# Inforex — a Collaborative System for Text Corpora Annotation and Analysis Goes Open

Michał Marcińczuk and Marcin Oleksy

G4.19 Research Group Department of Computational Intelligence Faculty of Computer Science and Management Wrocław University of Science and Technology, Wrocław, Poland {michal.marcinczuk,marcin.oleksy}@pwr.edu.pl

#### Abstract

In the paper we present the latest changes introduce to Inforex - a web-based system for qualitative and collaborative corpora annotation and analytext One of the most important news sis. is the release of source codes. Now the system is available on the GitHub repository (https://github.com/ CLARIN-PL/Inforex) as an open source project. The system can be easily setup and run in a Docker container what simplifies the installation process. The major improvements include: semiautomatic text annotation, multilingual text preprocessing using CLARIN-PL web services, morphological tagging of XML documents, improved editor for annotation attribute, batch annotation attribute editor, morphological disambiguation, extended word sense annotation. This paper contains a brief description of the mentioned improvements. We also present two use cases in which various Inforex features were used and tested in real-life projects.

## 1 Introduction

Development and evaluation of tools for various natural language processing task (named entity recognition, sentiment analysis, cyberbully detection and many other) require dedicated resources in a form of manually or semi-automatically annotated corpora. Corpus-based studies in the domain of Digital Humanities also require a support in the form of specialized tools and system. Both create a demand on development of tools and systems qualitative text corpora management, annotation, analysis and visualization. Inforex is one of several web-based systems for text corpora annotation which is being developed as an open source project. The other wellknown systems include, but are not limited to, WebAnno 3.0 (de Castilho et al., 2016), Brat (Stenetorp et al., 2012) and Anafora (Chen and Styler, 2013). Comparing to the other systems Inforex has some distinct features, including: support for untokenized and tokenized documents, support for both plain text and XML documents (XML tags are used to format the document layout) and integration with CLARIN-PL web services (utilizes on-demand morphological tagging).

In Section 2 we present the basic characteristic of the Inforex system. In Section the 3 we present the recents improvements and new features implemented in the system. In the Section 4 we present two projects in which the latest features were utilized.

## 2 Inforex Overview

Inforex is a web-based system for text corpora management, annotation and analysis. Since 2018 it is available as an open source project on the GitHub repository and is a part of the Polish CLARIN infrastructure<sup>1</sup> — it is integrated with the official repository for language resources in Polish CLARIN<sup>2</sup>. From the user perspective Inforex requires only a modern web browser to use the system.

Inforex offers several features for collaborative work on a single corpus, including concurrent access to data stored in the central database, role-based access to different modules, flag-based mechanism to track the process of various types of tasks. It support text cleanup, mention annotation, relations between annotations, morpholog-

<sup>&</sup>lt;sup>1</sup>https://inforex.clarin-pl.eu
<sup>2</sup>https://clarin-pl.eu/dspace/

ical tagging, annotation attributes, metadata and many others. A more comprehensive list of functions can be found in (Marcinczuk et al., 2017).

## **3** Recent Changes and Improvements

### 3.1 Open Source Project

After 10 years of development the project has been finally released as an open source project. The source codes are available under the LGPL license and can be obtained from https://github.com/CLARIN-PL/Inforex.

### 3.2 Easy Installation

The installation process was simplified by converting the system and all required components to run withing a set of Docker containers<sup>3</sup> defined in a Compose file. The Compose<sup>4</sup> file defines four containers: (1) **www** — web server running the Inforex application with background services (see Section 3.3), (2) **db** — MySQL database server, (3) **liquibase** — Liquibase database schema control and (4) **phpmyadmin** — web-based access to the database (for development and maintenance purposes).

A new installation of Inforex boils down to running the following two lines of code:

## 3.3 Background Processes

Time consuming tasks, like corpus export or morphological tagging, are handled by processes running in the background. That's how we avoid the web server timeouts and handle task queuing. The background processes have been added to the Docker container with web server and they are automatically run on the container startup.

## 3.4 Multilingual Morphological Tagging

Inforex uses CLARIN-PL Web Service API<sup>5</sup> (Walkowiak, 2018) to facilitate the on-demand morphological document tagging. CLARIN-PL WS API provides access to morphological taggers for 11 languages. Seven of them are available from Inforex, i.e. Polish, English, German, Russian, Hebrew, Czech and Bulgarian (see Figure 1). Inforex automatically choose the language specific tagger based on the document language set in the metadata.

