# A collaborative system for building and maintaining wordnets

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### Abstract

A collaborative system for wordnet construction and maintenance is presented. Its key modules include WordnetLoom editor, Wordnet Tracker and JavaScript Graph. They offer a number of functionalities that allow solving problems on every stage of building, editing and aligning wordnets by teams of lexicographers working in parallel. The experience collected in recent years has allowed us to refine applications and add new modules to provide the best user experience in a reliable and easily maintainable way.

# 1 Introduction

Wordnet is not yet another electronic dictionary. It is a complex lexico-semantic network. Its construction, especially when done manually by a team of lexicographers, and its further editing and/or aligning with other resources requires very advanced and flexible tools. Such tools should offer the possibility of simultaneous work of many team members on the same lexicon (a wordnet for a particular language), simultaneous work of different teams on different lexicons, and the subsequent manual or semi-automated linking of the constructed resources.

Dictionary compiling tools are mostly designed as complex XML editors such as, for instance, Lexonomy (Měchura, 2017). This approach may not be beneficial in working with graph-like structures. Therefore, several dedicated tools have been designed and are currently used by different wordnet teams e.g DEBVisDic (Horák et al., 2006), sloWTool (Fišer and Novak, 2011). Visualisation of wordnet graphs in most tools follows a radial pattern: a synset in focus is presented in the middle and all links, irrespectively of their types are placed radially around the central element, e.g. sloWTool or WordTies (Pedersen et al., 2012). GernEdiT (Henrich and Hinrichs, 2010) offers visualisation of the wordnet structure in the range selected by the user, but it is hierarchical and focused mainly on hypernymy. Moreover, the visual presentation does not allow for direct editing of the structures. WordnetLoom stands out of the remaining tools, because it offers a graph-based visualisation of wordnet data and provides entirely different workflow based on the direct interaction with graph nodes. In this paper, we will present the most recent development of WordnetLoom and progress in relation to earlier releases. We have improved the graphic design for better user experience and implemented the lexical unit graph visualisation.

Both dictionary making and wordnet building are usually carried out by teams of lexicographers and/or developers. Collaborative work, especially in distributed teams working from , requires control tools to provide quality assurance and development progress. In-built auditing/change backlog feature is often absent in these systems and data versioning is handled by external VCS<sup>1</sup> software or done manually. The newest version of WordnetLoom is interconnected with the Wordnet Tracker module which provides additional feedback channel for lexicographers to enrich their workflow. Every activity of each lexicographer is registered and can be monitored by a senior lexicographer. This paper will showcase how auditing and monitoring can be handled.

We will also present a new web-related module, namely JavaScript Graph. JavaScript Graph module is an answer to user needs and provides the possibility of embedding graph visualization to existing websites or applications.

<sup>&</sup>lt;sup>1</sup>VCS - Version Control System e.g. Git, Subversion

In this work, we will present the key modules that are part of a collaborative system for wordnet construction and maintenance including WordnetLoom editor, Wordnet Tracker and JavaScript Graph.

# 2 WordnetLoom Demo

Up to version 1.68, WordnetLoom was a standalone java fat client application directly connecting to its database with all logic contained on the client side. Such approach ensures that scaling of the application could only be possible by scaling the database server, in this case  $MySQL^2$ . In order to meet the growing numbers of users and challenges in providing dedicated endpoints not only for the client editor application, but also for other external applications, web pages or mobile applications, all business logic was extracted to a separate application built on top of JEE8<sup>3</sup> framework. The application is responsible for data validation, data auditing, user activity monitoring, user management and data processing. It provides a communication channel via REST API (Fielding, 2000) in the form of Siren<sup>4</sup>-like hypermedia specification. Scaling of the application itself is done by docker-compose<sup>5</sup> replicas, while database scaling can be achieved by replication configurations where at least two databases are available. Master database configuration is optimized for writing and slave databases have configuration optimized for high performance reading. Further scaling can be ensured by introducing new slave database nodes for each distinct consumer such as a mobile application or a web page.

