Computer-aided Analysis of Privacy Policies: Extraction of Data Subjects Rights According to GDPR

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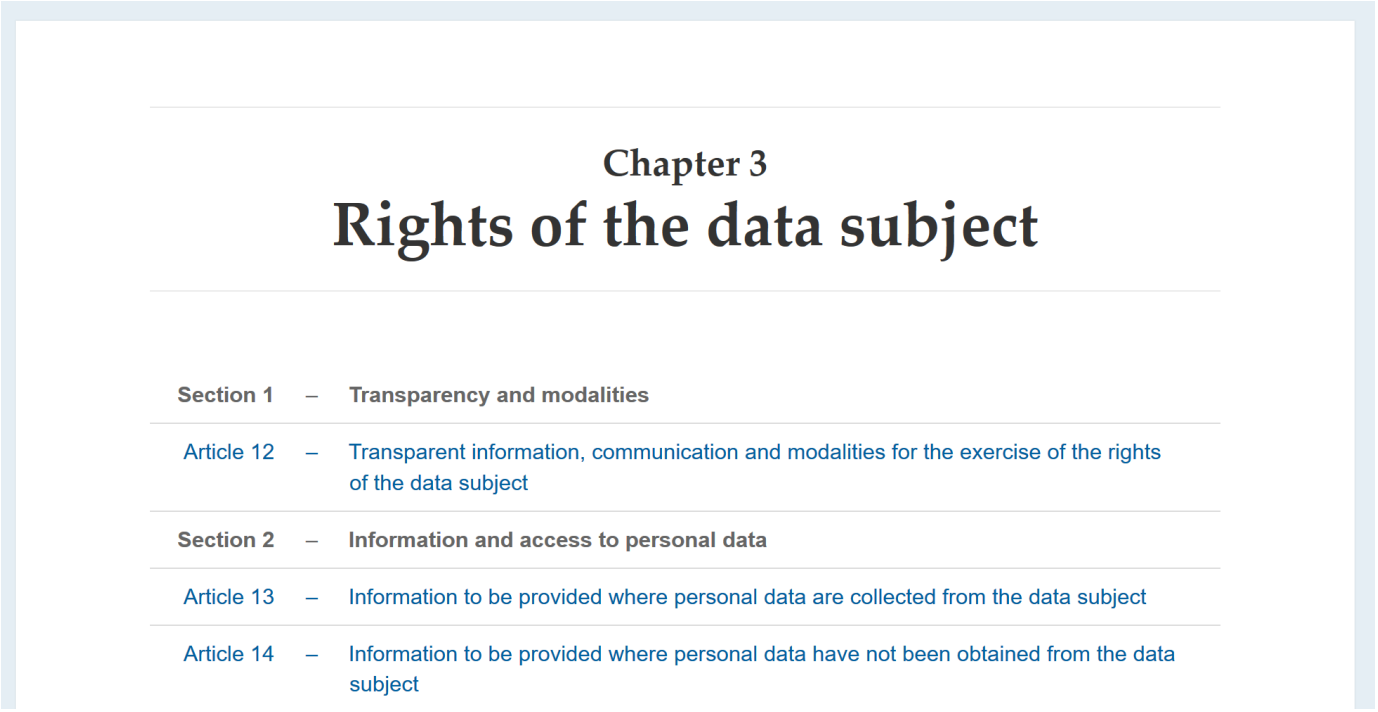
- Introduction
- Aims and Contribution
- Implementation
- Evaluation
- Live Demo
- Conclusion & Future Work

Introduction

General Data Protection Regulation (GDPR)

- Implementation of GDPR in 2016 and applicable as of May 2018
  - In response to increasing digitalization
  - Regularization of processing of personal data within the EU

- One chapter deals with data subject rights



Chapter 3

Rights of the data subject

Section 1	–	Transparency and modalities
Article 12	–	Transparent information, communication and modalities for the exercise of the rights of the data subject
Section 2	–	Information and access to personal data
Article 13	–	Information to be provided where personal data are collected from the data subject
Article 14	–	Information to be provided where personal data have not been obtained from the data subject

Image: https://dsgvo-gesetz.de/kapitel-3/

Introduction

Motivation – Automated Extraction of Data Subject Rights

Privacy policies are most important source of information for data collection and usage

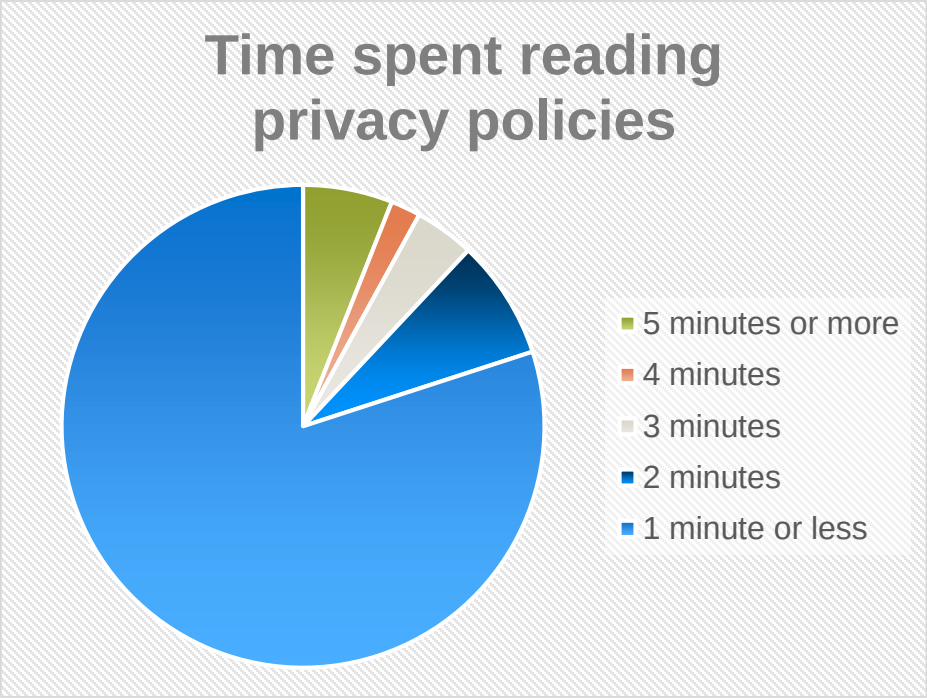
Problem:

Studies show that:

- Users are interested in protecting their data

But privacy policies…

- … often lack readability
- … cause an information overload



➡ Little time is spent reading privacy policies

➡ Not possible to make informed decisions regarding internet services

Image: Own illustration based on [2]

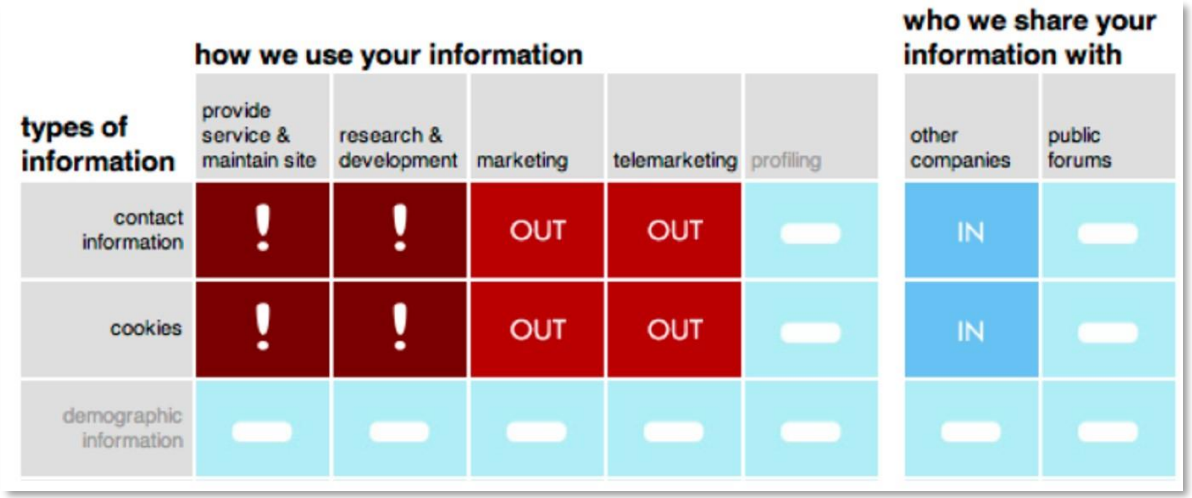
Introduction

Related Work – Privacy Policy Analysis Tools

Clear Representation of Contents:

- Layered Privacy Notices
- Platform for Privacy Preferences (P3P)
- Privacy Nutrition Labels

→ Rely on collaboration of service providers



types of information	how we use your information					who we share your information with	
	provide service & maintain site	research & development	marketing	telemarketing	profiling	other companies	public forums
contact information	!	!	OUT	OUT		IN	
cookies	!	!	OUT	OUT		IN	
demographic information							

