Automatic Extraction of Opt-Out Choices from Privacy Policies

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Motivation

- Privacy policies are very long documents and it is difficult for users to identify if any choices are offered to them.
- Is it possible to automatically extract information about such "choice instances" from privacy policies?

Opt-Out Choices

- A choice instance is a statement in a privacy policy that indicates the user has discretion over the collection, use, sharing, or retention of their data
- Examples of 'Opt-Out' Choices:
  - You are free to opt out of this data collection service by going to HasOffers Analytics' End User Opt-Out page at https://www.optoutmobile.com/optout.
  - Please click here to see a list of the third parties Military works with and to exercise your opt out.

Approach

- Supervised Machine Learning

Modal Verbs

- A modal verb is a type of verb that is used to indicate modality – that is: likelihood, ability, permission, and obligation
- NLTK Part of Speech Tagger used to extract Modal verbs
- Examples of modal verbs: may, might, can
- Examples of positive instances containing Modal Verbs:
  - You may opt out of receiving these general communications by using one of the following methods: Select the email opt out or unsubscribe link, or follow the opt-out instructions included in each email communication.
- Example of POS Tagging:

```plaintext
You may unsubscribe to any of our online e-mail updates or newsletters by clicking here.

PRP MD VB TO DT IN PRP JJ JJ NNS CC NNS IN VBG RB
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Topic Distributions as Features

- Each segment can be represented as a distribution of hidden topics
- Use topic distributions as features along with bag-of-ngram and modal verb features during classification
- Latent Dirichlet Allocation and Non-negative Matrix Factorization

Handling Noise in Data

- Hyperlink display in Annotation Tool
- Sentence segmentation
- Missing annotations

Two-Tier Model Architecture

Basic Model: Model to identify opt-out choices. Features used for classification:
- Bag-of-grams
- Topic Distributions
- Modal Verb
- Opt-out Specific Words

Fine-Grained Model: Model to identify the type of opt-out. Features used for classification:
- Bag-of-grams for sentences, segments
- Anchor Text
- Hyperlink
- Policy Url
- Url Similarity Measure: Measure of similarity of Hyperlink and policy Url

Results

<table>
<thead>
<tr>
<th>Feature Set</th>
<th>Model</th>
<th>Precision</th>
<th>Recall</th>
<th>F1</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unigram</td>
<td>Logistic Regression</td>
<td>0.574</td>
<td>0.493</td>
<td>0.530</td>
<td>0.987</td>
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<tr>
<td></td>
<td>SVM</td>
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<td>0.493</td>
<td>0.452</td>
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<tr>
<td></td>
<td>Naive Bayes</td>
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<td>0.634</td>
<td>0.372</td>
<td>0.967</td>
</tr>
<tr>
<td></td>
<td>Random Forest</td>
<td>0.667</td>
<td>0.254</td>
<td>0.367</td>
<td>0.987</td>
</tr>
</tbody>
</table>

| Unigram + Bigram                     | Logistic Regression| 0.59     | 0.507   | 0.545   | 0.987    |
|                                      | SVM                 | 0.537     | 0.507   | 0.522   | 0.986    |
|                                      | Naive Bayes         | 0.324     | 0.662   | 0.435   | 0.974    |
|                                      | Random Forest       | 0.645     | 0.282   | 0.392   | 0.987    |

| Unigram + Bigram + Custom Feature (Modal Verbs and opt-out specific phrases) * | Logistic Regression | 0.727 | 0.686 | 0.705 | 0.989 |
| Unigram + Bigram + Custom Feature + Topic Distribution (8 Topics) * | Logistic Regression | 0.765 | 0.722 | 0.742 | 0.99  |

* After Noise Handling in Data

OPP 115 Corpus

For each paragraph in a privacy policy, the annotators identify data practices in the paragraphs (segments).

- 115 Privacy Policies
- 3792 Segments

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**USABLEPRIVACY.ORG**

The usable privacy policy project

NSF SaTC Frontier project

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