Detecting Suicide Risk Through Twitter

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About the presenter..

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- eHealth systems & services
- Data analysis & process mining
- Service-oriented computing
- Cloud architectures
Outline

• Context
• Methodology
• Tweet identification
• Classification of suicide risk groups
• Automatic classification
• Conclusions
• **Mental illness** is one of the main causes of illness worldwide
  – Depression affects over 300m people (WHO)
• **Suicide** is one of the more controversial causes of death
  – In Spain represents the main cause of unnatural death, doubling the number of deaths in traffic accidents
• **Social platforms** can be used to analyse the emotional state of people
  – Sometimes is an anonymous media
  – Exposes real-time data
• **Twitter** is one of the most widely used social media platforms worldwide
  – In this work, *we focus on Tweets written in Spanish* (note that the methodology can be applied to other languages)
We propose a framework for the detection of suicide risk through Twitter

- Retrieval of selected Tweets according to specific rules and classifications
- Analysis of Tweet collections - processing of information flows (streams) in real time
- Application of clustering and machine learning techniques that facilitate the automatic classification of the information obtained
- In base to the classification, triggering of corrective/prevention mechanisms

Our approach represents a full framework...

- Engineered and implemented using different technologies
- Structured around a multidisciplinary team of professionals in Health Sciences and IT
- As a result, it provides a useful prototype for suicide prevention and detection of real emotional states in the population
Methodology

Early detection & prevention of suicide risk

Primary Care / Family / Environment

Content analysis

Property extraction

Expert’s evaluation

Automatic classification

Risk analysis/prediction

Clustering
Tweet identification

• Large vocabulary of emotional terms compiled from different sources
  – *The Spanish adaptation of Affective Norms for English words* (ANEW)
  – *Spanish dictionary of the Linguistic Inquiry and Word Count* (LIWC)

• Addition of emotional properties (*primary + secondary*)
  – *Hierarchy of emotions* (Parrott, 2001)
  – *Tree of emotions* (Shaver et al., 1987)
  – We have integrated the Indico affective and emotional text processing tool as a service

• The Amazon Web Service (AWS) infrastructure has been used to deploy the framework
Classification of suicide risk groups

- Clustering techniques
  - *K*-means + *elbow* method
  - *Knime* data analytics platform
  - Input: 3051 Tweets

- A team of experts in Health Sciences and Medicine reviewed the data & results

<table>
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<th>Cluster</th>
<th>#Tweets</th>
<th>Positivity</th>
<th>Anger</th>
<th>Joy</th>
<th>Fear</th>
<th>Sadness</th>
<th>Surprise</th>
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<td>0.24</td>
<td>0.09</td>
<td>0.22</td>
<td>0.39</td>
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Suicide risk

- Low
- High

K=4
Automatic classification

- **LSTM neural network**
  - *Tensorflow* machine learning framework
  - 10 LSTM hidden layers / 20 neurons in each layer
  - 70% training data / 30% test data
Automatic classification

• The evaluation function returns an accuracy of 93.34% (K=4)

<table>
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</table>

Success rate (Cluster 0) = 98.96%
Success rate (Cluster 1) = 99.26%
Success rate (Cluster 2) = 87.79%
Success rate (Cluster 3) = 87.23%
Conclusions

• We have presented a framework for the detection of suicide risk through Twitter
  – Deployed using AWS
• Very satisfactory and promising results (accuracy of 93.34%)
• Currently we are working on the connection with Primary Care Services
• The techniques developed in this work are easily adaptable to other contexts and studies
• Possible improvements
  – Use of different distance functions for clustering/K-means
  – Use of different classification techniques (Random Forest, SVM, ..)
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