### 3.5 Extended Annotation Attribute Editor

We have extended the annotation attribute editor to handle dictionary-based attributes with a large number of possible values (see Figure 2). The improvements include the following:

- Filtering of the list of values,
- Feature to add a new element to the dictionary directly from the value picker level.
- Suggestions based on values assigned to other annotations. We have implemented two heuristic of generating the candidates with different levels of certainty, i.e.:
  - values for other annotations matched by the text form with the Soundex algorithm<sup>6</sup>. The list of candidates is sorted by their frequency,
  - attribute values matched by the annotation text (full or partial matching).

Annotation de	tails	×
ld:	1217091	
Text:	BBC	
Туре:	PRO	Ø
Lemma:	BBC	
eid	PRO-BBC	× .
Save and c	Values for other annotations with similar phrase PRO-BBC (111)	
Annotation rel	PRO-BBC-website (9) PRO-White-paper-Poland (4) PRO-White-paper-UK (1)	
	Values matched to the search phrase EVT-Colosseo-Rosso	Ţ

Figure 2: Extended annotation attribute editor

#### 3.6 Batch Annotation Attribute Editor

Up to now the modification of annotation attributes was available only from the *Annotator* perspective using the annotation editor (see Figure 2). When an user had to modify an attribute for each annotation the only way was to go through all the annotations one by one. This process was time

<sup>&</sup>lt;sup>3</sup>https://www.docker.com/

<sup>&</sup>lt;sup>4</sup>https://docs.docker.com/compose/

<sup>&</sup>lt;sup>5</sup>http://ws.clarin-pl.eu/tagerml.shtml

<sup>&</sup>lt;sup>6</sup>https://www.archives.gov/research/ census/soundex.html

Tok	ens					Document content	Tokenization
No.	ld	From	То	Orth	Text	Gmina Boy	Union Web Convins
1	19767653	0	4	Gmina	Gmina		Using web Service
2	19767654	5	7	Bov	Bov t	Gmina Bov (duń. Bov Kommune) - istniejąca w latach 1970 - 2006 gmina w Danii w okręgu południowej Jutlandii (	Polish
3	19767655	8	12	Gmina	Gmina	Sønderjyllands Amt.). Siedzibą władz gminy było miasto Bov., Padborg. Gmina Bov została utworzona 1 kwietnia 1970 na mocy reformy podziału administracyjnego Danii.	<ul> <li>Wcrft2 (Morfeusz1)</li> </ul>
4	19767656	13	15	Bov	Bov		Wcrft2 (Morfeusz2)
5	19767657	16	16	(	(	Po kolejnej reformie administracyjnej w roku 2007 weszla w sklad nowej gminy Aabenraa .	English
6	19767658	17	19	duń	duń	Dans Kashawa	spaCy English
7	19767659	20	20			• Liczba ludności: (♀ 4 958 + ♂ 5 034) = 9 992	German
,	18707038	20	20	-	Deu	• week 0 . 6 . 7 . 2 %	spaCy German
8	19767660	21	23	Bov	Bov	• Wiek U-0.7,2.30	Russian
9	19767661	24	30	Kommune	Kommune	• wiek 7 - 16 : 13 , 1 %	UDPipe Russian
10	19767662	31	31	)	)	• wiek 17 - 66 : 65 , 3 %	Hebrew
11	19767663	32	32	-	-	• week (07 to 14 ( 4 ( 9)	UDPipe Hebrew
12	19767664	33	42	istniejąca	istniejąca	- With 07 -, 14, 4 70	Czech
13	19767665	43	43	w	w	zagęszczenie ludności: 68., 0 osób / km²	UDPipe Czech
14	19767666	44	49	latach	latach	bezrobocie : 4 , 8 % osób w wieku 17 - 66 lat	Bulgarian
15	19767667	50	53	1970	1970	cudzoziemcy z UE, Skandynawii i USA: 808 na 10.000 osób	UDPipe Bulgarian
16	10767668	54	54			eudociomer a Iroléu Traciona Świete 200 pp. 10. 000 pp.6h	
17	19767669	55	58	2006	2006	<ul> <li>Basks reliable additionarchip 5 (Tasks Mass 24)</li> </ul>	Tokenize

Figure 1: Document tokenization perspective

consuming and error-prone because it was easy to miss some annotations. To overcame these problems we have created a page for batch annotation attribute modification. The page consists of two main components, i.e. a document content with annotation preview and a table with annotations with their attribute (see Figure 3).