The main consumer of the API is a thick client in the form of WordnetLoom Editor java application (main application workspace presented at Fig. 1a) which has been slimmed down and does not contain essential business logic which reduces it to the role of a simple REST client. It enables advanced search functionalities and basic CRUD<sup>6</sup> operations on typical core objects being part of the semantic structure such as synset, sense (see sense editing properties Fig. 1b), sense relation, synset relation, and relation type. From the editor level, the user with administrator privileges can modify and add elements to dictionary entities such as: part of speech, domain, register (see editing dictionaries Fig. 1c) and adding or editing types of semantic relations (see editing relation types Fig. 1d). The main advantage of the application is the possibility of working with visualization in the form of a graph, which provides quick and easy navigation and simplifies the creative process. Due to the fact that the Editor has recently undergone a major architectural transformation, it has allowed for even simpler modifications and easier addition of new components, such as in the case of implementing the extended semantic description panel for Dictionary of Polish Borrowings in Yiddish<sup>7</sup> (see Fig. 1e). Also within this project we have created a graph visualization of lexical units which has become the part of a core application.

### 3 Wordnet Tracker Demo

An important aspect of the process of building and maintaining wordnet is the ability to monitor changes made by team members. It is made possible by the Wordnet Tracker module which provides tracking of user activity (see Wordnet Tracker dashboard Fig. 2) in terms of the number of lexical units, synsets and semantic relations entered (see Fig. 3 for synset relation changes). Through this application, the lexicographer has also access to the full history of changes that have been made within a given lexical unit (see Fig. 4 for current changes of lexical units). All changes in the synset structure are presented in Fig. 5 where the left side column displays the current synset state, while the right side column shows all changes in the synset elements. The user as well as the coordinator have access to current changes in real time for constant monitoring. This functionality turned out to be particularly valuable when working with new, inexperienced lexicographers. The application administrator has the possibility to create diagnostic queries within lexicons or even within the entire dataset, as well as to create statistic queries. In both cases the generated query results are available for download in the form of files. Wordnet Tracker also provides basic user management panel where the privileged user can add new users, reset passwords or restrict user access to chosen lexicons.

<sup>&</sup>lt;sup>2</sup>https://www.mysql.com/

<sup>&</sup>lt;sup>3</sup>Java Enterprise Edition 8 specification https://javaee.github.io/javaee-spec/

<sup>&</sup>lt;sup>4</sup>https://github.com/kevinswiber/siren

<sup>&</sup>lt;sup>5</sup>https://docs.docker.com/compose/overview/

<sup>&</sup>lt;sup>6</sup>CRUD are four basic functions of persistent storage (such as create, read, update and delete)

<sup>&</sup>lt;sup>7</sup>https://polonjid.wn.uw.edu.pl/?lang=en

### 4 JavaScript Graph Module Demo

Presenting work results in the form of a graph visualization outside WordNet Loom editor environment is possible now by a created javascript module. The module tries to faithfully preserve the navigation functions as in the WordNet editor, but at the same time gives the possibility to adjust the color scheme and nodes style to the host application/page design. The presentation data model is fetched from the WordnetLoom server via the REST endpoint and the D3.js<sup>8</sup> library with custom modifications handles graph visualization and user interaction. The module is constructed in such a way so as to allow easy embedding in other applications, such as a mobile application or a website. A very good example can be the main page of plWordNet<sup>9</sup> where the module is used in the form of a pop-up window or as a full scale central element of the website presented at the online Dictionary of Polish Borrowings in Yiddish<sup>10</sup>(see Fig. 6). Simple library import and basic configuration will allow to present wordnet lexicon as graph visualization on every platform where JavaScript is supported.

# 5 Conclusions and Further Works

This concludes our brief description of each module. We have seen that the combination of presented tools offers solutions to common tasks and problems encountered while building wordnets particularly by distributed teams. We will continue to be open-source software licensed under GNU LGPL 3.0. The source code is hosted in GitHub repository(https://github.com/CLARIN-PL/wordnetloom).

We will continue to actively develop presented tools over the next years focused on adding new functionalities based on the needs of users. We will also direct our development towards a reliable, fully-flagged web-based system and we will strive to continue to simplify system deployment by an extensive use of docker<sup>11</sup> containers.

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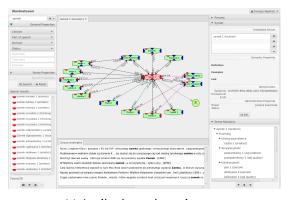
<sup>&</sup>lt;sup>8</sup>D3.js is a JavaScript library for manipulating documents based on data

<sup>&</sup>lt;sup>9</sup>http://plwordnet.pwr.edu.pl/wordnet/

<sup>&</sup>lt;sup>10</sup>http://polonjid-dictionary.clarin-pl.eu

<sup>&</sup>lt;sup>11</sup>https://www.docker.com/

### Figure 1: Key windows in WordnetLoom



(a) Application main workspace.

