

## Text Mining and Analysis

Summer School in Public Audit and Accountability<br>Pisa 25/07/2018<br>Jakub Piskorski

## Outlook

- What do we do?
- Europe Media Monitor (EMM) family of applications
- Event Extraction
- Importance of multilingual processing
- OSINT Suite (Open Source Intelligence)
- References \& Events


## Text and Data Mining Unit

Europe Media Monitor


Tools for Innovation
Monitoring



Statistics and Information Technologies for Anti-Fraud


BigData \& EOSS Earth Observation \& Social Sensing Big Data Pilot Project

## I3: Synergy

Interest and feedback from real world customers and policy makers for operational product, stimulating research and innovation

Interest from academia for collaboration and applied research in dynamic operational environment

## CLIENTS



## EU Institutions, EU Agencies, UN Agencies, African Union, Organization of American States, Member States Tax Agencies and Customs

[^0]
## 13: EMM - Philosophy

A complex system that works is invariably found to have evolved from a simple system that worked. A complex system designed from scratch never works and cannot be patched up to make it work. You have to start over with a working simple system. - John Gall (1975)

## Is Natural Language Processing Easy?

"I saw the man on the hill with a telescope"

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## Media Monitoring for Open Source information analysis

- Started in 2002 to provide Internet Media Monitoring to complement/replace traditional cut-and paste
- Information for decision makers, spokes persons: mainly 'political events'
- Initially main customer DG COMM. Evolved into monitoring for other kinds of events: disasters and crisis, security, health threats, countries, etc.


## What is EMM

Objective: Find knowledge that is hidden in text

## Gathers

## Enriches

## Selects

## Presents

Results: Find perhaps 100 relevant articles a day from 300000

## What is EMM

A tool to monitor, analyse and aggregate online and other electronically available sources

## Wide Coverage

- Local, Regional, National and International
- Multi-Lingual


## Rapid Updates

- High Frequency (5min)

Sources Covered

- Online media
- News wires
- Blogs
- BBC Monitoring
- Oxford Analytica
- Etc...



## Full Text Analysis



## EMM Architecture



## What EMM can do for you

Reduce amount of data to be analysed Filter out relevant information based on predefined categories

Provide additional information
Other categories, places, people, quotes
Provide automatic alerting functionality Simple email Breaking news
Breaking news per category
Replaces manual searching in selected sources

## EMM Architecture



## Language Detection



Language:
English

US president Donald Trump intention to cut the US corporate tax rate to 15 per cent may not be achievable with the border adjustment tax, which might have funded the reduction, now off the table. Irish tax experts remain convinced that US tax reform, whatever shape it takes, will not adversely damage Ireland's economic prospects, suggesting incentives for US multinationals to base operations here will continue. "All in all, I wouldn't be unduly worried at this juncture," Alan McQuaid said.

We cover ~ 70
languages

## Entity Detection



> US president Donald Trump intention to cut the US corporate tax rate to 15 per cent may not be achievable with the border adjustment tax, which might have funded the reduction, now off the table. Irish tax experts remain convinced that US tax reform, whatever shape it takes, will not adversely damage Ireland's economic prospects, suggesting incentives for US multinationals to base operations here will continue. "All in all, I wouldn't be unduly worried at this juncture," Alan McQuaid said.

Our entity DB is built on an Entity


## Database with <br> > 1 million entities

Guessing system.

