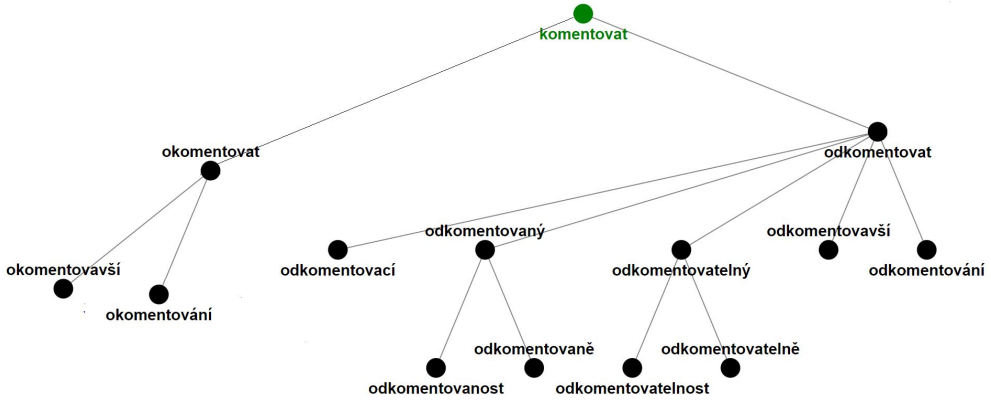
Understanding borrowing through derivational morphology

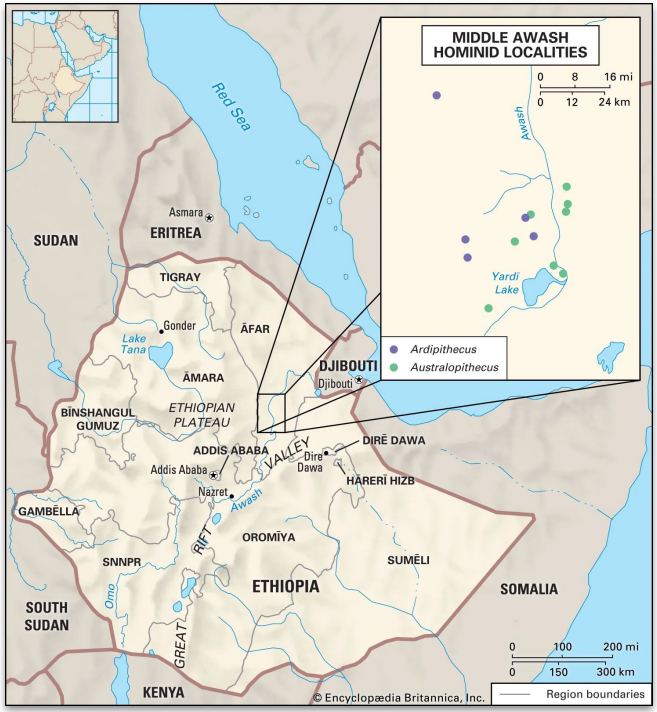
A case study of Czech verbs

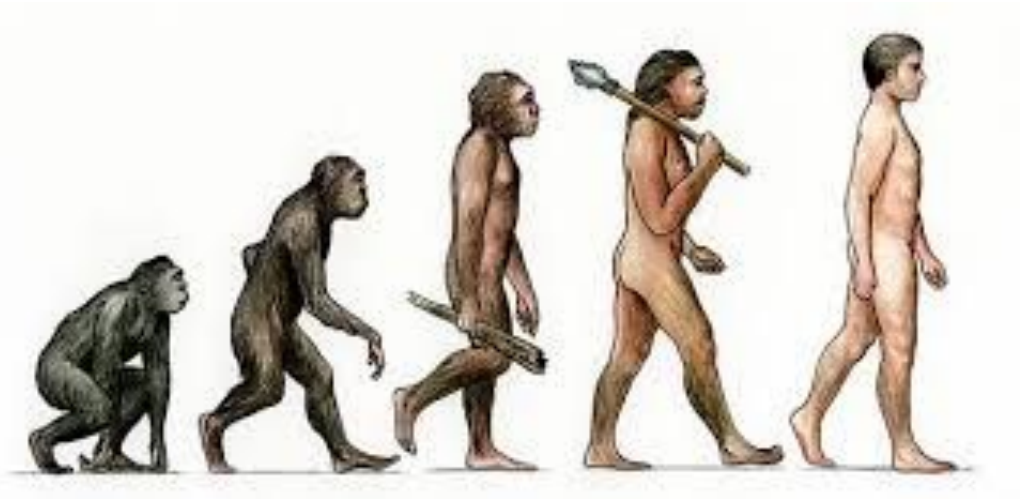


Abishek Stephen and Zdeněk Žabokrtský

Charles University
Faculty of Mathematics and Physics
Institute of Formal and Applied Linguistics