	Sense P	roperties
Sense Properties		
Sense Semantic Properties		Use cases
Lemma:		[P] Rzeka obmywa mury starego zamku i miejsk +
zamek	Variant: 1	8
Lexicon:		
Słowosieć	*	
Part of speech:		External Reference Link
noun	*	
Domain:		https://pl.wikipedia.org/wiki/Zamek
location	-	Administrative Properties
Register:		Status:
og.	-	*
Definition:		Comment:
warowna budowla mieszkalna, rezydencja pana księcia lub magnata.	, króla,	Qwner:
Comment:		Owner:
		EnSave x Close

(b) Sense properties window.

	Dictio	onaries 🛛 🛞
Dictionary types		Common fields
domains	*	Item name:
Dictionary items		activity
h. hierarchy	^	Item description:
activity		activity
artefact		Set as default value:
		Specified fields dependant on dictionary
property		Color:
body part		
thinking		
communication		
event		
emotion		
food		
+ 1	~	
		Save × Cancel

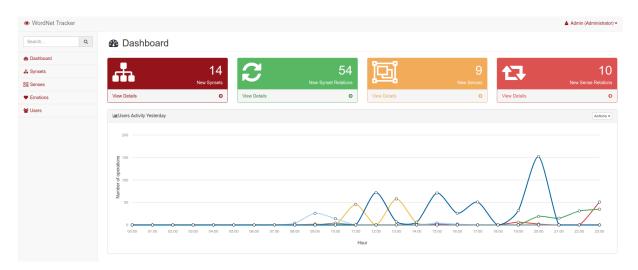
(c) Dictionaries window.

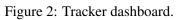
		Re	lation types		
Synset Relations Se	nse Relations				
Międzyjęzykowy					
<ul> <li>Międzyjęzykowy 1</li> </ul>					
Międzyjęzykowy		pIWN			
Międzyjęzykowy					
Part_holonym					
Part moronym				T	_
Relation properties				Relation tests	
Relation type	SYNSET_RELAT	TION	*	' <x#>' należy do języka angielskiego,</x#>	+
Parent relation	Międzyjęzykow	/y_typ	*		ß
Relation name	Typ_PWN-pIWM	N			Û
Shortcut	typ_ap				
Display form	typ				
	(dziedziczone)				
Description					
Lexicons	EnWorndet, Sł	owosieć			
Interlingual					
Global Wordnet Type	other		Ŧ		
Parts of speech	verb				
Reverse relation	Międzyjęzykow	/y_egzemplarz: Eg	ız_plW ▼		
Auto reverse	$\checkmark$				
Color	Black		*		
Direction	IGNORE		*	<>	
					_
		🖺 Save	+ Create relat	tion	

Sense Properties Yiddish\_Primary\_Lemma Variant Yiddish\_Primary\_Lemma New variant Variant type: Remove variant **Dialect:** Form YIVO spelling: pleytse Philological spelling: plejce Yiddish spelling: פלייצע Transcription phonetic ([płɛ̯t̪sɛ]) Add Remove Semantic Field Body Space, dimensions, shapes Add Remove Meaning the back of a person (from shoulders to waist) or an animal Qualifiers Grammatical gender: f. Style: Lexical characteristic: Status: relic P. plecy Etymology: Age: 1800-1939 Source **|Sz** Neuberg Add Remove Inflection pl plejces Add Remove Ŧ Etymological root: PLEC Comment Knaanic gloss plece 'shoulder' noted in "Rabbenu Gershom of Mainz" (Mosk2013 from shoulders to waist, esp. the upper part', MP, plec/plece 1. 'the shoulder or shoulder blade of a human or animal', 2. 'shoulder girdle, shoulders, sometimes the back of the torsco or the entire back of an animal' Context nemen di fis ojf di plejces (O, nr. 188) der menč gejt in der fincter un vejs - vejst nit, vos hinter zajne plejces gefint zix opzogn (...) ojsdrejen zix mit der plejce cu (O, nr. 473) fartejdikn (...) ojfsteln di plejces far, arojsšteln zix far (O, nr. 588) antlojfn (...) nemen di fis ojf di plejces; xapn di fis ojf di plejces (O, nr. 432) [ojsrufn] hejb a fus!; hejb di lefl!; gej ojf ejn fus!; nem di fis in di hent <di fis ojf c sterung, ophaltung, farhaltung uav (...) a štejn <milštejn> ojfn haldz; a horb ojf Particles plejc (root) -E (suffix)

(e) Extended semantic description for Polish Borrowings in Yiddish dictionary.

