An ecosystem of KOS tools

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NKOS Consolidated Workshop 2021

Networked Knowledge Organization Systems

(22/09/2021, online)
Outline

The ART Knowledge Engineering Unit at University of Tor Vergata: A few words about us and our university

ART KE Technology Asset
A quick run-through the various development directions and realized platforms

VocBench 3
An overview of some of the most recent features, with particular focus on dataset alignment

ShowVoc
The ideal companion to VocBench, ShowVoc is optimized for data publication and browsing

Loddy
A flexible data publication tool

CODA: An already known guest for VB. And yet one that has much still to say…
My Research Lab

Università degli Studi di Roma Tor Vergata

http://web.uniroma2.it/

http://art.uniroma2.it

• Realized as a University Campus distributed over a wide area in the SE of Rome

Our offices!

...and LAB!

We are located at the Faculty of Engineering, Information Engineering Building
Areas of Interest

Natural Language Processing
- Robust Parsing
- Information Extraction
- Semantic Role Labeling
- Textual Entailment
- ML for Natural Language

Machine Learning
- ML for Natural Language
- Computational Language Learning
- Ontology Learning
- Classification, Multimedia IR
- Music IR

Knowledge Engineering
- Ontologies and Knowledge Modeling
- Semantic Web Technologies
- Knowledge Acquisition
- Knowledge Sharing
- Knowledge-based Systems
ART Knowledge Engineering Unit's Research is oriented at finding solutions for information gathering, elaboration, elicitation and organization.

Aiming at:

- improving the experience of "humans in the loop"
- elaborating better scenarios for machine2machine collaboration

A byproduct of this work is the realization of systems for realizing the above tasks. Usually they are born as proof-of-concepts, at times evolve as testbeds for further speculation, until sometimes the "child" has grown enough to claim his own space in life.
ART Technology Asset (some history)

Semantic Turkey
- Flagship KM&A Platform
- Semantic Turkey extensions for Knowledge Acquisition
- Adding Concepts

OntoLing
- Ontology Linguistic Enrichment Tool

ALE
- Automatic Linguistic Enrichment

Linguistic Watermark
- Library and Ontologies for Accessing Heterogeneous Linguistic Resources

CODA
- Wrappers for different LRs
- Java Multi WordNet Library

These systems have been developed around 2004-2010
Appetite comes with eating...

Thanks to EU funding and specific missions, some of these systems have come to industry-standard level, yet open-source and freely licensed to open communities.

We'll show how these systems have gone past from their initial research status and became pieces of a bigger picture, aiming at unleashing a full ecosystem of platforms and tools for knowledge acquisition and management.
The ART SW Team

The Developers

Armando Stellato
PhD, Researcher, Project Leader
University of Rome Tor Vergata, Italy

An insane love for insane architectures... he has two imaginary friends, sitting on each of his shoulders, fighting an eternal battle between order and chaos.

Andrea Turbati
PhD, Research Associate
University of Rome Tor Vergata, Italy

Semantic Turkey developer
VocBench OSGi extension for Semantic Turkey

He can carve any system bit by bit, but don’t talk to him about ‘frameworks’... His motto? "If it works, it’s good and if it ain’t broke don’t fix it!"

Manuel Floridi
PhD, Research Associate
University of Rome Tor Vergata, Italy

Semantic Turkey developer
Dangerously following and amplifying Armando’s architectural leaps... his hobby is (before breakfast) refactoring 10 levels of abstraction into what Andrea just made work so well.

Tiziano Lorinczeti
Research Assistant
University of Rome Tor Vergata, Italy

Semantic Turkey developer

The Users

a whole community supporting its development
funding sponsors

EU law and publications

ISA²
Interoperability solutions for public administrations, businesses and citizens

and other users (the community now is much much bigger, those here were there since the beginning... and pls forgive any omission!)