Automated Analysis of Content:

- Machine Learning Based Approaches
  - Supervised ML classifiers for sentence classification
  - Answer categorical questions or summarize content
- Rule Based Approaches
  - Extraction rules and pattern matching
  - Often in combination with ML

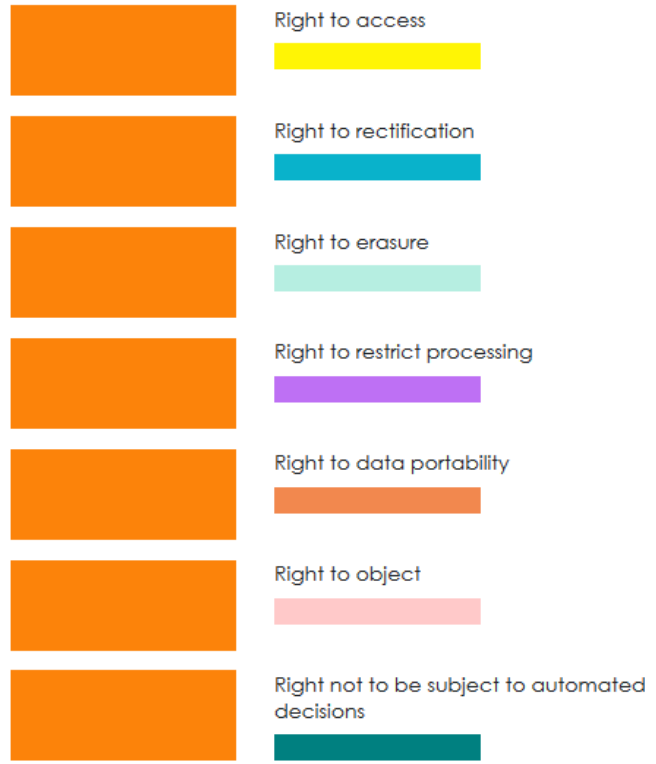
Image: Kelley, Patrick Gage, et al. "A nutrition label for privacy."

Aims and Contribution

Privacy Policy Analysis - Data Subject Rights

Requirements:

- Input of privacy policy text
- Automated analysis of policy text
- Display of contained data subject rights
- Mark relevant sentences in the input text



Aims and Contribution

Research Questions

RQ1: Which approaches exist to automatically analyze legal texts and privacy policies?

RQ2: Are supervised machine learning methods suitable to analyze privacy policies with regard to the coverage of the data subject rights?

RQ3: What are the strengths and weaknesses of sentence classification and sequence labeling based approaches?

RQ4: Which supervised machine learning approach performs best at extracting data subject rights from privacy policies?

RQ5: Which performance can be achieved on the test data and can the automated extraction add value for private consumers regarding the understanding of privacy policies?

Implementation

Analysis Tool

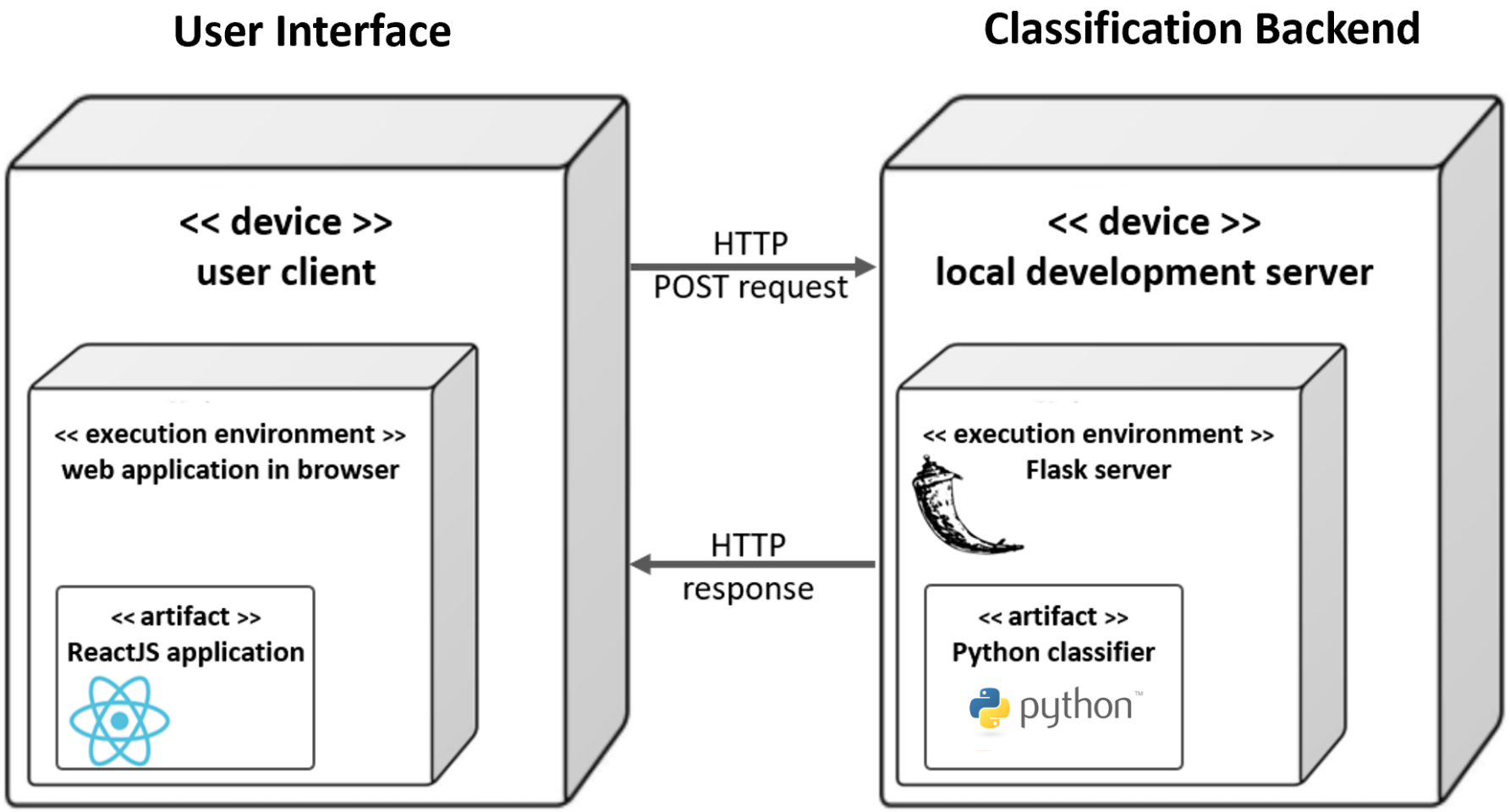


Image: Own illustration using logo prints for React, Flask and Python https://reactjs.org/, https://www.fullstackpython.com/flask.html, https://www.python.org/community/logos/

Implementation

Dataset and Classes

<< artifact >>
Python classifier
python

Class	Sentence-Based		Token-Based	
	Initial	Extended	Initial	Extended
Right to access	126	267	148	329
Right to rectification	114	258	158	331
Right to erasure	120	259	158	319
Right to restrict processing	75	159	113	211
Right to data portability	66	150	98	249
Right to object	108	204	136	244
Right not to be subject to automated decisions	21	60	26	81
TOTAL	630	1357	837	1764

- Extended dataset in the course of the thesis
- Added null class for sentences not containing any right

Implementation

Automated Extraction of Data Subject Rights

- Lowercasing
- Stopword removal
- Stemming
- Lemmatization

- TF/TF-IDF
- Word embeddings
- POS tags
- Prefix/suffix of words

- ML classifier
- Sequence labeling algorithm
- Rule based classifier

Implementation

Automated Extraction of Data Subject Rights

ML Classifier

Sentence classification in this case is a multi-label classification problem:

"You have the right to request that we confirm what personally identifying information (PII) we collect or hold about you, provide a copy of your PII to you in a machine readable format and to ask us to correct or update the PII."

