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

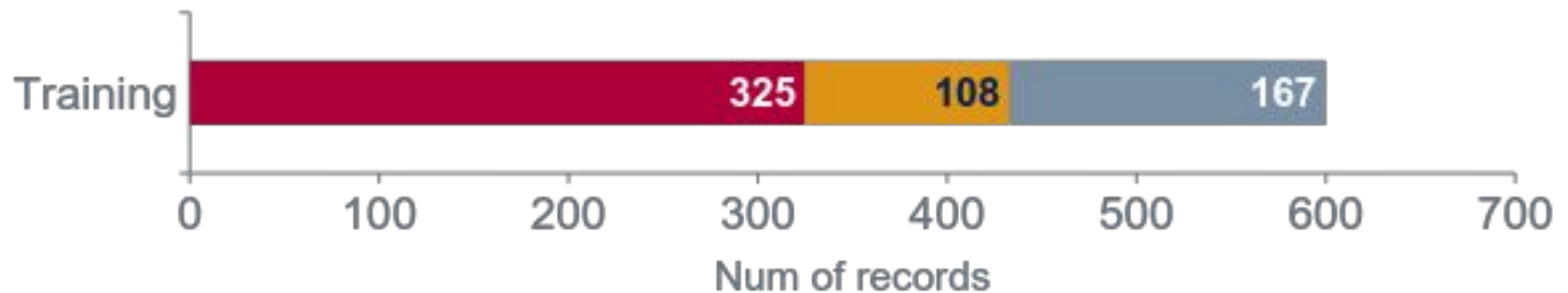# I2b2 Shared Task 2016

- 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

I2b2 RDoC Challenge Data Sample

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 garbabe. It was a nurse practictioner, 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 droppedHx 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):

depakote 500 mg HS

seroquel 300 mg HS

trazodone 100 mg PO QHS

...

Appearance: Physically unkempt

Clothing: Disheveled

Facial Expression: WNL

I2b2 RDoC Challenge Data Cleanup

Subject: Patient Initial Visit Note -Identifying Information Date of Service:

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Sex: Male

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(WP2, TASK 2.1)

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I2b2 RDoC Challenge Data Segmentation

Subject: Patient Initial Visit Note -Identifying Information Date of Service:

5/18/11**CPT 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 garbabe. It was a nurse practictioner, she didn't do

nothing."**Suicidal Behavior Hx of Suicidal Behavior:** Yes

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-**Psychiatric History Hx of Inpatient Treatment:** Yes

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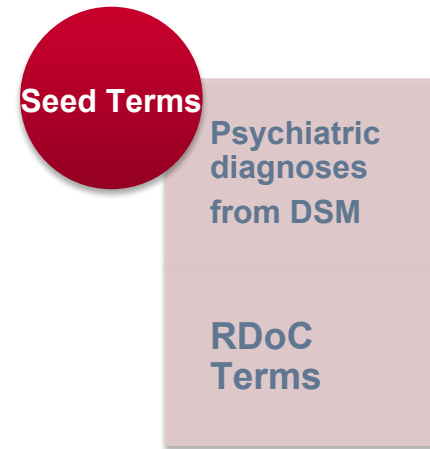trazodone 100 mg PO QHS

