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

Context

- Mental illness is one of the main causes of illness worlwide
  - 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 tp other languages)

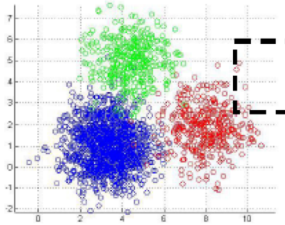
Context

- 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 learnig 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

Content analysis

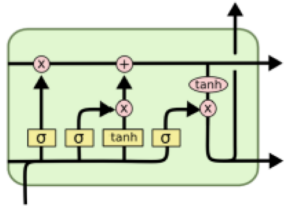
Property extraction



Clustering

Expert's evaluation

Automatic classification



Risk analysis/prediction

Early detection & prevention of suicide risk

Primary Care / Family / Environment

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

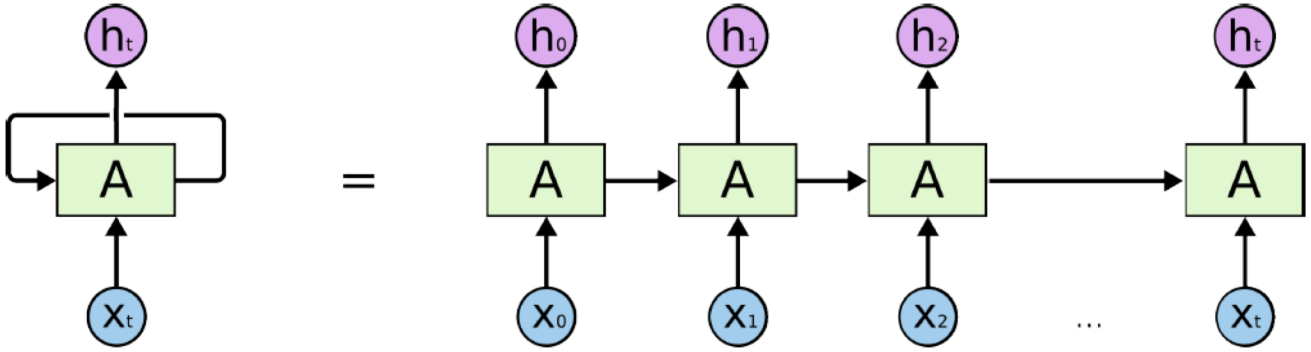
Suicide risk: Low ↓ High

Cluster	#Tweets	Positivity	Anger	Joy	Fear	Sadness	Surprise
#0	654	0.68	0.15	0.32	0.14	0.27	0.13
#1	884	0.80	0.24	0.23	0.15	0.26	0.12
#2	604	0.29	0.25	0.11	0.16	0.40	0.08
#3	909	0.42	0.24	0.09	0.22	0.39	0.05

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*



Layer (type)	Output Shape	Param #
lstm_1 (LSTM)	(None, None, 20)	2160
lstm_2 (LSTM)	(None, None, 20)	3280
lstm_3 (LSTM)	(None, None, 20)	3280
lstm_4 (LSTM)	(None, None, 20)	3280
lstm_5 (LSTM)	(None, None, 20)	3280
lstm_6 (LSTM)	(None, None, 20)	3280
lstm_7 (LSTM)	(None, None, 20)	3280
lstm_8 (LSTM)	(None, None, 20)	3280
lstm_9 (LSTM)	(None, None, 20)	3280
lstm_10 (LSTM)	(None, 20)	3280
dense_1 (Dense)	(None, 1)	21

Total params: 31,701
Trainable params: 31,701
Non-trainable params: 0

Automatic classification

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

	C0	C1	C2	C3
C0	**191**	1	1	0
C1	1	**267**	1	0
C2	4	1	**151**	16
C3	0	24	12	**246**

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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