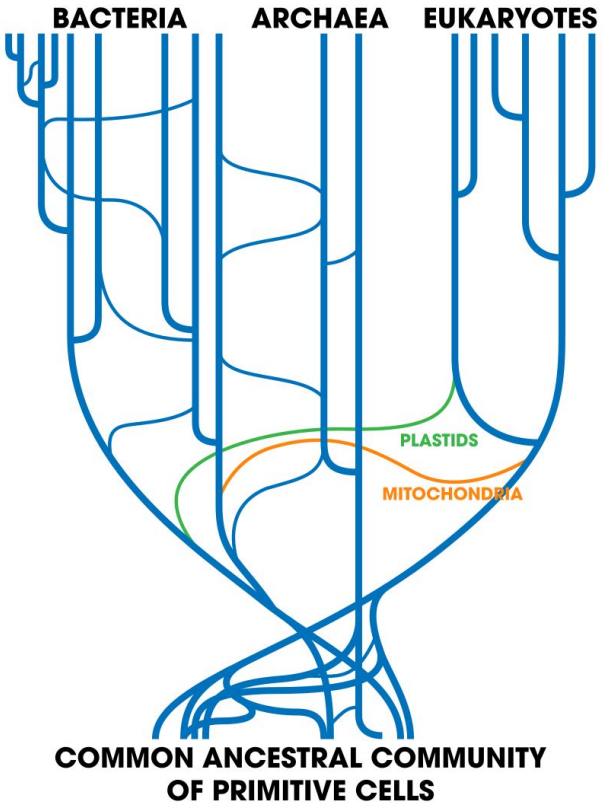
Aftermath of The Great Rift Valley



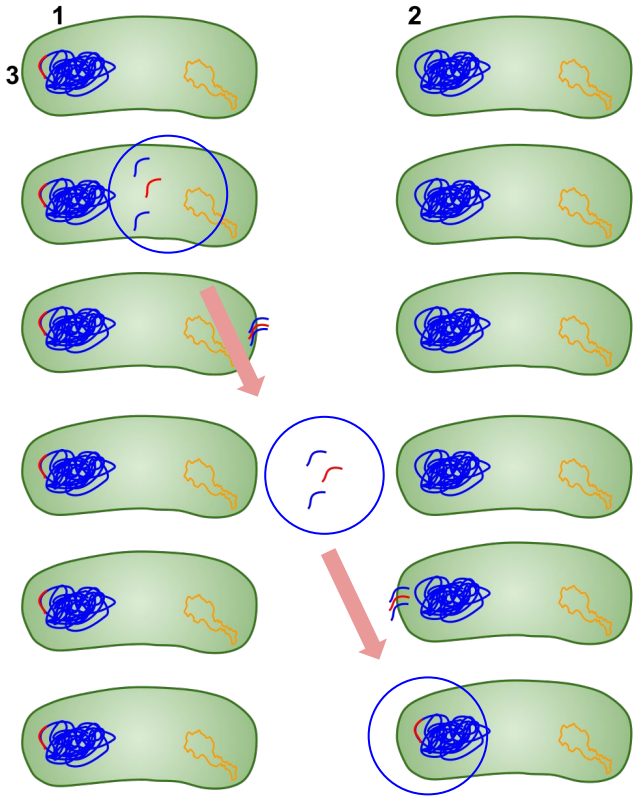


https://www.britannica.com/science/human-evolution

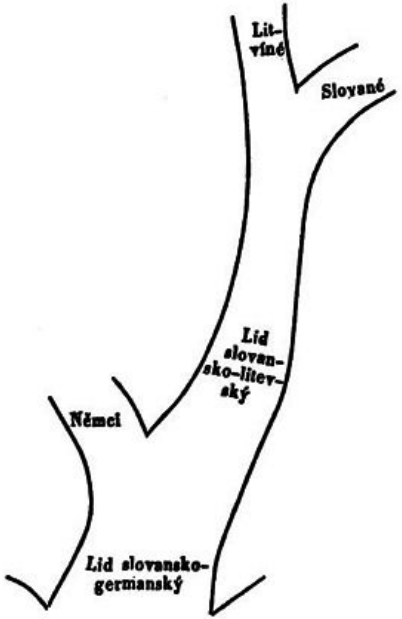
Lateral gene transfer



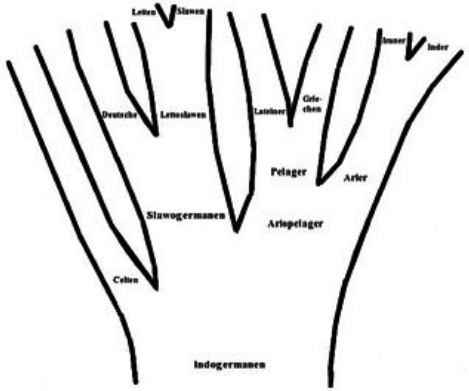
https://en.wikipedia.org/wiki/Horizontal_gene_transfer



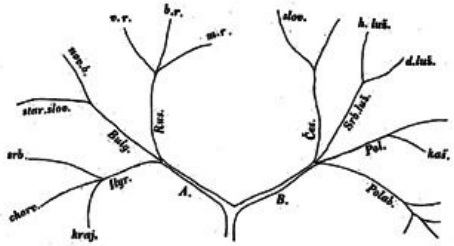
The Tree and The Wave



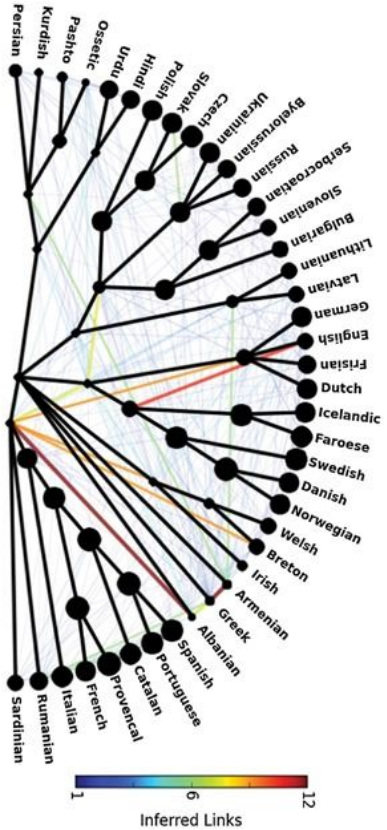
A) August Schleicher, 1853 [21]



B) August Schleicher 1853 [22]

