

itwêwina

<https://itwewina.altlab.app>

**Towards a morphologically intelligent and user-friendly on-line dictionary of
Plains Cree – next next round**

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of Canada

³ First Nations University of Canada

21st Century Tools for Indigenous Languages Partnership Project

- <http://altlab.artsrn.ualberta.ca>
- <https://21c.tools/>
- Developing “low-hanging fruit” software for Indigenous languages
 - (1) intelligent electronic dictionaries (I-DICT)
 - (2) easily searchable, linguistically analyzed databases of spoken recordings and written texts
 - (3) spell-checkers (+ grammar-checkers), and
 - (4) intelligent computer-aided language learning applications (ICALL)
- Intelligent
 - make use of language technology
 - to deal with the complex word structure

Acknowledgements

- Numerous native (Plains) Cree speakers and Elders
- Cree language instructors
 - Miyo Wahkohtowin Education → Maskwacîs Education Schools Commission (MESCC)
 - First Nations University of Canada
 - Wayne Jackson / nêhiyawêwin word of the day
- Long-standing, continuing, meticulous lexicographical work by Arok Wolvengrey
 - nêhiyawêwin : itwêwina / Cree : Words
- Funding through multiple grants from SSHRC, UAlberta, Kule Institute of Advanced Study, and support by National Research Council (NRC)
- Enduring encouragement
 - Arden Ogg (CLN), Earle Waugh (AECD), Ahmad Jawad (Intellimedia), Trond Trosterud, Sjur Moshagen, Lene Antonsen (Giellatekno/Divvun)

Spoken dictionary of Maskwacîs Cree

Mary Jean Littlechild, Louise Wildcat, Jerry Roasting, Harley Simon, Annette Lee, Arlene Makinaw, Rosie Rowan, Rose Makinaw, Kisikaw, Betty Simon, Brian Lightning, Brian Lee, Linda Oldpan, Mariam Buffalo, Debora Young, Ivy Raine, Paula Makinaw, Norma Linda Saddleback, Renee Makinaw, Atticus Harrigan, Katherine Schmirler, Dustin Bowers, Megan Bontohon, Sarah Giesbrecht, Patricia Johnson, Timothy Mills, Jordan Lachler & Antti Arppe

Maskwacîs Education Schools Commission (MESC)

Morphological intelligence – rich word structure (English vs. Plains Cree)

- *see*
 - *sees*
 - *saw*
 - *seen*
 - *seeing*
 - *I see ∅* → *I see it* → *I see him/her*
- *wâpiw* 's/he sees ∅'
- *wâpahtam* 's/he sees *it*'
- *wâpamêw* 's/he see *him/her*'
 - *kiwâpamin* 'You [one] see me'
 - *ê-wâpamiyan* 'You [one] see me'
 - *kiwâpaminân* 'You [one] see us'
 - *ê-wâpamiyâhk* 'You [one] see us'
 - *kiwâpaminâwâw* 'You all see me'
 - *ê-wâpamiyêk* 'You all see me'
 - *kiwâpaminân* 'You all see us'
 - *ê-wâpamiyâhk* 'You all see us'
 - ...
 - and up to 500 other core forms
 - plus thousands more complex forms (with 1-N preverbs)
- *pê-wâpamêw*
- *nikî-nitawi-wâpamâw*
- ...

Community/User feedback → initial design decisions

← Language instructors ← feedback sessions, CILLDI courses delivered in 2020, feedback emails

→ simple, but extendible

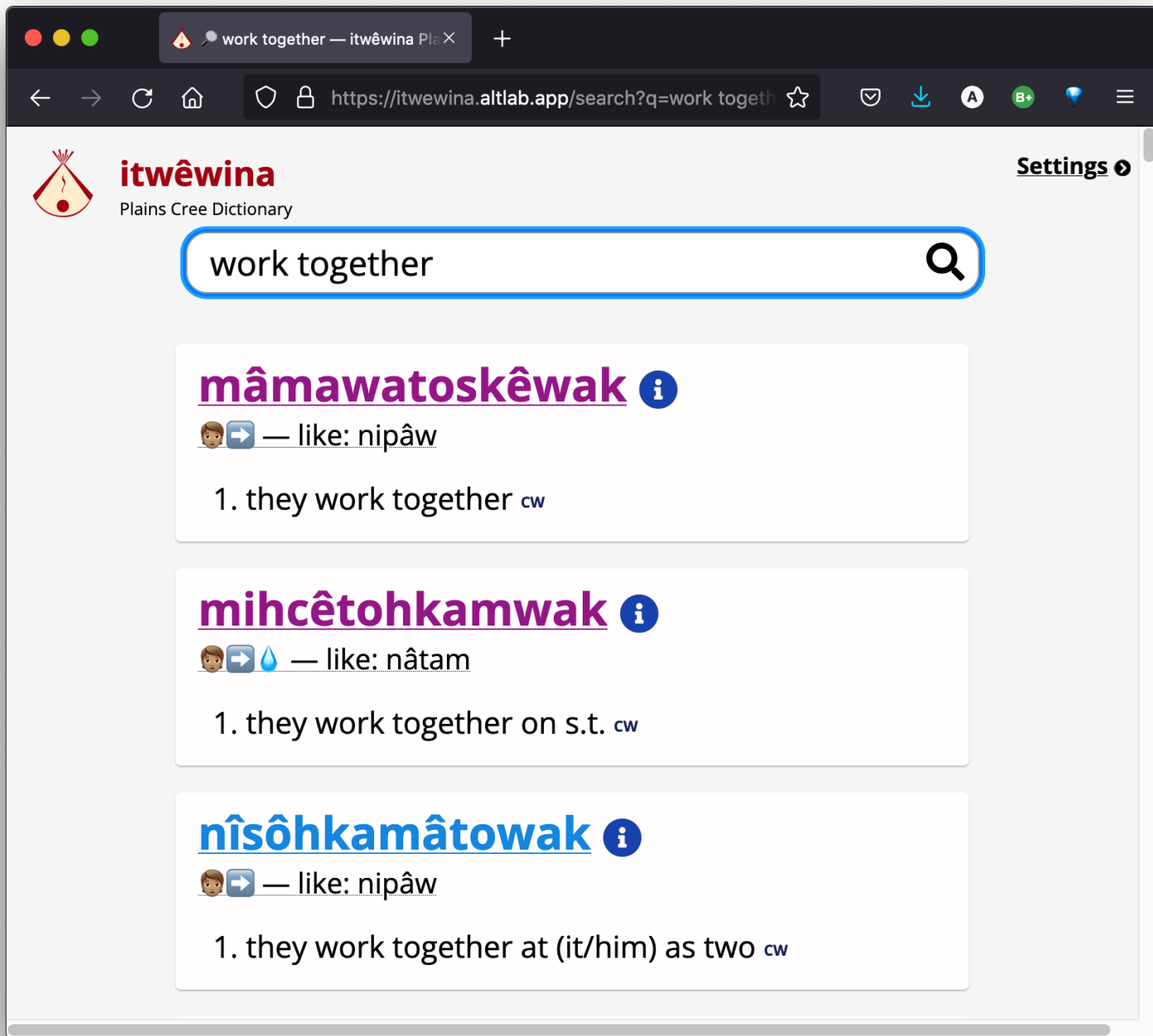
- Automatic handling of Cree/English as search language
- Showing only most essential core information first
 - But full lexicographical and other details easily accessible
- Plain (English) terminology as primary
 - But linguistic terminology/analysis easily accessible

Meeting expectations – last year → current status?

