Automatic Identification of anonymous Profiles on Social Networks

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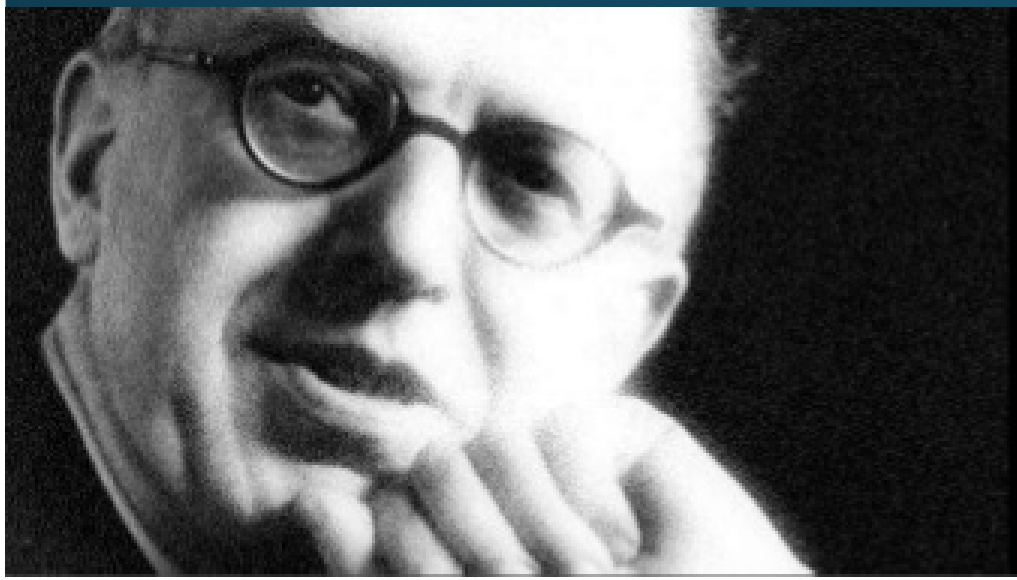


"Technology... is a queer thing.
It brings you great gifts with one hand,
and it stabs you in the back with the other."

Charles Percy Snow, New York Times, 1971

Cooperation: Police + Academic

- In the last years the cooperation between LEAs and Academic institutions has been increased.
- Dealing with crime has become a race for the use of technology.
  - New technologies enable new ways of crime and requires new ways of fighting it.
- (Lack of) Security is global. LEAs have to tackle crime.
- In this context, LEAs need the support of Academia for being updated.
- From the Academic point of view, LEAs show real needs and provide information based on real threats.

Dark Side of Technology

- ICTs are also tools for for extremist groups,
  - Those sheltering / hiding behind different social movements
  - Transnational terrorist groups.
- Used for:
  - Propaganda
  - Recruitment
  - Training
  - Radicalization

The Dark Side of Social Networks

- Offenders have moved from websites (easier to identify) to Social Networks (greater anonymity).
  - These networks ensure a wider dissemination with no costs

- Radical groups can use SN for:
  - Recruitment of new followers
    - Frequently telling stories looking to arise feelings of (in)justice
  - Mobilizing some sectors of society or specific individuals
    - SNs are currently the best tool to obtain publicity and go viral
  - Giving legitimacy to radicalization

The Dark Side of Social Networks

- Once recruitment and mobilization has been performed, it follows the ideological recruitment → transform the recruited individuals into individuals trained and ready to act.
- For these reasons, it is important to "patrol" these channels.
  - It is vital for collecting information and intelligence
- There is a need for (automatic) technological tools supporting this task
  - Better understanding and identification of information

Example of Hate Crime on Twitter

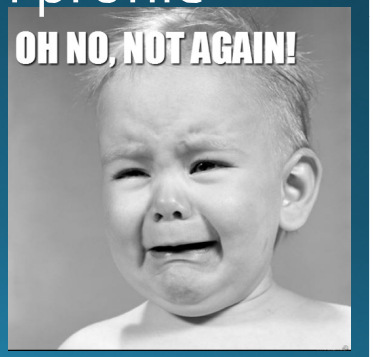
Detienen a un tuitero en Palma de Mallorca por un delito de odio contra el colectivo LGTB

- El arrestado tenía una intensa actividad en la red social, con más de 4.000 mensajes publicados

A “classical” problem

- One of the largest obstacles to LEAs is how easy results to create a new profile on this SN.

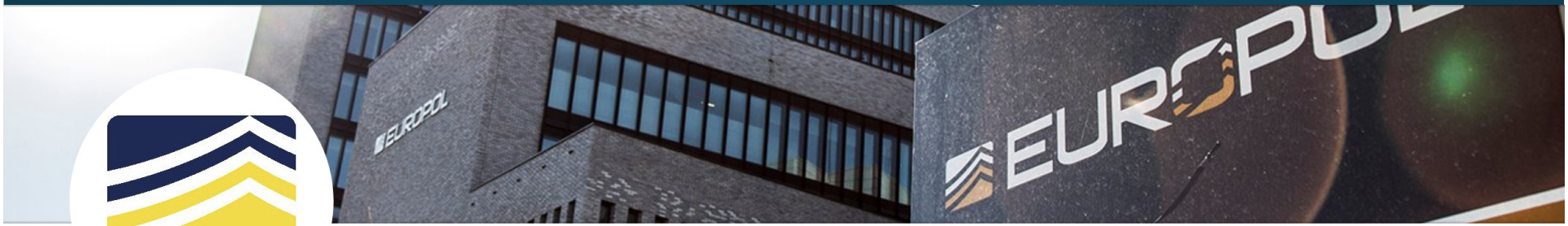
- It was observed, time and time again, that short time after closing a Twitter profile, similar ones came up:
  - Similar dogma and speech
  - Very difficult to identify individuals behind a given profile or publication
  - Police work should start all over again.



The goal

- Designing and implementing a data analysis tool…
- … Based on Semantic Analysis of written texts
- … Intended to link an anonymous SN profile to a "public" one
  - That is, a profile with elements enabling an identification of the user: personal pictures, address, work place, previous knowledge, etc.
- The initial prototype was implemented to analyse Twitter profiles
- The proposed approach does not rely on any specific language.
  - For example, for counter terrorism activities it can be used in language as different as Spanish, English, Pasthum or Bangla.