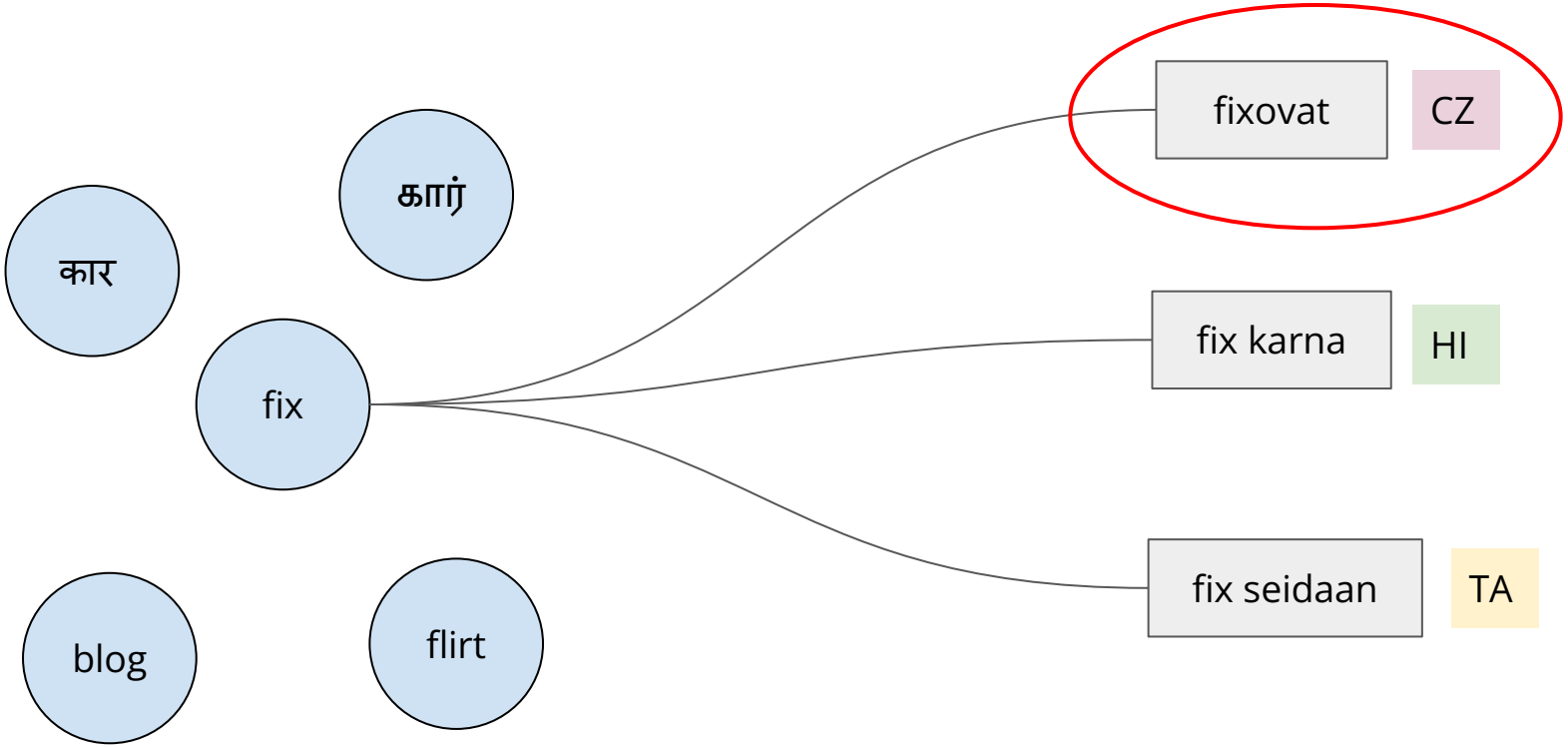


C) František Ladislav Čelakovský 1853 [24]

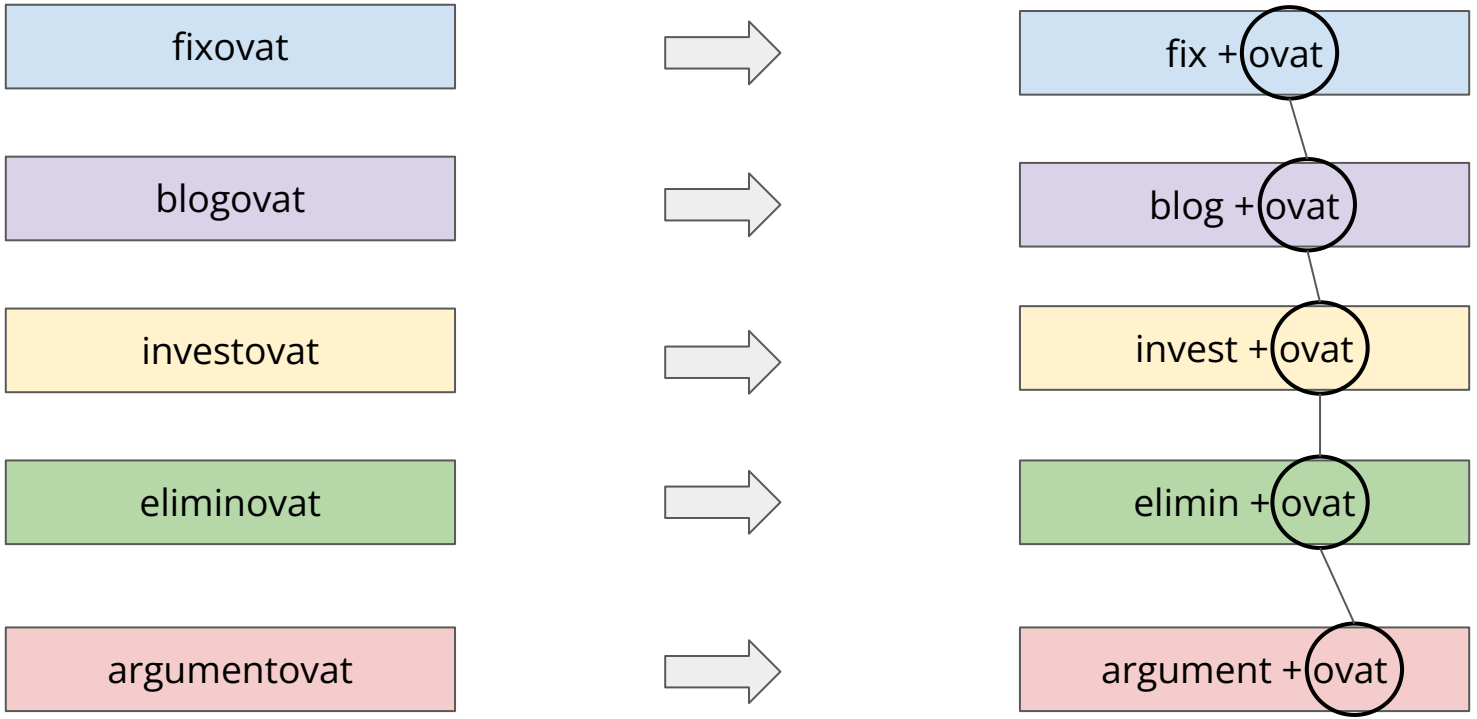


List, Johann-Mattis & Nelson-Sathi, Shijulal & Geisler, Hans & Martin, William. (2014). Networks of lexical borrowing and lateral gene transfer in language and genome evolution. BioEssays : news and reviews in molecular, cellular and developmental biology. 36. 10.1002/bies.201300096.