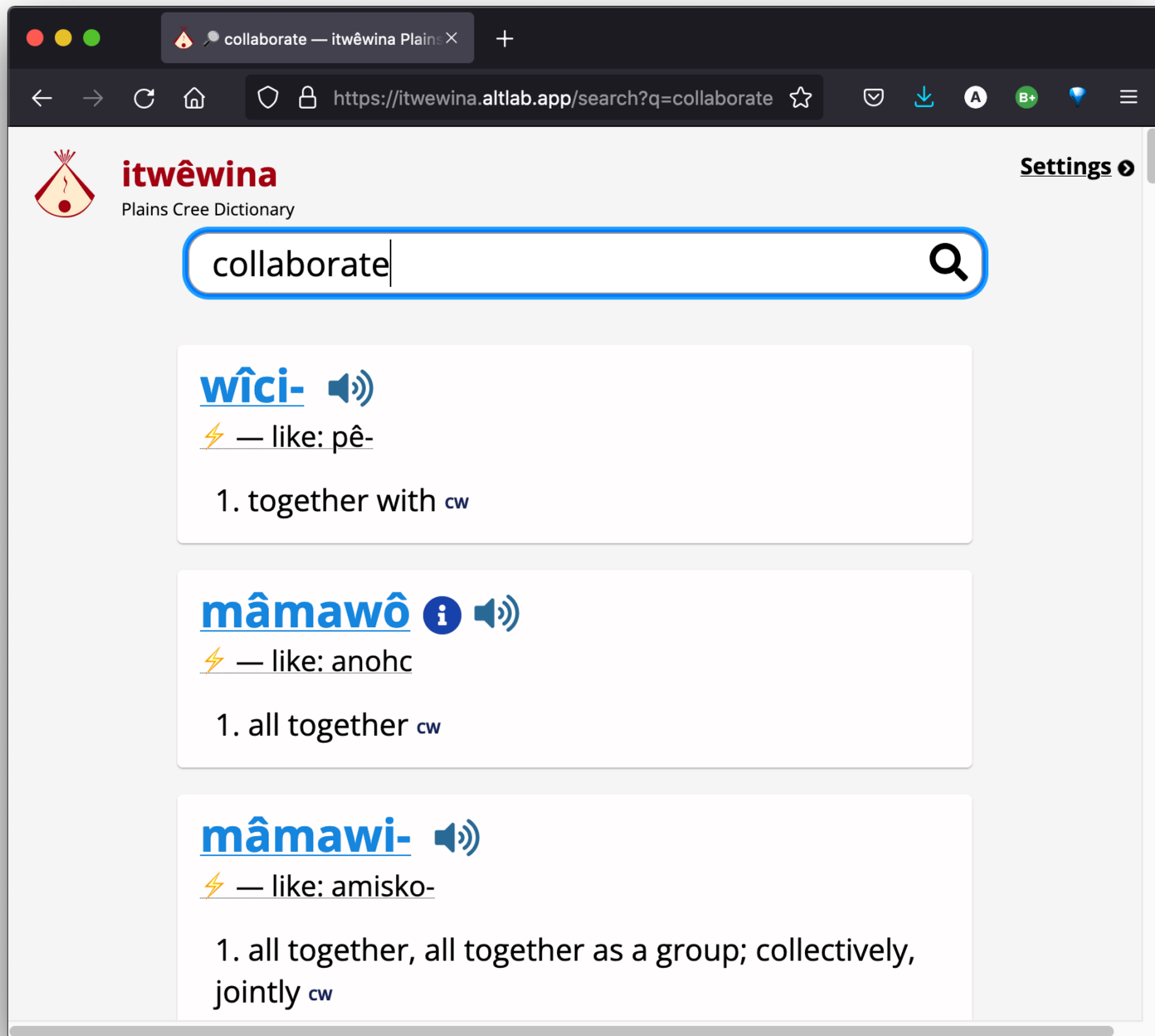
- Facebook: *nêhiyawêwin* word of the day – what linguistic help do people ask for?
 - Cree naming
 - What is the Cree word for X (English concept)?
→ Good start → multiword concepts
 - Cree phrases
 - How do I say X (English phrase) in Cree?
→ Step-wise through looking up paradigms → direct linking of English phrases to matching Cree word forms
 - Cree syllabics
 - How do I write X (Cree word) in Cree syllabics?
→ Done
 - Cree pronunciation
 - How do I say X (Cree word) in Cree?
→ Available for a part of the dictionary entries → increasing coverage to cover much more of the Cree paradigms
 - Cree-to-English translation
 - What does X (Cree word) mean in English?
→ good start → improving fuzzy matching
- Devices/Contexts
 - Most users have majority language keyboards → diacritic characters present a challenge
 - Mobile gadgets, rather than desktops or even laptops
 - Designing for the smaller screens
 - mobile, non-physical keyboards → typing of characters even more fuzzy
 - Internet connectivity is not guaranteed ← in particular in remote communities

What is the Cree word for X?

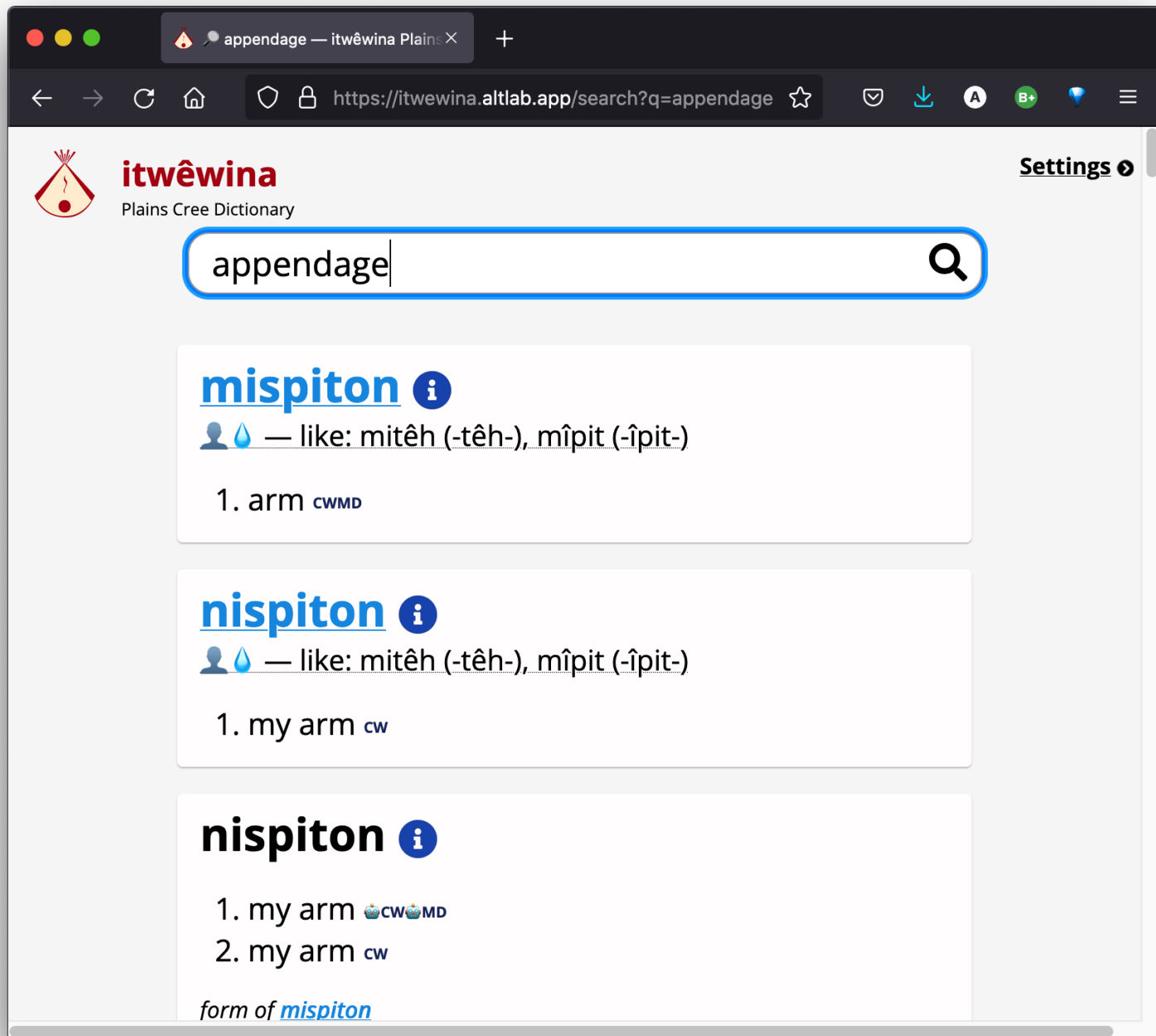
- multi-word searches
- “missing” rare words
- synonyms