### 3.7 Document Auto Annotation

This feature was designed to reduce user effort in annotating repeatable phrases in and across documents. Auto annotation works by annotating in given documents all phrases that were already annotated in other documents. This feature works for both untokenized and tokenized documents, however we advise to use it on tokenized documents as the phrases are aligned with token boundaries and we avoid matching of incomplete words. After running auto annotation the new annotations are presented to the user for verification. User can decide whether given annotation is correct, incorrect or the annotation type needs a change (see Figure 4). The discarded annotation are stored in the system for future run of auto annotation. During the next use of auto annotation the new annotations which were previously discarded are ignored.

#### 3.8 Lemma and Attribute Auto Fill

These features were designed to reduce user effort in setting annotation lemmas and attribute values. They both works in a similar way — for each annotation in the document the lemma or attribute value is set based on other annotations in the corpus. For lemma we collect annotations with the same text form and category. For attribute value we collect annotations with the same text form or lemma and category. In case of ambiguity, i.e. there are more than one possible value of lemma or attribute, the value remain empty and the user has to fill it manually. The lemma auto fill feature is available in the *Annotation lemmas* perspective and the attribute auto fill feature is available in the *Annotation attributes* perspective.

## **3.9** Tokenization of XML documents

Inforex allows to store documents in one of the two formats: plain text or XML. The XML format is used to encode document structure, like in the KPWr (Broda et al., 2012) and PCSN (Marcińczuk et al., 2011) corpora. During tagging the XML tags should be ignored and only the content should be processed. Thus, we made the tokenization process to be aware of the document format (see Figure 1). For XML format the document content is cleaned from XML tags, than the content is processed by the tagging service and at the end the tokenization is aligned with the original XML document.

## 3.10 Annotation Attribute Browser

The attribute value browser (see Figure 5) allows to browse corpus annotations by given attribute value. The page consists of three elements:

- View configuration provides a set of filters, including: shared attribute, document language and subcorpus,
- Attribute values assigned to annotations list of values their frequency,

Document content	Annotatic	n lemmas			
Франция е готова да приеме пакистанката Асия Биби	Туре	Phrase/Lemma	Attributes		Î
Дъщерите на Асия Биби държат нейна снимка Снимка: Ройтерс Франция) е готова да приеме пакистанката (Асия Биби), оправдана от Върховния съд в	LOC	Франция Франция	eid:	GPE-France × ▲ receiving D	
страната си, след като оеще осъдена на смърт за оотохулство, ако тя поиска това, заяви френското външно министерство, цитирано от <b>франс прес</b> . Предприехме необходимите стъпки пред пакистанските власти, за да може тя да дойде във в стали в да диди и таката с избита с поиста с поиста с с с с с с с с с с с с с с с с с с	PER	Асия Биби Асия Биби	eid:	Values for other annotations with similar phrase no change	
арданция, в случая че такова е неиното желание и желанието на семенството и, каза говорителка на министерството, предаде БТА франция вече прие в посолството си в Испамабад) адвоката на Биби. Сайфул Мулок, за да го пази	PER	пакистанката	eid:	GPE-Finland (96) no change	
преди отпътуването му за <mark>Холандия</mark> , където пристигна съгласно желанието си, допълни говорителката. Асия Биби, освободена от затвора в нощта срещу чатвъртък, слеп като бе оправлана от Бърховния съл. се намира на сигуано	PER	Асия Биби Асия Биби	eid:	GPE-Germany (50) GPE-Frankfurt-am-Main (19) no change	
място, но все още е в страната си, каза говорител на пакистанското външно министерство, докато някои медии съобщиха, че е заминала в чужбина.В събота съпругът на Биби поиска убежище за семейството си в САЩ, Великобритания и	ORG	Ройтерс Ройтерс	eid:	LOC-Gulf-of-Finland (8) GPE-Florence (6)	
Канада). Сподели Приятел Tweet Абонамент за печатен или електронен "24 часа *, както и за другите издания на Медийна група България.	LOC	Франция Франция	eid:	GPE-France x v no change	
	PER	Асия Биби Асия Биби	eid:	PER-Asia-Bibi x 🔻 no change 🖹	
	ORG	Франс прес Франс прес	eid:	ORG-AFP-Agence-France-Press x * no change	
	LOC	Франция Франция	eid:	GPE-France x * no change	
	LOC	Франция	eid:	GPE-France 🗴 💌 no change 😫	Ŧ
	Autofi	II empty attributes		Save all	

