV) $\frac{TN}{FN+TN}$
Measures	Sensitivity $\frac{TP}{TP+FN}$	Specificity $\frac{TN}{FP+TN}$	Accuracy $\frac{TP+TN}{TP+FP+FN+TN}$

System Description

- **Contingency Table Generation Module**
- **LaTex Table Generation Module**

unmodified pattern list

Threshold	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20	0.10	0.00	-0.10	-0.20	-0.30	-0.40	-0.50	-0.60	-0.70	-0.80	-0.90	-1.00
Precision	0.00	0.00	0.10	0.40	0.35	0.50	0.61	0.60	0.57							0.52	0.51	0.50	0.50	0.50	0.50
Recall	0.00	0.00	0.02	0.10	0.10	0.20	0.30	0.44	0.							1.00	1.00	1.00	1.00	1.00	1.00
F-score	0.00	0.00	0.03	0.16	0.16	0.29	0.40	0.51	0							69	0.67	0.67	0.67	0.67	0.67
Accuracy	0.50	0.50	0.51	0.55	0.5											54	0.51	0.50	0.50	0.50	0.50
Specificity																08	0.02	0.00	0.00	0.00	0.00
phi-coefficient	0.00	0.00	0.03	0.1												12	0.03	0.00	0.00	0.00	0.00

zero deleted

Threshold	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0							50	-0.60	-0.70	-0.80	-0.90	-1.00
Precision	0.00	0.00	0.10	0.40	0.40	0.50	0.59	0.60	0							52	0.51	0.51	0.50	0.50	0.50
Recall	0.00	0.00	0.02	0.10	0.12	0.24	0.30	0.46	0							00	1.00	1.00	1.00	1.00	1.00
F-score	0.00	0.00	0.03	0.16	0.18	0.32	0.40	0.52	0							69	0.67	0.67	0.67	0.67	0.67
Accuracy	0.50	0.50	0.51	0.55	0.54	0.59	0.56	0.57	0							54	0.51	0.51	0.50	0.50	0.50
Specificity	1.00	1.00	1.00	1.00	0.96	0.94	0.82	0.68	0.							.08	0.02	0.02	0.00	0.00	0.00
phi-coefficient	0.00	0.00	0.03	0.15	0.12	0.22	0.15	0.17	0.1							0.12	0.03	0.03	0.00	0.00	0.00

