ACCUMULATE
TECHNICAL MEETING

25th August 2016

Madhumita Sushil
OVERVIEW

- I2b2 shared task 2016: Psychiatric Symptom Severity Identification
  - Psychiatric data collection and pre-processing
  - Single and multi-word term identification
  - Application based evaluation
- cTakes usage analysis
  - Proposal: Standardizing input/output format
I2b2 Shared Task 2016: Psychiatric Symptom Severity Identification

Elyne Scheurwegs, Madhumita, Stéphan Tulkens, Walter Daelemans, Kim Luyckx
I2b2 Shared Task 2016

• Task
  • Severity Identification of Psychiatric Symptom:
    • Positive Valence Symptoms (Insel et al., 2010)
    • Severity scale: 0-4 (Absent – Severe)

• Data set
  • 1 Initial psychiatric evaluation note per patient in English
  • 216 test documents
Subject: Patient Initial Visit Note -Identifying Information Date of Service:
5/18/11CPT Code: 90792: With medical services
Sex: Male
Chief Complaint / HPI Chief Complaint (Patients own words)
I'm in pain. I need something for pain.

History of Present Illness and Precipitating Events
Chronic pain in both knees since the 2080s. Received percocet at MEDIQUIK but stopped going, because "they treat you like garbage. It was a nurse practitioner, she didn't do nothing."

Suicidal Behavior Hx of Suicidal Behavior: Yes
If Yes, comment on Timing, Lethality, Impulsivity, Comorbid Intoxication or Psychosis: tried to slice his wrist "I was young and stupid", back in the 2060s, when my father died.

Violent Behavior Hx of Violent Behavior: No

Psychiatric History Hx of Inpatient Treatment: Yes
"2 or 4 years ago, Brunswick Hotel, a nervous breakdown because of a situation with the court, charged with AB, which were eventually dropped"

Hx of Outpatient Treatment: Yes has been treated for bipolar disorder but denies that he ever experienced a manic episode.

Prior medication trials (including efficacy, reasons discontinued):
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seroquel 300 mg HS
trazodone 100 mg PO QHS
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Appearance: Physically unkempt
Clothing: Disheveled
Facial Expression: WNL
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I2b2 RDoC Challenge Data Pre-Processing

• Data pre-processing
  • Using off-the-shelf cTakes modules
    • Sentence splitting
    • Tokenization
    • POS tagging
    • Chunking

(WP2, TASK 2.1)
External Corpus Construction

- Wikipedia Articles
- PubMed Abstracts
- MIMIC III data

Large external psychiatry corpus

Seed Terms
- Psychiatric diagnoses from DSM
- RDoC Terms

(WP2, TASK 2.1)
Extraction of single and multi-term UMLS concepts

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(WP2, TASK 2.3 - 2.4)
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- **depakote** 500 mg HS
- **valproic acid/indigo carmine**
- **seroquel** 300 mg HS
- **hypromellose/quetiapine/sodium nitrate**
- **trazodone** 100 mg PO QHS

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Feature Generation:

- **Different feature generation approaches**
  - Bag-of-concepts after removing negated headers/content
    - E.g. negated header/content
      - Hx of Violent Behavior: No
  - QuestionSet features
    - Different categorical and descriptive features based on answer type of the question in the training set
      - Categorical features e.g.: Facial expression
      - Descriptive features e.g.: Patient’s Chief Complaint

(WP2, TASK 2.5)
Supervised and Semi-Supervised Solutions

- **Output classes**
  - Absent, Mild, Moderate, Severe

- **Metrics**
  - Macro-averaged inverse Mean Absolute Error (MAE)

\[
\text{MAE}^M = \frac{1}{|C|} \sum_{j=1}^{|C|} \frac{1}{|D_j|} \sum_{x_i \in D_j} |h(x_i) - y_i|
\]

- **Algorithms**
  - SVM
  - Random Forests

- **Bootstrapping**

- **Outlier removal**

(WP2, TASK 2.5)
<table>
<thead>
<tr>
<th>System</th>
<th>Inverse MAE 10 Fold CV</th>
<th>Inverse MAE Test</th>
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<tbody>
<tr>
<td>DSM</td>
<td>72.8%</td>
<td></td>
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<tr>
<td>DSM+1</td>
<td><strong>78.3%</strong></td>
<td><strong>79.52%</strong></td>
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<tr>
<td>DSM+1, MED</td>
<td>76.2%</td>
<td></td>
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<tr>
<td>Question sets</td>
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<td><strong>79.34%</strong></td>
</tr>
<tr>
<td>DSM+1, Bootstrapping,</td>
<td><strong>78.8%</strong></td>
<td><strong>80.64%</strong></td>
</tr>
<tr>
<td>Outlier Removal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(WP2, TASK 2.5)
Conclusions and Future Plans

- Simple approaches work better
  - Limitation of data set size
- Components to be reused for other tasks in Accumulate
  - Transferring technology to Dutch

- To explore further
  - Identifying concepts most relevant to task
    - Disambiguation on context
- Exploring deep learning techniques for clinical domain
  - With respect to applications such as patient recruitment for clinical trials
References


Experiences with cTakes
Experiences with cTakes

- Pipelines retrained using annotated clinical data
- Rich type system for clinical data
- Complex UIMA framework
  - Large learning curve
  - cTakes documentation not user friendly
- No support for Dutch pipelines like Frog
- Adding pipelines to cTakes
  - Impractical due to lack of annotated clinical data
- Seems to be naïve
  - Sentences often split on end quotes
  - All possible concepts are added instead of selecting the most likely concepts.
Proposal for Collaboration – standardizing input/output format

• Goal
  • Easier reuse of models developed by different partners
  • To provide basic structure for building prototypes to facilitate valorization

• How to reach the goal?
  • Our recommendation
    • Standardize input/output format for convenient exchange
    • Using cTakes output XML format for the purpose

• Why cTakes format?
  • Rich type system for medical domain – HL7 specification
  • Can be extended with new types if required
  • Assures compatibility with cTakes

(WP6, TASK 6.1)
THANK YOU!