Figure 3: Batch annotation attribute editor

Document content	Annotations to verify					
Bulgaria rozpoczęła półroczne przewodnictwo w UE	Туре	Text	Later	Accept	Discard	Change to
Hasło bułgarskiej prezydencji brzmi "Zjednoczenie tworzy siłę", a wśród	ORG	UE		۲		· •
priorytetów znalazły się m. in . kwestie polityki spójności , wspieranie konkurencyjności na wspólnym rynku oraz dalsza integracja państw Bałkanów	ORG	UE		۲		•
Zachodnich z UE. Wszystko to może się także przydać w poprawianiu	LOC	Bulgarii	•	0	•	
wizerunku Bułgarii na europejskiej arenie . Sofia przejęła od Tallina unijne						
przewodnictwo 1 stycznia. To pierwsza w historii Bulgarii , która członkiem	LOC	Bulgarii		۲		· •
sfinalizowaniu integracji europejskiej Sofia stanie zatem na czele prac	ORG	UE		۲		· •
Unii Europejskiej . Sofia podchodzi do unijnej prezydencji z dużą powagą .	ORG	UE		۲		· · · · · · · · · · · · · · · · · · ·
Bulgaria , najbiedniejszy obecnie kraj członkowski UE , od lat walczy z	ORG	Unii Europeiskiei		۰		
W przeszłości zdarzało się nawet, że Sofia traciła przez to okresowo część		(orm Corobolonde)				
funduszy europejskich. I choć przygotowania do objęcia unijnego przewodnictwa nie szły tak sprawnie , jak to bywa w przypadku krajów o	LOC	Bulgaria		۲		•
dłuższym stażu w UE, Bułgaria zapewnia, że jest już w pełni gotowa do	ORG	UE		۲		· •
pokierowania pracami Unii Europejskiej . "1500 przeszkolonych urzędników i	ORG	UE		۲		· · ·
unijnej prezydencji Liljana Pawłowa Jakie są bulgarskie priorytety ? Część	LOC	Bulgaria		٥		
wyzwań Bułgaria odziedziczyła po Estonii , od której przejęła unijne	200	Duguna				
przewodnictwo . woająz nie ma bowiem zgódy co do koniecznej retormy systemu azylowego i migracyjnego . Ponieważ państwa członkowskie dały	Auto annotate					Save all
sobie czas do czerwca na osiągnięcie w tej sprawie kompromisu, główny 🔹						

Figure 4: Auto annotation and candidate verification perspective

• Annotations with the selected value.

#### 3.11 Export of Morphological Tagging and Annotations Agreements

For tokenized document Inforex can store up to three layers of morphological tags:

- *Tagger* tags produced by a tool,
- Agreement tags entered by a user in the agreement mode,
- *Final* tags approved by the super user.

During export it is possible to define which layer of tags should be exported. It is possible to choose one of the following options (see Figure 6):

• *Final or tagger (if final not present)* — export the *final* tags. For tokens which does not have the *final* tag a *tagger* tag is taken.

- *Final* export only the *final* tags. If there are tokens without final tags than the missing tags are reported as errors.
- User (agreement) export tags created by selected user. For tokens which does not contain user agreement tags the tagger tags are taken.
- Tagger export tagger tags.

## 3.12 Improved Support for Word Sense Annotation

The existing mechanism for word sense annotation was limited to a single set of words and their senses (Marcińczuk et al., 2012). We have removed the limitation and allow to define and use any number of sets of word senses in the WSD

