Turning language documentation into reader’s and writer’s software tools

21st Century Tools for Indigenous Languages
Antti Arppe, Lene Antonsen, Trond Trosterud, Sjur Moshagen, Dorothy Thunder, Conor Snoek, Timothy Mills, Juhani Järvikivi & Jordan Lachler
21st Century Tools for Indigenous Languages

- **Partners**
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- **Co-investigators**
  - Antti Arppe, Jordan Lachler, Juhani Järvikivi, Timothy Mills (UofA), Trond Trosterud (UiT)
- **Collaborators**
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  - Conor Snoek, Atticus Harrigan
- **Labs/research teams**
  - Alberta Language Technology Lab (ALTLab), CILLDI, CCP, APhL (UofA), Giellatekno, Divvun (UiT)
- **Community contacts**
  - Miyo Wahkohtowin Education Board, Maskwacîs, AB
  - Etc.
Many shoulders to stand upon

- Cree elders, instructors, language activists, and speakers
- Alberta Elders’ Cree Dictionary
  - Earle Waugh et al.
- Maskwacis Cree dictionary
  - Miyo Wahkohtowin Education
- Cree words
  - Arok Wolvengrey
- Cree grammatical descriptions
  - Jean Okimâsis, H. Christoph Wolfart
- Cree text collections
  - H. Christoph Wolfart, Kevin Russell
  - Patricia Demers, Naomi L. McIlwraith, Dorothy Thunder
  - Bloomfield
  - Hopefully many more ...
- Haida native speakers, elders and scholars
- Giallatekno/Divvun (UiT) work on language technology for the Indigenous Saami languages
Key themes

• Dating service for field linguists and computational linguists → desiderata for lexicographical documentation

• “Talking refrigerators” → language technological low-hanging fruits
Key message to field linguists – how to enable computational models?

• systematic, well-structured, and detailed descriptions of words and their structure
  – exhaustive descriptions of all word-class paradigm types
  – matched with comprehensive lexicon with paradigm type specifications
Low-hanging fruit

• Toolkit for Indigenous languages
  – Intelligent web-based dictionaries
    • linking any inflected form with the appropriate dictionary entry +
      generation of word paradigms → ease-of-use
  – Spell-checker
    • adherence with one or more existing orthographical conventions →
      production of good-quality texts
  – Intelligent language training and education applications
    • dynamic generation of large numbers of exercises based combing core
      vocabulary with a substantially smaller set of exercise templates
  – basic text-to-speech synthesizers
  – linguistic analysis tools
Our dog slept by the door.
Our dog slept by the door.
Our dog slept by the door.
Our dog slept by the door.
Our dog slept by the door.
Our dog slept by the door.
Our dog slept by the door.

Notre chien dormait près de la porte.
Notre chien a dormi près de la porte.

Our dog slept near the door.
Our dog slept by the door.

Meidän koira nukkui oven.

Did you mean: Our dog *sleeps* by the door.
Notre chien dormait par la porte.
Notre chien dormait par la porte.
Notre chien dormait par la porte.
Notre chien dormait par la porte.
Notre chien dormait près de la porte.

Our dog was sleeping near the door.

Did you mean: Notre chien dort près de la porte.
Similar language technological tools for Indigenous languages?
Modeling word structure – morphology

• English
  – nouns: 4 forms
  – verbs: 4-5 forms
  – adjectives: 3 forms

• Morphological modeling for the 100k most frequent/common words
  – possible to list all forms
  – $90k \times 4 + 6k \times 5 + 4k \times 3 = 360k + 30k + 12k = 402k$
Cree word structure – verbs

- nipâw ‘s/he sleeps’
- ninipân ‘I sleep’
- nikînipân ‘I slept’
- nikînipânân ‘we slept’
- niwînipân ‘I will sleep’
- ninôhtênipân ‘I want to sleep’
- nikîmâcinipân ‘I started to sleep’
- nikînôhtêmâcinipân ‘I wanted to start to sleep’
Cree word structure – nouns

- maskisin ‘shoe’
- maskisina ‘shoes’
- nimaskisinin ‘my shoe’
- kimaskisin ‘your (sg.) shoe’
- omaskisin ‘his shoe’
- nimaskisininâna ‘our shoes’
- kimaskisininawa ‘our and your shoes’
- kimaskisiniwâwa ‘your shoes’
- omaskisiniwâwa ‘their shoe’
How to deal with complex morphology?
**Finite state transducers – components**

### nicêmisisinânak

<table>
<thead>
<tr>
<th>ni Pxlsg</th>
<th>têm atim+N+AN sisîp sisîp+N+AN ...</th>
<th>isis Dim ø</th>
<th>inân PxlPl ø ...</th>
<th>ak Pl ø Sg</th>
</tr>
</thead>
</table>

#### “Surface” form

1. Affixation sequence rules (associated with morphological features)

   - \( t \rightarrow c / _ { \text{Dim} } \)
   - \( i \rightarrow o / m \_ { \text{Dim} } \)

2. Morphophonological rules

3. Affix agreement rules “filters”

   - ni...inân
   - PxlPl+...+PxlPl
   - Pxlsg+...+PxlPl

#### “Deep/underlying” form

\( \text{atim+N+AN+Dim+Pl+PxlPl} \)
Finite state transducers – resultant data structure
“character tree” with labeled arches + states

nicêmisisinânak

atim+N+AN+Dim+Pl+Px1Pl
Plains Cree – nominal morphotax

- $stem$+NUM
- $stem$+OBV
- $stem$+LOC

- $stem$+DIM+NUM
- $stem$+DIM+OBV
- $stem$+DIM+LOC

- POSS+$stem$+(POSS)+NUM
- POSS+$stem$+DIM+(POSS)+NUM
- POSS+$stem$+DIM+(POSS)+OBV
- POSS+$stem$+(POSS)+LOC
- POSS+$stem$+DIM+(POSS)+LOC
Modeling affix and stem variation

• In computational modeling, we are trying to model the entire lexicon

• Identifying the exhaustive set of all paradigm types covering the entire lexicon is indispensable
  – Specification of the full set of possible affix (sequence) realizations and the associated morphological features for each paradigm/stem type
  – Classification of stems per each word class according to paradigm types
Finite state transducers – word paradigms and rules (Okimâsis 2004)

Chapter 5: Diminutives

The term "diminutive" is used here to refer to nouns for items or objects that are smaller than the name. This is represented by a sound change and the addition of suffixes. In some cases, adding a suffix is not enough so the "i" is replaced by "e". So, unlike English which uses entirely different words for objects smaller or younger than the mature version, (for instance, man-boy; cat-kitten; woman-girl), Cree uses suffixes. English also uses adjectives to show this concept as in: a box—a little box. As the following rules indicate a number of changes occur to the Cree nouns when the suffixes are added.