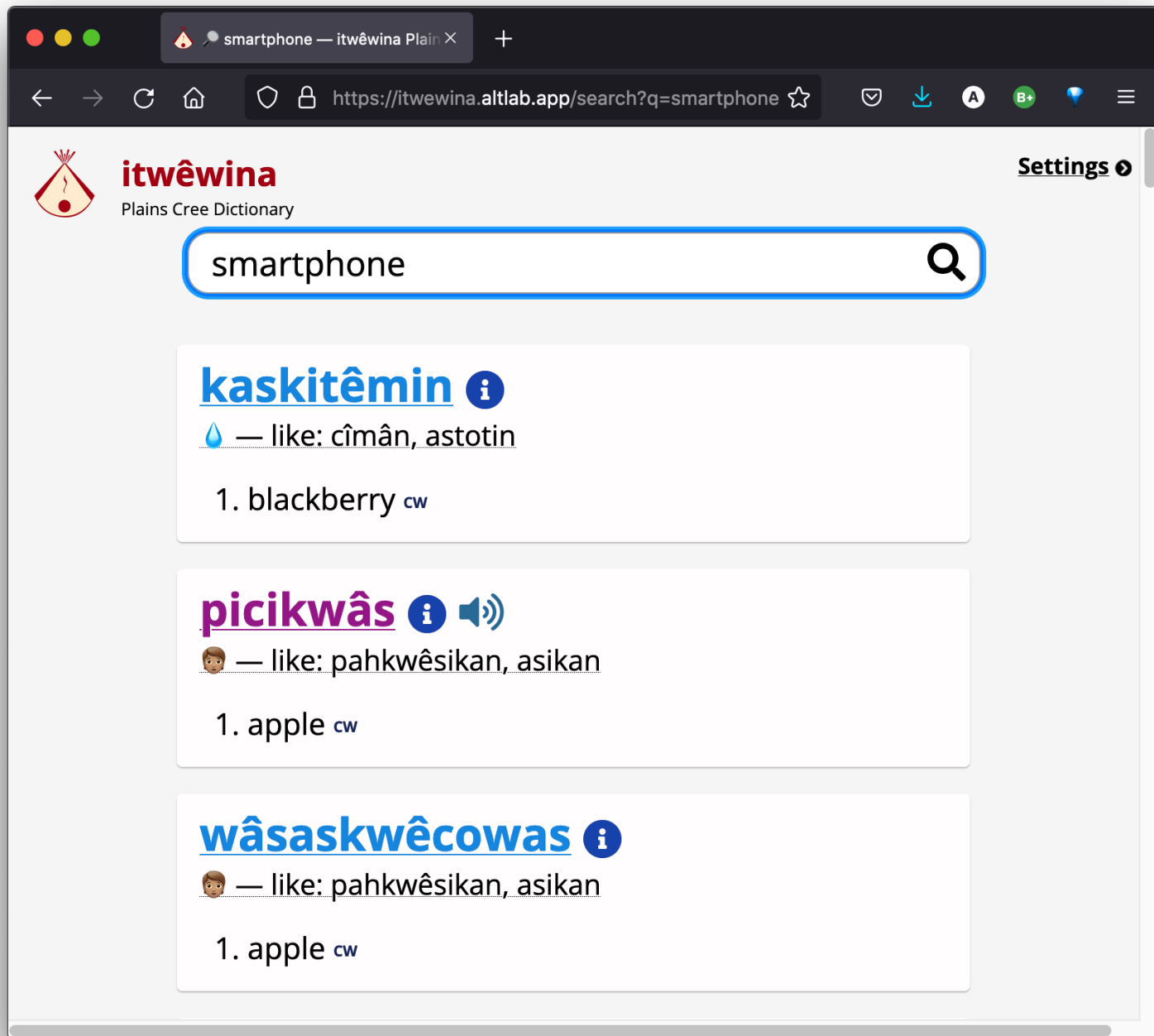
Searching with a multi-word expression: ***work together***



Searching with a rarer/synonymous word not in the English definitions: **collaborate**



Searching with a rarer/synonymous word not in the English definitions: **appendage**



Searching with a rarer/synonymous word not in the English definitions: **smartphone**

How was this improvement to search achieved?

- Using multiple criteria to rank the relevance of the search results
 - edit-distance
 - corpus—based frequency
 - morpheme frequency
 - survey of relevance ranking of search results
 - semantic vectors (trained on huge English corpora
← Google News Corpus)
 - applied to search words, and
 - English definitions

How do I say X in Cree?