Similar to...



Tweets 3.122 | Siguiendo 797 | Seguidores 59,3 K | Me gusta 6.131 | Listas 2

Siguiendo

Europol
@Europol

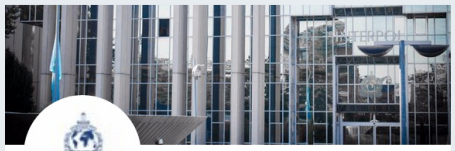
Official Twitter of the EU Agency for Law Enforcement Cooperation. Folllow us on facebook.com/europol & instagram.com/europol.eu

The Hague, The Netherlands
europol.europa.eu
Se unió en diciembre de 2012

Twittear a Europol

87 Seguidores que conoces

Recomendados



Seguir

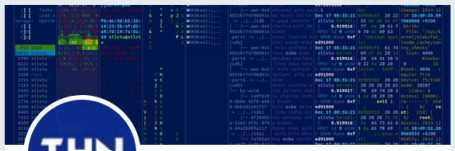
INTERPOL
@INTERPOL_HQ

All the latest news from the world's largest international police organization, with 192 member countries #INTERPOL #Police #LawEnforcement

Seguir

EC3
@EC3Europol

Official account of @Europol's European Cybercrime Centre (#EC3Europol), the EU Agency for Law Enforcement Cooperation. Our aim is to combat



Seguir

The Hacker News
@TheHackersNews

Popular, trusted, widely-read cyber security news source for everyone, including hackers, technologists, enthusiasts & IT nerds » fb.com

… but more subtle

- What if the target profile wants to "hide" itself?

> How to Hide Your Identity on Twitter
>
> *by Michelle Varsallona ; Updated September 28, 2017*

- Our hypothesis is that a given person will use similar speeches in all of them
  - →The real person could be identified against profiles with real data that are similar to the one investigated.

- The message resemblance is evaluated based on both the topics (words) and the perspective (grammar constructions) used.

Comparing in Twitter

- Analyzing tweet by tweet would not produce significant results.
  - Individual tweets are too short. (280 chars from Nov.7 !!).
- Our proposal is to combine all the tweets of a profile in a single document.
- So comparing Twitter profiles → comparing text documents.

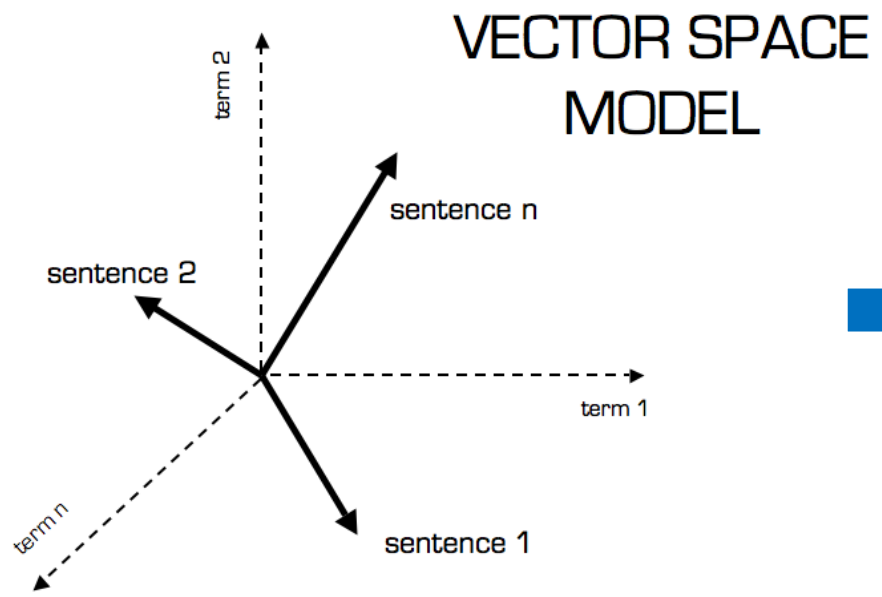
Comparing documents

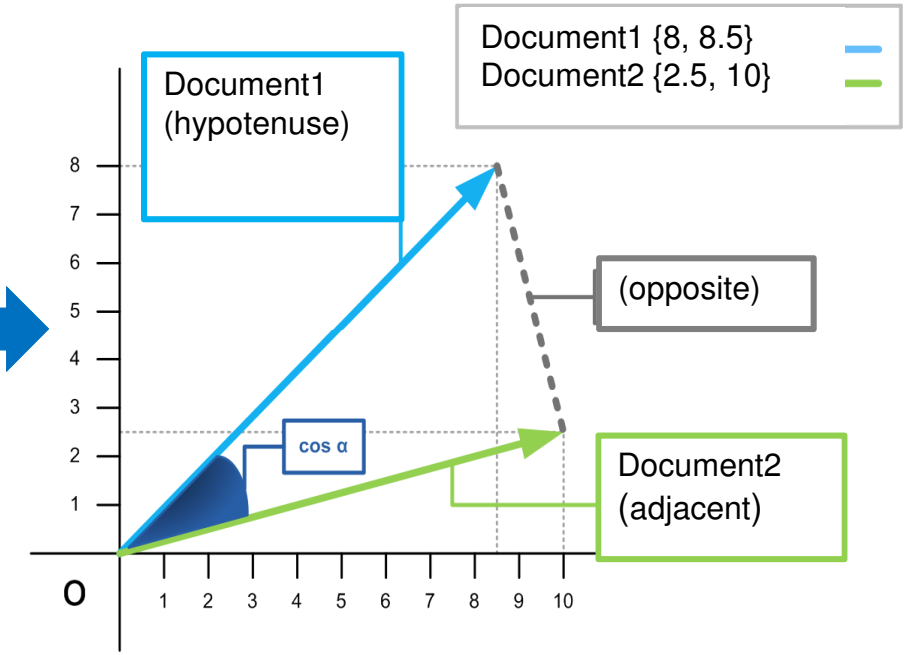
- Recurrent problem on the NLP field.
- It is needed a method for measuring document similarity

$$\frac{words\ in\ commong\ between\ documents}{total\ number\ of\ words\ on\ both\ documents}$$