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06/11/2018
ART Contributions to EU Data Infrastructure

Support for OntoLex
- Ontolex porting of many LRs

VocBench

Sheet2RDF
- Spreadsheet RDF Data Lifting

Loddy
- Data Browsing

Semantic Turkey
- Data Publication

Flagship KM&A Platform
- MAPLE Orchestrator
- MAPLE Service Engine
- Metadata Registry
- etc.

CODA
- Computer-aided Ontology Development Architecture

Next steps!
Supporting an Open Ecosystem for the Development of Semantic Web Resources

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Manuel Florelli
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Semantic Turkey developer
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Tiziano Lorenzelli
Research Assistant
University of Rome Tor Vergata, Italy

Semantic Turkey developer

A: Uh...Tiziano...if you have time could you implement...
T: Done.
A: Well, then, you could move on to...
T: I’m already on it, done by end of today.
A: This guy is so efficient it’s frustrating!

The Users

a whole community supporting this ecosystem development

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and other users (the community now is much much bigger, those here were there since the beginning...and pls forgive any omission!)

University of Rome Tor Vergata
Today, the University of tomorrow

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VOCBENCH 3
Requirements that drove the development of VB3

R1. Multilingualism
R2. Controlled Collaboration
R3. Data Interoperability and Consistency
R4. Software Interoperability/Extensibility
R5. Data Scalability
R6. Under-the-hood data access/modification
R7. Adaptive Context and Ease-of-use
R8. RDF Languages Support
R10. Full Editing Capability (RDF Observability&Reachability)
R11. Provenance
R12. Versioning Support
R13. Metadata Descriptions
R14. Customizable UI
R15. Everything’s RDF

06/11/2018
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VocBench UI
VocBench

A quick tour through some of its recent features
UI and Multilingualism (R1)

multilingual editing and visualization

Language preferences

multilingual editing
UI and Multilingualism (R1)
UI and Multilingualism (R1)
Graph Visualization

Two Views:

- **Model View**: strongly abstracted from triples, oriented to describing vocabularies
- **Data View**: more adherent to triples in the graph

Interwoven with different organization approaches:

- Exploration/Visualization: self-organizing diagram
- Diagram Editing: possibility to organize the elements of the graph
The class diagram features a new option for graph visualization: model-oriented graph. The model view describes all classes in an ontology and their relevant axioms (a filter is available). Properties are described as connectors between classes, by using their domain and range descriptors.
Any resource can be viewed in the data-oriented graph-view, which shows an almost triple-by-triple view of the resources managed in VocBench.

A detailed configuration provides several filters, based on specific languages, on a global toggle for all literals or on properties from specific sections of the resource view.

Whenever a resource is inspected, if the number of connected nodes is in any case too high, a dedicated window shows all the properties being used within that specific resource so that the user can prepare a tailored set of filters.

Resources can be dragged in or discovered by progressively expanding the boundary nodes in the graph.
Graph View: Class Diagram

The diagram content can be rearranged thanks to several options and exported in Support Vector Graphic.
It is possible to toggle between a IS-A only representation and a description of all the relations holding between the classes by identifying the involved properties.

This latter option is suggested for more detailed inspections of few elements (e.g. the three classes in this view).
Wizard status can be stored and reloaded.

Sheet2RDF

Associate the subject to any header. Better UI support for filling converters’ signature.

Support for memoization:

Editor for each header with multiple associable transformations:

- Simple ones (similar to those of the previous Sheet2RDF)
- And complex ones (possibility to edit graph patterns)

Complex transformations can be stored and reused for other headers or even in other projects.

Complex transformations consist in custom graph patterns with variables that can be bound:

- To elements outside the transformation, through pre-established names (e.g., subject)
- To converted nodes originated from the header itself

Generated PEARL transformation code and produced triples.

Possibility to export produced triples or to load them in the dataset.
Simplified Views: Terminologist View

An alternative to the resource-view for editing SKOS-concepts – inspired by the IATE User Interface – with simplified experience, less RDF-centric
Simplified Views: The Lexicographer View

A new simplified view for lexicographers:

- structured as an *editable* dictionary page
- fully exploits the Ontolex-lemon standard
- hides the complexities of the Ontolex model in RDF
DATASET ALIGNMENT IN VB3
Ontology Alignment (aka Ontology Matching, Ontology Mapping) defines the task of discovering and assessing alignments between ontologies.