1. Add "-is" or more often "-is" to most nouns:
   - Noun
     - Diminutive Noun
     - mânos
       - a little cat/kitten
     - oyyakan
       - oyykanis
     - a dish
       - sispis
     - sâp
       - a little duck/duckling

2. If the noun contains "t," all are changed to "e," in addition to adding the suffix "-in.
   - Noun
     - Diminutive Noun
     - mistikwats
       - a little box
     - mistikwânis
       - a little head
     - a hat/cap
       - a little hat
     - sahpinnâ
       - a chair
     - iseikwâhênes
       - a door

3. When the word ends in a vowel and a "w" drop the "w" and add "-is." If the vowel is short make it long then add "-is" or "-is.
   - Noun
     - Diminutive Noun
     - niwâs
       - a man
     - isekwâs
       - a woman
     - pâs
       - a group (prairie chicken)
     - âsâp
       - a bit of gum

4. For some nouns, the diminutive ending is "-osis," after changing any "i" s to "c"s.
   - Noun
     - Diminutive Noun
     - sell
     - a dog
     - mistâs
     - a horse

Chapter 31: Possession

Animate and Inanimate Nouns

It is important to know what is meant by dependent and independent when discussing the forms of nouns. In this chapter each category is dealt with separately. In addition, the information on dependent and independent nouns a section is devoted to kinship terms in that.

Independent Nouns

An independent noun, inanimate or animate, is one which makes sense on its own, without prefixes or suffixes. Nouns such as awâsis – a child, maxínâhik – a book. And okimâsis – a chief are examples.

To show possession of Independent nouns prefixes "ni-", "ki-", "o-" are attached to the beginning of nouns. These are used for two reasons: a) to show that they belong to someone, b) to specify who owns them.

Declension of Independent Nouns

Recall in the verb conjugation paradigms that: "ni-" is only for 1s or 1p; 1p or we, "ki-", is for 2s or you (sg); 21 or we; and 2p or you (pl). This same idea is applied to specify who the owner is when talking about possession but now:

1s ni ____ = my ___
1p ni ____ = our (incl) ___
21 ki n = your ___
21 ki ____ naw = our (excl) ___
2p ki ____ niwâw = your ___

To show that 3s, 3p, 2p owns an inanimate noun a special prefix "o-" is attached to the inanimate nouns in the examples.

3s o ____ = his/her/its ___
3p o ____ iyiw = his/her/its ___
3p o ____ niwâw = their ___

To put all of this in a format that we have been using for the conjugation here is a paradigm for the declension of possession of a singular object:

1s ni ____
1s o ____ 1s My ___
3s o ____ iyiw = 3s His/her/its ___
1p o ____ inâm = 1p Our (excl) ___
2p o ____ naw = 21 Our (incl) ___
3p o ____ wâw = 3p Your ___
3p o ____ iyiw = 3p Their ___

The plural suffixes:
## Word forms

<table>
<thead>
<tr>
<th>Word form</th>
<th>Analyses</th>
</tr>
</thead>
<tbody>
<tr>
<td>atim # “dog” – animate noun</td>
<td>atim+N+AN+Sg</td>
</tr>
<tr>
<td>atimwak</td>
<td>atim+N+AN+Pl</td>
</tr>
<tr>
<td>atimohk # really rare form</td>
<td>atim+N+AN+Loc</td>
</tr>
<tr>
<td>nitêm</td>
<td>atim+N+AN+Sg+Px1Sg</td>
</tr>
<tr>
<td>kitêm</td>
<td>atim+N+AN+Sg+Px2Sg</td>
</tr>
<tr>
<td>otêma # final a is because of obviative 3-on-3 marking</td>
<td>atim+N+AN+Sg+Px3Sg+Obv</td>
</tr>
<tr>
<td>otêmiyiwa # obviative possessor, always has -a suffix</td>
<td>atim+N+AN+Sg+Px3iSg+Obv</td>
</tr>
<tr>
<td>nitêminân</td>
<td>atim+N+AN+Px1Pl</td>
</tr>
<tr>
<td>kitêminaw</td>
<td>atim+N+AN+Px12Pl</td>
</tr>
<tr>
<td>kitêmiwâw</td>
<td>atim+N+AN+Px2Pl</td>
</tr>
<tr>
<td>otêmiwâwâ</td>
<td>atim+N+AN+Px3Pl+Obv</td>
</tr>
<tr>
<td>otêmiyâwa</td>
<td>atim+N+AN+Px3iPl+Obv</td>
</tr>
<tr>
<td>nitêmak</td>
<td>atim+N+AN+Pl+Px1Sg</td>
</tr>
<tr>
<td>kitêmak</td>
<td>atim+N+AN+Pl+Px2Sg</td>
</tr>
<tr>
<td>otêma</td>
<td>atim+N+AN+Pl+Px3Sg+Obv</td>
</tr>
<tr>
<td>otêmiyiwa</td>
<td>atim+N+AN+Pl+Px3iSg+Obv</td>
</tr>
<tr>
<td>nitêminânak</td>
<td>atim+N+AN+Pl+Px1Pl</td>
</tr>
<tr>
<td>kitêminawak</td>
<td>atim+N+AN+Pl+Px12Pl</td>
</tr>
<tr>
<td>kitêmiwâwak</td>
<td>atim+N+AN+Pl+Px2Pl</td>
</tr>
<tr>
<td>otêmiwâwâa # final a is because of obviative 3-on-3 marking</td>
<td>atim+N+AN+Pl+Px3Pl+Obv</td>
</tr>
<tr>
<td>otêmiyiwa</td>
<td>atim+N+AN+Dim+Sg</td>
</tr>
<tr>
<td>acimosis</td>
<td>atim+N+AN+Dim+Pl</td>
</tr>
<tr>
<td>acimosisak</td>
<td></td>
</tr>
<tr>
<td>acimosisihk # rare form, but theoretically correct</td>
<td>atim+N+AN+Dim+Loc</td>
</tr>
<tr>
<td>nicêmosis</td>
<td>atim+N+AN+Dim+Sg+Px1Sg</td>
</tr>
<tr>
<td>kicêmosis</td>
<td>atim+N+AN+Dim+Sg+Px2Sg</td>
</tr>
<tr>
<td>ocêmosisa</td>
<td>atim+N+AN+Dim+Sg+Px3Sg+Obv</td>
</tr>
<tr>
<td>nicêmosisinân</td>
<td>atim+N+AN+Dim+Sg+Px1Pl</td>
</tr>
<tr>
<td>kicêmosisinaw</td>
<td>atim+N+AN+Dim+Sg+Px12Pl</td>
</tr>
<tr>
<td>kicêmosisiwâw</td>
<td>atim+N+AN+Dim+Sg+Px2Pl</td>
</tr>
<tr>
<td>ocêmosisiwâwa</td>
<td>atim+N+AN+Dim+Sg+Px3Pl+Obv</td>
</tr>
</tbody>
</table>
The necessity of fieldwork?