<u>Problem:</u>

Traditional Classifiers can only deal with binary classification

➡ Algorithm Adoption or Problem Transformation

Implementation

Automated Extraction of Data Subject Rights

ML Classifier

Algorithm Adoption:

- Extensions of existing binary classification algorithms
- Multilabel-k-Nearest-Neighbor
- Multi-Label Twin Support Vector Machine

Problem Transformation:

- Convert multi-label classification problems into single-label classification problems
- In combination with binary classifier (e.g. decision tree, support vector machine)
- Binary Relevance
- Label Powerset
- Random K-Labelset
- Classifier Chain

Implementation

Automated Extraction of Data Subject Rights

ML Classifier

Binary Relevance:

Sentence	Access	Object	Erasure
1	1	0	1
2	1	1	0
3	0	1	1

	Access	¬Access
1	1	0
2	1	0
3	0	1

	Object	¬Object
1	0	1
2	1	0
3	1	0

	Erasure	¬Erasure
1	1	0
2	0	1
3	1	0

Implementation

Automated Extraction of Data Subject Rights

Sequence Labeling Algorithm

Conditional Random Field (CRF):

- Discriminative and graphical model for sequential data
- Used for sentence classification

```
[[('you', 'I'), ('may', 'I'), ('update', 'Rectification (Relevant)’), ('or', 'Rectification (Relevant)'),
('correct', 'Rectification (Relevant)’), ('information', 'I'), ('you', 'I'), ('have', 'I'), ('provided',
'I’), ('to', 'I'), ('us', 'I'), ('by', 'I'), ('going', 'I'), ('into', 'I‘), ('the', 'I'), ('user', 'I'),
('account', 'I'), ('settings', 'I’), ('screen', 'I'), ('within', 'I'), ('the', 'I'), ('app', 'I'), ('',
'I')], ...]
```

Implementation

Automated Extraction of Data Subject Rights

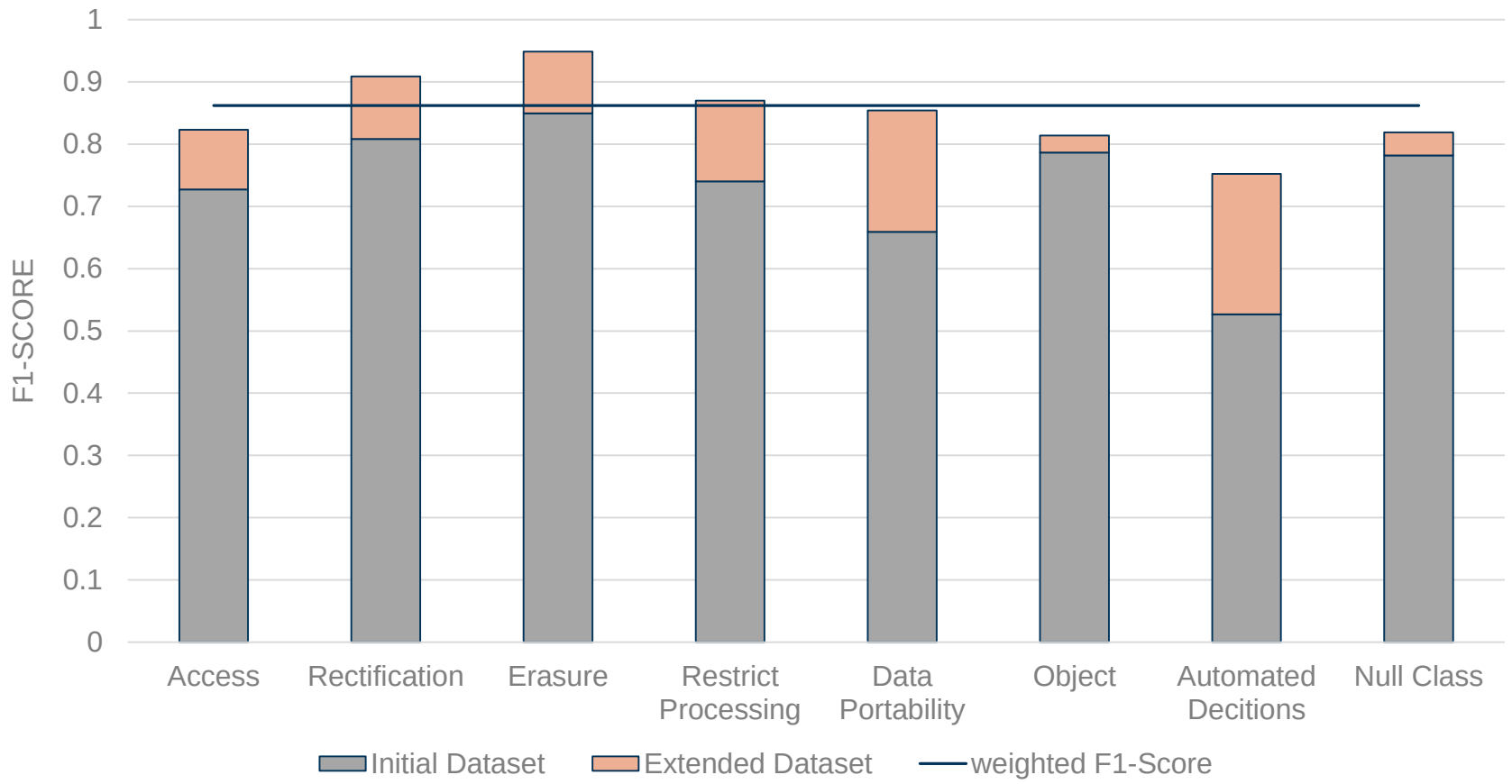
Rule Based Classifier

- Dictionary containing keywords for each class
- Automatically generated using training data and different thresholds

```
{Access:                {"access":  58,    "review":  8},
Rectification:          {"updat":  17,     "correct":  40,
                        "rectif":  18,     "edit":  5,
                        "incorrect":  7,   "rectifi":  7,
                        "incomplet":  6},
Erasure:                {"delet":  57,     "erasur":  16,
                        "account":  8,     "eras":  13,
                        "remov":  6},
Restrict Processing:    {"restrict":  42,  "limit":  5}
Data Portability:       {"format":  14,    "portabl":  16,
                        "structur":  8,    "commonli":  5,
                        "machin":  10,     "readabl":  10, ...
```