Precision
Recall
F-score
Accuracy
Specificity
Phi-coefficient

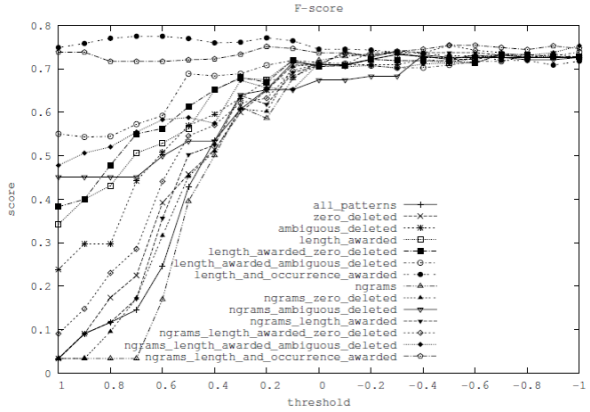
ambiguous deleted

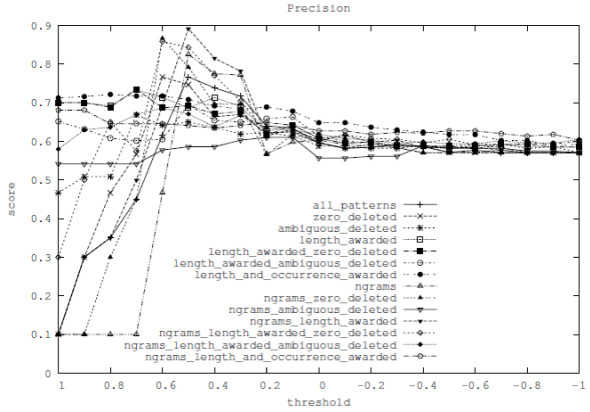
Threshold	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20	0.10	0.00	-0.10	-0.20	-0.30	-0.40	-0.50	-0.60	-0.70	-0.80	-0.90	-1.00
Precision	0.20	0.30	0.55	0.62	0.55	0.60	0.58	0.60	0.55	0.57	0.58	0.58	0.57	0.54	0.53	0.53	0.53	0.53	0.51	0.51	0.50
Recall	0.04	0.06	0.16	0.28	0.30	0.42	0.46	0.64	0.72	0.86	0.90	0.96	0.96	0.96	0.96	0.98	0.98	0.98	0.98	0.98	1.00
F-score	0.07	0.10	0.25	0.39	0.39	0.49	0.51	0.62	0.63	0.69	0.70	0.72	0.72	0.69	0.68	0.69	0.69	0.69	0.67	0.67	0.67
Accuracy	0.50	0.51	0.56	0.60	0.59	0.62	0.57	0.60	0.57	0.60	0.61	0.62	0.61	0.56	0.55	0.55	0.55	0.55	0.52	0.52	0.50
Specificity	0.96	0.96	0.96	0.92	0.88	0.82	0.68	0.56	0.42	0.34	0.32	0.28	0.26	0.16	0.14	0.12	0.12	0.12	0.06	0.06	0.00
phi-coefficient	0.00	0.03	0.17	0.24	0.20	0.27	0.15	0.21	0.15	0.23	0.27	0.31	0.29	0.16	0.13	0.13	0.13	0.13	0.05	0.05	0.00

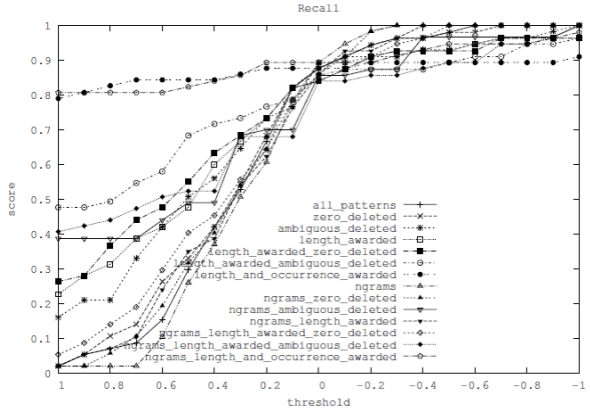
System Description

- **Contingency Table Generation Module**
- **LaTex Table Generation Module**
- **Graph Generation Module**

  Gnuplot (http://www.gnuplot.info/)







System Description

- **Contingency Table Generation Module**
- **LaTex Table Generation Module**
- **Graph Generation Module**
- **Result Analysis and Sentence Template Generation Module (beta)**

"When it comes to [weight calculations / pattern list modifications / ...], the highest [BEP / balanced F-score / Accuray / ...] was achieved by [zero_deleted / ambiguous _deleted / ...]".

System Description

- **Contingency Table Generation Modu**
- **LaTex Table Generation Module**
- **Graph Generation Module**
- **Result Analysis and Sentence Templ**
- **Most Useful Pattern Extraction Module**

  Useful in corpus linguistics

Emotive		Non-emotive	
freq.	example	freq	example
14	、＊た	11	い＊。
12	で	8	し＊。
11	ん＊。	7	です。
11	と	6	は＊です
11	ー	6	まし＊。
10	、＊た＊。	5	ました。
9	、＊よ	5	ます
9	、＊ん	5	い
8	し	4	です＊。
7	ない	3	この＊は＊。
7	！	3	は＊です。
6	ん＊よ	3	て＊ます
6	、＊だ	3	が＊た。
6	ちゃ	3	美味しい
6	よ。	3	た。
5	だ＊。	2	た＊、＊。
5	に＊よ	2	せ
5	が＊よ	2	か
5	ん	2	さ

Evaluation

- No GUI
- One command -> everything done automatically = Nothing to ask users about usability features
- How to evaluate??

Evaluation

- No GUI
- One command -> everything done automatically = Nothing to ask users about usability features
- How to evaluate??

1. Talk to users, ask their opinions
2. Use the system to perform research and get paper accepted (practical evaluation)

Evaluation

- User opinions
- “Add features/options”
  - Statistical significance calculation between all results
  - E-mail notification
  - Partial generation of presentation slides

Evaluation

- Practical evaluation

Michal Ptaszynski, Fumito Masui, Rafal Rzepka, Kenji Araki. 2014. **Automatic Extraction of Emotive and Non-emotive Sentence Patterns**, In *Proceedings of The Twentieth Annual Meeting of The Association for Natural Language Processing (NLP2014)*, pp. 868-871, Sapporo, Japan, March 17-21.