Distance between vectors (docs)

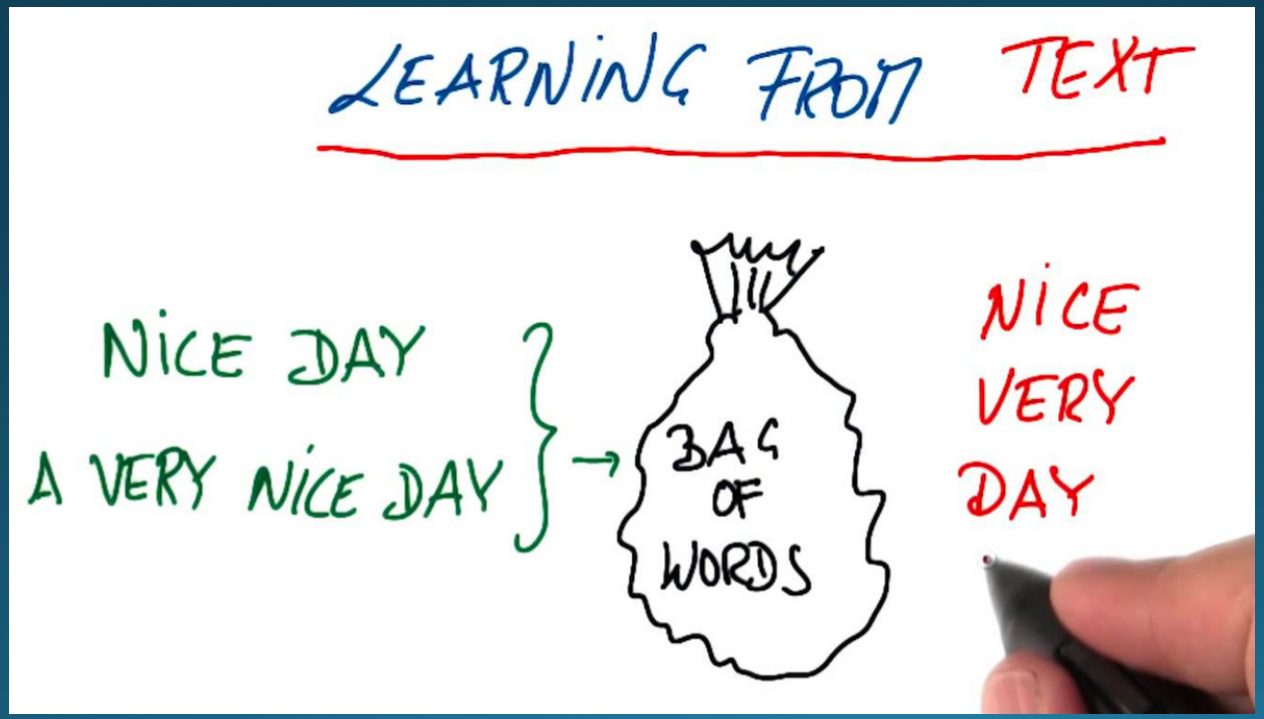
- Frequently documents are transformed to vectors for a faster calculation





Converting docs in vectors

- Original *Bag of Words* methods were used
  - They do not take into account the order or context of the words



Bag of Words example

Either present/not present or counting number of times

Document 1

The quick brown fox jumped over the lazy dog's back.

Document 2

Now is the time for all good men to come to the aid of their party.

Term	Document 1	Document 2
aid	0	1
all	0	1
back	1	0
brown	1	0
come	0	1
dog	1	0
fox	1	0
good	0	1
jump	1	0
lazy	1	0
men	0	1
now	0	1
over	1	0
party	0	1
quick	1	0
their	0	1
time	0	1

Stopword List

for
is
of
the
to

Most frequent words are discarded

Our proposal: to use Doc2Vec

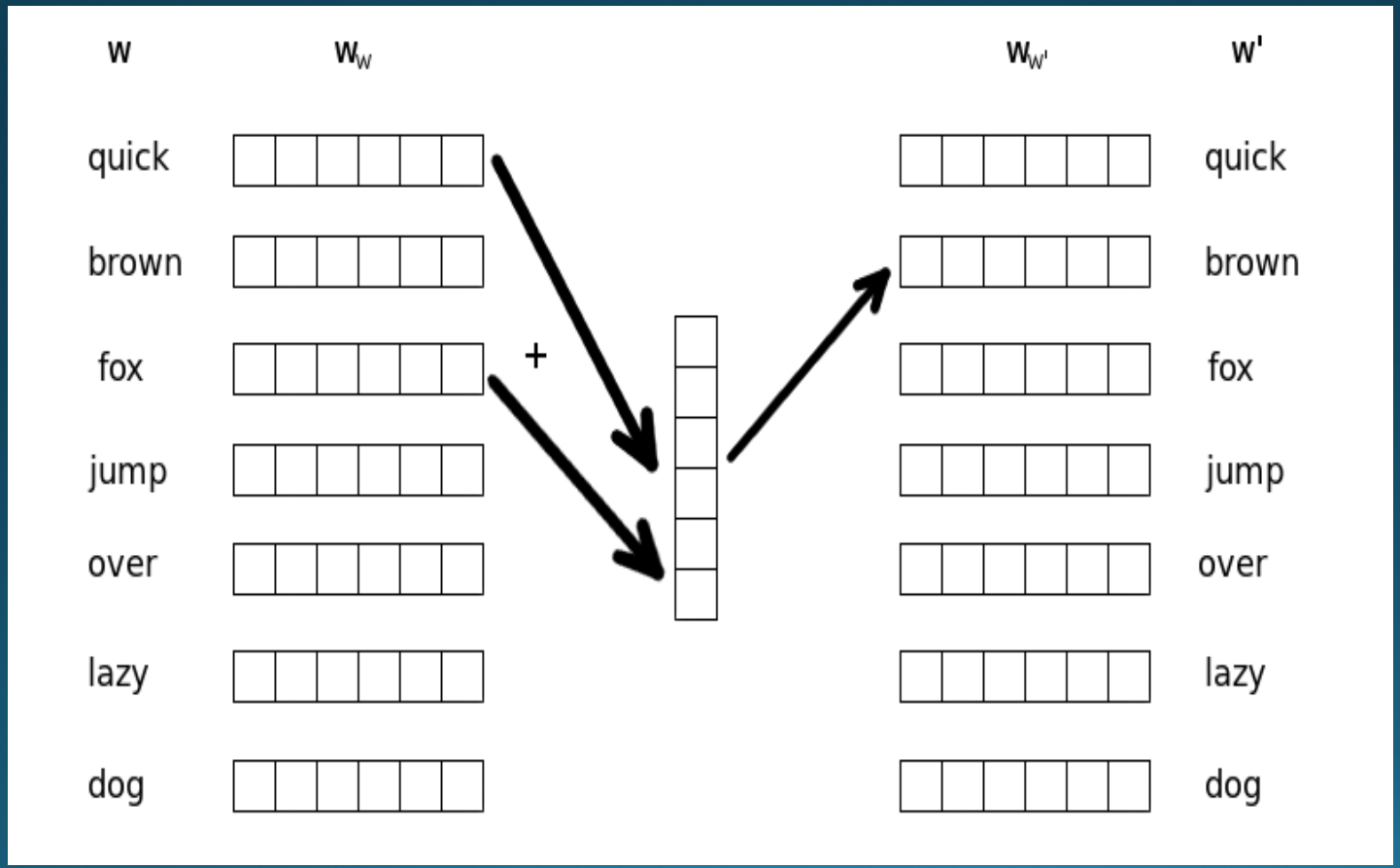
- *Bag-of-words* methods have a fundamental limitation: because they do not consider word order, they ignore how sentences are constructed (semantic).
  - If the way of expressing is significant, the grammar constructions and verb tenses should be considered