- Different names with same title
- New title with different name


## Named Entity Detection

An entity is only associated with his name

- Various spellings
- Acronyms
- Short/long forms and aliases

The entity system does not do any disambiguation
Joseph "Joe" Borg

- Maltese politician, former Commissioner for Fisheries and Maritime Affairs
- Maltese soccer player
- American financial regulator who has served as the Securities Commissioner of Alabama since 1994


## Update Known Entities

- Guessed entities are used to enrich and keep up-to-date the known entity resource
- 600 unknown names per day are compared daily with $\sim 1,500,000$ known name variants
- 120 are automatically merged with known entities


## Geo Detection

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Database with
1.3 million entries

## Geo Dissambiguation

## - Matching

Bill Clinton went to Venice during his visit in Italy

- Disambiguation

Clinton:Pemmsumannia:U'UA Cls: -3 Entity
Venice:Veneto:Italy cls:-3
Venice:Venice:Veneto:Italy cls:2 The most specific wins!
Venice:iviadison.tilimuis:USA cls:5 Nothing USA related
Italy cls: -1

- Result
georss: Venice:Venice:Veneto:Italy fullgeo: Italy


## Entity-Geo Disambiguation

## Montenegro

- Common place name (country, cities, regions)
- Common person surname
- Spanish famous fiction character
- Italian bitter liquor


## Other examples:

- Hannah Montana
- Paris Hilton
- Asia Argento
- Michael Jordan


## Machine Translation



- Statistical Machine Translation (planning for NMT)
- Only from original Ianguage to English.
- 14 EU languages
- Czech, Danish, Dutch, Finnish, French, German, Greek, Italian, Latvian, Lithuanian, Polish, Portuguese, Spanish and Swedish
-     + Russian, Farsi, Chinese* and Arabic.


## Quote Detection



> US president Donald Trump intention to cut the US corporate tax rate to 15 per cent may not be achievable with the border adjustment tax, which might have funded the reduction, now off the table. Irish tax experts remain convinced that US tax reform, whatever shape it takes, will not adversely damage Ireland's economic prospects, suggesting incentives for US multinationals to base
> operations here will continue. "All in all, I wouldn't be
> unduly worried at this juncture," Alan McQuaid said.


## Categorisation

US president Donald Trump intention to cut the US corporate tax rate to 15 per cent may not be achievable with the border adjustment tax, which might have funded the reduction, now off the table. Irish tax experts remain convinced that US tax reform, whatever shape it takes, will not adversely damage Ireland's economic prospects, suggesting incentives for US multinationals to base operations here will continue. "All in all, I wouldn't be unduly worried at this juncture," Alan McQuaid said.

Categorization:
Taxation
Economy EU-US trade
3.000 categories/topics based on more than 60.000 keywords

## Powerful Categorisation Engine

- Based on user defined keywords/patterns
- Boolean combinations, proximity, wildcards
- Support for Arabic and similar (automatic noun-prefix processing)
- Support for Chinese and similar (no whitespace).
- Categories can be overlapping, no ontology


## Complex criteria...



## Tonality

US president Donald Trump intention to cut the US corporate tax rate to 15 per cent may not be achievable with the border adjustment tax, which might have funded the reduction, now off the table. Irish tax experts remain convinced that US tax reform, whatever shape it takes, will not adversely damage Ireland's economic prospects, suggesting incentives for US multinationals to base operations here will continue. "All in all, I wouldn't be unduly worried at this juncture," Alan McQuaid said.

Tonality:
$+$
POSITIVE
;
European Commission

## Structured data: logical view



Language: English

US president Donald Trump intention to cut the US corporate tax rate to 15 per cent may not be achievable with the border adjustment tax, which might have funded the reduction, now off the table. Irish tax experts remain convinced that US tax reform, whatever shape it takes, will not adversely damage Ireland's economic prospects, suggesting incentives for US multinationals to base operations here will continue. "All in all, I wouldn't be unduly worried at this jumeture," Alan McQuaid said.