Michal Ptaszynski, Fumito Masui, Rafal Rzepka, Kenji Araki. 2014. **Emotive or Nonemotive: That is The Question**, In *Proceedings of 5th Workhsop on Computational Approaches to Subjectivity, Sentiment & Social Media Analysis (WASSA 2014),* pp. 59-65, held in conjunction with *The 52nd Annual Meeting of the Association for Computational Linguistics (ACL 2014)*, Baltimore, USA, June 22-27.

Michal Ptaszynski, Fumito Masui, Rafal Rzepka, Kenji Araki. 2014. **Detecting emotive sentences with pattern-based language modelling**. In *Proceedings of the 18th International Conference on Knowledge-Based and Intelligent Information & Engineering Systems - KES2014*, Gdynia, Poland, 15-17 September, 2014.

Michal Ptaszynski, Dai Hasegawa, Fumito Masui, Hiroshi Sakuta, Eijiro Adachi. 2014. **How Differently Do We Talk? A Study of Sentence Patterns in Groups of Different Age, Gender and Social Status**. In *Proceedings of The Twentieth Annual Meeting of The Association for Natural Language Processing (NLP2014)*, pp. 3-6, Sapporo, Japan, March 17-21.

Michal Ptaszynski, Dai Hasegawa, Fumito Masui. 2014. **Women Like Backchannel, But Men Finish Earlier: Pattern Based Language Modeling of Conversations Reveals Gender and Social Distance Differences**, In *9th International Conference on Natural Language Processing (PolTAL 2014)*, Samsung HLT Young Researchers Symposium, 2014.09.17-19, Warsaw, Poland.

Emotional and non-emotional sentences.

Discovery: automatic approach to affect analysis can yield similar results to tools developed manually.

Finding similarities between various conversations

Discovery: The system extracted several linguistic rules (confirmed statistically) which were previously unknown.

Evaluation

- Practical evaluation

Yoko Nakajima, Michal Ptaszynski, Hirotoshi Honma, Fumito Masui. 2014. **Investigation of Future Reference Expressions in Trend Information**. In *Proceedings of the 2014 AAAI Spring Symposium Series*, "Big data becomes personal: knowledge into meaning – For better health, wellness and well-being –", pp. 31-38, Stanford, USA, March 24-26, 2014.

Yoko Nakajima, Michal Ptaszynski, Fumito Masui, Hirotoshi Honma. 2015. **Extracting References to the Future from News using Morphosemantic Patterns**, *IJCAI 2015 Workshop on Chance Discovery, Data Synthesis, Curation and Data Market*, Buenos Aires, July 25-31, 2015. (to appear)

Future related sentences

Discovery: semantic and grammatical information is useful in finding future sentences.

Michal Ptaszynski, Fumito Masui, Yasutomo Kimura, Rafal Rzepka, Kenji Araki. 2015. **Brute Force Works Best Against Bullying**, *IJCAI 2015 Workshop on Intelligent Personalization (IP 2015),* Buenos Aires, July 25-31, 2015. (to appear)

Detecting cyberbullying entries

Discovery: Cyberbullying is best discriminated using sophisticated language patterns.

Conclusions

- Research process consists of
  - creative tasks
  - laborious non-creative tasks
- Computers are poor at creative tasks, but good at non-creative tasks
- Computers could help researchers focus on the creative part of research
- Developed a system which helps with non-creative part of research.

Conclusions

- The proposed system :
  - prepares the data for the experiments
  - automatically performs the experiments
  - from the results calculates scores in different measures (Precision, Recall, etc.)
  - creates tables in LaTex template containing all results
  - draws graphs comparing each groups of results
  - generates descriptions of those results using sentence templates
- Does all that with a single command.

Future Work

- Implement additional functions:
- add various classification algorithms.
- statistical significance calculation.
- n-fold cross validation multiple times
- e-mail notification
- automatically summarize sentence templates
- generation of presentation slides
- handle multi-label data

THANK YOU FOR YOUR ATTENTION!

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http://orion.cs.kitami-it.ac.jp/tipwiki/michal