- Level of explicitness required for a computational model beyond many grammatical descriptions
  - Individual morphological phenomenon types (possession, locative, plural, obviation) are typically individually explained, but not all their possible combinations are necessarily covered
- For a computational model, one needs the paradigms in full
  - for all paradigm types
- “missing” theoretically possible morphological forms should be submitted to fluent native speaker scrutiny
  - But considerable variety among native speaker specialists regarding the acceptability of some non-core inflected forms
  - Individual speakers have only partial experience of the full possible extent of a language
The ideal solution?

- Exhaustive sets of full paradigms
- Corresponding sets of paradigm member words
- But are these abstractions/generalizations “creating” some individual forms which do not in practice exist in the linguistic system?
Plains Cree
Nominal inanimate morphotax – affix/feature bundles (Wolvengrey, p.c.)

### Consonant-Initial Regular NI Stem

#### Example: cimān – “canoe, boat”

<table>
<thead>
<tr>
<th>Prefix</th>
<th>NI Stem</th>
<th>Ending</th>
<th>Word</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1s ni–</td>
<td>(–im)</td>
<td>–a</td>
<td>cimāna</td>
<td>canoes</td>
</tr>
<tr>
<td>2s ki–</td>
<td>(–im)</td>
<td>–a</td>
<td>kicimāna</td>
<td>my canoes</td>
</tr>
<tr>
<td>1p ni–</td>
<td>(–im)</td>
<td>–inān</td>
<td>nicimāninān</td>
<td>our canoes</td>
</tr>
<tr>
<td>21 ki–</td>
<td>(–im)</td>
<td>–inawa</td>
<td>kicimāninawa</td>
<td>our canoes</td>
</tr>
<tr>
<td>2p ki–</td>
<td>(–im)</td>
<td>–iwāw</td>
<td>kicimāniwāwa</td>
<td>your canoes</td>
</tr>
<tr>
<td>3s o–</td>
<td>(–im)</td>
<td>–iwāw</td>
<td>ocimān</td>
<td>his/her canoe</td>
</tr>
<tr>
<td>3p o–</td>
<td>(–im)</td>
<td>–iyiwa</td>
<td>ocimāniyiwa</td>
<td>their canoes</td>
</tr>
<tr>
<td>4 o–</td>
<td>(–im)</td>
<td>–iyiwa</td>
<td>ocimāniyiwa</td>
<td>another’s canoe</td>
</tr>
</tbody>
</table>

#### Locative

<table>
<thead>
<tr>
<th>Prefix</th>
<th>NI Stem</th>
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<th>Word</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1s ni–</td>
<td>(–im)</td>
<td>–ihk</td>
<td>cimānihk</td>
<td>in the canoe(s)</td>
</tr>
<tr>
<td>2s ki–</td>
<td>(–im)</td>
<td>–ihk</td>
<td>kicimānihk</td>
<td>in my canoe(s)</td>
</tr>
<tr>
<td>1p ni–</td>
<td>(–im)</td>
<td>–ināhk</td>
<td>nicimānināhk</td>
<td>in our canoe(s)</td>
</tr>
<tr>
<td>21 ki–</td>
<td>(–im)</td>
<td>–ināhk</td>
<td>kicimānināhk</td>
<td>in your canoe(s)</td>
</tr>
<tr>
<td>2p ki–</td>
<td>(–im)</td>
<td>–iwāhk</td>
<td>kicimāniwāhk</td>
<td>in your canoe(s)</td>
</tr>
<tr>
<td>3s o–</td>
<td>(–im)</td>
<td>–ihk</td>
<td>ocimānihk</td>
<td>in his/her canoe(s)</td>
</tr>
<tr>
<td>3p o–</td>
<td>(–im)</td>
<td>–iwāhk</td>
<td>ocimāniwāhk</td>
<td>in their canoe(s)</td>
</tr>
<tr>
<td>4 o–</td>
<td>(–im)</td>
<td>–iyihk</td>
<td>ocimāniyihk</td>
<td>in another’s canoe(s)</td>
</tr>
</tbody>
</table>

#### Diminutive

|         | (–im)   | –is(is)* | cimānis | small canoe |

*The Diminutive derivation will also convert any /t/ present in the stem (and usually the prefix as well) to [c] (i.e. /t/ > [c]).