- Matching English phrases directly with most frequent/central Cree word-forms

itwêwina Plains Cree dictionary

https://itwewina.altlab.app/search?q=make+some

itwêwina
Plains Cree Dictionary

Settings

make someone work

atoskêwinihkêw ⓘ
👤 ➡ — like: nipâw
1. s/he makes work (for someone) cw

atotêw ⓘ
👤 ➡ 👤 — like: nakatêw
1. He tells him or them to do some work. MD
2. s/he makes a request of s.o., s/he asks s.o. to do something; s/he engages s.o. for something, s/he employs s.o.; s/he commands s.o. cw

atoskahêw ⓘ
👤 ➡ 👤 — like: wîcihêw

Searching with an English multi-word concept: ***make (someone) work***

atotêw — itwêwina Plains Cree

https://itwewina.altlab.app/word/atotêw/?paradigm

itwêwina
Plains Cree Dictionary

Settings

Search in Cree or English

atotêw

👤 ➡ 👤 — like: nakatêw

VTA-4: transitive animate verb – class 4

1. He tells him or them to do some work. **MD**
2. s/he makes a request of s.o., s/he asks s.o. to do something; s/he engages s.o. for something, s/he employs s.o.; s/he commands s.o. **CW**

► Show plain English labels

	ni-/ki- word	ê-/kâ- word
<i>I → you (one)</i>	kitatotitin	ê-atotitân
<i>I → him/her</i>	nitatotâtaw	ê-atotak
<i>I → you (all)</i>	kitatotitinâwâw	ê-atotitakok

Looking up an inflected word-form in the paradigm: ***I made them work***

atotêw — itwêwina Plains Cree

https://itwewina.altlab.app/word/atotêw/

itwêwina
Plains Cree Dictionary

Settings

Search in Cree or English

atotêw

👤👤 — like: nakatêw

VTA-4: transitive animate verb – class 4

1. He tells him or them to do some work. **MD**
2. s/he makes a request of s.o., s/he asks s.o. to do something; s/he engages s.o. for something, s/he employs s.o.; s/he commands s.o. **CW**

▼ Show linguistic labels

	Ind
1s → 2s	kita
1s → 3s	nita
2s → 1s	kita
2s → 3s	kita

- Plain English labels
- Linguistic labels**
- Nêhiyawêwin labels

Changing the paradigm labeling to **scientific / linguistic**

atotêw — itwêwina Plains Cree

https://itwewina.altlab.app/word/atotêw/

itwêwina
Plains Cree Dictionary

Settings

Search in Cree or English

atotêw

👤👤 — like: nakatêw

VTA-4: transitive animate verb – class 4

1. He tells him or them to do some work. **MD**
2. s/he makes a request of s.o., s/he asks s.o. to do something; s/he engages s.o. for something, s/he employs s.o.; s/he commands s.o. **CW**

▼ Show nêhiyawêwin labels

niya	→	kiya
niya	→	wiya
kiya	→	niya
kiya	→	wiya

Plain English labels

Linguistic labels

Nêhiyawêwin labels

Changing the paradigm labeling to plain **nêhiyawêwin**

atotêw — itwêwina Plains Cree

https://itwewina.altlab.app/word/atotêw/?paradigm

something happened earlier

	ni-/ki- word	ê-/kâ- word
<i>I → you (one)</i>	kikî-atotitin	ê-kî-atotitân
<i>I → him/her</i>	nikî-atotâw	ê-kî-atotak
<i>I → you (all)</i>	kikî-atotitinâwâw	ê-kî-atotitakok
<i>I → them</i>	nikî-atotâwak	ê-kî-atotakik
<i>I → him/her/them</i>	nikî-atotimâwa	ê-kî-atotimak

	ni-/ki- word	ê-/kâ- word
<i>you (one) → me</i>	kikî-atosin	ê-kî-atosiyan
<i>you (one) → him/her</i>	kikî-atotâw	ê-kî-atotat
<i>you (one) → we (but not you)</i>	kikî-atosinân	ê-kî-atosiyâhk
<i>you (one) → them</i>	kikî-atotâwak	ê-kî-atotacik
<i>you (one) → him/her/them</i>	kikî-atotimâwa	ê-kî-atotimat

	ni-/ki- word	ê-/kâ- word
<i>we (but not</i>	kikî-atotitinân	ê-kî-atotitâhk

Looking up an inflected word-form in the paradigm: **Prt+1Sg+3PIO** → *I made them work*

How do I say X in Cree?

- What is the Cree word-form that corresponds to a simple English phrase?
- Better solution than paradigm lookup?

itwêwina
Plains Cree Dictionary

Settings

I made them work espt:1

nikî-atotâwak ⓘ

Preverb : **kî-** ⓘ

form of [atotêw](#)

atotêw

👤➡️👤 — like: nakatêw

1. He tells him or them to do some work. MD
2. s/he makes a request of s.o., s/he asks s.o. to do something; s/he engages s.o. for something, s/he employs s.o.; s/he commands s.o. CW

kocipayihtâw ⓘ

👤➡️💧 — like: kisihtâw

Looking up with a simple English phrase: *I made them work*

when I make them work espt:1

https://itwewina.altlab.app/search?q=when I make

itwêwina
Plains Cree Dictionary

Settings

when I make them work espt:1

atotakwâwi ⓘ

1. when I tell them or them to do some work. MD
2. when I make a request of them, when I ask them to do something; when I engage them for something, when I employ them; when I command them CW

form of [atotêw](#)

atotêw


👤 ➡ 👤 — like: nakatêw

1. He tells him or them to do some work. MD
2. s/he makes a request of s.o., s/he asks s.o. to do something; s/he engages s.o. for something, s/he employs s.o.: s/he commands s.o. CW

Looking up with another simple English phrase: ***when I make them work***

my many bears espt:1 — itwê X

https://itwewina.altlab.app/search?q=my many be

 **itwêwina**
Plains Cree Dictionary

Settings

my many bears espt:1

niwâkâyôsak ⓘ

1. my black bears. 🐻MD
2. my bears 🐻CW

form of [wâkâyôś](#)

[wâkâyôś](#)