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Clothing: Disheveled
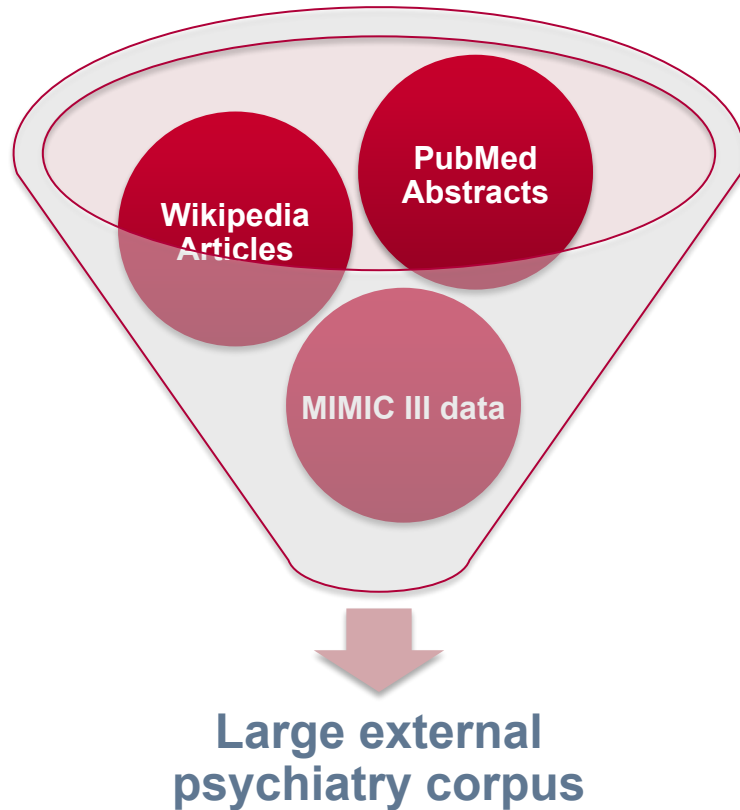
Facial Expression: WNL

(WP2, TASK 2.1)

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

Subject: Patient Initial Visit Note -Identifying Information Date of Service:

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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 garbabe. It was a **nurse** practictioner, 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 droppedHx of **Outpatient Treatment**: Yes

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IDF based fuzzy match of chunk tokens to UMLS entries (Scheurwegs et al. – under review)

(WP2, TASK 2.3 - 2.4)

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Restricting detected concepts to DSM concepts

Subject: Patient Initial Visit Note -Identifying Information Date of Service:

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(WP2, TASK 2.3 - 2.4)

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Extending to DSM+1 concepts

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(WP2, TASK 2.3 - 2.4)

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Identifying Medication – RxNorm (Liu et al., 2005)

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)

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Chronic pain in both knees since the 2080s. Received **percocet** at MEDIQUIK but stopped

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Appearance: Physically unkempt

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(WP2, TASK 2.3 - 2.4)

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Identifying Medication – ATC (World Health Organization, 2000)

Subject: Patient Initial Visit Note -Identifying Information Date of Service:

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Sex: Male

Chief Complaint / HPI Chief Complaint (Patients own words)

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has been treated for bipolar disorder but denies that he ever experienced a manic

episode.Prior medication trials (including efficacy, reasons discontinued):

depakote 500 mg HS   **valproic acid/indigo carmine**

seroquel 300 mg HS   **hypromellose/quetiapine/sodium nitrate**

trazodone 100 mg PO QHS

...

Appearance: Physically unkempt

Clothing: Disheveled

Facial Expression: WNL

(WP2, TASK 2.3 - 2.4)

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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)

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

- Algorithms

  - SVM

  - Random Forests

- Bootstrapping

- Outlier removal

(WP2, TASK 2.5)

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Results (Awaiting official ranking)

System	Inverse MAE 10 Fold CV	Inverse MAE Test
DSM	72.8%	
DSM+1	**78.3%**	79.52%
DSM+1, MED	76.2%	
Question sets	**78.0%**	79.34%
DSM+1, Bootstrapping, Outlier Removal	**78.8%**	**80.64%**

(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

- Insel, et al. "Research domain criteria (RDoC): toward a new classification framework for research on mental disorders." *American Journal of Psychiatry* 167.7 (2010): 748-751.

- Scheurwegs, et al. "Assigning Clinical Code with Data-driven Concept Representation. " *Journal of Biomedical Informatics* (Under Review)

- American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders (4th ed.)*

- Liu, et al. "RxNorm: prescription for electronic drug information exchange." *IT professional* 7.5 (2005): 17-23.

- World Health Organization. "Anatomical therapeutic chemical (ATC) classification index with defined daily doses (DDDs)." *Oslo: WHO Collaborating Centre for Drug Statistics Methodology* (2006).

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.

- 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)

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THANK YOU!