All derived diminutive verbs become regular stems of the appropriate animacy.
## NI₁
Consonant-Initial Regular NI Stem
example: cīmān—“canoe, boat”

<table>
<thead>
<tr>
<th>Prefix</th>
<th>NI₁ Stem</th>
<th>(–im)</th>
<th>Ending</th>
<th>Word</th>
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</tr>
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<tbody>
<tr>
<td>1s</td>
<td>ni–</td>
<td>(–im)</td>
<td></td>
<td>cīmān</td>
<td>canoe</td>
</tr>
<tr>
<td>2s</td>
<td>ki–</td>
<td>(–im)</td>
<td></td>
<td>nicīmān</td>
<td>my canoe</td>
</tr>
<tr>
<td>1p</td>
<td>ni–</td>
<td>(–im)</td>
<td>–inān</td>
<td>nicīmāninān</td>
<td>our canoe</td>
</tr>
<tr>
<td>2₁</td>
<td>ki–</td>
<td>(–im)</td>
<td>–inaw</td>
<td>kicīmāninaw</td>
<td>our canoe</td>
</tr>
<tr>
<td>2p</td>
<td>ki–</td>
<td>(–im)</td>
<td>–iwāw</td>
<td>kicīmāniwāwa</td>
<td>your canoe</td>
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<td>their canoe</td>
</tr>
<tr>
<td>4</td>
<td>o–</td>
<td>(–im)</td>
<td>–iyiw</td>
<td>ocīmāniyiw</td>
<td>another’s canoe</td>
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<td>–ināna</td>
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</tbody>
</table>
Plains Cree nominal paradigm types  
(Wolvengrey, p.c. 2014)

• Inanimate: 10
  – NI1 C-Initial Regular NI Stem: cîmân “canoe, boat”
  – NI1 V-Initial Regular NI Stem: astotin “hat, cap”
  – NI2 C-Initial VW NI Stem: mîkisasâkay “beaded coat, beaded dress”
  – NI2 V-Initial VW NI Stem: oskasâkay “new coat, new dress”
  – NI3 C-Initial Cw NI Stem: pahkêkin:pahkêkinw- “leather, rawhide”
  – NI3 V-Initial Cw NI Stem: askêkin:askêkinw- “fresh rawhide”
  – NI4 C-Initial Single-Syllable NI Stem: wâw– “egg”
  – NI4 V-Initial Single-Syllable irregular NI Stem: ôsi:ôs- “canoe, boat”
  – NI4w C-Initial Single-Syllable-/w/ NI Stem: mihkw– “blood”
Nominal animate morphotax – affix/feature bundles (Wolvengrey, p.c.)

### NA<sub>1</sub>
Consonant-Initial Regular NA Stem

**Example:** *pahkwēšikan* – “bannock”

<table>
<thead>
<tr>
<th>Prefix</th>
<th>NA&lt;sub&gt;1&lt;/sub&gt; Stem</th>
<th>(-im)</th>
<th>Ending</th>
<th>Example</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>singular</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1s</td>
<td>ni–</td>
<td>(-im)</td>
<td>inim</td>
<td>nipahkwēšikanim</td>
<td>my bannock</td>
</tr>
<tr>
<td>2s</td>
<td>ki–</td>
<td>(-im)</td>
<td>inim</td>
<td>kipahkwēšikanim</td>
<td>your bannock</td>
</tr>
<tr>
<td>1p</td>
<td>ni–</td>
<td>(-im)</td>
<td>inān</td>
<td>nipahkwēšikanininān</td>
<td>our bannock</td>
</tr>
<tr>
<td>21</td>
<td>ki–</td>
<td>(-im)</td>
<td>inaw</td>
<td>kipahkwēšikanininaw</td>
<td>our bannock</td>
</tr>
<tr>
<td>2p</td>
<td>ki–</td>
<td>(-im)</td>
<td>iwāw</td>
<td>kipahkwēšikaniniwāw</td>
<td>your bannock</td>
</tr>
</tbody>
</table>

| **plural** | | | | | |
| 1s | ni– | (-im) | inim | nipahkwēšikanimak | my bannocks |
| 2s | ki– | (-im) | inim | kipahkwēšikanimak | your bannocks |
| 1p | ni– | (-im) | ianānak | nipahkwēšikanininānak | our bannocks |
| 21 | ki– | (-im) | inawak | kipahkwēšikanininawak | our bannocks |
| 2p | ki– | (-im) | iwāwak | kipahkwēšikaniniwāwak | your bannocks |

| **oblique** | | | | | |
| 1s | ni– | (-im) | ina | nipahkwēšikanima | my bannock(s) |
| 2s | ki– | (-im) | ina | kipahkwēšikanima | your bannock(s) |
| 1p | ni– | (-im) | inānāna | nipahkwēšikanininānāna | our bannock(s) |
| 21 | ki– | (-im) | inawana | kipahkwēšikanininawana | our bannock(s) |
| 2p | ki– | (-im) | iwāwana | kipahkwēšikaniniwāwana | your bannock(s) |
| 3s | o– | (-im) | ina | opahkwēšikanima | his/her bannock(s) |
| 3p | o– | (-im) | iwa | opahkwēšikanimiwāwa | their bannock(s) |
| 4 | o– | (-im) | iyiwa | opahkwēšikanimiyiwa | another’s bannock(s) |

| **locative** | | | | | |
| 1s | ni– | (-im) | ihk | nipahkwēšikanihk | in the bannock(s) |
| 2s | ki– | (-im) | ihk | kipahkwēšikanihk | in your bannock(s) |
| 1p | ni– | (-im) | iāhk | nipahkwēšikaniniāhk | in our bannock(s) |
| 21 | ki– | (-im) | iāhk | kipahkwēšikaniniāhk | in our bannock(s) |
| 2p | ki– | (-im) | iwāhk | kipahkwēšikaniniwāhk | in your bannock(s) |
| 3s | o– | (-im) | ihk | opahkwēšikanihk | in his/her bannock(s) |
| 3p | o– | (-im) | iwhk | opahkwēšikanimiwhk | in their bannock(s) |
| 4 | o– | (-im) | iyiwhk | opahkwēšikanimiyiwhk | in another’s bannock(s) |

| **dim** | | | | | |
| 1s | ni– | (-is(is)* | isis | pipahkwēśikanis | small piece of bannock |