- Doc2Vec is based on a **neural network** used to **maximize the probability to predict a word** based on a set of words and a given document vector.

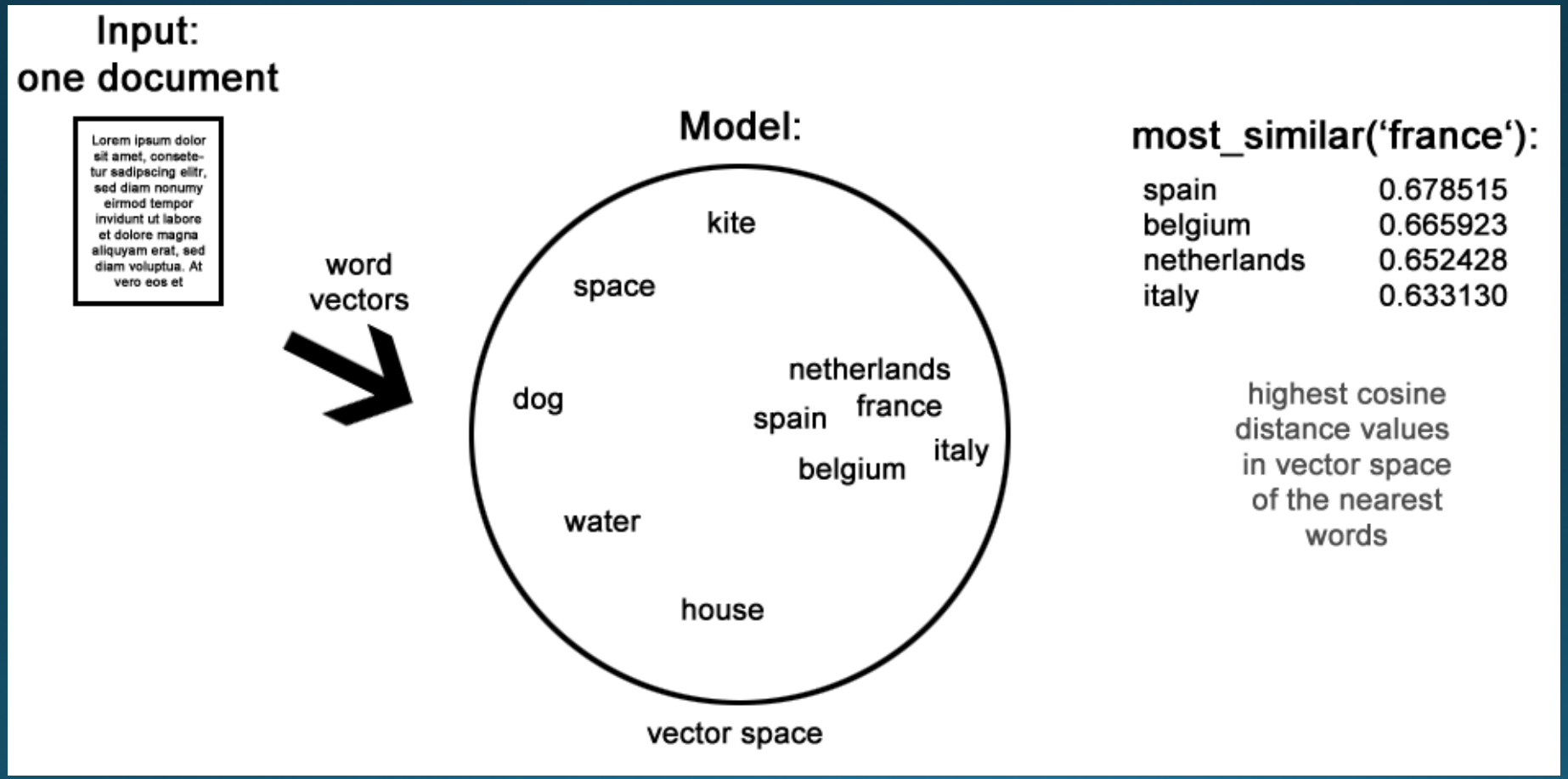
- Depending on the goal StopWords are discarded and Steaming method used (**looking for similar topics**) or the original text is used (**looking for similar profiles**)