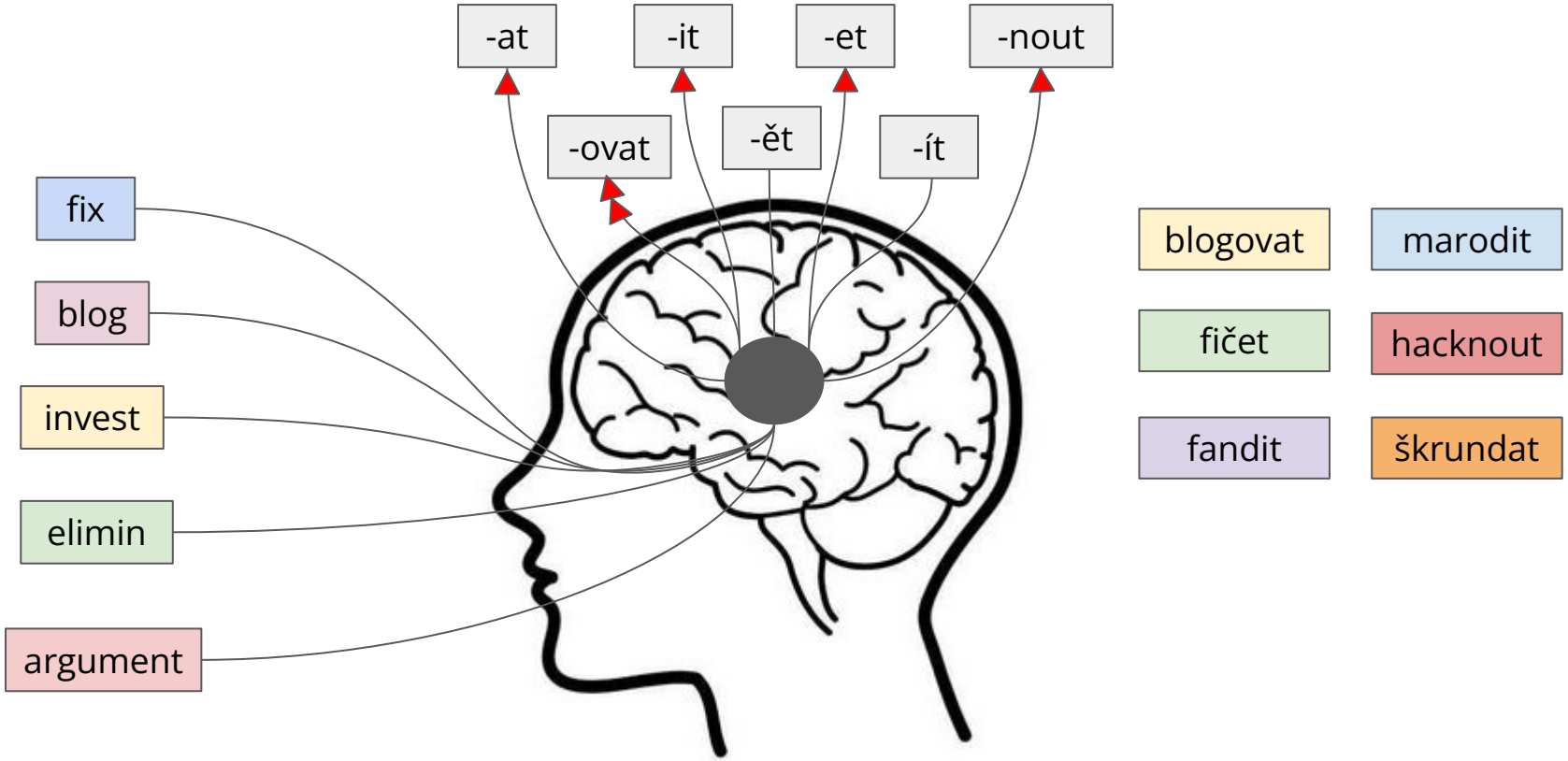
The Morph



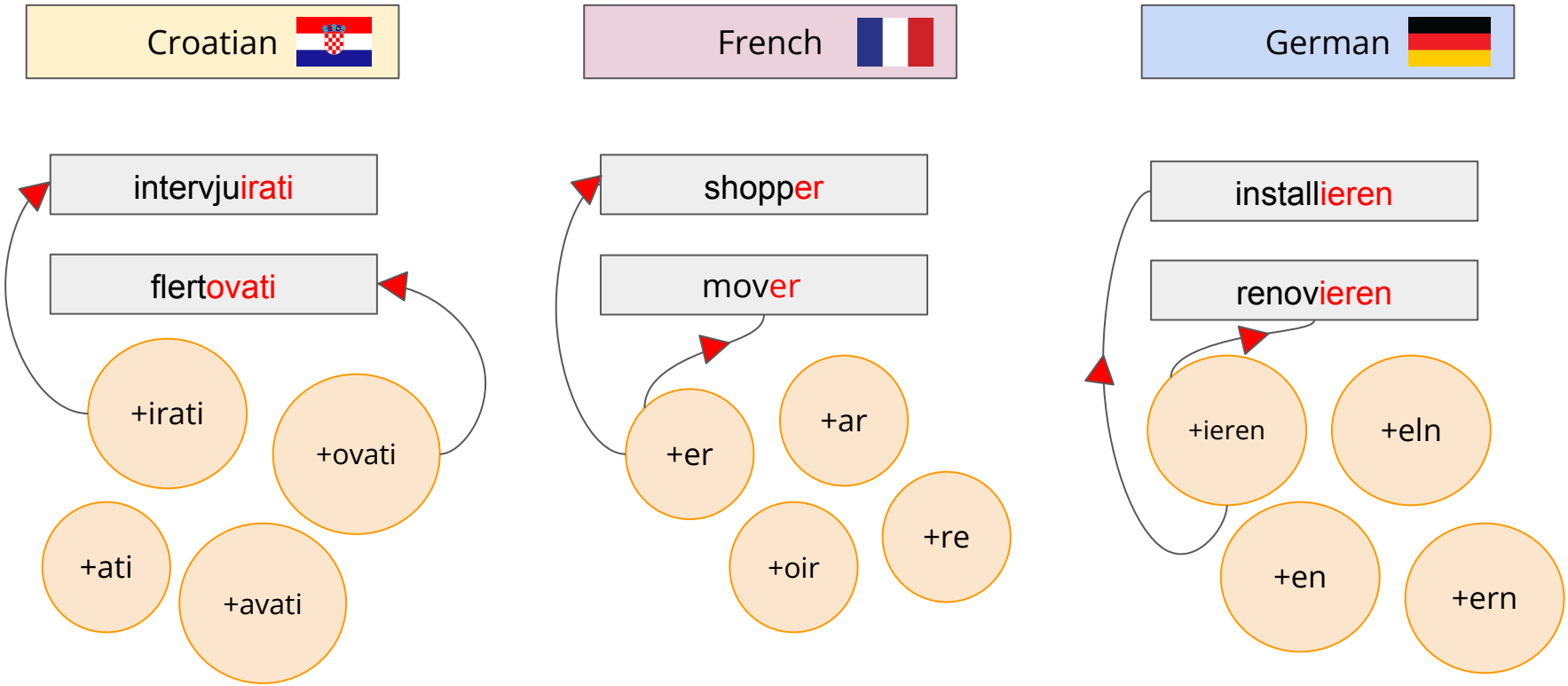
Verbs with borrowed roots



THE NEURAL Network

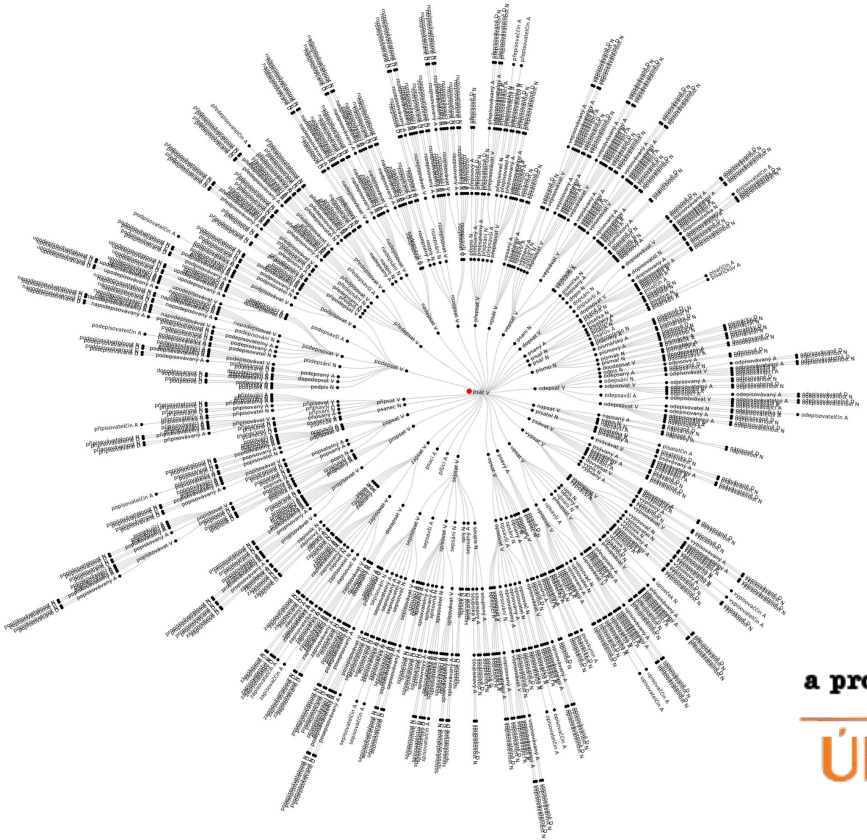


Integration Strategies



Approach

DeriNet



DeriNet 2.1, contains over 1 million lexemes

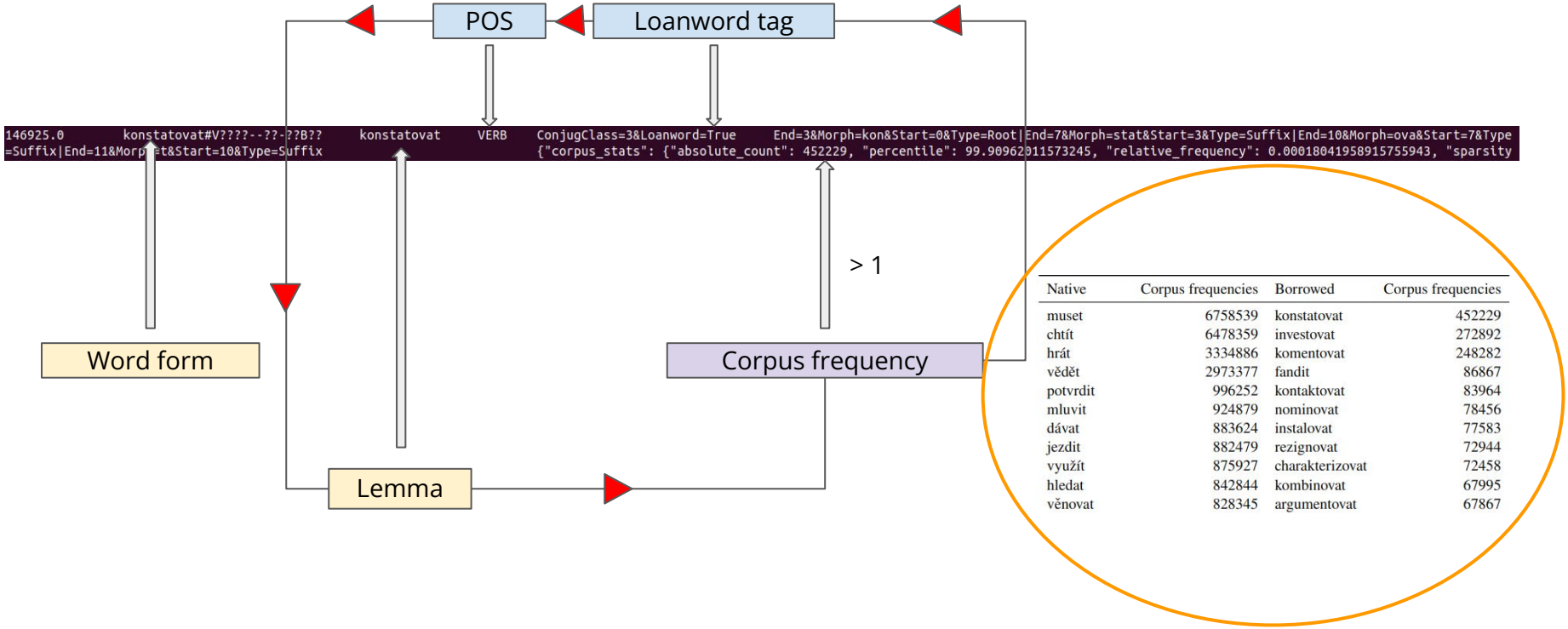
DeriNet is a lexical network which models word-formation relations in the lexicon of Czech.

autogenerated full morphological segmentations of all lemmas

a project by ÚFAL

LINDAT CLARIAH-CZ

DeriNet



Native	Corpus frequencies	Borrowed	Corpus frequencies
muset	6758539	konstatovat	452229
chtít	6478359	investovat	272892
hrát	3334886	komentovat	248282
vědět	2973377	fandit	86867
potvrdit	996252	kontaktovat	83964
mluvit	924879	nominovat	78456
dávat	883624	instalovat	77583
jezdit	882479	rezignovat	72944
využít	875927	charakterizovat	72458
hledat	842844	kombinovat	67995
věnovat	828345	argumentovat	67867

Evaluation and Results

Frequencies

Type	Total verbs	Corpus attested
Native root	42930	19854
Borrowed root	13378	3972

Table 1: Frequencies of verbs in DeriNet

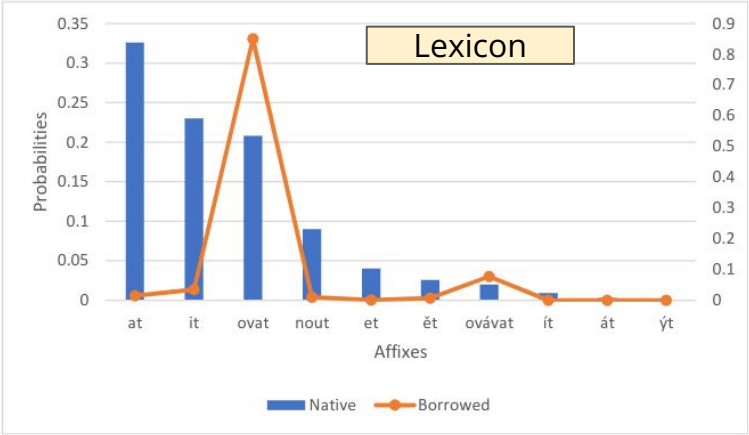
Affixes	Native root	Tokens	Borrowed root	Tokens
-at	6481	19225633	62	10724
-it	4492	25400609	141	130751
-ovat	4132	10791009	3377	3749598
-nout	1780	6024365	41	22712
-ovávat	413	128614	307	3307
-et	778	12355416	3	347
-ět	519	6481870	28	860
-át	67	5676169	0	0
-ít	195	11439639	0	0
-ýt	28	228658	0	0

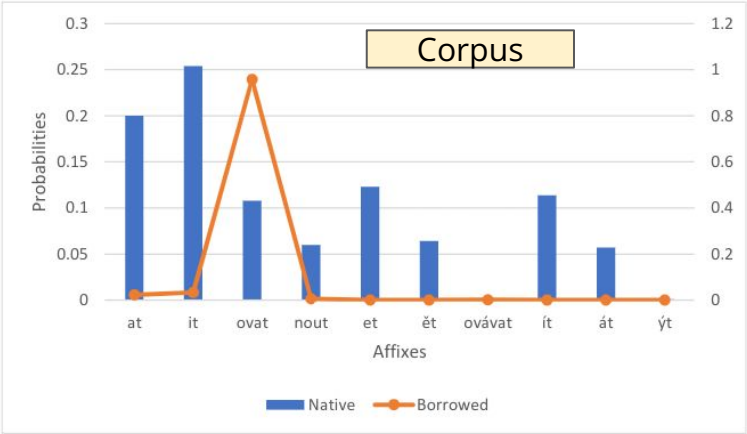
Table 2: Frequencies of derivational affixes

Entropy

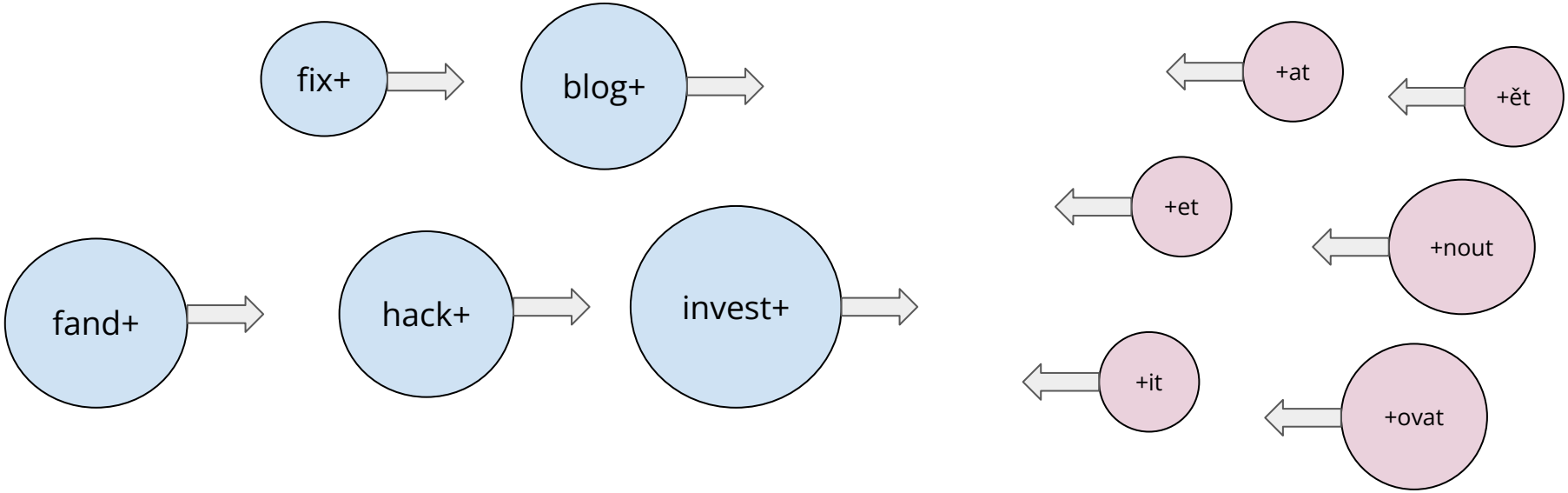
Origin of root	Affix	Lexicon frequencies		Corpus frequencies	
		P(Suffix|Origin)	Entropy	P(Suffix|Origin)	Entropy
Native	*-at*	0.326	2.330	0.200	2.803
	-it	0.230		0.254	
	-ovat	0.208		0.108	
	-nout	0.090		0.060	
	-ovávat	0.020		0.001	
	-et	0.040		0.123	
	-ět	0.026		0.064	
	-át	0.003		0.057	
	-ít	0.009		0.114	
	-ýt	0.001		0.002	
Borrowed	*-at*	0.015	0.873	0.023	0.401
	-it	0.035		0.033	
	-ovat	0.850		0.958	
	-nout	0.010		0.006	
	-ovávat	0.078		0.001	
	-et	0.001		0.000	
	-ět	0.007		0.000	
	-át	0.000		0.000	
	-ít	0.000		0.000	
	-ýt	0.000		0.000	