*Remember the Diminutive derivation /t/ > [c]
<table>
<thead>
<tr>
<th>Prefix</th>
<th>NA₁ Stem</th>
<th>(-im)</th>
<th>Ending</th>
<th>Example</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>pahkwēsikan</td>
<td>bannock</td>
</tr>
<tr>
<td>1s</td>
<td>ni–</td>
<td>(+im)</td>
<td>–inān</td>
<td>nipahkwēsikaniminān</td>
<td>our bannock</td>
</tr>
<tr>
<td>2s</td>
<td>ki–</td>
<td>(+im)</td>
<td>–inaw</td>
<td>kipahkwēsikaniminaw</td>
<td>our bannock</td>
</tr>
<tr>
<td>1p</td>
<td>ni–</td>
<td>(+im)</td>
<td>–iwāw</td>
<td>kipahkwēsikanimiwāw</td>
<td>your bannock</td>
</tr>
<tr>
<td>21</td>
<td>ki–</td>
<td>(+im)</td>
<td>–iwaw</td>
<td>kipahkwēsikanimiwawak</td>
<td>your bannocks</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>pahkwēsikanak</td>
<td>bannocks</td>
</tr>
<tr>
<td>1s</td>
<td>ni–</td>
<td>(+im)</td>
<td>–ak</td>
<td>nipahkwēsikanimak</td>
<td>my bannocks</td>
</tr>
<tr>
<td>2s</td>
<td>ki–</td>
<td>(+im)</td>
<td>–ak</td>
<td>kipahkwēsikanimak</td>
<td>your bannocks</td>
</tr>
<tr>
<td>1p</td>
<td>ni–</td>
<td>(+im)</td>
<td>–inānak</td>
<td>nipahkwēsikaniminānak</td>
<td>our bannocks</td>
</tr>
<tr>
<td>21</td>
<td>ki–</td>
<td>(+im)</td>
<td>–inawak</td>
<td>kipahkwēsikaniminawak</td>
<td>our bannocks</td>
</tr>
<tr>
<td>2p</td>
<td>ki–</td>
<td>(+im)</td>
<td>–iwaw</td>
<td>kipahkwēsikanimiwawak</td>
<td>your bannocks</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>pahkwēsikana</td>
<td>bannock(s)</td>
</tr>
<tr>
<td>1s</td>
<td>ni–</td>
<td>(+im)</td>
<td>–a</td>
<td>nipahkwēsikanima</td>
<td>my bannock(s)</td>
</tr>
<tr>
<td>2s</td>
<td>ki–</td>
<td>(+im)</td>
<td>–a</td>
<td>kipahkwēsikanima</td>
<td>your bannock(s)</td>
</tr>
<tr>
<td>1p</td>
<td>ni–</td>
<td>(+im)</td>
<td>–ināna</td>
<td>nipahkwēsikanimināna</td>
<td>our bannock(s)</td>
</tr>
<tr>
<td>21</td>
<td>ki–</td>
<td>(+im)</td>
<td>–inawa</td>
<td>kipahkwēsikaniminawa</td>
<td>our bannock(s)</td>
</tr>
<tr>
<td>2p</td>
<td>ki–</td>
<td>(+im)</td>
<td>–iwawa</td>
<td>kipahkwēsikanimiwawaa</td>
<td>your bannock(s)</td>
</tr>
<tr>
<td>3s</td>
<td>o–</td>
<td>(+im)</td>
<td>–a</td>
<td>opahkwēsikanima</td>
<td>his/her bannock(s)</td>
</tr>
<tr>
<td>3p</td>
<td>o–</td>
<td>(+im)</td>
<td>–iwa</td>
<td>opahkwēsikanimiwawa</td>
<td>their bannock(s)</td>
</tr>
<tr>
<td>4</td>
<td>o–</td>
<td>(+im)</td>
<td>–iwiwa</td>
<td>opahkwēsikanimiwaiwa</td>
<td>another’s bannock(s)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>pahkwēsikanihk</td>
<td>in the bannock(s)</td>
</tr>
<tr>
<td>1s</td>
<td>ni–</td>
<td>(+im)</td>
<td>–ihk</td>
<td>nipahkwēsikanimihk</td>
<td>in my bannock(s)</td>
</tr>
</tbody>
</table>
Plains Cree nominal paradigms types
(Wolvengrey, p.c. 2014)

• Animate: 10
  – NA1 C-Initial Regular NA Stem : pahkwêsikan “bannock”
  – NA1 V-Initial Regular NA Stem : asikan “sock”
  – NA2 C-Initial V-Glide NA Stem : kihc-ôkinîy “tomato”
  – NA2 V-Initial V-Glide NA Stem : ayapiy “net”
  – NA3 C-Initial C-/w/ NA Stem :
    masinahikanâhtik:masinahikanâhtikw—“pencil”
  – NA3 V-Initial C-/w/ NA Stem : askihk:askihkw—“kettle, pail”
  – NA4 C-Initial Single-Syllable NA Stem : niska:nisk- “goose” (and siht—“spruce”)
  – NA4 V-Initial Single-Syllable NA Stem : êsa:ês- “clam; shell”
  – NA4w C-Initial Single-Syllable-/w/ NA Stem : wâhkwa:wâhkw- “roe, fish eggs; lump of roe”
  – NA4w V-Initial Single-Syllable-/w/ NA Stem : ihkwa:ihkw- “louse”
Nouns classified according to paradigm types in *Cree: Words* (Wolvengrey 2001)

NI-1 acâwêwikamikos little store, shop
NI-1 acikâsimin evergreen berry; kinnikinnick berry, ground cedar berry
NI-3 acikâsîpakwa:acikâsîpakw- bearberry leaves; plant-like evergreen (mixed with tobacco); Arctostaphylos uva-ursi
NI-1 acimomêyisimin cactus berry, red berry from a cactus; literally: "little dog-feces berry"
NI-1 ahcahkowin spirituality
NI-2 ahcâpahciy bowstring
NI-3 ahcâpâhtik:ahcâpâhtikw- bow stick, stick previously used as a bow
NI-2 ahcâpiy bow
NI-2 ahkâmasiniy round stone for breaking bones

...
Nouns classified according to paradigm types (Wolvengrey 2001)

\sro acâhkos
\syl Ñℓ<ú"d^n
\ps NA-1
\def star
\dl Cree: pC
\dl Cree: wC
\gr1 singular, diminutive
\stm acâhkos-
\drv atâhkw- +/-is/
\mrp atâhkw-
\mrp /-is/
\alt
\rel atâhk
\sem Sky
\gl star
\gl little star
\cat
\his *aθa:nkwa
\his *aθankwa
\his Saulteaux: Anna
\gr2
\dt 25/May/2009

[Toolbox]
“New” possible variation and subparadigms

• Determinants of -im- affix in possessive forms
• Determinants of short vs. long diminutive affix –is vs. –isis
• animate nouns and the locative form
  – e.g. atimohk
• animate nouns and the distributive form
  – groups of people and buffalos but not any other animals (bears, beavers, geese, etc.) or plants (trees)?
• mass nouns → only singular
Northern Haida
Northern Haida – 75 verb paradigms (Lachler, p.c.)