Categorization:
Taxation
Economy
EU-US trade

## Entities:



## Quotes:

"All in all, I wouldn't be unduly worried at this juncture"


Sentiment:
POSITIVE


## Top Stories

| Main Menu |
| :---: |
| Top Stories |

24 Hours Overview Events Detection Most Active Themes Help about EMM Overview Advanced Search Sources list Web Site Map

## EU Focus

Jean－Claude Juncker （Commission President） Commission Vice－Presidents Commissioners
EC News
Investment Plan for Europe
Council President
EP Presidency
Brexit
European Pillar of Social Rights
Austrian Presidency of the EU Council
$-$

$\Rightarrow$ The Latest：Lebanese analyst：US，Iran on＇brink of war＇
II｜｜Articles ：883｜Last update ：Jul 23,2018 4：17：00 PM｜Start ：Jul 21,2018 11：28：00 PM｜Sources ： 333 ｜Peak ： 1 ｜Current rank ： 1
Politics The Latest：Trump security adviser echoes warning to Iran［
boston Monday，July 23,2018 4：17：00 PM CEST｜info［other］
｜Entities：Hassan Rohani［6］；Kamel Wazne［1］；Benjamin Netanyahu［1］；Heshmatollah Falahatpisheh［1］；Javad Zarif［2］；Sarah Huckabee Sanders［1］；Vladimir Putin［1］；Christofer Burger［1］；Donald Trump［8］；Gholam Hossein［1］；Prophet Muhammad［1］；Kim Jong II［1］；Kim Jong un［2］；
Other categories：JRC Safeguards；JRC Nuclear Security；
Quotes in this article
Sarah Huckabee Sanders says：＇if anybody＇s inciting anything，look no further than to Iran＂
Hassan Rohani comments：＂America must understand well that peace with Iran is the mother of all peace and war with Iran is the mother of all wars ${ }^{\text { }}$
Christofer Burger said：＂threats of military force are never helpful，and I think that particularly in the tense situation in the Middle East this is not a helpful means of discourse＂
She says：＂The president consults with his national security team on a daily basis．＂8：10 a．m．The White House says President Donald Trump＇s threatening tweet shows he＇s not going to tolerate critical rhetoric from Iran，but claims the U．S．leader isn＇t

Tools
Monday，July 23， 2018
4：36：00 PM CEST
RSS IMAP
Facebook
subscribe｜manage
info

## $\square$ App Store Google play

Languages

Legend
＋

## Top Stories

## Event Extraction

Recent Disease Incidents

## Alert Statistics

Communicable Diseases
Symptoms
Bioterrorism
Nuclear
Chemical
ECDC
EFSA
EMCDDA
ENV_RISKS
Food Security
SAM
Medical Devices

## Vaccination

Other
Continents
Official Sources
Sources List

## Latest News About - Dengue Fever



Top Twitter Users
Top HashTags

## \#dengue

\#Zika \#chikungunya \#1050DaysOfWar \#mosquitos \#Mosquito \#Yemen msaludpy redezikaCS

Top URLs
/www.theverge.... 1] vital.rpp.pe/s... /olhardigital.. /twitter.com/s. www.charlesmil. /timesofindia. /www. breakdeng. www.thelancet. /www.mspbs.gov. www.xevt.com/v.

## Tools

Tuesday, July 24, 2018
11:40:00 PM CEST
RSS \| MAP
subscribe | manage
current page | all pages
info | definition


[^1]high medium low

NEW DELHI: is turning out to be the fastest mosquito-borne disease this As per municipal data released on
Monday, 75 people have been affected by malaria as on July 21 this year. It is higher than the number of
people affected by dengue (43) and chikungunya (34), the two other mosquito-borne diseases, in the said

مأرب تعلن الحرب على عدة حشرات مؤذية للمجتمع گـ] [m arebpress Tuesday, July 24, 2018 8:19:00 PM CEST | info [iti [en] [other [1Trigger words: [DengueFever
[1 أحمد الجبادي[1: : Entities Other categories
تتواصل لليوم الثاني على التوالي حملة الرش الضبابي لمكافحة البعوض الناقل لحمى الضنك بمدير يتي الوادي ومدينة مأرب ؛ التي ينفذها مكتب الصحة بالمحافظة بالتعاون مع جمعية الإصلاح الإجتماعي الخير ية CSSW. وأكد الدكتور عبدالعزيز الشدادي مدير عام مكتب الصحة بالمحافظة أن الحملة تأتي ضمن الإجراءات التي اتخذها المكتب في مواجهة حمس الضنك والحد من انتشارها..