Attribute values assigned to annotations		Annotations	with the sele	acted value		
O Search Here		Id	Туре	Text	Lemma	Document
		1196293	EVT	druhé světové války	druhá světová válka	197908
EVT-The-Brussels-Summit-A-Future-for-	1	1196190	EVT	Druhé světové války	Druhá světová válka	197921
Europe	- 1	1107781	EVT	drugiej wojnie światowej	Druga Wojna Światowa	199379
EVT-The-Holocaust	1	1110520	EVT	II wojny światowej	II wojna światowa	199495
EVT-The-Troubles	7	1112625	EVT	drugiej wojny światowej	Druga wojna światowa	199626
EVT-TU-Doors-Open-Days-2018	1	1145636	EVT	II wojnie światowej	II Wojna Światowa	199883
EVT-UEFA-Europa-League	1	1135575	EVT	II wojnie światowej	II wojna światowa	199932
EVT-Vostok-2018-East-2018-Military-exercise	1	1149085	EVT	druga wojna światowa	Druga Wojna Światowa	200117
EVT-Weimar-Summit	1	1160843	EVT	II wojnie światowej	II Wojna Światowa	200186
EVT-Windrush-scandal	2	1169941	EVT	II wojny światowej	II Wojna Światowa	200307
EVT-World-Economic-Forum-Davos	6	1209194	EVT	Второй мировой войны	Второй мировой войны	217785
EVT-World-Economic-Forum-Petersburg	3	1209251	EVT	Второй мировой войны	Вторая мировая война	217796
EVT-World-War-I	3	1145273	EVT	druhé světové války	druhá světová válka	222440
EVT-World-War-II	30	1189398	EVT	Втората световна война	Втора световна война	224876
EVT-Year-of-the-Eucharist	1	1188282	EVT	Втората световна война	Втора световна война	225148
GPE-Aberdeen	1	1192050	EVT	Втората световна война	Втора световна война	225233
GPE-Addis-Ababa	1	1192051	EVT	Втората световна война	Втора световна война	225233
GPE-Afghanistan	14 🗸	1186126	EVT	Втората световна война	Втора световна война	225329
• Down	load	1193664	EVT	Втората световна война	Втора световна война	225429

Figure 5: Annotation attribute browser



Figure 6: Export configuration dialog window

perspective. We also added the option to annotate the word senses in an agreement mode for further agreement (see Figure 7). Finally, we have imported all lexical units with their senses from Słowosieć 3.2 (Piasecki et al., 2016) as an annotation set to Inforex.

#### 3.13 Morphological Agreement

The last feature is support for morphological disambiguation agreement. Inforex provides a page with morphological tag agreement across a given set of documents (see Figure 8). The agreement is presented in a numerical form for each documents in the set and after a specific document a list of disagreements is presented. This feature is complemented by a document perspective for comparing and choosing the final morphological tags (see Figure 9).

### 4 Case Studies

In this section we present two uses cases in which various features of Inforex were used in real-life projects.

### 4.1 BSNLP 2019 Shared Task

Inforex was used to create the training and testing datasets for the need of 2nd Edition of the Shared Task on Multilingual Named Entity Recognition for Slavic languages<sup>7</sup>. The task aims at recognizing mentions of named entities in news articles in Slavic languages, their lemmatization, and cross-language matching.

More than 10 people were involved in the annotation process for four languages, i.e. Polish, Czech, Russian and Bulgarian. There were 1-3 annotators per language. The annotation process consists of four main steps:

- Selection of relevant documents the document were automatically crawled and uploaded to Inforex, therefore some of them were duplicates or text not relevant to the subcorpus topic. The selected documents were marked with a flag *Valid content*.
- 2. Annotation of named entity mentions the same set of five annotation types was used to annotated all the selected documents. For Polish and Czech the annotators utilized the auto annotate feature described in Section 3.7 and we were able to evaluate the usability of