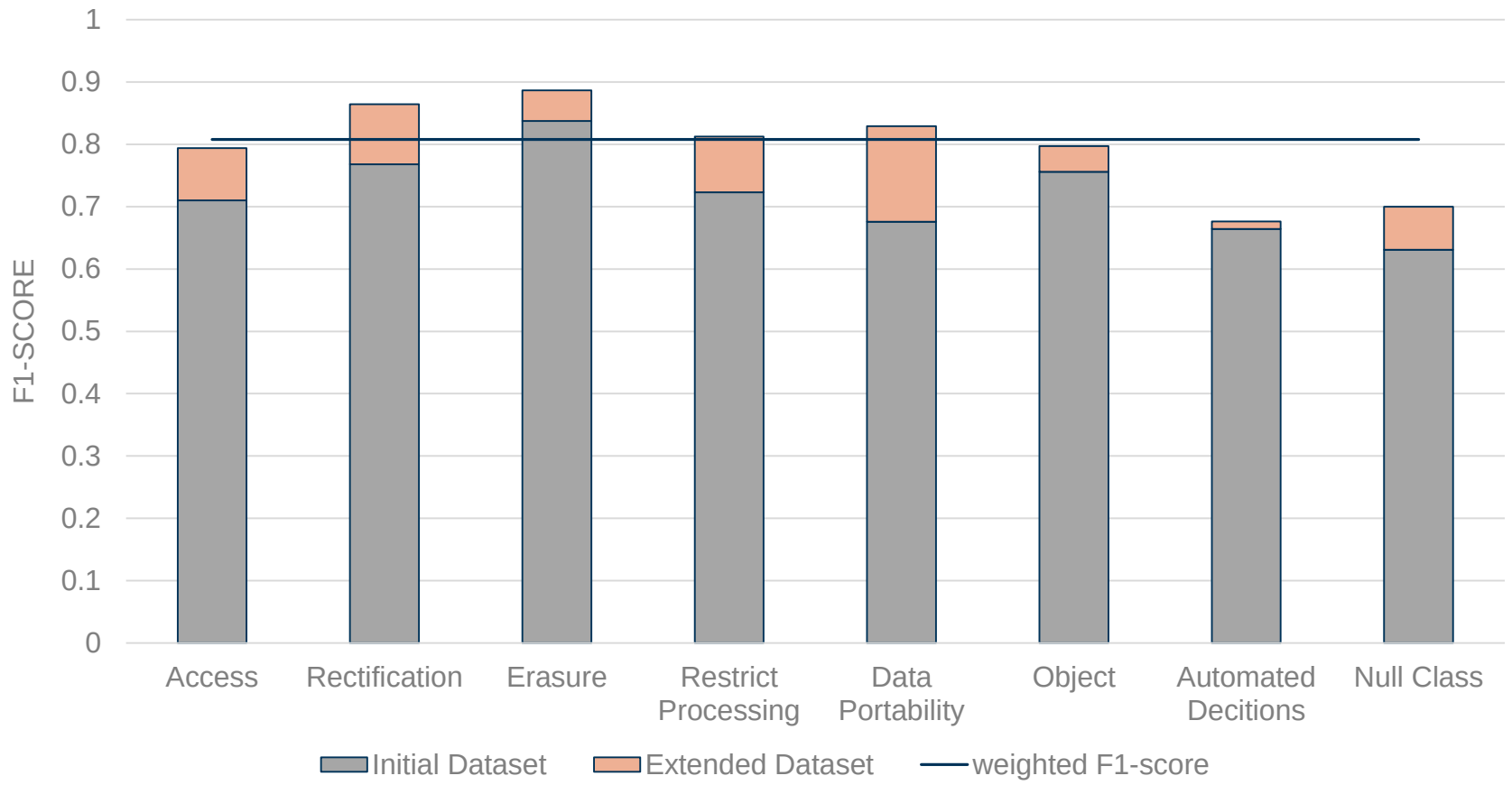
Evaluation

Quantitative Results – ML Classifier



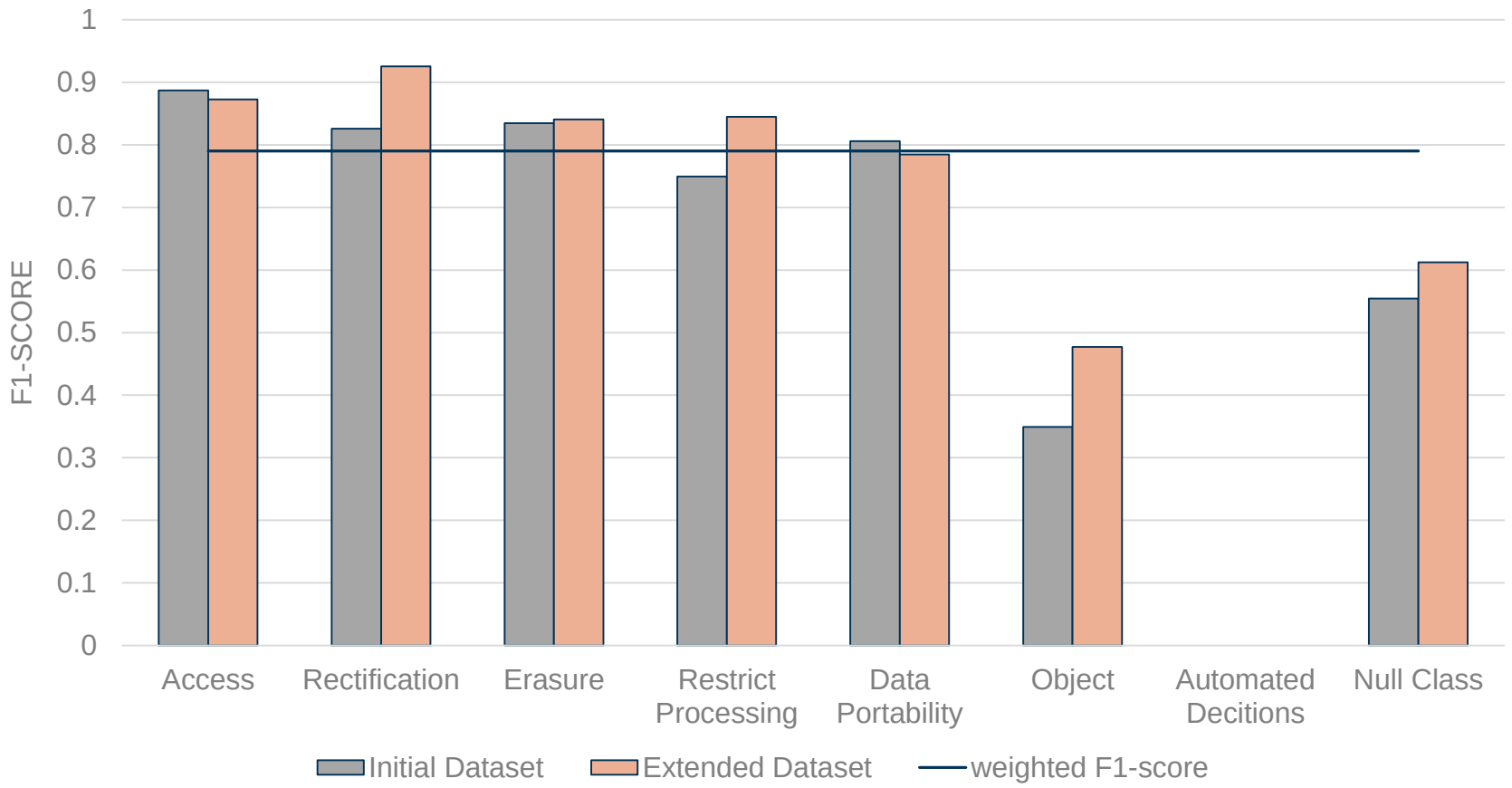
Evaluation

Quantitative Results – Sequence Labeling



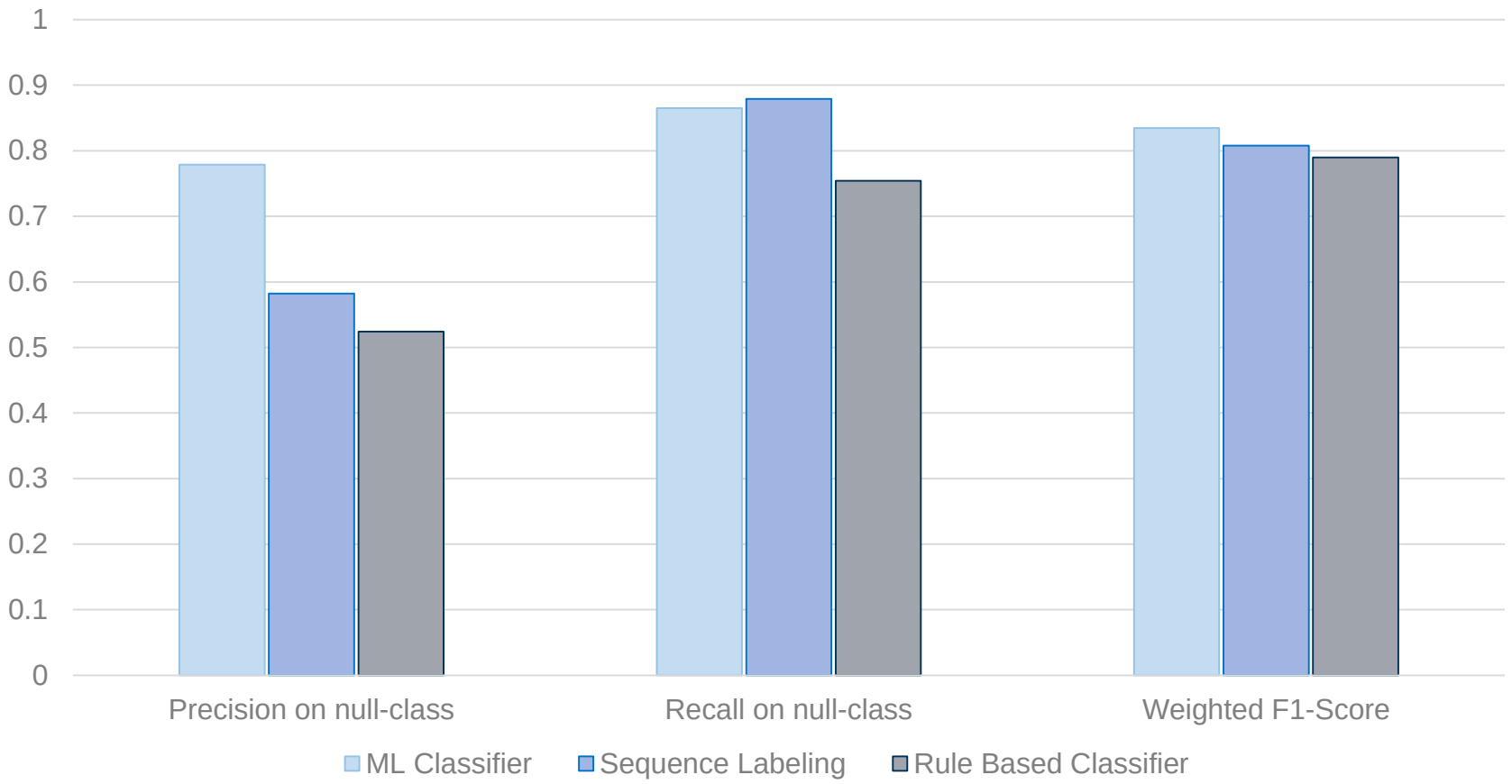
Evaluation

Quantitative Results – Rule Based Classifier

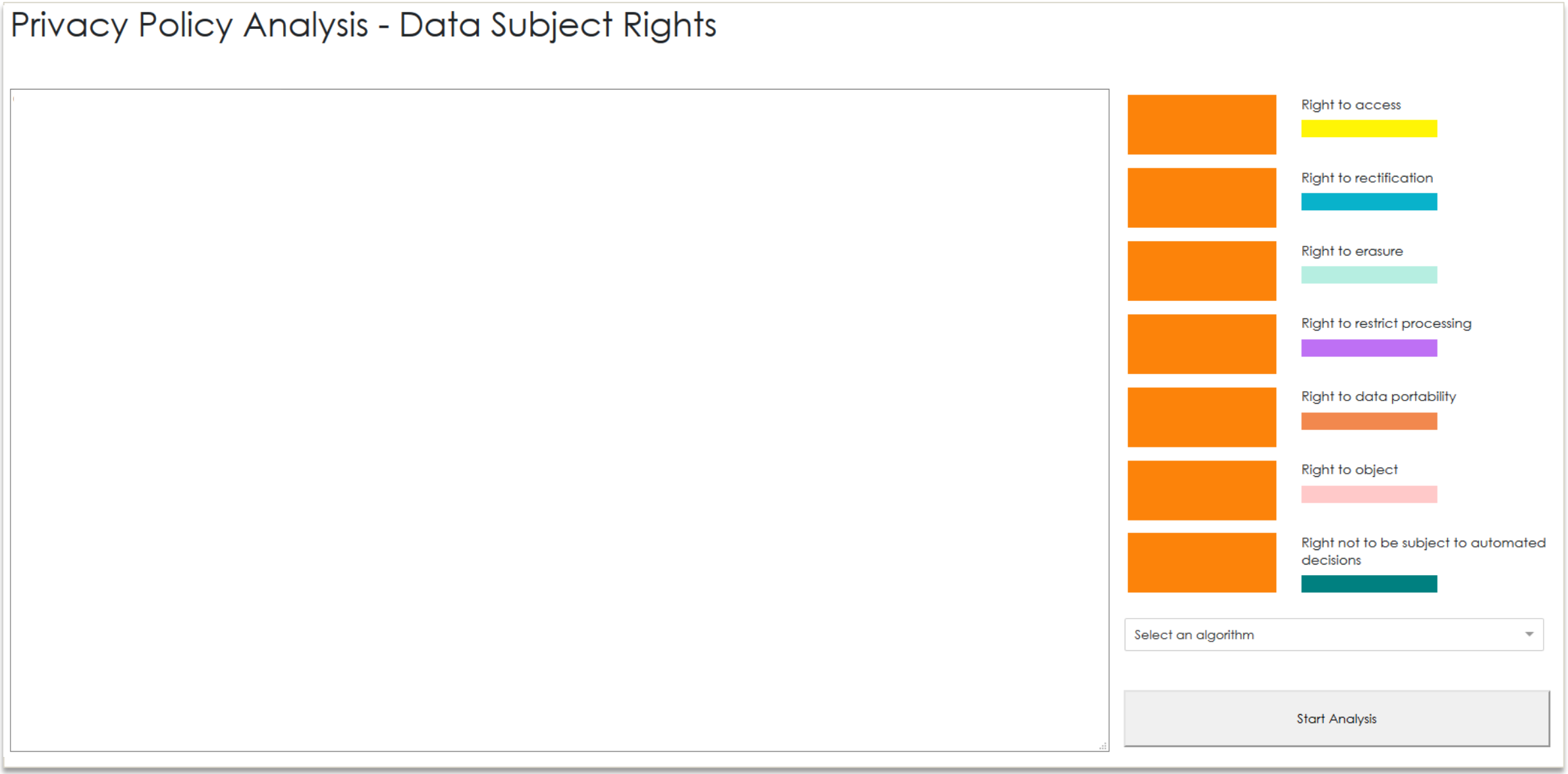


Evaluation

Quantitative Results – Comparison of Three Approaches



Live Demo


Privacy Policy Analysis - Data Subject Rights
Right to access
Right to rectification
Right to erasure
Right to restrict processing
Right to data portability
Right to object
Right not to be subject to automated decisions
Select an algorithm
Start Analysis

Conclusion & Future Work

Conclusion

RQ1: Which approaches exist to automatically analyze legal texts and privacy policies?

RQ2: Are supervised machine learning methods suitable to analyze privacy policies with regard to the coverage of the data subject rights?