The term ontology is to be intended in its broadest meaning, including thesauri, terminologies, authoritative lists and other datasets in general.

- The task is well-defined
  - There are variations: Tbox/Schema matching, instance matching, instance-to-schema (also called annotation) etc..

- It is intensive and error-prone

- Several approaches for its automation have been devised
  - An Ontology Alignment Evaluation Initiative is run every year since 2004

- However…
It is not limited to automatic discovery of alignments!

Once developed, alignments should be subject to a full maintenance lifecycle, which includes differential updates, taking into account newly added or deleted resources, topological changes in the mapped datasets, possibly collaboration between teams of the involved resources, etc.
Alignment Maintenance: Some Literature

• Chimæra
  – Web based environment for merging ontologies and checking their correctness.
  – Mixes automatic mapping procedures with UI for content visualization and mapping validation

• MAFRA Toolkit
  – Focus on transformation rather than matching (prior to SPARQL)

• Agreement Maker
  – Visual tool for creating and managing mappings (includes automatic alignment)
  – Focus on geospatial resources

• Alignment API
  – Reusable set of API
  – Alignment Server: online service for alignment manipulation
  – EDOAL: a dedicated language for representing alignments as first-class citizens. A de-facto standard and interchange format

• Integrated Mapping Environments (within editors), e.g. PoolParty or Topbraid Enterprise Data Governance


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Capitalizing on past approaches, we developed a fully-fledged Alignment Environment within our popular Collaborative Environment for Management of Ontologies, Thesauri, Lexicons (and now Alignments ;-) ) VocBench.
Alignment Support at Large

Not a single entry point for alignment development

Alignment is a pervasive aspect appearing in diverse points of the UX

• Alignment from within the resource-view
  – Manual alignment (search based)
  – Semi-automatic (search keywords based on available labels)

• Alignment Validation
  – Input coming from a static EDOAL file
  – Input coming from the invocation of an automatic alignment system

• EDOAL projects
Alignment from within the Resource View (1)
Alignment from within the Resource View (2)

Directly from the editing view of a resource, it is possible to perform quick alignment actions towards:

- Browsing datasets hosted on VocBench (local datasets)
- Assisted search on both local and remote datasets on the Web (Linked Open Datasets)
Alignment from within the Resource View (3)
Dataset Metadata Exploitation

- The second option for alignment exploits datasets' metadata in order to automatically select the search keywords for the target dataset.

- The keywords basically come from the labels of the resource to be aligned

- Language selection through metadata comparison, thanks to a rich metadata description of the lexical asset
The Metadata Registry is based on a application profile mixing several dataset metadata vocabularies:

- DCAT
- VoID
- LIME

LIME (Linguistic MEtadata) is the metadata module of the Ontolex-Lemon suite of ontologies for Ontology-Lexicon interfaces.
Alignments computed through different means (alignment systems, manually etc..) can be compared through a dedicated UI

The EDOAL model has been adopted, providing a rich, vocabulary-neutral perspective on alignments

Alignments can be validated, refined, projected onto a specific model (e.g. OWL/SKOS mapping properties/axioms)

Vetted alignments can be compared to other ones, and/or can be ingested into hosted datasets
A new type of project, based on the EDOAL standard

Alignments are first class citizens in the project, which is linked to two other projects in VocBench.

The Alignment Validation tool is available both on dataset-centric projects and on EDOAL ones.
AUTOMATIC ALIGNMENT
Metadata-driven Ontology Alignment: MAPLE

- MAPLE is an orchestrator for ontology alignment scenarios
- By analyzing the metadata of the datasets involved in a mediation process, MAPLE can inform alignment systems on the proper configuration and best strategies to adopt
- In VB3, MAPLE analysis can be inspected by the user, who can override several of its performed choices
- VB provides an Open API for Alignment Systems so that they can interact with it
- Possibility for connected Alignment Systems to define a set of matchers and to export their configuration schemes
  - General configuration
  - Matchers Configuration
- Currently available systems
...I have to summon here

...two very dear old friends...
Hi, I’m Merlin the Wizard. I see you are a Genie, so I suppose we can talk about magic*

Oh yes, I like talking about magic.