<sup>&</sup>lt;sup>7</sup>http://bsnlp.cs.helsinki.fi/shared\_ task.html

Preview Agreement Metadata	Annotator WSD Import annotations Morphological Disambiguation Morphological Disambiguation Agreement	💌 ه
Working mode	Document content	Words senses
<ul> <li>final</li> <li>agreement</li> </ul>	Sherlock Hollmes i Batokata Opaaka P W zapiakach z ostatnich ośmiu lati, obejmujących siedemdziesią spraw, podcza kłółych studiował em metody działania mojego przysielieli Sherlocka Holmesa i zmajduje sporo episów przypadków trajcznych, kiku komicznych welu nieco dziwnych, sie żadnych pospoltych, odyć pracowal on nie dla bogactwa, sie z miastej do uprawanej	<ul> <li>milość 1.n</li> <li>witi co, wito u czasta, objewiające się przewszbrie przystązaniem, oddaniem, prowadzące do silnoj klęd emogonalnej z kimi ku czymi, jarzie i mora kohuterowi Rami Luban narskipują do worzeniej miekd brakeniej przedstawionej w indystem eposie Ramajana j MPP. Pes</li> </ul>
Words Annotation set Słowosieć 3.2	sztüki; ne podłęł by się Medziwa. Miste by nie dobyczyći przew nadzwyczanych czy nawet nadprzyrodzonych . Jednak wielod wszystkich tych rozmatych przypadków nie ma zadnogo, który był ny bardzaj posóbiwy niż tem związany z tedzna, Roylottów ze Stoke Moran. Bółcze znaną w Surrey. Wyskrzenia la mały miejsce na poszątka mojej przyłazi z Holmesem, ktedy, jeszcze	spoglejalni na svejego polna z neskonczony mnoceji (jimi- Miości polstalowa je kiej czyczej cijnistka ji (mko: ) miości do kraju, mieda do pieniędzej (MAT, (zadoźć, cobro, szczęścia) + m [Mołe, Moż czyczi kaj naj miej kaj wyszała się w wielu gestach, IF#A2; (zadość, zaufanie; dobro, szczęścia) + m [ch miedać przetrawała wszyskie proby i zestarzani z nazma tnia, jie kiej osób do chościa]]
Select word to navigate through their occurrences: I Hide words without occurrences	jako kawalerowie i, mieszkał śmy razem przy Baker Street. Możtwej ze już gożele je spisał em, ale przysiązj em zachować je w tajemnicy. Poprzednicypo miestąca został em jednak zakolnosty z tej obietnicy ze wzgłędu na przedwczeną śmierć dumy, której ona dotyczyla. Być może szczegódy tej sprawy powimny wreszcie uszed światb dzienne, ze wzgłędu na liczne płota narode wokić išmierci doktora Grimesbiego Roylota "czętokoroć mroczniejsza od išamej prawdy. I tak oto na przeztyku kwietnia toku	(wm 1671) wm loods 3,n werk cg. arrib zaminowanie do czępst, głębolka zaterkosowanie (JezP). Rodotko of makego jelekgrował w mel make do muzyk (J. H.A.F.): (pidodk, wiesta, k. częsteloj + m (P i gaur wiestajach niczach) gwiedko do bitoria wygana (J. #AZ): (pidodk wiesta, k. częsteloj + Molek do bitoriani roma w mel z kubom homi kołdow liwn 1727)
akr_n ahr_n aparyda_n artyleria_n artyleria_n arystokrata_n balustrada_n balustrada_n balustrada_n	osiemdziesiątący trzeciego izbudzwazy się wczesnym rankiemi, zastał en kompietnie ubranago Holmesa (stojącego nad moim 165kemi, Zegar na kominka wskazywał kwastrami po likódmaj, a Sherlock (zwyłł wstawać o późmiejszej porzei. Spojrzał em na niego z zaskoczeniemi i lodobina, niectęci), portieważ tam jestem štáby w rawykach. Strasznie mi przykro, że zywami cję tak wczesniej, Watsonie , ale tak się dziś zbóżyło. Wyżerw pani Hudson została zzewana z 165ka, po czym Gelegataji się na mnie ,	<ul> <li>ImiDick 4.m.</li> <li>ImiDi</li></ul>
<ul> <li>bengalski_adj</li> <li>bezpiecznie_adv</li> <li>biedny_adj</li> <li>bilet_n</li> <li>biady_adj</li> <li>bilski_adj</li> </ul>	a ja - na tobe U	millość.5.n     #WC: ktajżk. #RD: żbiżenie łudzi w celu prokresovjinym lub dla ostającieja przytarmosoć. (t#PE-Upraviali milość przez osłą noc.) (##L: nitb.jri/u. wkajedia org/wisiOstownek_p%c5%82ciowy) #WA1: (radość, zautanie, szczęściej) + s [Mariena mawiała,

Figure 7: The extended perspective for word sense annotation

the auto annotation feature. Table 1 contains evaluation of the automatically recognized and added annotations for two languages and two subcorpora (each on a different topic). The auto annotation feature yielded very high precision of 97-99% with relatively high recall of 66-82%. This means that in case of Polish and Czech subcorpora 10k out of 14k annotations were added automatically. It was a significant facilitation of the work.