Based on Word2Vec

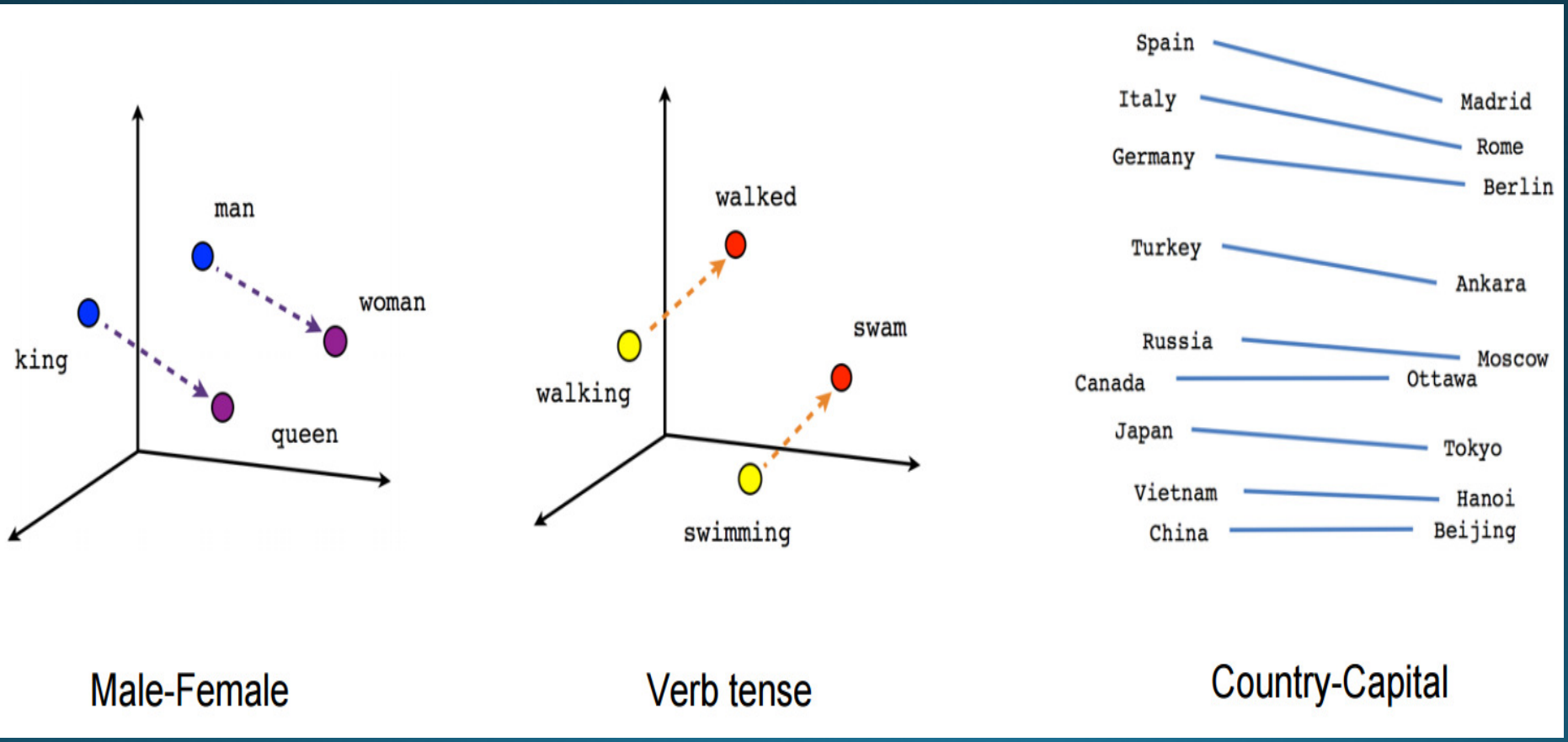
- Predicting the next word given its context (semantic)