Delhi: Malaria cases outpace dengue this season [ $\mathcal{Z}$
$\boxed{2}$ tim esofindia Tuesday, July 24, 2018 7:58:00 PM CEST | info [other]
Trigger words: [DengueFever] Aedes aegypti[1]; dengue[4];
Other categories: WHO; Malaria; Pharmaceuticals;

## Personal News Dashboard



## MyNews: Hashtags



## MyNews: Most retweeted tweets



## MyNews: Most Active Users



## MyNews: Keywords cloud



## EMM News Desk






## EMM Mobile



European
Commission

## End-to-End solution

## EMM

(Europe Media Monitor)


- 8.000 News Sites
- 300.000 articles per day
- 70 Languages
- 3000 Categories/Topics
- 60000 keywords
- Runs 24/7
- Visitors 25000/day


Breaking
News


Domains:

- Border Security, Cybercrime \& Fighting Crime
- Socio Political Event Monitoring
- Public Health Threats \& Food Safety
- Conflict Early Warning
- Science and the Citizen


## Event Metadata Extraction

"To detect automatically who/what did what to whom when, why, with what instruments and determine the consequences"
© Information Extraction Task as opposed to Information Retrieval
© Extracting information in order to fill slots of database-like structures

- Try to maintain EMM approach of being as much as possible language agnostic "syntactic lightweight"
"Baghdad 12/01/2010 American soldiers involved in a firefight shot dead five Iraqi insurgents today during a routine patrol in Baghdad, 2 US soldiers were slightly injured with minor wounds. The firefight started after..."

| Slot Name | Value |
| :--- | :--- |
| TYPE: | Shooting |
| PERPETRATOR: | American Soldiers |
| DEAD | Iraqi Insurgents |
| DEADCOUNT | 5 |
| INJURED | US Soldiers |
| INJUREDCOUNT | 2 |
| LOCATION : | Baghdad |
| TIME: | 12.01 .2010 |



Natural Disaster Crisis Event Types


Other Crisis Event Types


- G NEXUS Maritim
NEXUS Maritime
- Medisys-NEXUS (Medinex)
CP 24 hour EN
EP 7 Day EN
E 24 hour FR
雷 7 Day FR
- EMM Moderated Events
- $\quad$ News Clusters
- General Alerts
- $\quad$ NewsBrief BNS
Events
Q
$\checkmark$ Layers
V - Primary Databas
- Ir P Borders and Labels
    - Places
    - Photos
Roads
- F- 30 Building
- Ocean
$-\quad$ Weathe
W Weathe
Gallery
$\square$ More
- Terrain



## Basic Aggregation Analysis over Space and Time

## Civil Unrest and Protest Violent Events



| Crisis Events | en,fr,it,es,pt,ru,ar,tr,bg[zh] |
| :--- | :--- |
| Border Security Events | fr,it,es,ar,(en,ru)* |
| Medical Events | en,fr,tr |

* 1500 moderated events were imported into the Frontex Eurosur system, the event extraction and moderation systems were also used as inspiration define the policy for Eurosur (exchange of border security related events between Member States)