- 3. Assignment of annotation lemmas to assign lemmas the annotators utilized batch lemma editor and lemma auto fill. For the correctly added annotations the lemmas were also automatically assigned.
- 4. Assignment of cross-lingual identifier the goal was to assign the same identifier for each mention across all languages referring to the same real-world entity. There were more than 4k identifiers. The annotators utilized the auto fill features described in Section 3.8. The attribute browser was used to validate the entity mentions.

### 4.2 Polish Translation of the NTU Multilingual Corpus

An ongoing project which goal is to provide Polish translation of the NTU Multilingual Corpus (Tan and Bond, 2011) which consists of two stories from the Sherlock Holmes Canon (The Adventure of the Speckled Band and The Adventure of the Dancing Men. The Adventure of the Speckled Band is the first one translated and prepared for

Language	Pol	lish	Cz	ech
Subcorpus	A	В	Α	В
Total	5139	2440	4183	2504
Final	5032	2386	4128	2502
Discarded	107	53	55	2
Add by user	1015	648	696	829
Precision [%]	97.4	97.0	98.4	99.9
Recall [%]	79.9	72.8	83.1	66.9

Table 1: Evaluation of the *auto annotation* featureon the BSNLP 2019 Shared Task dataset

manual annotation. The text was divided into 31 samples (txt files) of a similar size and imported directly into Inforex system. Then automatic morphological tagging was performed using WCRFT morpho-syntactic tagger for Polish (Radziszewski, 2013). The tagger provided morphological disambiguation on the basis of its context but also other possible forms for this particular word were listed. The result of the automatic annotation was then verified by two linguists independently. They were able to see morphological analysis of each token and the decision of the tagger (see Fig. 9). It could be accepted or discarded by the human annotator. It was also possible to add and assign an interpretation which was not identified by the tagger (e.g. in the case of unknown words). Inter-annotator agreement was calculated and its level was high enough (0,97) to perform further. Then, after completion the manual verification of morphological tagging by both linguists team coordinator proceeded with inconsistencies analysis. The decision was made for every token differently

Selected s	ubcorpora			
		Sear	ch:	
ID 💵	Title ↓↑	Total tokens ↓↑	Divergent tags ↓î	PSA ↓↑
121801	Holmes1.txt	291	22	96.13
121802	Holmes2.txt	260	14	97.28
121803	Holmes3.txt	243	19	95.95
121804	Holmes4.txt	290	26	95.34
121805	Holmes5.txt	276	23	95.73
121806	Holmes6.txt	264	25	95.03
121807	Holmes7.txt	251	18	96.31
121808	Holmes8.txt	255	16	96.75
121809	Holmes9.txt	293	18	96.88
121810	Holmes10.txt	276	11	97.97
121811	Holmes11.txt	354	12	98.28
121812	Holmes12.txt	346	29	95.69
121813	Holmes13.txt	243	15	96.84
121814	Holmes14.txt	316	16	97.41
121815	Holmes15.txt	282	20	96.39
121816	Holmes16.txt	235	10	97.84
4				•

Figure 8: Summary of morphological disambiguation agreement

annotated. All tags verified by the team leader obtained the status of final annotations. They were added to the version published within CLARIN-PL infrastructure (Błaszczak et al., 2019).



Figure 10: Morphological information provided for human annotators

After the Inforex functionality was developed

and primarily used for creation of The Adventure of the Speckled Band corpus, it was successfully applied to prepare Corpus of the colloquial Polish language (Oleksy, 2019) in another project. This corpus has been designed to address the problem of morphological tagging of user-generated content (UGC) as part of the project "SentiCognitiveServices — next generation service for automating voice of customer and social media support based on artificial intelligence methods"<sup>8</sup>. The whole corpus (approximately 400000 tokens) is manually annotated with morphological information and furthermore the sample of 100 documents was prepared as a result of 2+1 annotation.

#### 5 Summary

The last two years have been productive in the development of the Inforex system. Many new features and extensions were implemented during that time and the most important were presented in this paper. Majority of the features and improvements were dedicated by users. The most important news is the that Inforex has been finally released as an open source project.

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<sup>&</sup>lt;sup>8</sup>https://sentione.com/knowledge/eu-research-project



Figure 9: The perspective for morphological disambiguation agreement

Polish Ministry of Science and Higher Education.

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