👤 — like: pahkwêsikan, asikan

1. A black bear. MD
2. bear CW

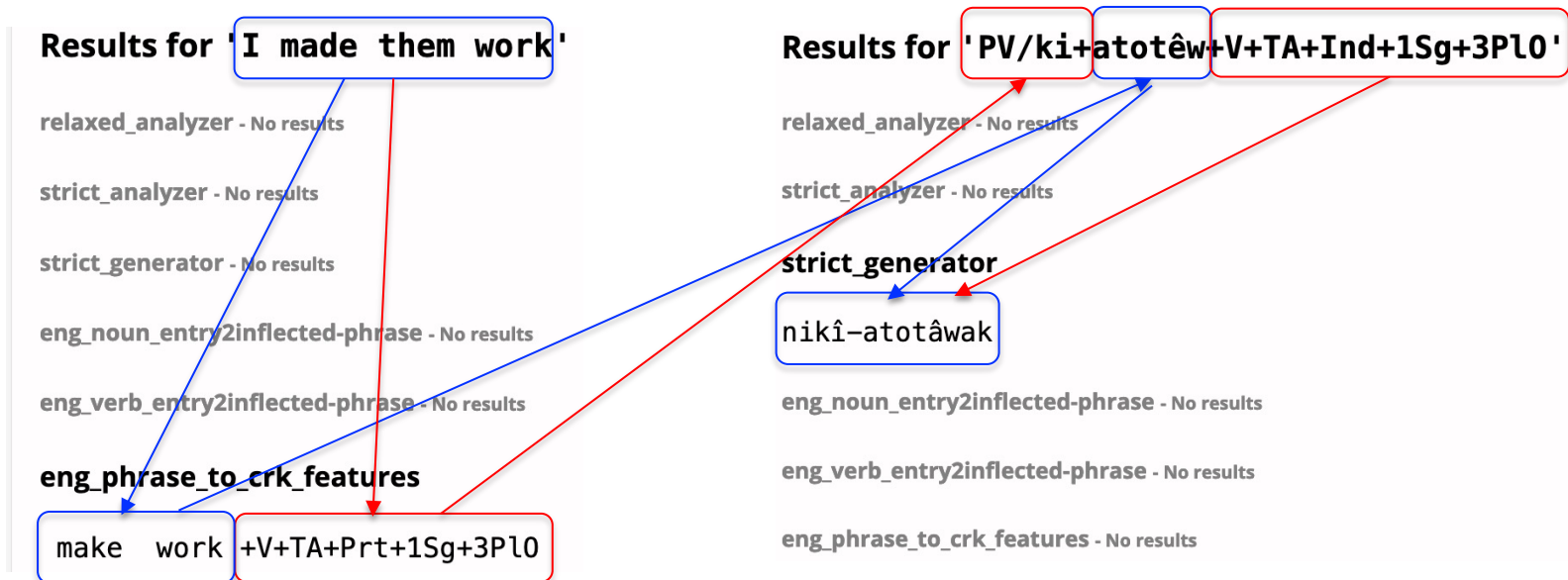
wâkâyôś ⓘ

1. a little black bear; a little literally: a little crooked

Looking up with a simple English phrase: **my many bears**

How is this achieved?

- A computational model for the analysis of simple English phrases
- These are matched with the Cree word-forms in the full paradigms



How do I write X in Cree
syllabics?

atotêw — itwêwina Plains Cree

https://itwewina.altlab.app/word/atotêw/?paradig

itwêwina
Plains Cree Dictionary

Settings

Search in Cree or English

atotêw

👤👤 — like: nakatêw

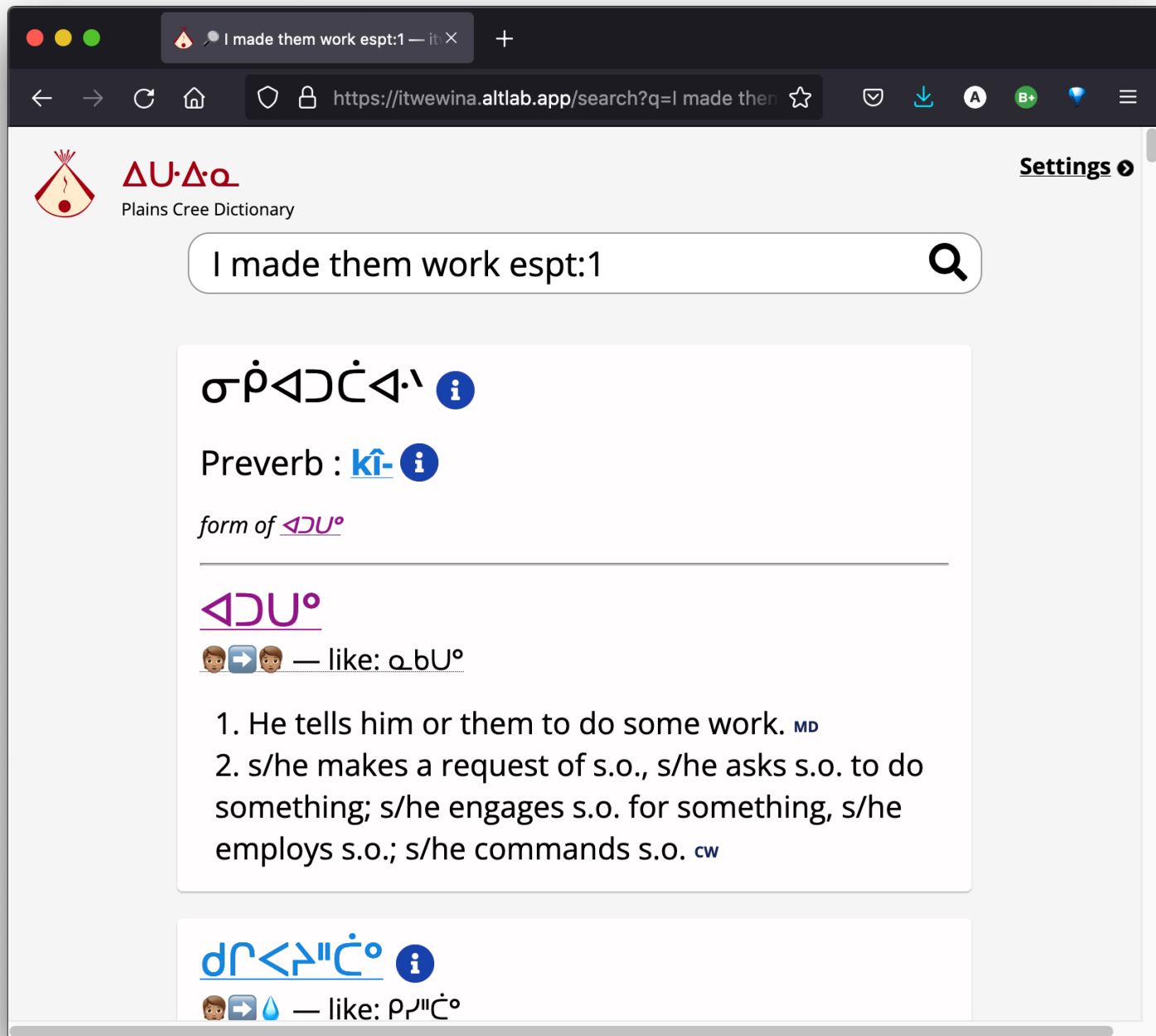
VTA-4: transitive animate verb – class 4

1. He tells him or them to do some work. **MD**
2. s/he makes a request of s.o., s/he asks s.o. to do something; s/he engages s.o. for something, s/he employs s.o.; s/he commands s.o. **CW**

▼ Show nêhiyawêwin labels

ê-ispayik anohc/m		ni-/ki- itwêw
niya → kiya	kitatotitin	Plain English labels
niya → wiya	nitatotât	Linguistic labels
niya →	kitatotitinâw	Nêhiyawêwin labels


Choosing **Western Cree syllabics** as the display orthography for the Cree content





Choosing *Western Cree syllabics* as the orthography of the Cree content

atotêw — itwêwina Plains Cree

https://itwewina.altlab.app/word/atotêw/

 **ΔU·Δ·α**
Plains Cree Dictionary Settings

Search in Cree or English 

ᐱᐅᐅᐅ
 — like: αbU°
 VTA-4: transitive animate verb – class 4

1. He tells him or them to do some work. **MD**
 2. s/he makes a request of s.o., s/he asks s.o. to do something; s/he engages s.o. for something, s/he employs s.o.; s/he commands s.o. **CW**

► Show nêhiyawêwin labels

σ↳ → ρ↳	σ-/ρ- ΔU·Δ·?
σ↳ → Δ·↳	ρCᐅᐅᐅᐅ
ρ↳ → σ↳	σCᐅᐅᐅᐅ
ρ↳ → Δ·↳	ρCᐅᐅᐅᐅ

Choosing **Western Cree syllabics** as the orthography of the Cree content – also in the **paradigms**

How do I ***SAY*** X in Cree?