- AAHL_STEM_1
- AAHL_STEM_2
- AAL
- AANG
- AAN
- AAW
- AAY
- AA
- AD_STEM_1
- AD_STEM_2
- AHL_STEM_1
- AHL_STEM_2
- AHL_STEM_3
- AH
- AL_STEM_1
- AL_STEM_2
- AN_STEM_1
- AN_STEM_2
- AS_STEM_1
- AS_STEM_2
- AS_STEM_3
- AW_STEM_1
- AW_STEM_2
- AYD
- AY_STEM_1
- AY_STEM_2
- A_STEM_2
- A_STEM_3
- E.EHL_STEM_2
- E.EHL_STEM_3
- E.E_STEM_2
- E.E_STEM_3
- EED
- EEHL_STEM_1
- EEHL_STEM_2
- EE

- ID_STEM_1
- ID_STEM_2
- IHL_STEM_1
- IHL_STEM_2
- IHL_STEM_3
- IID
- IIHL_STEM_1
- IIHL_STEM_2
- IIHL_STEM_3
- II_STEM_1
- II_STEM_2
- ING_STEM_1
- ING_STEM_2
- IN_STEM_1
- IN_STEM_2
- IS_STEM_1
- IS_STEM_2
- IS_STEM_3
- I

- UD_STEM_1
- UD_STEM_2
- UHL_STEM_1
- UHL_STEM_2
- UHL_STEM_3
- UNG_STEM_1
- UNG_STEM_2
- UN_STEM_1
- UN_STEM_2
- US_STEM_1
- US_STEM_2
- US_STEM_3
- UUHL_STEM_1
- UUHL_STEM_2
- UUHL_STEM_3
- UU_STEM_1
- UU_STEM_2
- UU_STEM_3
- U
Northern Haida – ~152 forms per verb paradigm (Lachler, p.c.) – AAHL-STEM1

- 0
- 0
- s
- áng
- ásáa
- ás
- ásáang
- ásáa
- ásáas
- ásáa.ang;
- áng %^WSñasa'áa
- áng% %^WSñasa'áang
- áng% %^Wsñasaasdláa
- áng% %^Wsñasaasdláang
- 'úuu
- 'úujang
- ásáa'ujang
- 'us
- 'ujáa
- 'úujaangaa
- ásáa'us
- 'ahlánggang
- 'ahlánggan
- 'ahlánggiinii
- ...
- +V+SINGULAR+IMPERATIVE
- +V+INTERROGATIVE+SIMPLE+PRESENT
- +V+RELATIVE
- +V+NON_FACTIVE
- +V+INTERROGATIVE+FUTURE+LONG
- +V+INTERROGATIVE+FUTURE+SHORT
- +V+SIMPLE+FUTURE
- +V+IMMEDIATE+FUTURE
- +V+RELATIVE+FUTURE
- +V+FUTURE+NON_FACTIVE
- +V+INTERROGATIVE+NEAR+FUTURE
- +V+NEAR+FUTURE
- +V+INTERROGATIVE+VERYNEAR+FUTURE
- +V+VERYNEAR+FUTURE
- +V+BIASED+IMMEDIATE+PRESENT
- +V+BIASED+SIMPLE+PRESENT
- +V+RESIGNED_OBLIGATION
- +V+BIASED+INTERROGATIVE+PRESENT
- +V+BIASED+INTERROGATIVE+PAST;
- +V+BIASED+INTERROGATIVE+PAST+HABITUAL
- +V+BIASED+INTERROGATIVE+FUTURE
- +V+CERTAIN+PRESENT
- +V+CERTAIN+PAST;
- +V+CERTAIN+PAST+HABITUAL
- ...
- ...
Northern Haida – ~152 forms per verb paradigm (Lachler, p.c.) – AAHL-STEM1

- skyáahl
- skyáahl
- skyáahls
- skyáahlang
- skyáahläsaa
- skyáahläs
- skyáahläsang
- skyáahläsga
- skyáahläsas
- skyáahläsaa.ang
- skyáahläng
- skyáahläng
- skyáahläng
- skyáahl'üuj
- skyáahl'üujang
- skyáahläsaa'üujang
- skyáahl'us
- skyáahl'ujaa
- skyáahl'ujaangaa
- skyáahläsaa'us
- skyáahl'ahlanggang
- skyáahl'ahlanggan
- skyáahl'ahlanggiinii
- ...
- skyáahl+V+SINGULAR+IMPERATIVE
- skyáahl+V+INTERROGATIVE+SIMPLE+PRESENT
- skyáahl+V+RELATIVE
- skyáahl+V+NON_FACTIVE
- skyáahl+V+INTERROGATIVE+FUTURE+LONG
- skyáahl+V+INTERROGATIVE+FUTURE+SHORT
- skyáahl+V+SINGLE+FUTURE
- skyáahl+V+IMMEDIATE+FUTURE
- skyáahl+V+RELATIVE+FUTURE
- skyáahl+V+FUTURE+NON_FACTIVE
- skyáahl+V+INTERROGATIVE+NEAR+FUTURE
- skyáahl+V+NEAR+FUTURE
- skyáahl+V+INTERROGATIVE+VERYNEAR+FUTURE
- ...
- skyáahl+V+RESIGNED_OBLIGATION
- skyáahl+V+BIASED+IMMEDIATE+PRESENT
- skyáahl+V+BIASED+SIMPLE+PRESENT
- ...
- skyáahl+V+CERTAIN+PRESENT
- ...
- skyáahl+V+CERTAIN+PAST
- skyáahl+V+CERTAIN+PAST+HABITUAL
Northern Haida – ~152 forms per verb paradigm (Lachler, p.c.) – AAHL-STEM1

-0
-0
-s
-áng
-ásáa
-ás
-ásáang
-ásaga
-ásáas
-ásáa.ang
-áng%^WSñasa'áa
-áng%^WSñasa'áang
-áng%^AWSñasa'áang
-áng%^AWSñasa'áang
How about the low-hanging fruits?
Dictionaries

Plains Cree → English

WRITTEN VARIANT

Standard (aâ)
Mobile friendly (a → a ~ â)

Plains Cree (Standard) → English

Search term
Search  Search texts

Search for a word, or an inflected form. Click the word for a list of inflected forms.