My reference ontology for magic is: Xxxx/magic.owl

Erm…sorry, mine is: YYYY/mana.owl

Well, ok, what’s your language(s)?

Mmm… I just speak arabian, and I’m able to express some of my ideas in a very simple english (Freelang, automatic translation with 23% coverage of ontology concepts)

Well, ok, what’s your language(s)?

Erm… sorry, mine is: YYYY/mana.owl

Actually I’m a good english speaker (ontology natively filled with english terms) and I’ve just found on the yellow pages an english/arabian translator (Dict english/arabian dictionary Semantic Web Service), maybe they can help us a bit…”

That’s great, I can summon a familiar of mine who is a good english speaker (a Wordnet 2.1 resource agent) and I’ve just found on the yellow pages an english/arabian translator (Dict english/arabian dictionary Semantic Web Service), maybe they can help us a bit…”

*agents are talking on the basis of a minimal agreed protocol which can then start a semantic coordination activity
Semantic/Linguistic Coordination

...let's see what happens behind the stages...
"Alignment Scenario" Evaluation by MAPLE

<table>
<thead>
<tr>
<th>description</th>
<th>code</th>
<th>dataset</th>
<th>url</th>
<th>sparql endpoint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short Description of the datasets to be compared</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description of the support datasets: usually lexicalizations of the same datasets to be aligned, but can include external supporting resources (e.g. lexical resources such as WordNet to expand language coverage, so called synonymizers)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Possible suggested pairings between lexicalization sets (supported by synonymizers, translators etc.) and summarized into a score</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Semantic/Linguistic Coordination

...and, in VocBench,

what the user sees...
Quality of potential pairings is mainly measured in terms of:

- **coverage of the dataset** (percentage of resources that are lexicalized in that given language)

- on a second order, on the lexical richness in that language (overall number of lexicalizations, thus revealing the presence of alternative expressions, synonyms etc.).

- **Availability of support resources** (that can expand the possible anchors between resources).
ShowVoc

A browsing & publication companion to VocBench
The PMKI Project

- PMKI (Public Multilingual Knowledge Infrastructure) is a project funded by the ISA2 programme of the EU, aimed at the development of open data portals focusing on terminological and linguistic content.

- Within the project, the idea of a specific portal mutated into a sort of read-only VocBench, including the resource view and much of the browsing views, with a focus on efficiency and streamlined fruition of content.

- Besides browsing UX, the system features capabilities oriented at showing datasets as whole resources.

- These features include, among others:
  - global free-text search over all datasets and machine translation API
  - browse linksets between datasets through a dedicated graph exploration
    - each node represents a dataset as a whole
    - the arcs represent the linksets
  - For each linkset, it is possible to list its mapping statements and browse the involved aligned resources.
The ShowVoc Platform

- Revised resource-view thought for a more readable and streamlined visualization of resource details
- Exploitation of VocBench advanced visualization solutions (e.g. Custom Forms, adapted to the new resource-view)
- Focus on language resources, from (multilingual) thesauri to lexicons
- Global index-based search separated from the dataset-specific indexes (which are stored per-repository)
- SPARQL interface (reused and adapted from VocBench)
- Graph View (reused and adapted from VocBench)
  - Dataset-oriented graph-view
- Mappings Page
- Contributors’ Services and Pages
- Administration Panel
All datasets in the connected triple store are reported by the platform. These can be filtered by:
- Open-only repositories
- Language
- Type of dataset (KOS or Lexicon)
The status can be:
- pristine
- staging
- public

Various operations can be performed by the admin directly from this dashboard.
Browsing Datasets

The resource-view show details in a simplified and friendlier version than in VB. This is because attention is focused more on content rather than other details (provenance, datatypes etc.).