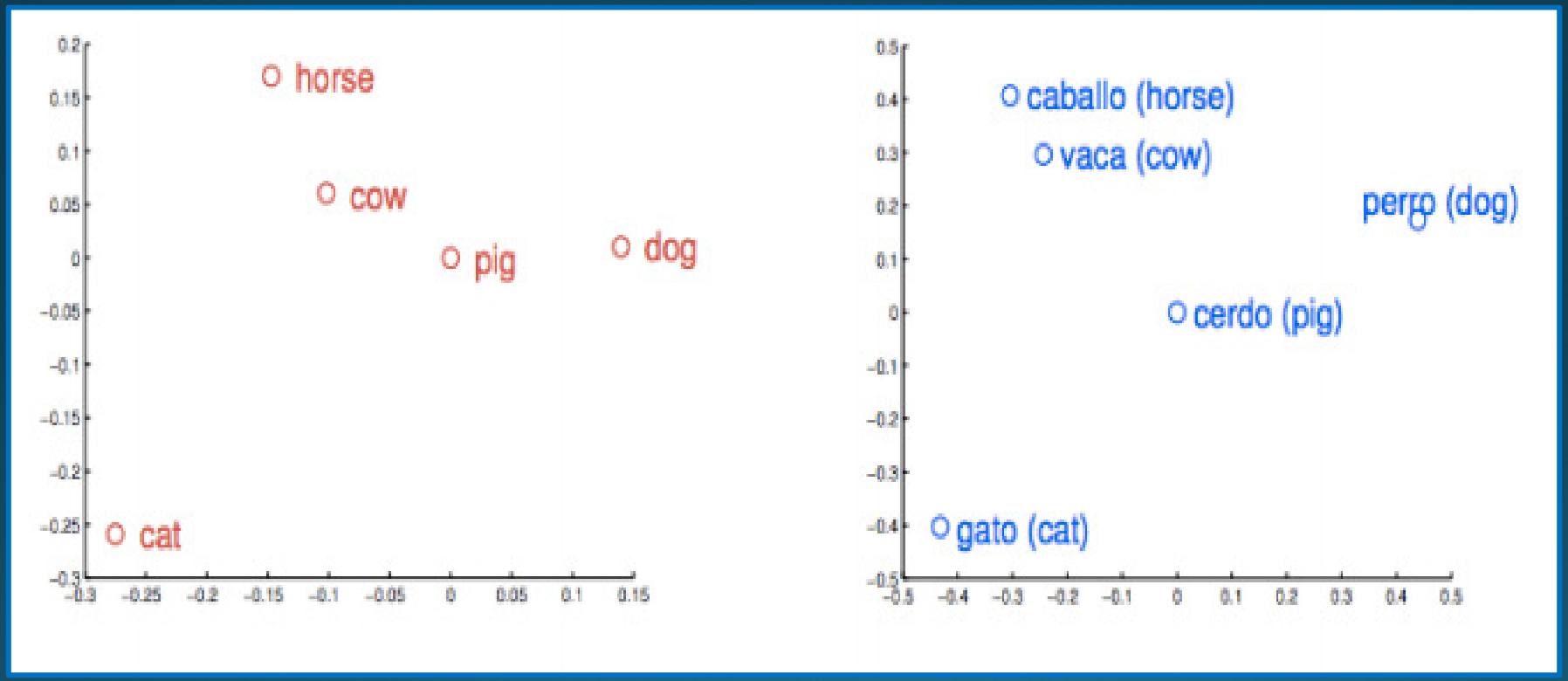
Word2Vec at Work



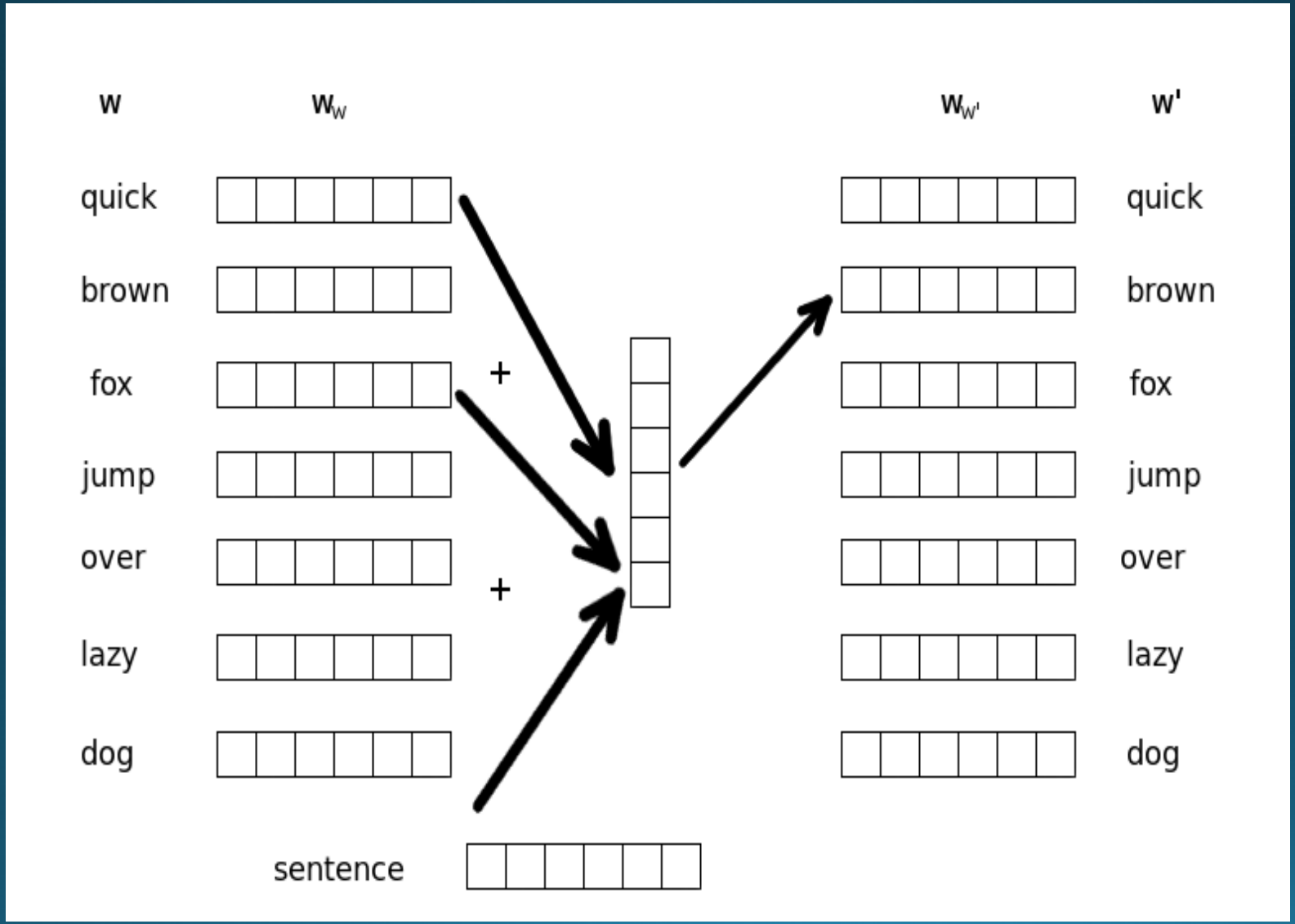
Results of Word2Vec



Results of Word2Vec



Doc2Vec at Work