RQ3: What are the strengths and weaknesses of sentence classification and sequence labeling based approaches?

RQ4: Which supervised machine learning approach performs best at extracting data subject rights from privacy policies?

RQ5: Which performance can be achieved on the test data and can the automated extraction add value for private consumers regarding the understanding of privacy policies?

Conclusion & Future Work

Future Work

Points that remain unresolved by this thesis and suggest improvements:

- Interviews for qualitative evaluation of analysis tool
- Extensive parameter tuning
- Creating a larger and balanced dataset for training
- Widen the area of application
- Evaluate combinations of ML and rule based approaches

References

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Use-Case Diagram

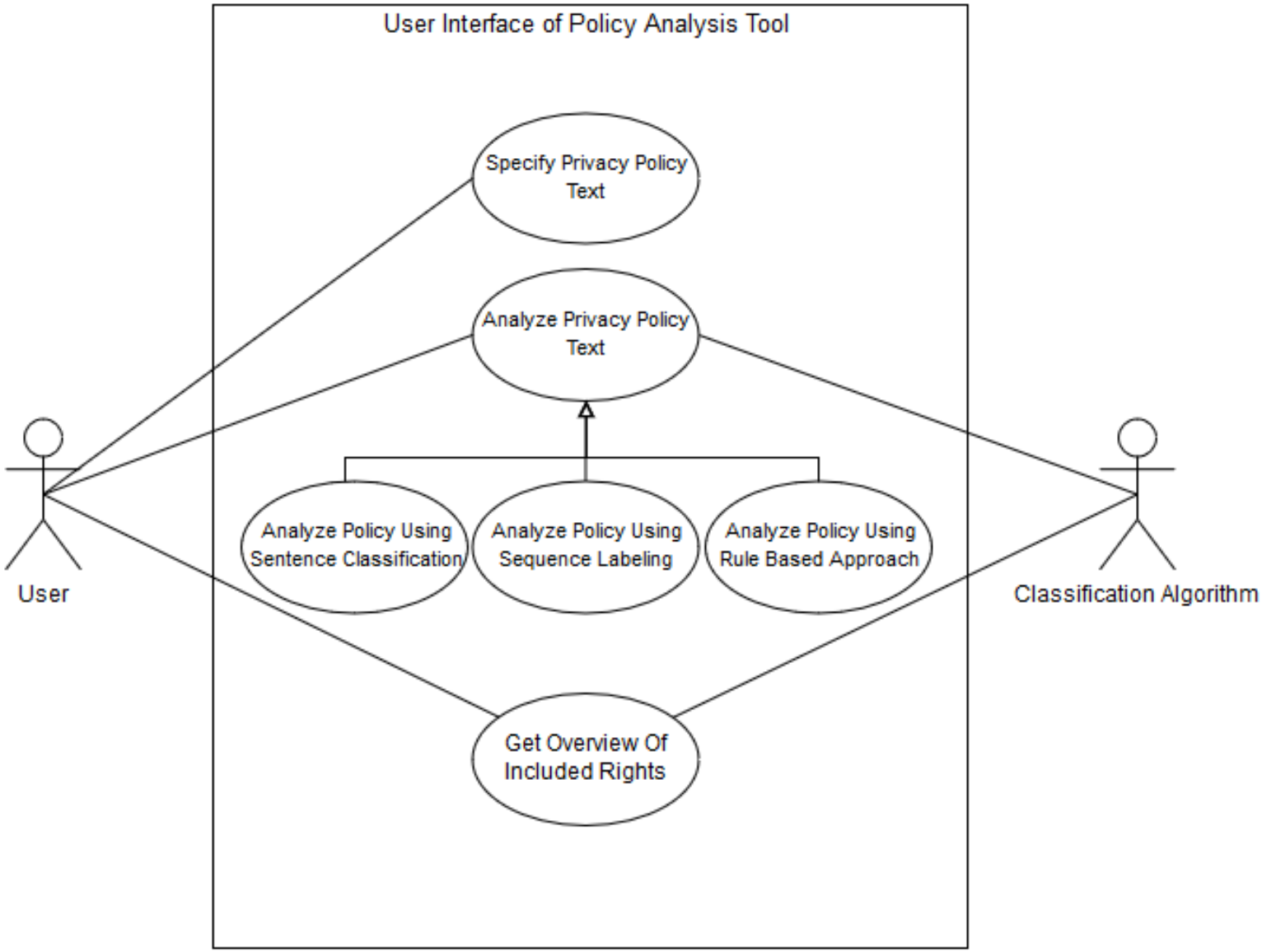
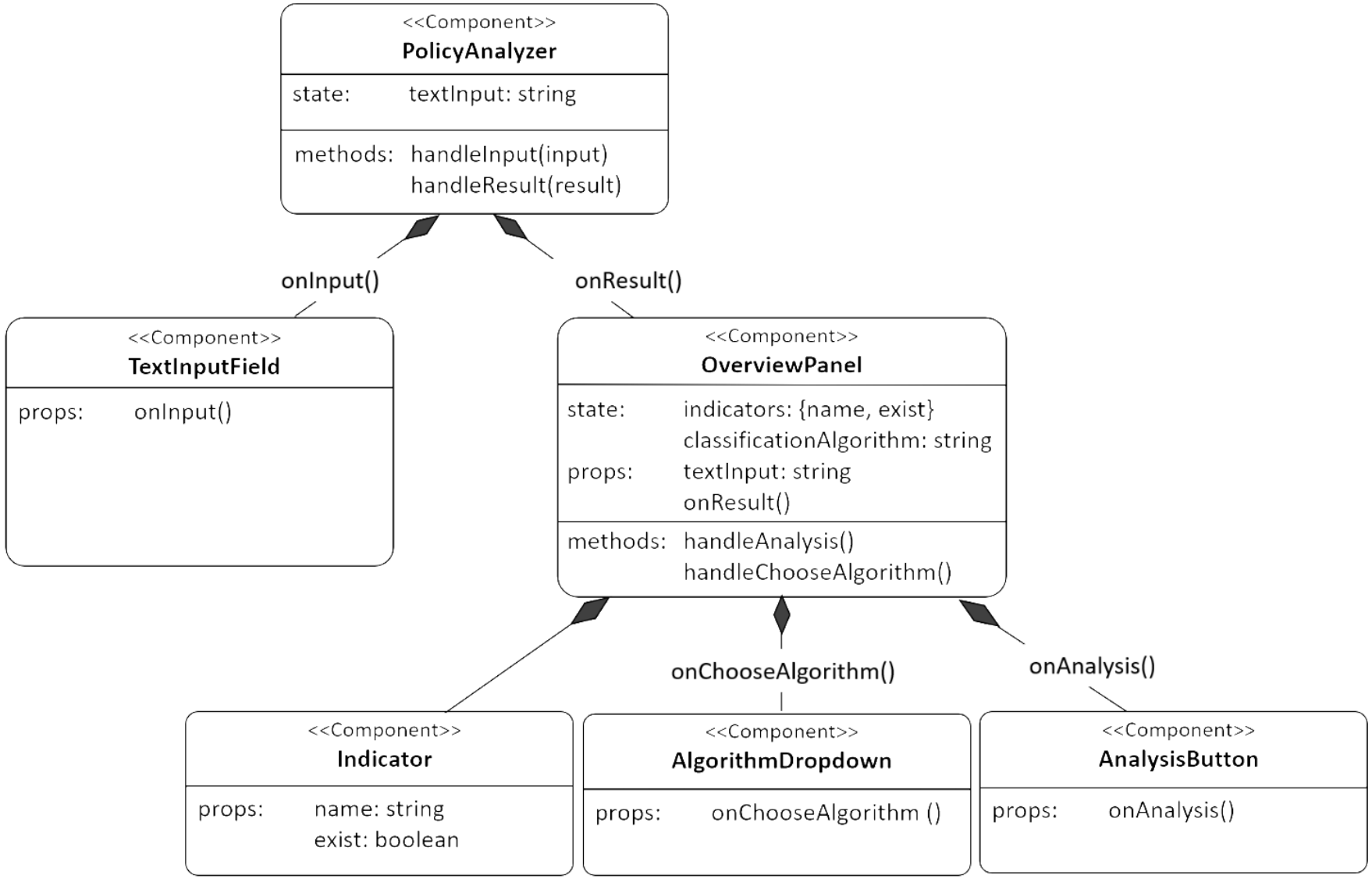