European Commission

## Event Moderation



Search events


## Event Linking

| Category Type | Crime Violence Terrorist Attack | b. |  | Category <br> Type | Crime Violence Terrorist Attack |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Location | Manchester:Greater <br> Manchester:England:UK |  |  | Location | Manchester:Greater <br> Manchester:England:UK |
| Dead | 19 | identity | dependency | Dead | 22 |
| Injured | 59 |  |  | Injured | 59 |
| Title | 19 killed in blast at Ariana Grande's Manchester concert (Third Lead) |  |  | Title | Manchester attacker <br> identified as 22 -year-old <br> Salman Abedi: Police |
| Description | At least 19 persons were killed and 59 injured in a | Category | Crime Violence | Description | The man suspected of carrying out an attack at an Ariana Grande concert in Manchester, England, Monday that killed 22 people and injured 59 others was identified as 22-year-old Salman Abedi, police said today. Abedi died at the scene after using an improvised explosive device, officials said. |
|  | terror attack here on Monday night at the conclusion of a | Type | Terrorist Attack |  |  |
|  | concert by American pop singer Ariana Grande, police said. The explosion, the | Location | Manchester:Greater <br> Manchester:England:UK |  |  |
|  | second in the city in 21 years, took place around | Dead | 19 |  |  |
|  | $10.35 \mathrm{p} . \mathrm{m}$. (local time) on Monday at the Manchester | Injured | 59 |  |  |
|  | Arena.... | Title | 'Suspected terror attack' after Ariana Grande gig at Manchester Arena |  |  |
| Category | Crime Violence | Description | Nineteen people have died and more than 50 others are injured following a suspected terror attack at the Manchester Arena. Greater Manchester Police said the explosion, which happened just before 10.35 pm on Monday, is being treated as a suspected terror incident. | Category | Crime Violence |
| Type | Terrorist Attack |  |  | Type | Terrorist Attack |
| Location | Manchester:Greater <br> Manchester:England:UK |  |  | Location | Manchester:Greater <br> Manchester:England:UK |
| Dead | 22 |  |  | Dead | 22 |
| Injured | 0 |  |  | Injured | 0 |
| Title | Islamic State claims responsibility in Manchester blast |  |  | Title | Manchester attack: Jihadist celebrates bombing in video |
| Description | In a statement, the Greater Manchester Police said that they arrested a 23-year-old man in south Manchester in connection with the attack as hundreds of police swarmed through the city in the aftermath of the blast. Authorities are trying to determine if the suicide bomber acted alone or was [...] | dependency | same_cause | Description | 'The lions of the Islamic State are beginning to attack all the crusaders. Allahu Akbar.' Traumatised families today told of the carnage they witnessed after a suicide bomber set off a ball bearing explosive at a packed Ariana Grande concert last night. |

## Features with high discriminative power for event linking:

- Named-Entity Overlap
- Weighthed Content

Word Overlap

- Hypernym Overlap
- Location Information


## Importance of Multilinguality



Italian - German


English - French


Spanish - Portuguese


## Importance of Multilinguality

- A random selection of 523 events from 22 non-consecutive days in 2010 (6 languages)
- $\sim 10 \%$ reported in $>1$ language
- $\quad \mathbf{6 7 \%}$ reported in non-English news only
- ~2\% reported in non-English news are reported in >1 language



## Importance of Multilinguality



## Importance of Multilinguality



## EMM Open Source Intelligence Suite



## EMM OSINT Suite: Acquire Documents

- Web search
- interface for exploiting results returned by most popular search engines
- facility to integrate new search engines
- Crawl of targeted web sites
- Import of local document collections
- Conversion of documents into plain text
- HTML, PDF, Microsoft Office and Open Office
- Creation of metadata
- Unique File ID, Acquisition Source, Language ID, ...


## EMM OSINT Suite: Extract Information

- Extraction of "generic" built-in entity types
- Person, organisation and location names
- Time and numeric expressions
- Identifiers (e.g., email/postal addresses, URLs, IBAN/VAT numbers, phone numbers, currency expressions, etc.)
- Extraction of user-defined entities
- Lists of known entities and their variants
- Regular expressions
- Categorisation of documents (simmilar as in EMM/Medisys)


## EMM OSINT Suite: Analyse Data

- Viewing extracted entities in Entity Browser
- links to documents in which they appear
- frequency-based list of co-occurring entities
- Creation of entity graph
- based on co-occurence information
- to derive intelligence about relationships which are not necessarily obvious
- Creation of reports
- Predefined (e.g., related entities, list of URLs, etc.)
- Customised by the user