You can also search for the word in a text corpus, or for all inflected forms of the word by clicking the 'texts' link next to it in the search results.

We have updated our URL to itwewina.oahpa.no, please update your bookmarks.
Plains Cree (Standard) → English

Search for a word, or an inflected form. Click the word for a list of inflected forms.

You can also search for the word in a text corpus, or for all inflected forms of the word by clicking the ‘texts’ link next to it in the search results.

We have updated our URL to itwewina.ca, please update your bookmarks.
We have updated our URL to itwewina.cahta.no, please update your bookmarks.
Itywewina

Nēhiyawēwin (wēhci-masinahikêwin) → âkayâsîmowin

Nawasôna tânisi kâ-isini
Nēhiyawasinahikêyan

Papêyâhtak nēhiyawasinahikêwin (aâ)
Wēhci-masinahikêwin (a → a ~ â)

Nîkî-nitawi-kiskinwahamâkosin
Nitona
Nitona masinahikêwinihk

Nitona nēhiyaw-itwewina ta-miskaman
âkayâsiwascîkêwin (êkwa mîna tânisi kâ-isini
âniskôpitamihk).

We have updated our URL to
itwewina.oahpa.no, please update your
bookmarks.
nêhiyawêwin → âkayâsîmowin

nêhiyawêwin (papêyâhtak nêhiyawasinahikêwin) → âkayâsîmowin

nikî-nitawi-kiskinwahamâkosîn | nitona | nitona masinahikêwinîhk

nitona nêhiyaw-itwêwin ta-miskaman âkayâsiwascikêwin (êkwa mîna tânisi kâ-isi-âniskîpitamîhk).

We have updated our URL to itwewina.oahpa.no, please update your bookmarks.
itwēwinānahikāna

nēhiyawēwin → âkayâsîmowin

NAWASÔNA TÂNIS KÂ-ISI-
NĒHIYAWASINAHIKÉYAN

papêyâhtak nēhiyawasinahikêwin (aâ)

wêhci-masinahikêwin (a → a ~ â)

We have updated our URL to itwewina.oahpa.no, please update your bookmarks.

nēhiyawēwin (papêyâhtak nēhiyawasinahikêwin) → âkayâsîmowin (_SWAP)

ê i o hide

itwêwin nitona nitona masinahikêwinihk

kiskinwahamâkosiw (verb)
- s/he learns; s/he is a student, s/he attends school; s/he is taught

nēhiyawēwin : itwēwinâ / Cre : Words

kiskinwahamâkosiw

Texts →
PV/nitawi Verb AI Indicative Past Subject: 1st person singular
itwēwasinahikana

nēhiyawēwin → ākayāsinowin

NAWASŌNA TÂNISI KĀ-ISI-
NĒHIYAWASINAHIKÉYAN

papēyāhtak nēhiyawasinahikēwin (aā)

wēhci-masinahikēwin (a → a ~ ā)

nēhiyawēwin (papēyāhtak nēhiyawasinahikēwin) → ākayāsinowin (⇐ Swap)

ā ē ĩ ō hide

itwēwin  nitona  nitona masinahikēwiningk

nāpēw (noun)

○ man, male adult, male being; husband

nēhiyawēwin : itwēwina / Cree : Words

We have updated our URL to itwēwina.oahpa.no, please update your bookmarks.
CQP query:
[lemma = "nāpēw"]
Cree Literacy Network

miywásin, kísip ta-kakwè-nisitohtamék ëkwa mìna ta-kakwè-mitoni-wíchisoyék anima, óma néhiyawéwin kísip kinõhté-kiskéyihténawáw.

There is value indeed in trying to understand the Cree language and also in trying to study it in earnest if you want to learn it.

Dog Biscuits – Y-dialect – With Audio

Thanks to Solomon Ratt for preparing this y-dialect (Plains Cree) version – in print and audio – of this original Residential School story, written in his own th-dialect (Woodlands Cree) and translated into English. Click the audio link to listen and read along!

Dog Biscuits – Salamô ñécinow

Dog Biscuits – Salamô âcimow


When I was a child I went to school away from my reserve. It was at Prince Albert where I went to school, there was a Residential School there where I went. There was a lot of ill treatment, but I’m not going to talk about that, I’m going to tell a story about my fellow pitiful ones, my fellow students.
Dog Biscuits – Salamô âcimow


When I was a child I went to school away from my reserve. It was at Prince Albert where I went to school, there was a Residential School there where I went. There was a lot of ill treatment, but I’m not going to talk about that, I’m going to tell a story about my fellow pitiful ones, my fellow students.
Dog Biscuits – Salamô âcimow


âcimow (verb) — s/he tells, s/he tells a story; s/he tells news, s/he gives an account, s/he narrates; s/he tells his/her own story

When I was a child I went to school away from my reserve. It was at Prince Albert where I went to school, there was a Residential School there where I went. There was a lot of ill treatment, but I’m not going to talk about that, I’m going to tell a story about my fellow pitiful ones, my fellow students.
Dog Biscuits – Salamô âcimow

ispîhk

ispîhk (particle) — when

When I was a child I went to school away from my reserve. It was at Prince Albert where I went to school, there was a Residential School there where I went. There was a lot of ill treatment, but I’m not going to talk about that, I’m going to tell a story about my fellow pitiful ones, my fellow students.
Dog Biscuits – Salamô âcimow