Image: Own illustration

GUI Components



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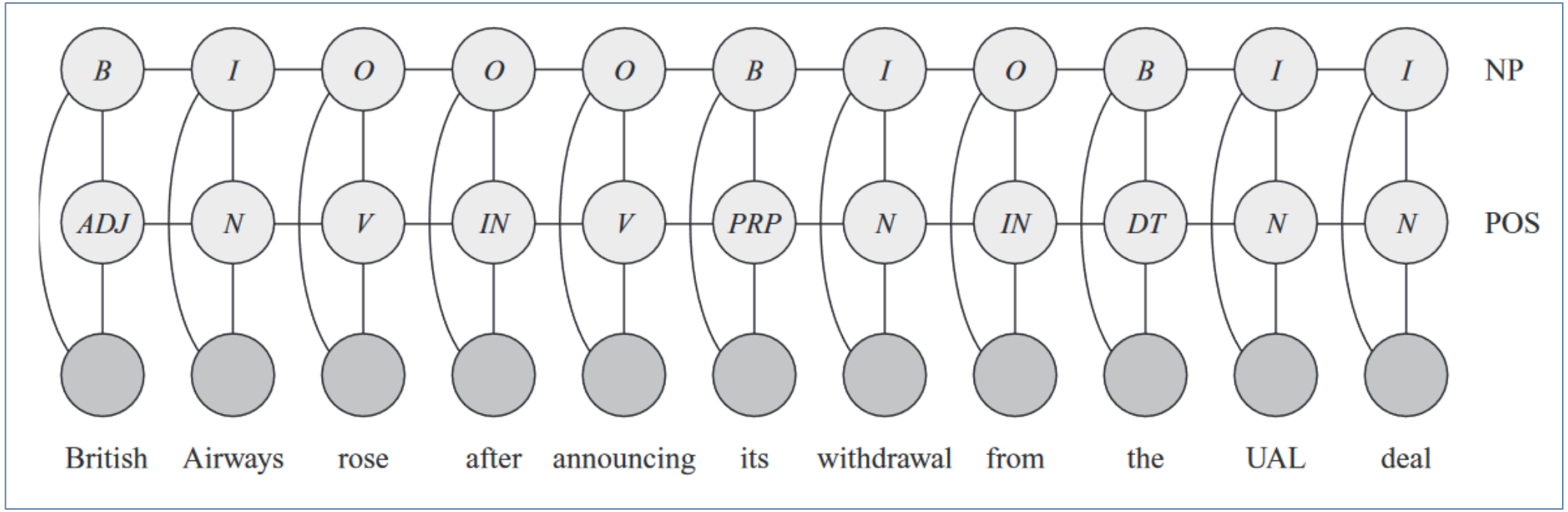
CRF for POS Tagging