## Advanced Extraction Pattern Language

```
person :> ((dictionary & [TYPE: "first_name",
                        SURFACE: #first])
            (dictionary & [TYPE: "initial",
                        SURFACE: #in]
    token & [SURFACE: "."]) ?
    (token & [TYPE: "first_capital_word",
        SURFACE: #last])):name
-> name: person & [NAME: #full_name,
            FIRST_NAME: #first,
            LAST_NAME: #last,
            INITIAL: #in
            AMOUNT: "1"]
            & #full_name := ConcWithBlanks(#first,#in,#last)
            & ValidatePersonName(#full_name).|
```


## Advanced Extraction Pattern Language

```
credit_card_number :> ( separator
    ( digit & [SURFACE: #d1]
                        ( digit & [SURFACE: #d2]
                            ( sym & [SURFACE: "-"] )?
        )+
        ) :card
        separator
        )
-> card: credit_card_number & [SURFACE: #final_card,
                ISSUER: #card_type]
    & #final_card := Trim(#d1,#d2)
    & #card_type := CreditCardIssuer(#final_card)
    & LuhnTest(#final_card).
```





Father: Abderrahmane Abdeslam
Mother: Faklan Abdeslam
Brothers: Brahim Abdeslam, Mohamed Abdeslam
FOOTBALL WEAPONS ISIS EU $\qquad$
https://www.facebook.com/ abdeslam.salah. 1
https://www.facebook.com/ abdeslam.salah. 50
https://www.instagram.com/ explore/tags/abdeslam/

| QUOTATIONS |
| :--- |
| "going to see the game at Stade |
| de France this week ..." |
| o7.06.2015 |
| "the cheaperst way to travel to |
| Syria is ...." |
| 04.04.2015 |



## Timelines Extraction

## TIMELINES EXTRACTION

Since 1971, he has chaired The Trump Organization, the principal holding company for his real estate ventures and other business interests.

Trump was born on June 14, 1946, in Jamaica, Queens, a neighborhood in New York City.

Trump attended Fordham University in the Bronx for two years, beginning in August 1964.

While there, from 1968 he worked at the family's company, Elizabeth Trump \& Son, named for his paternal grandmother.

## EVENT TYPE: MANAGEMENT

 EVENT TRIGGER: has chairedTIME: Since 1971
RELATED ENTITIES:

## EVENT TYPE: BIRTH

EVENT TRIGGER: was born
TIME: June 14, 1946
RELATED ENTITIES: Jamaica,
Queens, New York City

## EVENT TYPE: PARTICIPATION EVENT TRIGGER: attended TIME: August 1964 RELATED ENTITIES: Fordham University, Bronx

## EVENT TYPE: WORK-FOR EVENT TRIGGER: worked at TIME: 1968 <br> RELATED ENTITIES:

European Commission

## References

- EMM Newsbrief: http://emm.newsbrief.eu
- Medisys: http://medisys.newsbrief.eu/
- Event Extraction (KML): http://labs.emm4u.eu/view.kml
- EMM OSINT Suite:
https://wiki.emm4u.eu/confluence/display/osintpublic/EMM+Open+So
urce+Intelligence+Suite
- EMM Language Technology Resources: https://ec.europa.eu/jrc/en/language-technologies
- More: http://emm.newsbrief.eu/overview.html


## OSINT Workshop

- When: 25-27 September (3 full days)
- Where: Villa Cagnola, Gazzada, Italy (http://www.villacagnola.it/)
- What:
- Sharing experience of using OSINT tools/methods
- Latest Developments in Research
- Tutorials (EMM News Desk, OSINT Suite, Advanced Topics - IE, Machine Learning)
- Audience:
- MS experts from national authorities
- Practitioners from EC and other EU institutions
- More Info: Jakub.Piskorski@ec.europa.eu


## Thank you!

## Any questions?

You can find us at $\mathbf{R C} C$-TMA-CC@ec.europa.eu
EMM support: JRC-EMM-SUPPORT@ec.europa.eu


[^0]:    EU Institutions
    Member States International

[^1]:    Previous 14 days average
    Alert level:

