

A PyFOMA Grammar for Quechua Verbal Morphology

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1 Quick introduction to Quechua

2 Overview of Quechua Grammar

3 UniMorph and SIGMORPHON

4 PyFOMA FST

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Quechua typology



Figure: Branches of Quechua (Rios, 2010)

Quick History of Quechua people



Quick History of Quechua people



Figure: Inca Empire c.1525 (Wikipedia)

Quick History of Quechua people



Figure: Francisco Pizarro claiming the Pacific Ocean for the Kings of Spain (Wikipedia)



Figure: Colonial manuscript depicting Andean agriculture (Wikipedia)

Quick History of Quechua people



Figure: Indigenous people in colonial silver mines



Figure: Piece of silver with the seal of Felipe II of Spain, 16th century

Quick History of Quechua people



Figure: Domingo de Santo Tomás, missionary from Sevilla

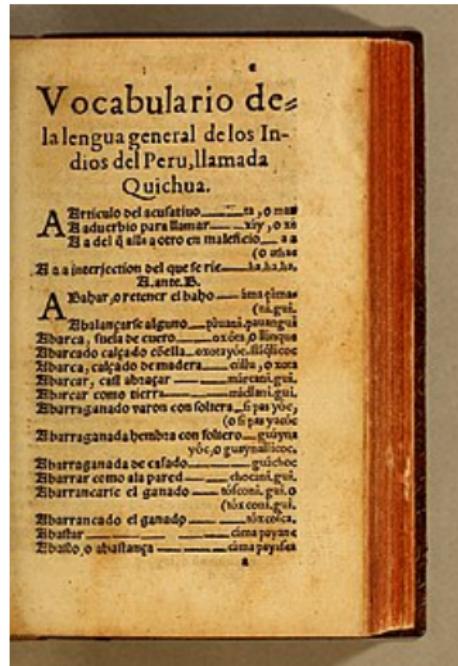


Figure: Quechua Lexicon published by Domingo de Santo Tomás in Valladolid in 1560

Quick History of Quechua people



Figure: Tupac Amaru II, illustration c. 1784



Figure: Argentinian General José de San Martín's proclamation of the independence of Peru (28 July 1821 in Lima)

Quick History of Quechua people



Figure: Criollo landowner being carried over a river by indigenous servant, 1968 (photo by Roy Palomino)



Figure: José María Arguedas, Peruvian bilingual author

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Phonology

	low central	unrounded front	unrounded front
phoneme	/a/	/i/	/u/
allophones	[a]	[i], [e]	[u], [o]

Table: Vowels of Cuzco Quechua and Ayacucho Quechua

Phonology

	Bilabial	Alveolar	Palatal	Velar	Uvular	Glottal
Plain stop	p	t	ch [tʃ]	k	q	
Aspirated stop	ph [p ^h]	th [t ^h]	chh [tʃ ^h]	kh [k ^h]	qh [q ^h]	
Ejective stop	p'	t'	ch' [tʃ']	k'	q'	
Fricative		s				h
Nasal	m	n	ñ [n]			
Lateral liquids		l		ll [ɬ]		
Vibrant liquids		r				
Semi-consonants	w		y [j]			

Table: Consonants of Cuzco Quechua and Ayacucho Quechua. Adapted from Zariquiey and Córdova (2008)

Phonology

Cuzco Quechua	Ayacucho Quechua	Gloss
t'anta	tanta	bread
qhaway	qaway	to see
chhachu	chachu	filthy and hairy

Table: Equivalence of stop consonants from Cuzco to Ayacucho Quechua

Verbal Morphology

Pronoun	Person
ñuqa	1st Singuar
qam	2nd Singular
pay	3rd Singular
ñuqanchik	1st Plural Inclusive
ñuqayku	1st Plural Exclusive
qamkuna	2nd Plural
paykuna	3rd Plural

Table: Cuzco and Ayacucho Quechua Pronouns

Verbal Morphology

Extremely regular !

verb	gloss
miku-y	to eat
rima-y	to speak
muna-y	to want

Table: Some verbs in Quechua

Verbal Morphology

Suffix	POS	example	translation
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-ni	1st P. Sing	rima-ni	I speak

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-yku (<i>Cuzco</i>)	1st P. Pl. Excl.	miku-yku	We (exclusive) eat
-niku (<i>Ayacucho</i>)	1st P. Pl. Excl.	rima-niku	We (exclusive) speak

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Table: Indicative Present suffixes

Verbal Morphology

Prefix	POS	example	translation
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Verbal Morphology

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-rqa-n	Exp. Past 3rd P. Sing.	rima-rqa-n	he/she/it spoke(I know)

Verbal Morphology

Suffix	POS	example	translation
-rqa-n	Exp. Past 3rd P. Sing. Future	rima-rqa-n	he/she/it spoke(I know)
-nki	2nd P. Sing	muna-nki	You (sing.) will want

Verbal Morphology

Suffix	POS	example	translation
-rqa-n	Exp. Past 3rd P. Sing. Future	rima-rqa-n	he/she/it spoke(I know)
-nki	2nd P. Sing Non-exp.Past	muna-nki	You (sing.) will want
-sqa-nku	3rd P.PI	muna-sqa-nku	they wanted (I heard)

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-chunku	3rd P. PI.	rima-chunku	They must speak!

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ama- -chunku	3rd P. Pl.	ama-rima-chunku	They must not speak!

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Table: More verbal morphology

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UniMorph and SIGMORPHON

- Unimorph schema
- morphological features for any language
- Quechua included in SIGMORPHON task 2017

lemma	inflected forms	tag set
rimay	rimachunku	V;IMP;POS;3;PL
rimay	rimanku	V;PRS;3;PL

Table: Sample entries for Cuzco Quechua from SIGMORPHON 2017

Unimorph and SIGMORPHON

Feature	Explanation
1	First person
1+EXCL	Exclusive first person
1+INCL	Inclusive first person
2	Second person
3	Third person
AGT	Agentive
FH	Firsthand
NFH	Non firsthand

Feature	Explanation
SG	Singular
PL	Plural
PRS	Present
PST	Past
FUT	Future
IMP	Imperative
NEG	Negative
POS	Positive
NFIN	Non-finite

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PyFOMA FST

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tags # ['V;NFIN;AGT', 'V;PRS;1;SG', ...]
```

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The first FST outputs:

achalachiy [Prefix] [V;FUT;2;PL] [Prefix]achalachiy [V;FUT;2;PL]
achalachiy [Prefix] [V;FUT;3;PL] [Prefix]achalachiy [V;FUT;3;PL]
achalachiy [Prefix] [V;FUT;1;SG] [Prefix]achalachiy [V;FUT;1;SG]
....

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achalachiy [Prefix] [V;FUT;2;PL] [Prefix]achalachinkichik

achalachiy [Prefix] [V;FUT;2;SG] [Prefix]achalachinki

achalachiy [Prefix] [V;FUT;3;PL] [Prefix]achalachinqaku

...

achalachiy [Prefix] [V;IMP;NEG;2;PL]

[Prefix]achalachiy[V;IMP;NEG;2;PL]

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...

achalachiy [Prefix] [V;IMP;NEG;2;PL]

[Prefix]achalachiy[V;IMP;NEG;2;PL]

...

- tag sets corresponding to circumfixes have **not** been replaced!

- 7 When there is a tag set for circumfixes at the end of the word, the prefix symbol is replaced by *ama*.

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achalachiy [Prefix] [V;IMP;NEG;2;PL]

amaachalachiy [V;IMP;NEG;2;PL]

...

- 8 the tag sets for circumfixes are replaced with their corresponding endings.

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achalachi **[Prefix]** [V;FUT;2;PL] **[Prefix]**achalachinkichik

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achalachi **[Prefix]** [V;FUT;3;PL] **[Prefix]**achalachinqaku

...

achalachi **[Prefix]** [V;IMP;NEG;2;PL] amaachalachiychikchu

...

9 all instances of the prefix symbol are erased.

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...

10 The final result is a grammar for all Quechua verbs.

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Evaluation Methodology

- dataset from Unimorph is used for evaluation.

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- feeding each lemma and tag set from the dataset into the grammar and comparing the generated form to the correct inflection.

Evaluation Results

- extremely positive results
- 99.3% of the inflections are correctly generated by the grammar.

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- Maybe due phonological rule involving the distribution of ejective stop constants.
- Could not find the exact formulation of this phonological rule was not found.
- left as-is.
- Overall, very successful!!

Bibliography

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- Sulpayki!
- ¡Gracias!
- Thank you!
- Eskerrik asko!