itwêwina

Plains Cree Dictionary

Settings

nipiy



nipiy

— like: mîkisasâkay, oskasâkay

1. water CWMD

nîpiy

— like: mîkisasâkay, oskasâkay

1. leaf; blade of grass cw

2. [plural:] leaves; salad cw

pikwâwanipiy


— like: mîkisasâkay, oskasâkay

1. spring of water cw

Minimal pairs

itwêwina — itwêwina Plains Cree x +

https://itwewina.altlab.app/search?q=nipiy

 **itwêwina**
Plains Cree Dictionary Settings

nipiy ⓘ 🔊
— like: mîkisasâkay, oskasâkay
1. water CWMD

nîpiy ⓘ 🔊
— like: mîkisasâkay, oskasâkay
1. leaf; blade of grass cw
2. [plural:] leaves; salad cw

pikwâwanipiy ⓘ
— like: mîkisasâkay, oskasâkay
1. spring of water cw

Minimal pairs

itwêwina — itwêwina Plains Cree dic X

https://itwewina.altlab.app/word/nîpiy/

itwêwina
Plains Cree Dictionary

Settings

Search in Cree or English

nîpiy 🔊

💧 — like: mîkisasâkay, oskasâkay
NI-2: Vowel-glide inanimate noun stem

Choose a name from the dropdown to hear the word said by the speaker.

Rose Makinaw, Maskwacîs ▾ ▶ [Learn more about the speaker.](#)

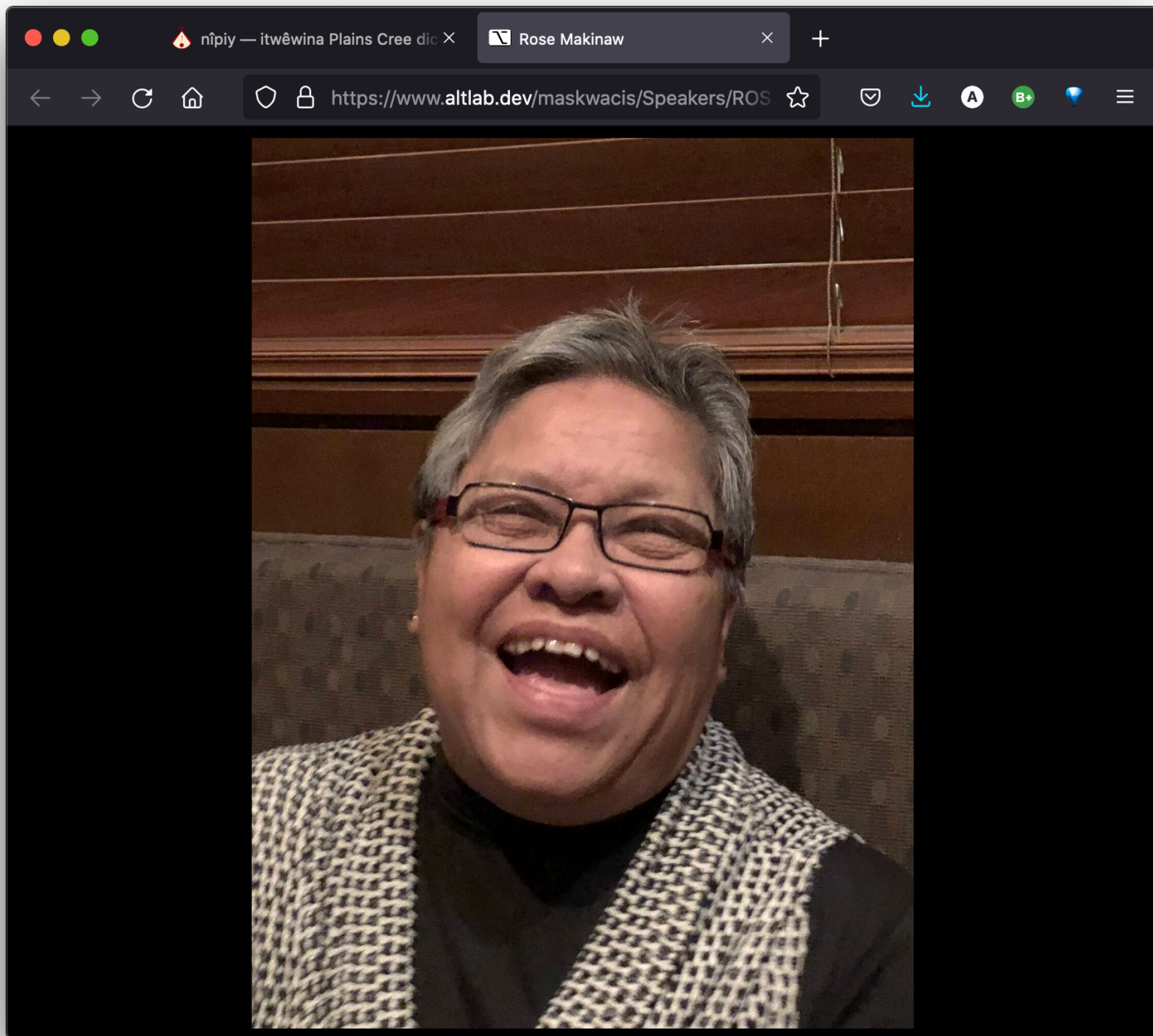
1. leaf; bl
2. [plural:

✓ Rose Makinaw, Maskwacîs
Annette Lee, Maskwacîs
Annette Lee, Maskwacîs

► Show nêhiyawêwin labels

<i>pêyak</i>	nîpiy
<i>mihcêt</i>	nîpiya
<i>pîhci-, tahkoht, ohci</i>	nîpîhk
<i>nawac apisîs / ayiwâk osk-âyis</i>	

Selecting another **speaker** for their recording



Looking up the speaker page for **Rose Makinaw** (Maskwacîs)

kâ-nêhiyawî-pîkiskwêcik maskwacîsihk — Maskwacîs Cree Speakers



Mary Jane Littlechild



Louise Wildcat



Jerry Roasting



Harley Simon



Annette Lee



Arlene Makinaw



Rosie Rowan



Rose Makinaw



Kisikaw



Betty Simon



Filter by: ☐ All ☐ New ☐ Linked

Choose a recording session: All Sessions

Select

Showing all entries from all sessions

Translation:

Recording

▶ ● 0:00 / 0:00 🔊 ●
▶ ● 0:00 / 0:00 🔊 ●
▶ ● 0:00 / 0:00 🔊 ●
▶ ● 0:00 / 0:00 🔊 ●
▶ ● 0:00 / 0:00 🔊 ●
▶ ● 0:00 / 0:00 🔊 ●
▶ ● 0:00 / 0:00 🔊 ●
▶ ● 0:00 / 0:00 🔊 ●
▶ ● 0:00 / 0:00 🔊 ●

Where do all these recordings come from? ← *Spoken Dictionary of Maskwacîs Cree:*
<https://speech-db.altlab.app>

Speaker

MAR

MAR

MAR

MAR2

MAR2

MAR2

MAR2

ARL

ARL

What does X (Cree) mean (in English)?