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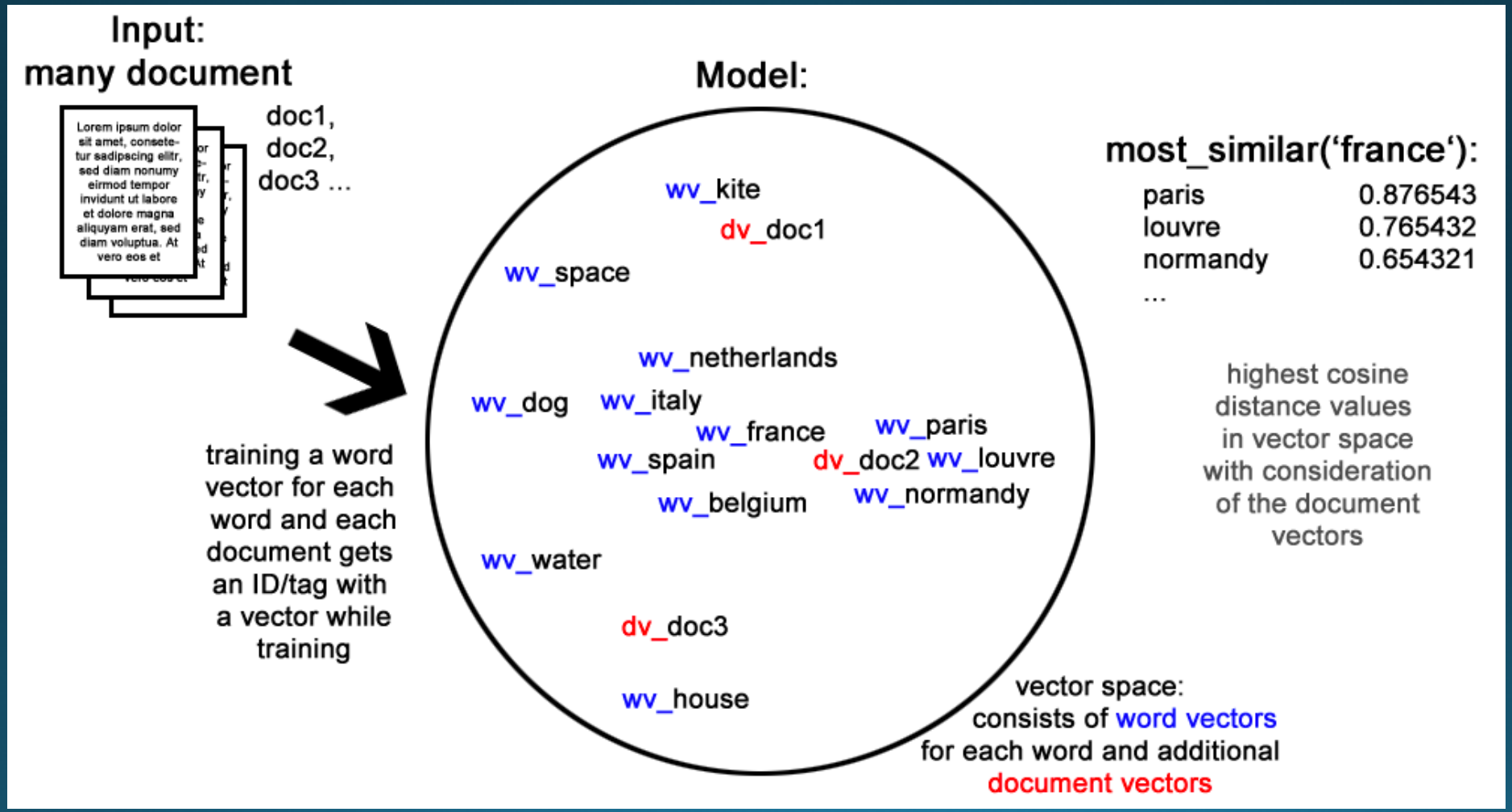
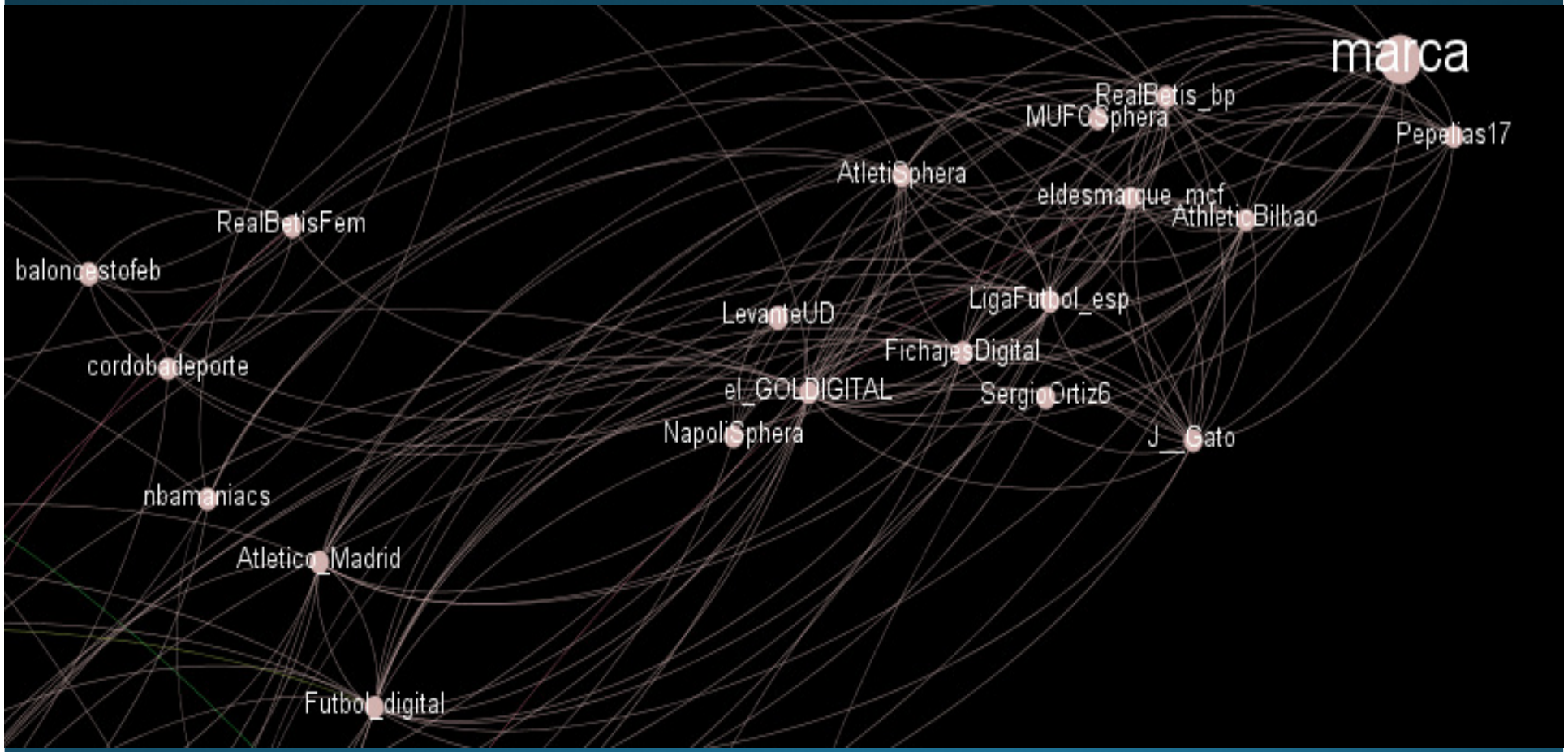
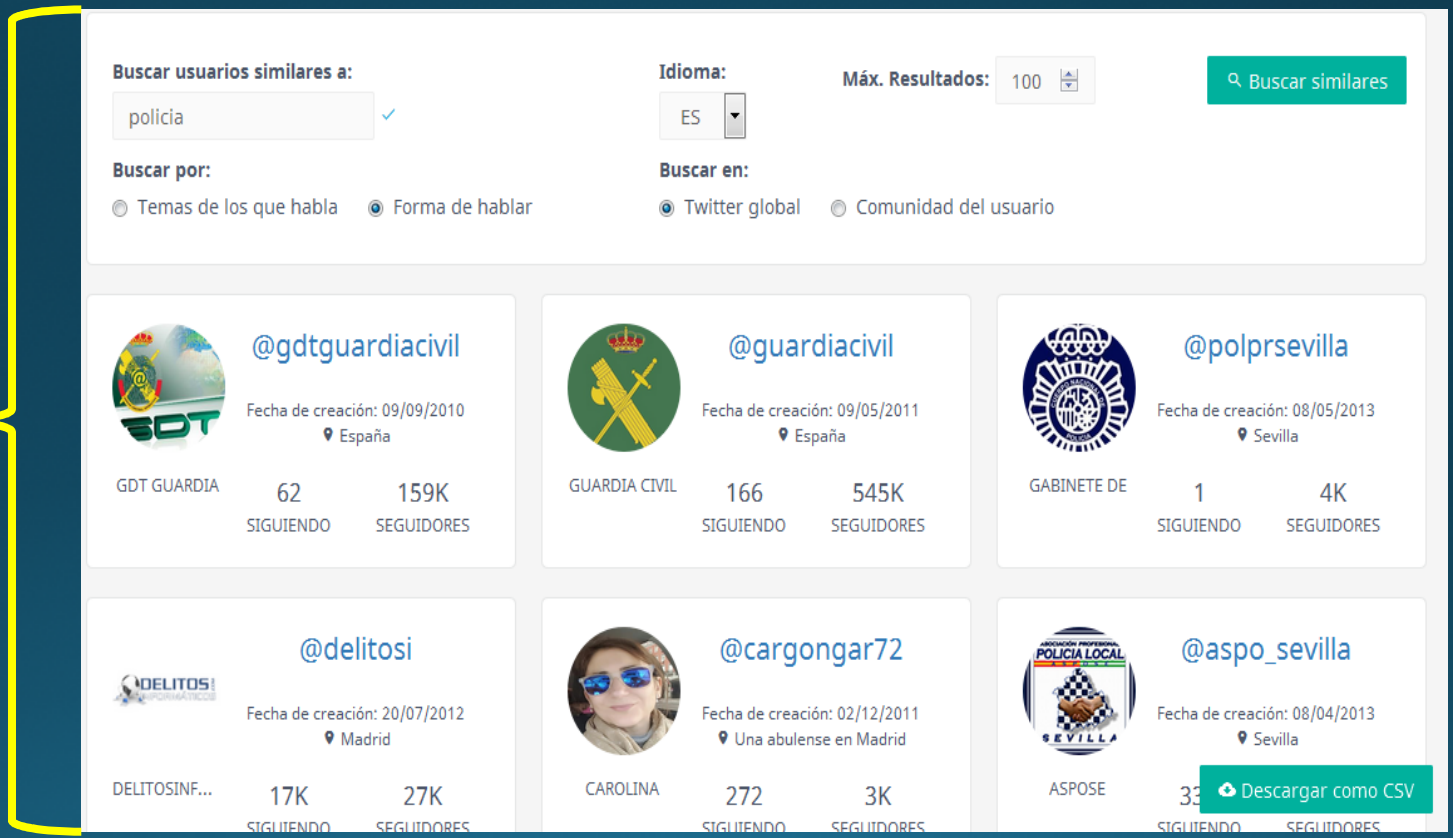