When I was a child I went to school away from my reserve. It was at Prince Albert where I went to school, there was a Residential School there where I went. There was a lot of ill treatment, but I’m not going to talk about that, I’m going to tell a story about my fellow pitiful ones, my fellow students.
Dog Biscuits – Salamô âcimow


When I was a child I went to school away from my reserve. It was at Prince Albert where I went to school, there was a Residential School there where I went. There was a lot of ill treatment, but I'm not going to talk about that, I'm going to tell a story about my fellow pitiful ones, my fellow students.

ohpîmê

ohpîmê (particle) — off, away, to the side; at another place, elsewhere, somewhere else
Dog Biscuits – Salamô âcimow


When I was a child I went to school away from my reserve. It was at Prince Albert where I went to school, there was a Residential School there where I went. There was a lot of ill treatment, but I’m not going to talk about that, I’m going to tell a story about my fellow pitiful ones, my fellow students.
Dog Biscuits – Salad

kistapinân (noun) — Prince Albert, SK; literally: place of wealth; meeting place; gathering place

kistapinânihk (noun) — Prince Albert, SK; literally: place of wealth; meeting place; gathering place

When I was a child I went to school away from my reserve. It was at Prince Albert where I went to school, there was a Residential School there where I went. There was a lot of ill treatment, but I’m not going to talk about that, I’m going to tell a story about my fellow pitiful ones, my fellow students.
Dog Biscuits – Salamô âcimow

[1] ispîhk kâ-kî-awâsisîwiyân nikî-nitawi-kiskinwahamåkosin ohpîmê nitiskonikanîh
ohci. kistapînînih kâ-kî-nitawi-kiskinwahamåkosiyân, ëkota Residential School
ê-kî-itîktâhikow. îstakîpî kâ-kî-ikîmåkahkikinâw, mâka namôya îwako
niwî-âkisak, nîcî-okiskinwahamåkanak.

mâna (particle) — to be feared, trouble ahead
mâna (particle) — usually, habitually, generally, always; used to

When I was a child I went to school away from my reserve. It was at Prince Albert where
I went to school, there was a Residential School there where I went. There was a lot of ill
 treatment, but I’m not going to talk about that, I’m going to tell a story about my fellow
pitiful ones, my fellow students.
nitêminan nipâw sisone iskwâhtemihk

∪ ∩ ∆ ASCII
nitêminan nipâw sisone iskwâhtemihk
nitêminan nipâw sisone iskwâhêmihk
nêhiyawêtân

tânisi

LEKSA  MORFA-S  MORFA-C  NUMRA
Words and Inflect words Inflect words in Practice numerals translations sentences

nêhiyawêtân is an internet program for learners of Plains Cree. The program can be adjusted to different topics and levels of difficulty, and it generates new task sets automatically. This is a beta demo version.

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Contact oahpa@uit.no
<table>
<thead>
<tr>
<th>Type</th>
<th>Book</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plural</td>
<td>all</td>
</tr>
</tbody>
</table>

**New set**

ótēnaw
ótēnawa
wiyâkan
wiyâkanâna
okimâw
okimawak
anikwacâs

Practise plural nouns
Put the nouns in the correct forms. You get a translation if you click on a word.

wayasit

Your score: 3/5

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<table>
<thead>
<tr>
<th>Tense</th>
<th>Book</th>
</tr>
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<tbody>
<tr>
<td>present</td>
<td>Book1</td>
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<table>
<thead>
<tr>
<th>verb</th>
<th>translation</th>
<th>correct forms</th>
</tr>
</thead>
<tbody>
<tr>
<td>nipâw</td>
<td>(klyânaw) anohc kinipanaw</td>
<td>(kinipânaw, kinipânânaw)</td>
</tr>
<tr>
<td>pâhpwiw</td>
<td>(klyâ) anohc kipâhpin</td>
<td>(kipâhpin)</td>
</tr>
<tr>
<td>masinahikêw</td>
<td>(klyânaw) anohc</td>
<td>kimasinahikânaw, kimasinahikânânaw</td>
</tr>
<tr>
<td>pihtokwêw</td>
<td>(klyawâw) anohc</td>
<td>kipihtokwânawâw</td>
</tr>
<tr>
<td>minihkwêw</td>
<td>(wîya) anohc mihihkwew</td>
<td>minihkwêw</td>
</tr>
</tbody>
</table>

Your score: **2/5**
néhiyawêtan

Tense
-present

New set

kipâhpin cî anohc

ehâ, nipâhpin anohc.

kinipân cî anohc

namoya, namoya ninipân anohc.

kinîmihitonâwâw cî anohc

ehâ, kinîmihitonânân anohc.

nitayamihckân cî anohc

ehâ, nitayamihckân anohc.

kinikamon cî anohc

namoya, namoya ninikamon anohc.

Practise present tense

Your score: 3/5
Dictionaries

Haida → English

Haida → English

Other dictionaries

Haida → English

t'ahigúuhl (verb)

- for S to put or wrap O around their shoulders

Search

Search texts

t'ahigúuhiwaa.ang f'asasdláa is a possible form of ...

t'ahigúuhiwaa.ang f'asasdláa is a possible form of ...

t'ahigúuhl

verb third plural interrogative

very near future

Search

Search texts
Tools – accessibility

• publicly available over the Internet
• integrated as part of general software applications such as web browsers and word processors
• with little or no cost
• by any speakers or language-learners in the respective communities as well as any researchers, anywhere
  – instead of remaining on an individual researcher’s computer drive or on a library bookshelf.
Key message to field linguists again – how to enable computational tools?

• systematic, well-structured, and detailed descriptions of words and their structure
  – exhaustive descriptions of all word-class paradigm types
  – matched with comprehensive lexicon with paradigm type specifications
21st century tools for indigenous languages: 2013-2016

Using Plains Cree as the spearhead language, this project will produce tools such as spell-checkers, language teaching and learning software, and text-to-speech synthesizers.

These technologies are available for world’s majority languages (e.g. English), but have so far been created only for a few minority languages. In providing minority language speakers with these applications the project aims to facilitate the use of minority languages in all spheres of life by community members.