Table 3: Probabilities and entropies of derivational affixes





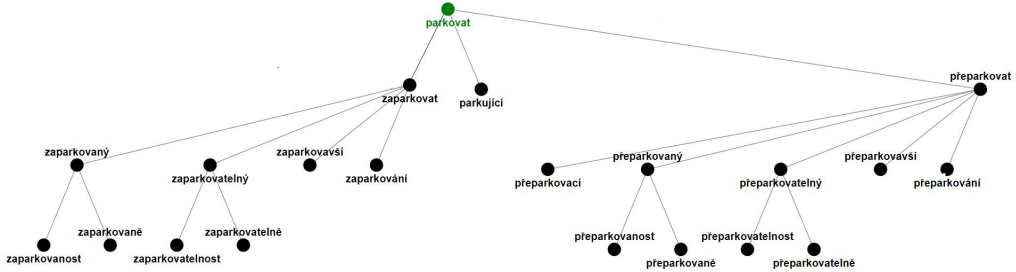
Dice coefficient

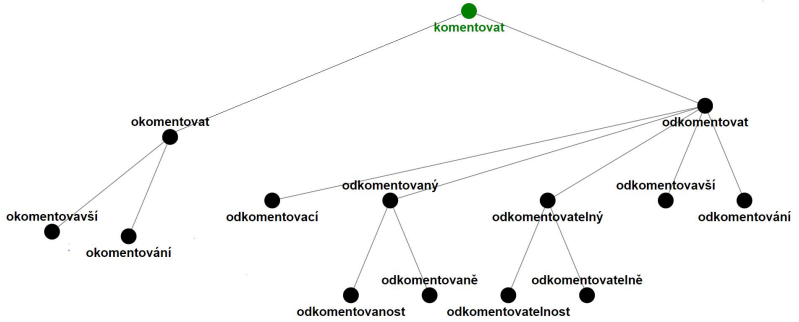


	-at	*-it*	*-ovat*	*-nout*	*-ovávat*	*-et*	*-ět*	*-át*	*-ít*	*-ýt*
Native root	0.322	0.404	0.188	0.114	0.002	0.220	0.122	0.107	0.205	0.005
Borrowed root	0.001	0.009	0.406	0.005	0.001	0	0	0	0	0

Table 4: Dice coefficient based on corpus frequencies

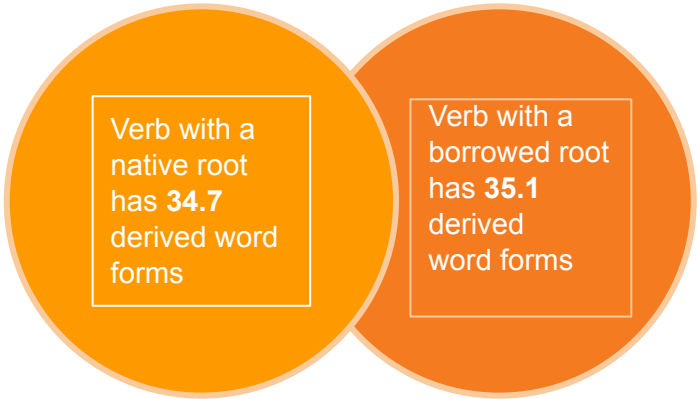
Children






```
if word.is_loanword != "None" and word.absolute_count > 1:
   if word.is_loanword == "True":
           count_loan++
           count_children_loan += word.get_all_children()
           if word.pos == "VERB":
               count_verb_loan++
               count_children_verb_loan += word.get_all_children()
   else:
           count_native++
           count_children_native += word.get_all_children()
           if word.pos == "VERB":
               count_verb_native++
               count_children_verb_native += word.get_all_children()

avg_children_verb_loan: float = count_children_verb_loan / count_verb_loan
avg_children_verb_native: float = count_children_verb_native / count_verb_native
```



Prefixes

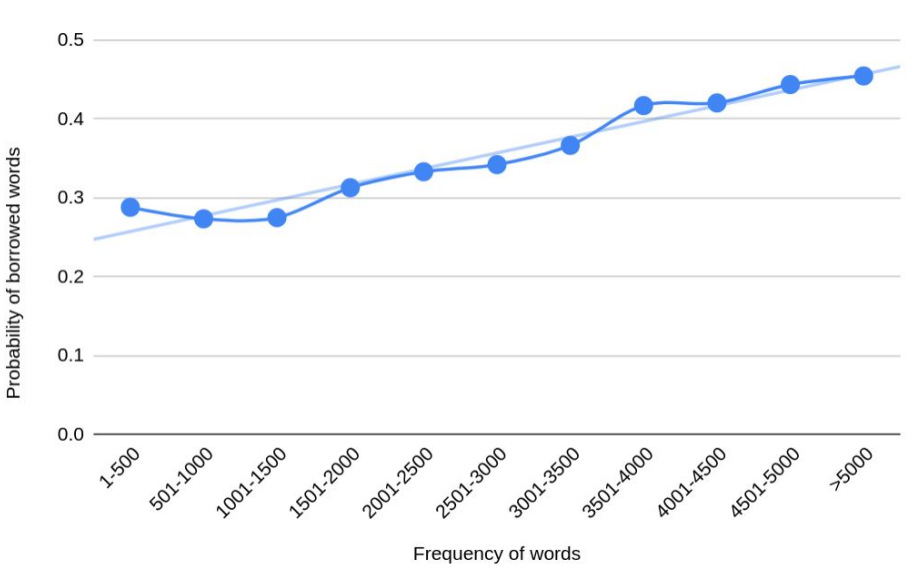
	do-	*roz-*	*o-*	*po-*	*pod-*	*od-*	*u-*	*v-*	*vy-*	*z-*	*za-*	*pře-*	*před-*
Native root	616	649	568	661	134	506	652	623	1228	1263	1226	454	117
Borrowed root	108	38	70	44	7	104	23	47	187	338	214	140	14