(d) Relation types window.





#### 击 Synset Relations History

Changes Fr	om 🗎	Changes To		Select User	Select Relation Type		•	Synset ID		Q Search		
Operation				Source Synset				n			Target Synset	
#	Audit Log	Operation	ID	Unitstr	Name	ID	Unitstr					
12013595	Katarzyna.Kowol 2019-04-05 12:41:39	Created	328585	(couple 2* (grp) [grp]   mates 1* (grp), mat	211	Hipo_PWN- pIWN	104473	3 (para 7* (grp) [grp]   )				
12013594	Katarzyna.Kowol 2019-04-05 12:41:38	Created	104473	(para 7* (grp) [grp]   )			Hiper_plWN- PWN	328585	(couple 2* (grp) [grp]   mates 1* (grp), match 8* (grp))			)))
12013589	Katarzyna.Kowol 2019-04-05 12:06:17	Created	323413	(exclamation 1* (por) [por]   exclaiming 1* (por))			Syn_PWN- pIWN	14000	(okrzyk 1* (	por) [por]   v	vykrzyknienie 2* (por))	
12013588	Katarzyna.Kowol 2019-04-05 12:06:16	Created	14000	(okrzyk 1* (por) [por]   wykrzyknienie 2* (p	por))	208	Syn_plWN- PWN	323413	(exclamatio	in 1* (por) [p	or]   exclaiming 1* (por))	
12013587	Katarzyna.Kowol 2019-04-05 11:35:50	Removed	320588	(letter 1* (por) [por]   missive 1* (por))		213	Hiper_PWN- pIWN	19891	(liścik 1* (po	or) [por]   )		
12013586	Katarzyna.Kowol 2019-04-05 11:35:49	Removed	19891	(liścik 1* (por) [por]   )		210	Hipo_pIWN- PWN	320588	(letter 1* (po	or) [por]   mi	ssive 1* (por))	

Figure 3: Synset relations changes history view.

멸 Sense History												
Changes From  Changes To Changes												
Attributes												
Audit Log	Operation		Key	lemma	variant	domain	pos	status	comment	owner		
Justyna.Ławniczak	Modified	86815	włazić					Partially Checked				
2019-04-04 16:12:13	mounied	00015	WIGZIG					Error				
Justyna.Ławniczak 2019-04-04 16:10:40	Modified	83689 wpadać						Partially Checked	##K: pot. ##D: nie radzić sobie z trudnościami, przegrywać ze swoimi słabościami, ktopotami i problemami. [##P: Mężczyraw wpadał w coraz większe długi, bo chodził często do kasyna i przegrywał swój majątek.] [##Ko: wpadać w dugi] c##V/C: ST >			
2018-04-04 16:10:40								Error	##K: pot. ##D: nie radzić sobie z trudnościami, przegrywać ze swoimi słabościami, kłopotami i problemami. [##P: Mężczyzna wpadał w coraz większe długi, bo chodził często do kasyna i przegrywał swój majątek.] <##VLC: ST>			
Justyna.Ławniczak	Modified	21814	wpadać						##K: pot. ##D: składać komuś krótką wizytę, odwiedzać kogoś i nie być u kogoś długo [##P: Znajomi wpadają do nas co kilka dni i przynoszą plotki z "wielkiego świata".] <##VLC: CZ>			
2019-04-04 16:09:40	modified	21014	wpaudc						##K: pot. ##D: składać komuś krótką wizytę, odwiedzać kogoś i nie być u kogoś długo. [##P: Znajomi wpadają do nas co kilka dni i przynoszą plotki z "wielkiego świata".] <##VLC: CZ>			
Justyna.Ławniczak	Modified	82682 wpadać						Unprocessed				
2019-04-04 16:09:14	moullied	03003	83683 wpadać					Error				

Figure 4: Senses changes view.