Images: MURPHY, Kevin P. Machine learning: a probabilistic perspective. 2012

Generated Dictionary

```
{Access:                 {"access":  58,    "review":  8},
Rectification:           {"updat":  17,     "correct":  40,
                         "rectif":  18,     "edit":  5,
                         "incorrect":  7,   "rectifi":  7,
                         "incomplet":  6},
Erasure:                 {"delet":  57,     "erasur":  16,
                         "account":  8,     "eras":  13,
                         "remov":  6},
Restrict Processing:     {"restrict":  42,  "limit":  5}
Data Portability:        {"format":  14,    "portabl":  16,
                         "structur":  8,    "commonli":  5,
                         "machin":  10,     "readabl":  10,
                         "transmit":  4,    "transfer":  4},
Object:                  {"object":  56,    "withdraw":  14,
                         "consent":  9,     "opt":  16}
Automated Decisions:     {"decis":  9,      "subject":  4,
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                         "autom":  8}}
```
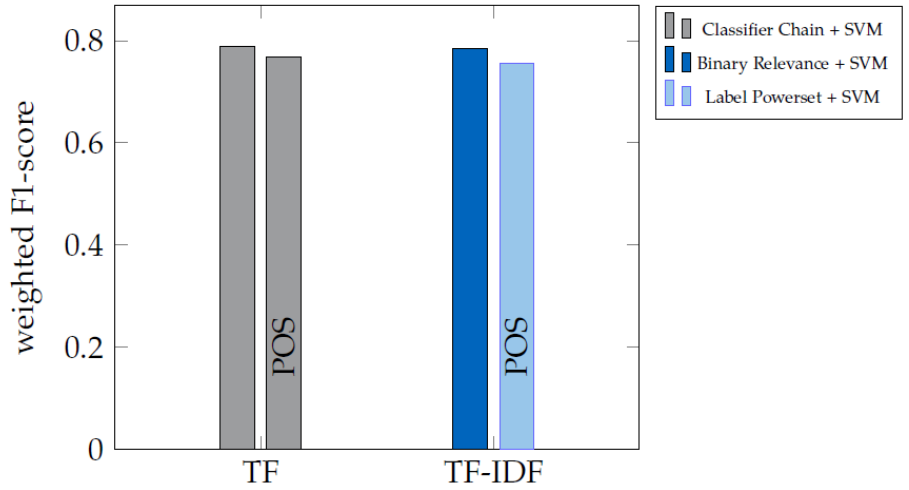
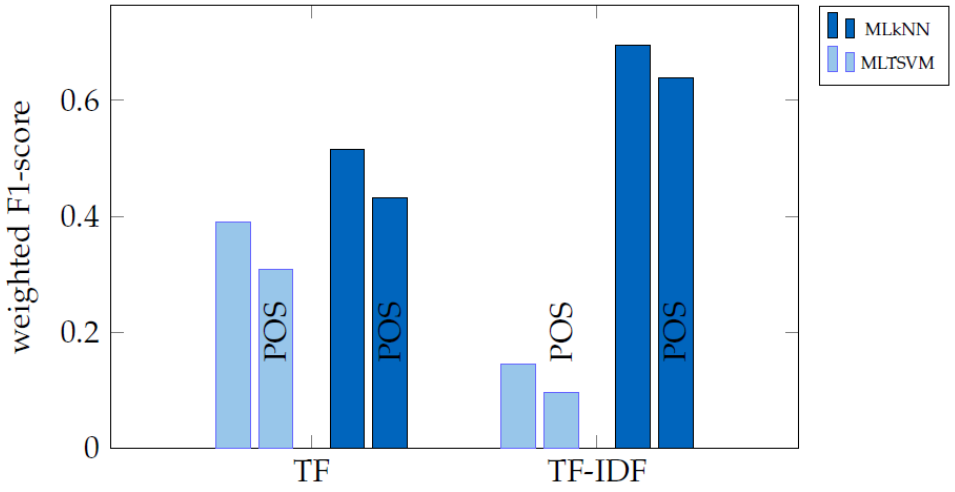
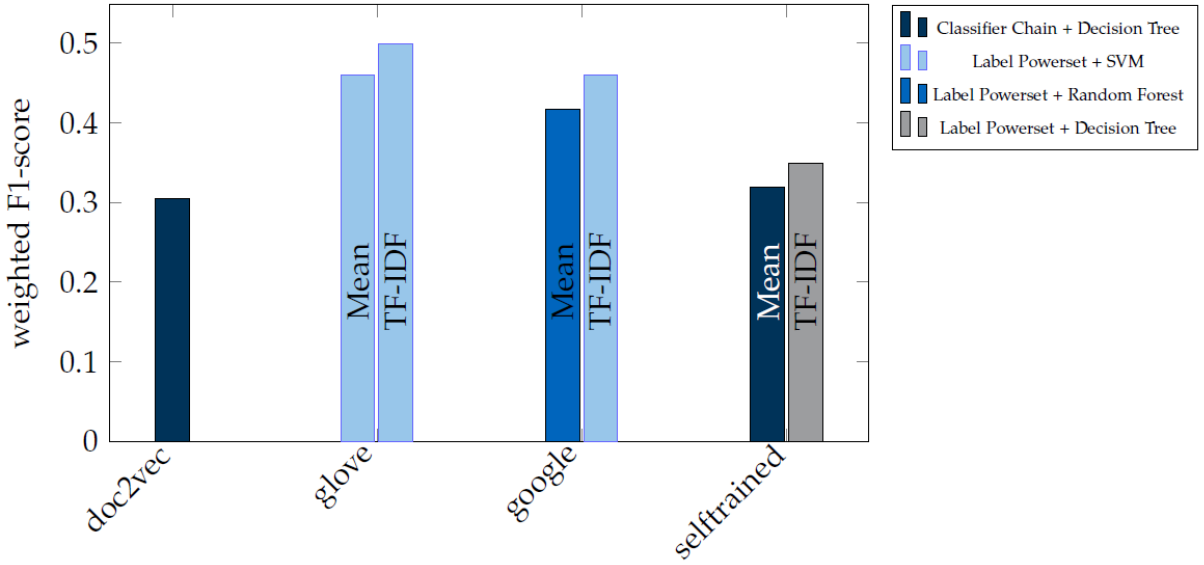