Doc2Vec Results



Example of Use: twin profiles



The big data problem

- We need to search for profiles similar to one given among millions of candidates in a minimal time.
- We have used some of the latest technological development for dealing with large datasets
- The prototype requires some time for training (learning vectors), but then it can scan through millions of profiles in a few seconds.

Use Cases

- The search of twin profiles can be done either vertically (within a given SN) or horizontally (looking for similar publications among different SN and forums).
- The method can also be used to link current profiles with profiles long inactive.
- Given a well-known and dangerous user, the method can be applied to look for similar users
  - That feature could enable to discover hidden relationships, even criminal networks.
- The method is indifferent to crime domain (radicalization, child pornography, hate speech, etc.) or language.

Context of Use

- The tool would not replace the human work in any case; on the contrary, it was designed to assist police agents on their work.
  - It can save time by searching in a few minutes through millions of SN profiles, producing a small set of candidate profiles.
  - These profiles should be afterwards analyzed by experts in order to determine if any of them could correspond to the target.

Future Work

- Algorithms for text classification can be improved, as new and more efficient versions are being continuously researched.
- Text analysis can be combined with traditional SNA analysis for measuring and looking for similarity.
- These analysis can be combined with personality profiling
  - Personality is an individual features extremely difficult to hide.
  - It can be used to risk prediction.
  - We have already made some progress on inferring personality through open source information.

Thank you very much!

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