#### 🛔 Synset

Synset Properties		III Synse	t History							
ld 274650		Audit	Operation		Def	inition	Common	Abstract	Owner	Units String
Definition Bedouins"; "believed t happy future"; "wande	mobile society"; "the nomadic habits of the he profession of a peregrine typist would have a ring tribes"	2013-	Created	migrator	y; "a restless mobile soc s"; "believed the profess	iety"; "the normadic habits of the ion of a peregrine typist would ha		0	owner	(mobile 1* (adj) [adj]   nomadic (adj), peregrine (adj), roving 1*
Comment Abstract False		09:01:16		a happy	future"; "wandering tribe	s"				(adj), roving 1 (adj), wanderin; 1* (adj))
Owner										
Units String (mobile 1* (adj) [adj]	nomadic 1* (adj), peregrine 1* (adj), roving 1*									
(adj), wandering 1* (a Status Urprocessed	dj))									
Status Error Comment										
및 Senses		3 Sens	as History							
mobile 1	Adjective Princeton			Audit Lo	a	Operation			Ser	150
nomedic 1	Adjective Princeton		20	213-11-18 09		Attached Sense		wandering		
				013-11-18 09		Attached Sense		roving 1		
peregrine 1	Adjective Princeton			013-11-18 09		Attached Sense		peregrine 1		
roving 1 wandering 1	Adjective Princeton			013-11-18 09 013-11-18 09		Attached Sense Attached Sense		nomadic 1 mobile 1		
Incoming Relations			ing Relation							
Relation Similar to	Synset (unsettled 2* (adj) [adj]   )		-	Operation	Rel Hipo p/WN-PWN	ation		Syns	et	
ipo_pfWN-PWN	(nomadyczny 2* (jak) [jak]   nomadzki 1* (jak))		0/ 00/30/50	Created	1.2		ezdny 2* (jak) [j			
ipo_pfWN-PWN	(półwędrowny 2* (jak) [jak]   )		na.Kowol 27 09:30:15	Removed	Hipo_pIWN-PWN		(przejezdny 1* (os) [os]   przejeżdżający 1* (os			
ipo_p/WN-PWN	(półosiadły 1* (jak) [jak]   półkoczowniczy 1* (jak))		na.Kowol 33 14:55:15	Created	Hipo_pfWN-PWN		(przejezdny 1* (os) [os]   przejeźdźający 1* (			" (08))
iędzyjęzykowa_synonimia_częściowa_pIWN- WN	(półosiadły 2* (jak) [jak]   półkoczowniczy 2*		na.Kowol 07 15:14:23	Created	Hipo_p/WN-PWN		pdrowny 2* (jak			
ipo pIWN-PWN	(jak)) (koczowniczy 1* (jak) [jak]   nomadyczny 1* (jak),		A TRUTTO	Created	Hipo_pIWN-PWN		(półwędrowny 1* (jak) [jak]   ) (wędrowny 2* (jak) [jak]   wędrowniczy 4* (jak))			
ipo_piww-PwW	nomadzki 2* (jak))			Created	Hipo_plWN-PWN				miczy 4*	jak))
lipo_priviv-P-WN				Created	Hipo_p/WN-PWN		otny 4* (jak) [jal			
lipo_p/WN-PWN	(przelotny 4* (jak) [jak]   )		09/08/041:33	Created	Hipo_p/WN-PWN	(wędr	owny 1* (jak) (ja	ak]   wędrov	miczy 1*	jak))
lipo_pfWN-PWN	(wędrowny 2* (jak) [jak]   wędrowniczy 4* (jak))	Katarzy 2016-09-	na.Kowol 10 22:48:52	Created	Hipo_pIWN-PWN	(kocz	wny 1* (jak) [ja			
Hipo_pIWN-PWN Hipo_pIWN-PWN	(półwędrowny 1* (jak) [jak]   ) (przejezdny 2* (jak) [jak]   )	Katarzy 2016-08-	na.Kowol 11 09:39:25	Created	Hipo_p/WN-PWN	(kocz) 2* (jał	(koczowniczy 1* (jak) [jak]   nomadyczny 1* (jak), non 2* (jak))			
HIDO_DHIWN-P-WIN	(przejezony 2. (jak) (jak) ( )	Katarzy 2016.02	na.Kowol 29 12:56:27	Created	międzyjęzykowa_syno	nimia_częściowa_plWN- (półos	iadły 2* (jak) (ja	ak]   półkocz	owniczy:	2* (jak))
			Buttacka	Created	Hipo_p/WN-PWN	(pólos	iadly 1* (jak) (ja	sk]   półkocz	owniczy	(jak))