It looks more like the entry of a traditional (yet electronic) dictionary.

The concept tree view is useful for those datasets having a clear hierarchy with not too many siblings.

Filters for languages to be shown.

The view is highly customizable! PMKI exploits VB's custom forms making them uniform with the new lightweight UI.

* e.g. in this concept, scope notes and notations are both reified, yet their indirectly linked content is shown seamlessly in the resource-view.
SPARQL querying in ShowVoc

The SPARQL panel provides syntax highlighting and completion (fed by the same data in the dataset). Results can be stored in different formats or even inspected!
ShowVoc Graph View

Mostly inherited from VB but...more to come for overall metadata at dataset level!
Browsing Alignments

Alignments
Source dataset: AGROVOC

AGROVOC

STW

Eurovoc

IATI_en-fr

FISMA

OP_EDCC
Browsing Alignments
Support for OWL Ontologies

PMKI Datasets Search Alignments

CDM_(2020-02-04)

Class Property Alignments

owl:Thing

:agent
:entity_temporal
:period
:expression
:item
:manifestation

:manifestation_case-law
:manifestation_distribution
:manifestation_print

:manifestation_court-report
:manifestation_court-report_part

Type owl:Class

Label Manifestation of case law

Sub Class Of
:manifestation_case-law_operative_part MAX 1
:manifestation_case-law_subject MAX 1
:manifestation_case-law_keywords MAX 1
:manifestation_case-law_endorsements MAX 1
:manifestation_case-law_costs_decisions MAX 1
:manifestation_case-law_grounds MAX 1
:manifestation_case-law_parties MAX 1
:manifestation

Comment Note: Concisely suppressed are: 1, décision + 2, sommaire proprement dit (avec référence aux affaires précédentes) -

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Global Search is powered by an index built over all datasets:

- Allowing for seamless access to heterogenous lexicalization models (RDFS, SKOS, SKOS-XL, Ontolex)
- Keeping provenance information
Performant service API for term translation

Translations are provided by authoritative multilingual resources

Test on the sandbox:
access showvoc first on: https://zeus.art.uniroma2.it/showvoc/
then, through the same browser (Firefox will give a better rendering of the response), go to:
http://zeus.art.uniroma2.it/semanticturkey/it.uniroma2.art.semanticturkey/st-core-services/GlobalSearch/translation?searchString=law&searchLangs=en&transLangs=it&caseSensitive=false

High-level Translation API

04/06/2019
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Contributors' Page

Name: Armando
Last name: Stellato
Email: stellato@uniroma2.it
Organization: University of Rome Tor Vergata

Contribution: I want to provide metadata about an existing resource on the web

Base URI: http://eurovoc.europa.eu/
Resource name: Eurovoc
Identity: Identity IRI
Derererenciation system: Yes
Sparql endpoint: http://publications.europa.eu/webapi/rdf/sparql
URI space: http://eurovoc.europa.eu/
ShowVoc: Where do I find it?

ShowVoc has been publicly released to the community…

…just today!

http://showvoc.uniroma2.it
Loddy

An easy and flexible solution for publishing your data
Loddy

In this example, a page template for:

- SKOS thesauri
- described by SKOS-XL labels has been adopted.

Only one query is fired on the connected dataset, but different, complementary, filters, take out information on the left columns

Similar in principle to the dear old Pubby, which provided:

- a Linked Data interface to local or remote SPARQL protocol servers
- a dereferenceable URIs by rewriting URIs found in the SPARQL-exposed dataset into the Pubby server's namespace
- Provides a simple HTML interface showing the data available about each resource
- Takes care of handling redirects and content negotiation

Pubby features use of the Velocity template engine, for tinkering with the graphical view

Loddy:

- Based on JSF/Facelets, projects a data model onto a plain HTML page
- Offers a layered configuration based on reusable query components that can be edited even by RDF neophytes

http://wifo5-03.informatik.uni-mannheim.de/pubby/
CODA

Computer-aided Ontology Development Architecture

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Some Definitions…

• **COD** (Computer-aided Ontology Development)
  – All processes for enriching ontology content through exploitation of external resources, by using (semi)automatic approaches.