Sentence Classification

Embeddings and Sparse Representations

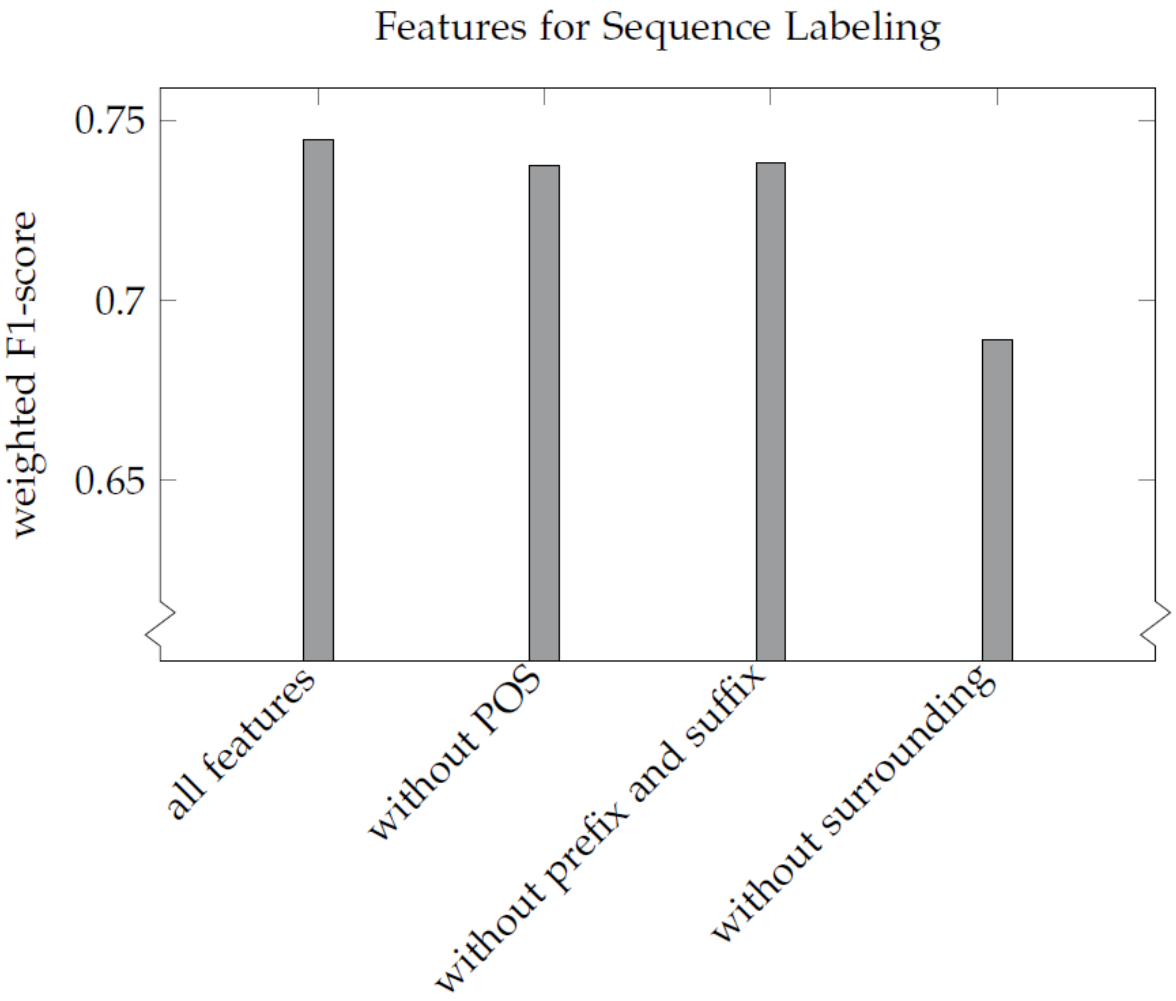




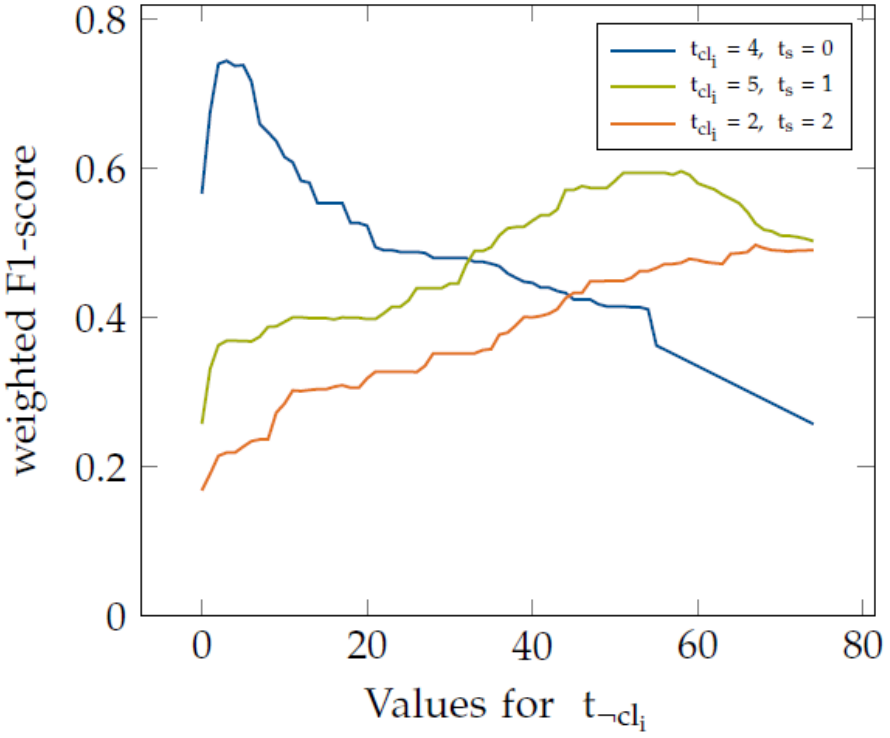


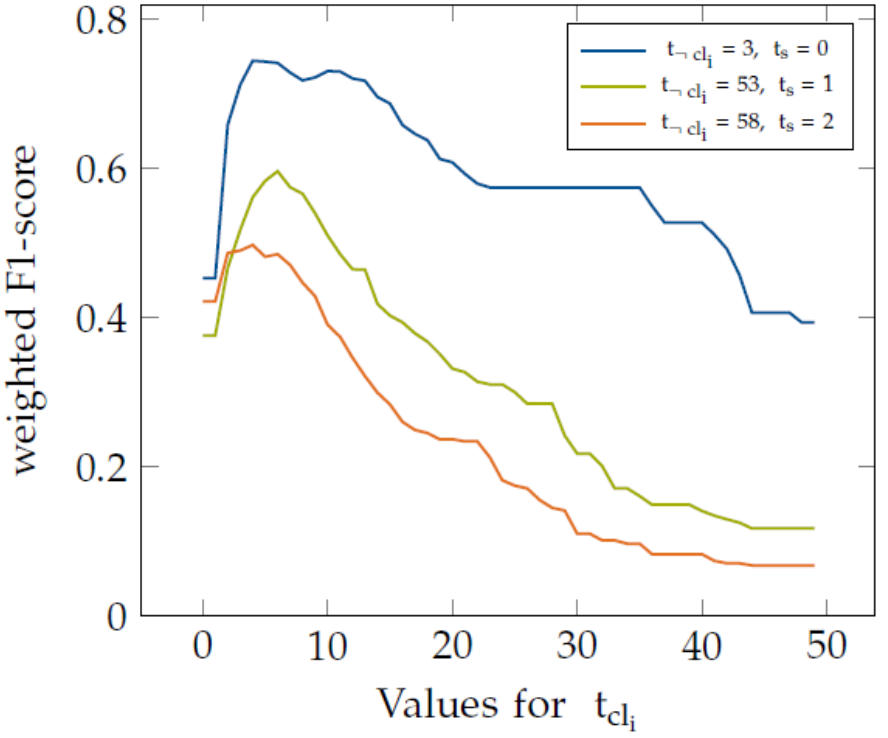
Sequence Labeling

Impact of Different Features

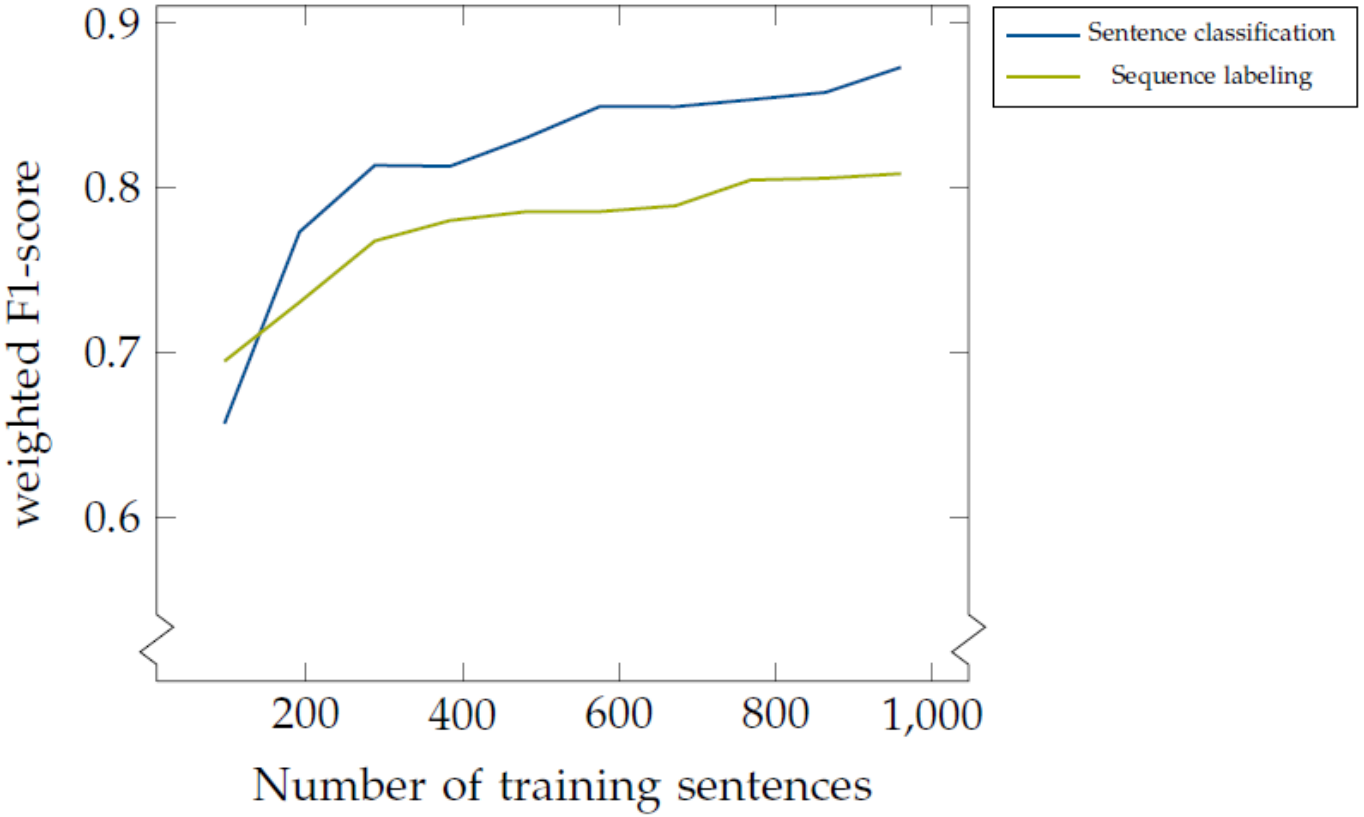


Combinations of Threshold for Dictionary Generation





Learning Curve of ML Methods



Analysis Tool

Privacy Policy Analysis - Data Subject Rights

7\. What rights do I have?

Access my data:

You may be able to receive a report about the data Blizzard stores about you. To learn more about accessing your data, please click on this [link](https://eu.battle.net/support/help/product/services/1327/1329) .

Erasure:

You may have a right to request the deletion of some your data. Blizzard is required by law to retain certain data. To learn more about having your data erased or anonymized, please click on this [link](https://eu.battle.net/support/help/product/services/1327/1328) .

Object:

You may object to the processing of your data if you believe Blizzard doesn't have the appropriate rights to engage in that processing or if you wish to ask Blizzard not to process your personal data for direct marketing purposes. To learn more about making an objection, please click on this [link](https://eu.battle.net/support/help/product/services/1327/1330) .

Rectification:

You can correct your personal data if you feel it's inaccurate. Please log in to your Blizzard account and use the account management settings to make the changes.

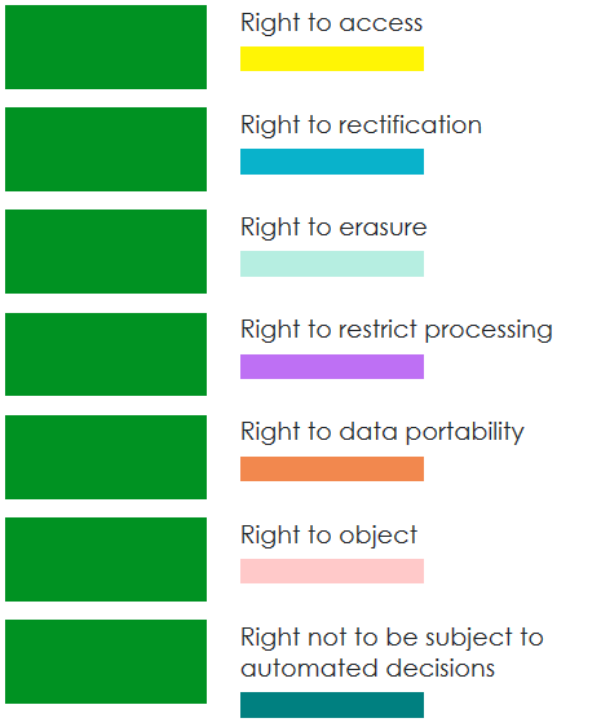
Restrict Processing:

You can request that your data no longer be processed in certain cases, for instance, when you exercise your right to object as described above. When objecting, you will be given an option to restrict processing.

Portability:

Data portability is the ability to move data from one company to another (for instance, when you transfer your mobile phone service to another carrier). While this right is not very applicable to Blizzard's current business, we will provide you with an electronic file with your most basic account information, should you request it. To obtain this file, please click this [link](https://eu.battle.net/support/help/product/services/1327/1342/solution) .

8\. What is RealID?



Analysis Tool

Privacy Policy Analysis - Data Subject Rights

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