			a.Podlaska 24 19:28:14	Removed		nimia_częściowa_plWN-	iadly 1* (jak) (ja	ak]   półkocz	owniczy	l* (jak))
				Created	międzyjęzykowa syno	the second stress and the	iadly 1* (iak) fia			
			Witkowski 7 13:16:08	CIERCO	PWN	• · · ·	iadly 1* (jak) (ja			0
				Removed						
			4 10:21:55	Created	None Hipo p/WN-PWN		iadły 1* (jak) (ja			• •
			0 13:57:37	Created			idyczny 2* (jak)			
			one 06 14:46:54		pot_odp_pIWN-PWN		ny 1* (jak) [jak]		harny 2* (	ak))
		2013-11-	18 09:03:53	Created	Similar_to	(unse	tled 2* (adj) [ad	坦1)		
Outgoing Relations		te Outgo	ing Relation	ns History						
Relation	Synset			Operation	Rel	ation		Syns	et	
Hiper_PWN-pIWN	(wędrowny 1* (jak) [jak]   wędrowniczy 1* (jak))		1 00.00.00	Created	Hiper_PWN-pfWN	(przej	ezdny 2* (jak) (j	jak]   )		
Hiper_PWN-pIWN	(koczowniczy 1* (jak) [jak]   nomadyczny 1* (jak), nomadzki 2* (jak))	Katarzy 2017-04-	na.Kowol 07 09:30:14	Removed	Hiper_PWN-pIWN	(przej	ezdny 1* (os) (o	os]   przejeż	dżający 1	" (os))
Hiper_PWN-pNVN	(wędrowny 2* (jak) [jak]   wędrowniczy 4* (jak))	Katarzy 2017-04-	na.Kowol 3 14:55:16	Created	Hiper_PWN-pfWN	(przej	ezdny 1* (os) (o	os]   przejeż	dżający 1	(08))
Similar_to	(unsettled 2* (adj) [adj]   )		na Kowol	Created	Hiper_PWN-pfWN	(półw	drowny 2* (jak	) [jak]   )		
Hiper_PWN-pIWN Hiper_PWN-pIWN	(przejezdny 2* (jak) [jak]   ) (koczowny 1* (jak) [jak]   )		an Kennel	Created	Hiper_PWN-p/WN	(półw	drowny 1* (jak	) [jak]   )		
Hiper_PWIN-pIWN	(półosiadły 1* (jak) [jak]   półkoczowniczy 1*		an Manual	Created	Hiper PWN-pIWN		owny 2* (jak) [ja		miczy 4*	īak))
niertzviezykowa synonimia częściowa PWN-	(jak))		an Marriel	Created	Hiper_PWN-pfWN		otny 4* (jak) (jal			- 79
aWN	(jak))		10:46:17 na.Kowol 29 09:41:34	Created	Hiper_PWN-pfWN		owny 1* (jak) [ja		niczy 1*	iak))
Hiper_PWN-pIWN	(nomadyczny 2* (jak) [jak]   nomadzki 1* (jak))			Created	Hiper_PWN-pNVN		owny 1° (jak) (ja owny 1° (jak) (ja		y f	e=-111
liper_PWN-pNVN liper_PWN-pNVN	(półwędrowny 1* (jak) [jak]   ) (półwędrowny 2* (jak) [jak]   )								advezne 1	* (jak), nomadz
liper_PWN-pIWN	(przelotny 4* (jak) [jak]   )		na.Kowol 11 09:39:25	Created	Hiper_PWN-pfWN	(KUC2) 2* (ja)		and Loon	y-any	Gary, nontada
		Katarzyn 2015-11-	a.Podlaska 34 19:28:53	Created	Hiper_PWN-pfWN	(pólos	iadly 1* (jak) (ja	ak]   półkocz	owniczy	l* (jak))

Figure 5: Selected synset history view.

The Online I			ngs in Yiddish		HOME PROJECT SITE ABOUT
	Wordlist:		🕫 🚬 🔯 Search 🔍 Q. Search		
YIVO	Yiddish	Philological	plejce ו פלייצע   pleytse	Lir	nguistic information:
pleytse 1			noun, f.	Variants:	pleytse (Primary Lemma)
pleytse 2 pleytse 3			B. φ<8	Philological spelling:	plejce
pleytse 4				Yiddish spelling:	פַּוֹייַנע
			Y	YIVO spelling:	pleytse
				Part of speech:	noun
			Grammatical f. qualifiers:	f.	
			Inflection:		
			Sensitive M	Meaning:	the back of a person (from shoulders to waist) or an animal
				Semantic field:	Body Space, dimensions, shapes
				Style:	
				Rootedness:	relic
		Press 272	Etymology:	P. plecy	
				Age:	1800-1939
				Sources:	
					EYDES CompYid-Eng.
					Compyto-Eng. Astr2008
					Mosk2013
					Neuberg
					JSz

Figure 6: Example of embedded java script visualization module.