• **CODA**: COD Architecture
  – An Architecture for systems for Computer-aided Ontology Development
  – A Platform supporting development of such systems
CODA Project Objectives

• A *conceptual systematization*
  
  – of the tasks covering reuse of data extracted from unstructured information to improve ontology content

• An *architecture*
  
  – defining the components which take part in such a scenario

• A *framework*
  
  – supporting all of the above through standard implementations and components orchestration
CODA Architecture

- **Input data**
  - A RDF Dataset
  - A UIMA CAS (Common Analysis System)
  - PEARL Projection Documents

- **PEARL Parser**
  - PEARL: a language for projecting UIMA features into RDF triples
  - The Parser reads PEARL documents and transforms them into directives for data manipulation

- **PEARL Processor**
  - and realizes the projection of information extracted through traditional UIM components (i.e. UIMA Annotations)

- **CODA Component Repositories (Local and Distributed)**
  - Provide access to custom pluggable components for performing CODA tasks

CODA as a whole, can be used as an Analysis Engine in a UIMA Pipeline

CODA as a whole, can be used as an Analysis Engine in a UIMA Pipeline
CODA Today…

CODA is already part of Semantic Turkey and used in VocBench, for powering:

- **Sheet2RDF** (spreadsheets are converted into feature structures, and then manipulated through CODA transformation language)

- **Custom Forms** rather unhortodox use of the framework: in this case the extraction template is actually what will be asked to the user, and a form is built around this template
...and a look ahead on tomorrow

What is missing in the ecosystem is a platform for knowledge acquisition from text, covering diverse tasks, such as ontology learning, document categorization, information extraction and triplification.

This platform could be put at the hands of user, allowing them to work from VocBench, seamlessly moving in between processed content and acquired knowledge.
Showcase – Annotation with AgroIE

Semantic Turkey

AgroIE plugin

Insects

Plants

AGROVOC Thesaurus (Small cut)

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Adding Concepts
### Adding Relations Showcase - Ontology Enrichment (2)

#### Maize weevil - Wikipedia, the free encyclopedia - Mozilla Firefox

### Adding Relations

<table>
<thead>
<tr>
<th>Select</th>
<th>Subject</th>
<th>Predicate</th>
<th>Object</th>
</tr>
</thead>
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### Scientific classification

- **Animalia**
- **Arthropoda**
- **Insecta**
- **Coleoptera**
- **Curculionidae**
- **Sitophilus**
  - **S. zeamais**

#### Inominal name

- *Sitophilus zeamais* (Motschulsky), 1855

- It has a long, thin body, similar to *Sitophilus oryzae*, but has a darker color.

- In storage, there are several other types of stored, processed cereal products such as pasta, cassava, and various coarse, milled grains. It has been known to attack fruit while in storage, such as apples.
Conclusions

• In the context of EU ISA2 action, a few attempts at providing an ecosystem of free and open-source platforms for development of digital data have been carried on

• The objective is two-fold:
  – Using state-of-the-art findings and technologies in order to deliver industry-standard solutions free and open-sourced
  – Use these same solutions as a basis for further research and improvement

• Development must go vertical on each new platform…
  …but not lose focus on the whole picture

• Future work will focus will
  – Continue on VocBench development, as Semantic Web technologies are continuously evolving and so must do VocBench
  – Explore new directions for expanding information management to the processing of unstructured information and the acquisition of knowledge
"That's all Folks!"
Contacts

VocBench site: http://vocbench.uniroma2.it/

You can also follow VB by registering to:

- **VocBench Mailing Lists:**
  - User: http://groups.google.com/group/vocbench-user
  - Developer: http://groups.google.com/group/vocbench-developer

- **Semantic Turkey Mailing Lists** (only for backend related aspects):
  - User: http://groups.google.com/group/semanticturkey-user
  - Developer: http://groups.google.com/group/semanticturkey-developer