OVERVIEW

• In-depth look at Part 3 (Classification)
  • (last week you saw in-depth look at Parts 1 and 2)
• Breakdown of sample data
• Piazza recap
• Q&A
CLASSIFICATION

• Four parts:
  • Compare classifiers
  • Experiment with the amount of training data used
  • Select the best features for classification
  • Do cross-fold validation
CLASSIFICATION 1: COMPARE CLASSIFIERS

• Randomly split data into 80% training, 20% testing.

• We have 5 classification methods, which you can consider to be ‘black boxes’ (input goes in, classes come out).
  1. Support vector machine with linear kernel
  2. Gaussian naïve Bayes classifier.
  3. Random forest classifier
  4. Neural network
  5. Adaboost (with decision tree)
CLASSIFICATION I: COMPARE CLASSIFIERS

Results for SGDClassifier:
- Accuracy: 0.XXXX
- Recall: [0.XXXX, 0.XXXX, 0.XXXX, 0.XXXX]
- Precision: [0.XXXX, 0.XXXX, 0.XXXX, 0.XXXX]

Confusion Matrix:

```
[[ XXX XXX XXX XXX ]
 [ XXX XXX XXX XXX ]
 [ XXX XXX XXX XXX ]
 [ XXX XXX XXX XXX ]
 [ XXX XXX XXX XXX ]]```

Results for GaussianNB:
... results for the rest of classifiers

my optional written analysis goes here :)

"
CLASSIFICATION 1: COMPARE CLASSIFIERS

Results for SGDClassifier:
Accuracy: 0.XXXX
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Confusion Matrix:
[[ XXX XXX XXX XXX]
 [ XXX XXX XXX XXX]
 [ XXX XXX XXX XXX]
 [ XXX XXX XXX XXX]]

Results for GaussianNB:
... results for the rest of classifiers

my optional written analysis goes here :)

Accuracy over all classes

Precision and recall per class (e.g. index 0 corresponds to class Left)
CLASSIFICATION I: COMPARE CLASSIFIERS

Results for SGDClassifier:
- Accuracy: 0.XXXX
- Recall: [0.XXXX, 0.XXXX, 0.XXXX, 0.XXXX]
- Precision: [0.XXXX, 0.XXXX, 0.XXXX, 0.XXXX]
- Confusion Matrix:

```
[ [XXX XXX XXX XXX]
  [XXX XXX XXX XXX]
  [XXX XXX XXX XXX]
  [XXX XXX XXX XXX]]
```

Examples labeled Left in the training data

Examples the model classified as Left

Results for GaussianNB:
- ... results for the rest of classifiers

my optional written analysis goes here :)
You previously used a random $0.8 \cdot 40K = 32K$ comments to train.

Using the classifier with the highest accuracy from Sec3.1, retrain the system using an arbitrary $1K, 5K, 10K, 15K, 20K$ samples from the original $32K$. 
CLASSIFICATION 2: AMOUNT OF DATA

1000: 0.XXXX
5000: 0.XXXX
10000: 0.XXXX
15000: 0.XXXX
20000: 0.XXXX

here is my insightful comment. it's 2+ sentences and explains much.
## Classification 2: Amount of Data

<table>
<thead>
<tr>
<th>Number of training examples</th>
<th>Accuracy on test set when training on the corresponding number of training examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>0.XXXX</td>
</tr>
<tr>
<td>5000</td>
<td>0.XXXX</td>
</tr>
<tr>
<td>10000</td>
<td>0.XXXX</td>
</tr>
<tr>
<td>15000</td>
<td>0.XXXX</td>
</tr>
<tr>
<td>20000</td>
<td>0.XXXX</td>
</tr>
</tbody>
</table>

Here is my insightful comment. It's 2+ sentences and explains much.
CLASSIFICATION 3:
FEATURE ANALYSIS

• Certain features may be more or less useful for classification, and too many can lead to various problems.
• Here, you will select the best $k$ features for classification for $k = \{5,50\}$.
• Train the best classifier from Sec3.1 on just $k = 5$ features on both $1K$ and $32K$ training samples.
• Are some features always useful? Are they useful to the same degree ($p$-value)? Why are certain features chosen and not others?
CLASSIFICATION 3:
FEATURE ANALYSIS

5 p-values: [0.XXXX, 0.XXXX, ... p-values 5 feats]
50 p-values: [0.XXXX, 0.XXXX, ... p-values 50 feats]
Accuracy for 1k: 0.XXXX
Accuracy for full dataset: 0.XXXX
Chosen feature intersection: {XX, XXX, XX, XXX} # should be 5 or fewer
Top-5 at higher: {XXX, XX, XXX, XXX, XX} # should be 5

My answers to questions go here:
(a) answer
(b) goes
(c) here :)

[Image contents]

[Image alt text]
p-values for the \{5,50\} features when we set \(k=5\) and \(k=50\) for SelectKBest, using the full dataset.
CLASSIFICATION 3: FEATURE ANALYSIS

5 p-values: [0.XXXX, 0.XXXX, ... p-values 5 feats]  
50 p-values: [0.XXXX, 0.XXXX, ... p-values 50 feats]  

Accuracy for 1k: 0.XXXX  
Accuracy for full dataset: 0.XXXX  

Chosen feature intersection: \{XX, XXX, XX, XXX\} # should be 5 or fewer  
Top-5 at higher: \{XXX, XX, XXX, XXX, XX\} # should be 5  

My answers to questions go here:  
(a) answer  
(b) goes  
(c) here :)

Accuracy for the best model from 3.1, trained on the 5 best features from the 1K dataset and the full dataset
Indices of the best features (in range 0-172)

- **"Chosen feature intersection"** means intersection of the top $k=5$ features selected for 1K and the full dataset.
- **"Top-5 at higher"** means the top $k=5$ features for the full dataset.
• What if the ‘best’ classifier from Sec3.1 only appeared to be the best because of a random accident of sampling?

• Test your claims more rigorously.

<table>
<thead>
<tr>
<th>Part 1</th>
<th>Part 2</th>
<th>Part 3</th>
<th>Part 4</th>
<th>Part 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iteration 1</td>
<td></td>
<td></td>
<td></td>
<td>: Err1 %</td>
</tr>
<tr>
<td>Iteration 2</td>
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<td></td>
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<td>: Err2 %</td>
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<td></td>
<td>: Err3 %</td>
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<tr>
<td>Iteration 4</td>
<td></td>
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<td></td>
<td>: Err4 %</td>
</tr>
<tr>
<td>Iteration 5</td>
<td></td>
<td></td>
<td></td>
<td>: Err5 %</td>
</tr>
<tr>
<td>Kfold Accuracies:</td>
<td>[0. XXXX, 0. XXXX, 0. XXXX, 0. XXXX, 0. XXXX]</td>
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<tr>
<td>p-values:</td>
<td>[0. XXXX, 0. XXXX, 0. XXXX, 0. XXXX]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CLASSIFICATION 4: CROSS-FOLD VALIDATION

First classifier from Part 3.1 (SGDClassifier)

First fold of the data

Kfold Accuracies: [0.0000, 0.0000, 0.0000, 0.0000, 0.0000]
Kfold Accuracies: [0.0000, 0.0000, 0.0000, 0.0000, 0.0000]
Kfold Accuracies: [0.0000, 0.0000, 0.0000, 0.0000, 0.0000]
Kfold Accuracies: [0.0000, 0.0000, 0.0000, 0.0000, 0.0000]
p-values: [0.0000, 0.0000, 0.0000, 0.0000, 0.0000]
CLASSIFICATION 4: CROSS-FOLD VALIDATION

p-values from t-tests comparing the accuracies across folds between the best classifier from Part 3.1 and the other classifiers
CLASSIFICATION 4: CROSS-FOLD VALIDATION

p-values from t-tests comparing the accuracies across folds between the best classifier from Part 3.1 and the other classifiers.

Ex: If the best classifier from 3.1 was the RandomForestClassifier (the 3rd classifier), then the p-values should be reported in the order: [1 vs. 3, 2 vs. 3, 4 vs. 3, 5 vs. 3].

What do these p-values tell us?
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SAMPLE DATA

• 3 files:
  • `sample_in.json` -- input to `a1_preproc.py`
  • `sample_out.json` -- output of `a1_preproc.py` (to be fed to `a1_extractFeatures.py`)
  • `sample.npz` -- output of `a1_extractFeatures.py`
"body": "Hehe, I second this. I adore Clueless."
hehe/UH ,/, I/PRP second/VBP this/DT ./.
I/PRP ADORE/VBP clueless/NNP ./.

```json
{
    "id": "c0b61z2",
    "body": "hehe/UH ,/, I/PRP second/VBP this/DT ./.
    I/PRP ADORE/VBP clueless/NNP ./.
    "cat": "Left"
}
```
SAMPLE DATA

sample_feats.npz -- output of a1_extractFeatures.py

Tip: compare your output to the numbers in sample.npz using the method np.allclose()
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REMINDER: TEMPLATE CHANGES

- `a1_preproc.py`
  - Updated regex for removing URLs
- `a1_classify.py`
  - Output format string for printing p-values
GENERAL QUESTIONS

• **Global variables**
  - You may define them outside of main, as we have done for wordlists.
  - IF you define them in the main() function, use the global keyword.

• **Versions** – Use Python 3.9 on cdf (where spaCy 3.2.1 is installed).

• **Runtime** – Parts 1 and 2 should each take around 10 minutes or less. Part 3 may take longer depending on CDF traffic. Be sure to use `alpha=0.05` for the MLPClassifier!

• Don't change **function headers** or string **output formats** for Part 3.
QUESTIONS ON PART I

• **SpaCy version matters**
  • Tagging varies between spaCy versions. Use version 3.2.1.
  • There was some confusion about whether single-word comments raise an error. This is not an issue with version 3.2.1 (which you should use).
QUESTIONS ON PART 2

What counts as future tense?

• ’ll, will, gonna, going+to+VB
• Note that "going" --> "go/VBG" after preprocessing.
• Don't need to worry about:
  • Cases with an elided verb (e.g. "I'm going to")
  • Non-standard contractions (e.g. "I'ma")

In general, we will consider whatever spaCy outputs to be the “correct” output, and we will not autotest unusual edge cases.
QUESTIONS ON PART 2

• What counts as **multiple punctuation**?
  • All characters in the token must be punctuation.

• What about **spaces in lemmas**?
  • (e.g. "N.Y." -> "New York/NNP")
  • Use your judgement, we will not test these cases.

• Why are my **uppercase counts** so low?
  • Problem: Lemmas are all lowercase, so replacing tokens with their lemma makes this feature less meaningful.
  • What to do: Continue using lemmas, since it's what's specified in the assignment handout.
• What are we supposed to do with train and test data in 3.4, when we're doing k-fold validation?
  • Re-combine these into one dataset, then use that.
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