- Providing a simple English phrase as a translation, rather than a linguistic analysis

itwêwina Plains Cree dictionary

https://itwewina.altlab.app/search?q=niwapamaw

itwêwina
Plains Cree Dictionary

Settings

niwapamaw

niwâpamâw ⓘ

1. I see **wâpam-**
2. I see Action word — like: wîcihêw, itêw w
ni-/ki- word
form of ⓘ I → him/her

wâpamêw

👤➡👤 — like: wîcihêw


1. He sees him. MD
2. s/he sees s.o., s/he witnesses s.o. CW

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Settings
View search results in:
Community mode
Linguist mode

Looking up the relatively common Cree word-form: **niwâpamâw** → *analysis in pop-up*



itwêwina
Plains Cree Dictionary

Settings

niwâpamâw

VTA-1

1. I wâpam-

2. I Verb — transitive animate

Independent

form c Actor: 1st Person Singular → Goal: 3rd Person Singular

wâpamêw

transitive animate verb – class 1: regular

1. He sees him. MD

2. s/he sees s.o., s/he witnesses s.o. CW

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[Linguist mode](#)

Swapping the labeling of linguistic features to: *linguistic labels*

niwapamaw auto:1 — itwêwin X

https://itwewina.altlab.app/search?q=niwapamaw

itwêwina
Plains Cree Dictionary

Settings

niwapamaw auto:1

niwâpamâw ⓘ

1. I see him/her. MD
2. I see him/her, I witness him/her CW

form of *wâpamêw*

wâpamêw

👤➡️👤 — like: wîcihêw

1. He sees him. MD
2. s/he sees s.o., s/he witnesses s.o. CW

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Looking up the relatively common Cree word-form: **niwâpamâw** → *I see him/her, ...*

Browser tabs: nimaskomak auto:1 — itwêwina

Address bar: <https://itwewina.altlab.app/search?q=nimaskomak>

itwêwina
Plains Cree Dictionary

Settings

Search bar: nimaskomak auto:1

nimaskomak ⓘ

- 1. my bears. MD
- 2. my bears, my black bears CW

form of [maskwa](#)

[maskwa](#)

👤 — like: wâhkwa, ihkwa

- 1. A bear. MD
- 2. bear, black bear CW

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Settings
 View search results in:
 Community mode
 Linguist mode

Looking up the relatively common Cree word-form: ***nimaskomak*** → *my bears*, ...

nikinitawiwapamaw auto:1 — ×

https://itwewina.altlab.app/search?q=nikinitawiwa

itwêwina
Plains Cree Dictionary

Settings

nikinitawiwapamaw auto:1

nikî-nitawi-wâpamâw ⓘ

Preverb : **kî-** ⓘ

Preverb : **nitawi-** ⓘ

form of **wâpamêw**

wâpamêw

👤 ➡ 👤 — like: wîcihêw

1. He sees him. **MD**
2. s/he sees s.o., s/he witnesses s.o. **cw**

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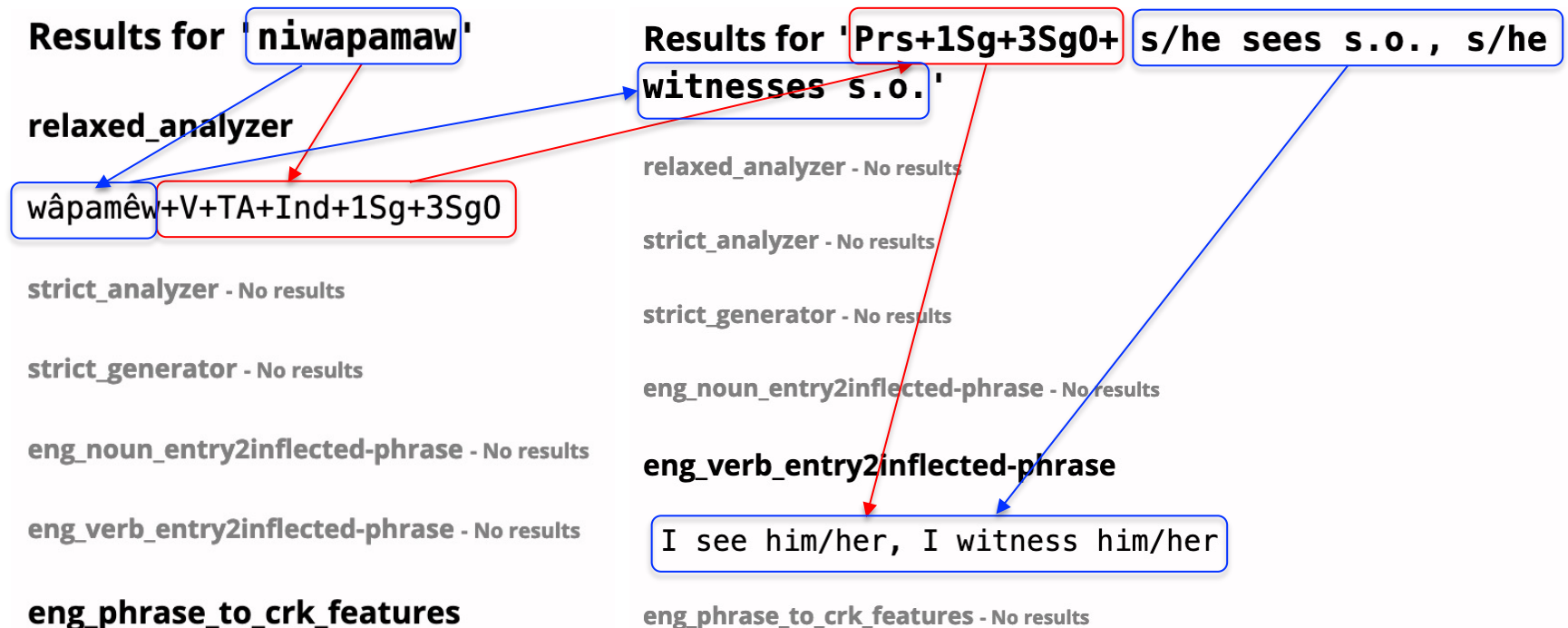
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Settings
View search results in:
Community mode
Linguist mode

For more complex Cree word-forms: **nikî-nitawi-wâpamâw** → *only pop-up analysis available*

How is this achieved?

- Linguistic analyses for Cree word-forms are used to computationally generate corresponding simple English phrases



Meeting expectations – current status?

- Cree naming
 - What is the Cree word for X (English concept)?
→ multiword concepts, rare words and synonyms now provide good matches
- Cree phrase
 - How do I say X (English phrase) in Cree?
→ Step-wise, through looking up paradigms → simple English phrases are directly linked to matching Cree word forms → increasing phrase coverage
- Cree syllabics
 - How do I write X (Cree word) in Cree syllabics?
→ Done
- Cree pronunciation
 - How do I say X (Cree word) in Cree?
→ more and more recordings are being gradually added → continuing to add more recordings + synthesizing word-forms that have not been recorded
- Cree-to-English translation
 - What does X (Cree word) mean in English?
→ plain English representation of linguistic analyses → rough English translations can be provided for the most frequent inflected Cree word forms → increasing phrase coverage

Other possible/necessary developments?

- ***Mobile/off-line*** version of ***itwêwina*** available for beta testing
 - minimal set of functionalities
 - BUT can be used without an Internet/WiFi connection
- Full functionalities available in **on-line *itwêwina***

Other possible/necessary developments?