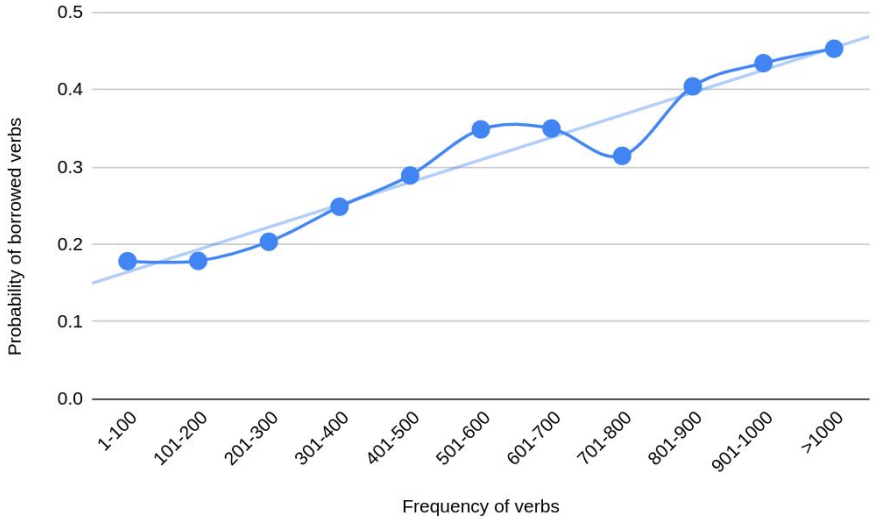
Table 5: Lexicon frequencies of the prefixed verbs with native and borrowed roots

	do-	*roz-*	*o-*	*po-*	*pod-*	*od-*	*u-*	*v-*	*vy-*	*z-*	*za-*	*pře-*	*před-*
Native root	112	123	141	129	30	126	129	106	306	270	293	119	26
Borrowed root	69	23	51	37	4	66	25	23	142	291	160	91	11

Table 6: Lexicon frequencies of the prefixed verbs with native and borrowed roots with affix *-ovat*

Frequency of loanverbs





Central tendency

Affixes	Native root	Tokens	Borrowed root	Tokens
-at	6481	19225633	62	10724
-it	4492	25400609	141	130751
-ovat	4132	10791009	3377	3749598
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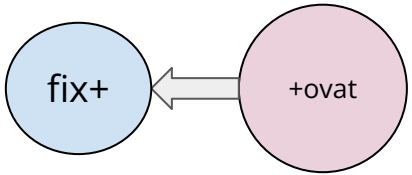
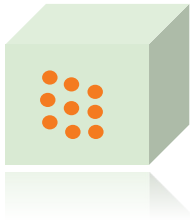
Table 2: Frequencies of derivational affixes

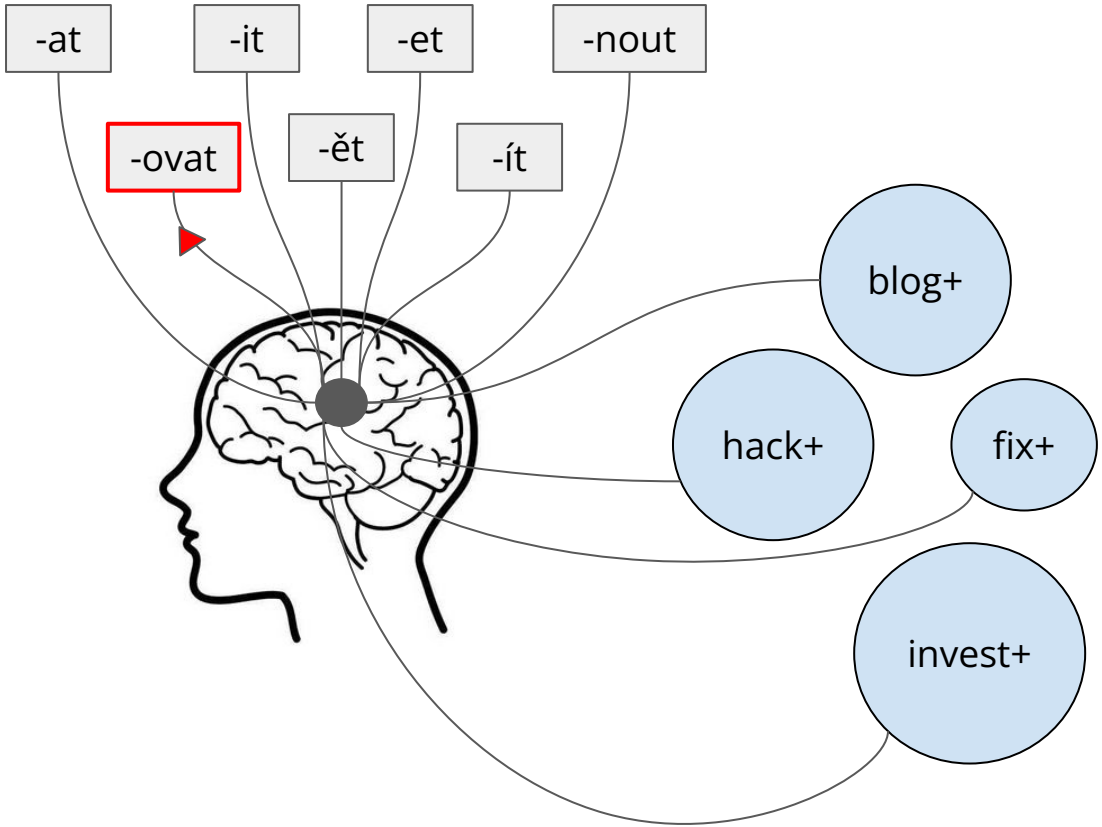
8.6 million

Summary

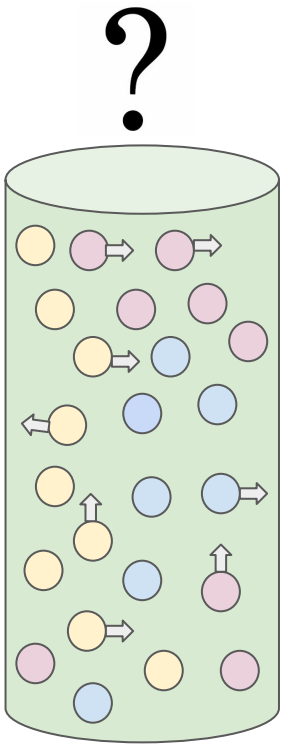
Summary







Summary



To keep the morphological system out of chaos that can be caused due to the incoming borrowed words, the *central* derivational process is extended towards handling the morphology of loanwords in the presence of multiple verb conjugation classes.

These underlying mechanisms act as a positive pressure for accepting borrowings and thus contribute to the evolution of language in terms of its vocabulary range and morphological specializations to name a few among the various other modifications.

Thus, the verb integration strategies or in this study the derivational processes led by the conjugation classes play a vital role in language change and evolution over time.

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Thank you!