- On-line dictionary as a language learning/instruction tool
 - Cree word building
 - What are little Cree words made up of?
 - Showing morpheme boundaries, in paradigms and throughout (inflection → derivation)
 - Linguistic reference data → “grammar” pages
- Meeting the needs and expectations of multiple user communities
 - Choice of linguistic terminology → linguistic analysis, paradigms
 - Choice of linguistic interface → Plain English vs. Plain nêhiyawêwin vs. Linguistic
 - Semantic classification of dictionary entries (already exists)

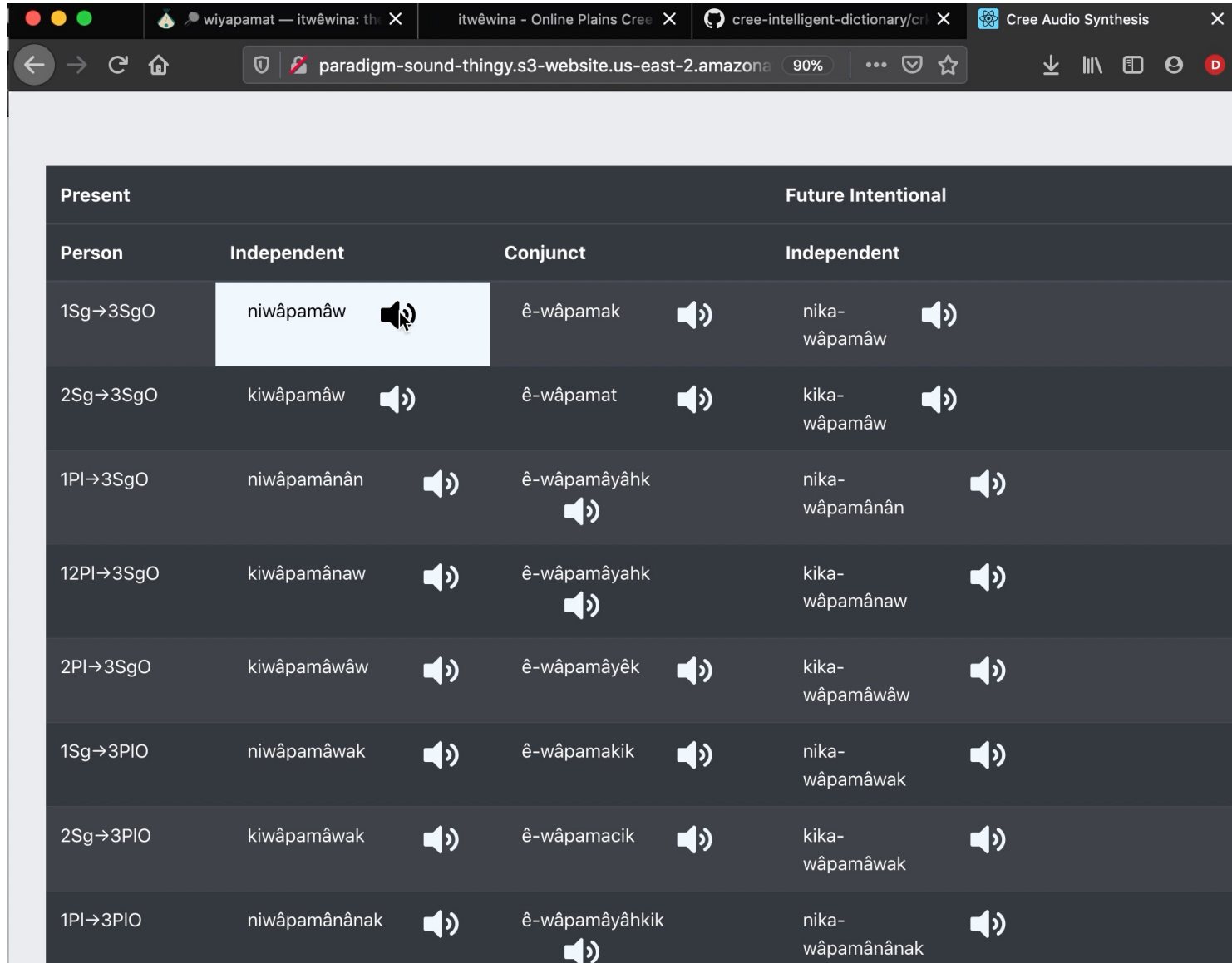
Morphological breakdown

























← already supported by computational model

	<i>One</i>	<i>Many</i>	<i>Further</i>	<i>In/On</i>
<i>someone's</i>	—	—	—	—
<i>my</i>	n·ôhkom	n·ôhkom·ak	n·ôhkom·a	n·ôhkom·ihk
<i>your (one)</i>	k·ôhkom	k·ôhkom·ak	k·ôhkom·a	k·ôhkom·ihk
<i>his/her</i>			o·hkom·a	ohkom·ihk
<i>our (but not your)</i>	n·ôhkom·inân	n·ôhkom·inân·ak	n·ôhkom·inân·a	n·ôhkom·inân·hk
<i>your and our</i>	k·ôhkom·inaw	k·ôhkom·inaw·ak	k·ôhkom·inaw·a	k·ôhkom·inân·hk
<i>your (all)</i>	k·ôhkom·iwâw	k·ôhkom·iwâw·ak	k·ôhkom·iwâw·a	k·ôhkom·iw·âhk
<i>their</i>			ohkom·iwâw·a	ohkom·iw·âhk
<i>his/her/their (further)</i>			ohkom·iyiw·a	ohkom·iy·ihk

Inflectional morpheme boundaries shown in the paradigm of **nôhkom** ‘my grandmother’

Spoken Cree paradigms ← synthesizer already exists



Present			Future Intentional	
Person	Independent	Conjunct	Independent	
1Sg→3SgO	niwâpamâw 	ê-wâpamak 	nika-wâpamâw 	
2Sg→3SgO	kiwâpamâw 	ê-wâpamat 	kika-wâpamâw 	
1PI→3SgO	niwâpamânân 	ê-wâpamâyâhk 	nika-wâpamânân 	
12PI→3SgO	kiwâpamânaw 	ê-wâpamâyahk 	kika-wâpamânaw 	
2PI→3SgO	kiwâpamâwâw 	ê-wâpamâyêk 	kika-wâpamâwâw 	
1Sg→3PIO	niwâpamâwak 	ê-wâpamakik 	nika-wâpamâwak 	
2Sg→3PIO	kiwâpamâwak 	ê-wâpamacik 	kika-wâpamâwak 	
1PI→3PIO	niwâpamânânak 	ê-wâpamâyâhkik 	nika-wâpamânânak 	

Synthesized recordings shown for full paradigm of: **wâpamêw**

Final words

- Developing an on-line language-technological application for an Indigenous language community – that the community will fully use – is much more than a one-off delivery
 - ← gathering feedback and adjusting the tool accordingly requires time
 - feedback can change over time, as experience with the tool grows
- Software coding development is the bottleneck, not so much the creation of linguistic models and resources

Thank you – ay hay – kiitos!

Questions? Comments! Feedback?

Application: <https://itwewina.altlab.app/>

Instructions:

<https://altlab.artsrn.ualberta.ca/itwewina/>

Source code:

<https://github.com/UAlbertaALTLab/morphodict/>