# Inuktitut morphological analysis

Features; agglutination, assimilation, incorporation, polypersonal agreement, head marking

* Web demo analyzer (sample output): <http://www.inuktitutcomputing.ca/Uqailaut/Demo/demoword.php?lang=en&demoword=imiqtarvingmunngauliqhlutik>
* Morphological inventory: <http://www.inuktitutcomputing.ca/Technocrats/ILFT.php#morphology>, <https://uqausiit.ca/morpheme-list/infix>
* We consider a single full form

## For modelling: Analysis for the word *atausiulugu*

Verb feat. incorporation and polypersonal agreement, produced by Uqailaut analyzer

Row1: form (atausiulugu)

Row2: morphological segmentation

Row3: morphological glosses

atausiulugu

{atausi:atausiq/1n}{u:u/1nv}{lugu:lugu/tv-part-1s-3s-fut}

{one}{existence; is}{part. future: while I ...him/her/it}

atausiulugu

{atausi:atausiq/1n}{u:u/1nv}{lugu:lugu/tv-part-2s-3s-fut}

{one}{existence; is}{part. future: while you ...him/her/it}

atausiulugu

{atausi:atausiq/1n}{u:u/1nv}{lugu:lugu/tv-part-4s-3s-fut}

{one}{existence; is}{part. future: while he/she/it ...him/her/it}

atausiulugu

{atausi:atausiq/1n}{u:u/1nv}{lugu:lugu/tv-part-1d-3s-fut}

{one}{existence; is}{part. future: while we (two) ...him/her/it}

atausiulugu

{atausi:atausiq/1n}{u:u/1nv}{lugu:lugu/tv-part-2d-3s-fut}

{one}{existence; is}{part. future: while you (two) ...him/her/it}

atausiulugu

{atausi:atausiq/1n}{u:u/1nv}{lugu:lugu/tv-part-4d-3s-fut}

{one}{existence; is}{part. future: while they (two) ...him/her/it}

atausiulugu

{atausi:atausiq/1n}{u:u/1nv}{lugu:lugu/tv-part-1p-3s-fut}

{one}{existence; is}{part. future: while we (many) ...him/her/it}

atausiulugu

{atausi:atausiq/1n}{u:u/1nv}{lugu:lugu/tv-part-2p-3s-fut}

{one}{existence; is}{part. future: while you (many) ...him/her/it}

atausiulugu

{atausi:atausiq/1n}{u:u/1nv}{lugu:lugu/tv-part-4p-3s-fut}

{one}{existence; is}{part. future: while they (many) ...him/her/it}

atausiulugu

{atausi:atausiq/1n}{u:u/1nv}{lu:luk/3vv}{gu:guk/tv-imp-2s-3s}

{one}{existence; is}{to perform an action in a poor or bad manner}{order: you ...him/her/it}

atausiulugu

{ata:ata/1n}{u:u/1nv}{si:siq/2vn}{u:u/1nv}{lugu:lugu/tv-part-1s-3s-fut}

{bottom}{existence; is}{custom; way; habit; manner of doing s.t.}{existence; is}{part. future: while I ...him/her/it}

atausiulugu

{ata:ata/1n}{u:u/1nv}{si:siq/2vn}{u:u/1nv}{lugu:lugu/tv-part-2s-3s-fut}

{bottom}{existence; is}{custom; way; habit; manner of doing s.t.}{existence; is}{part. future: while you ...him/her/it}

atausiulugu

{ata:ata/1n}{u:u/1nv}{si:siq/2vn}{u:u/1nv}{lugu:lugu/tv-part-4s-3s-fut}

{bottom}{existence; is}{custom; way; habit; manner of doing s.t.}{existence; is}{part. future: while he/she/it ...him/her/it}

atausiulugu

{ata:ata/1n}{u:u/1nv}{si:siq/2vn}{u:u/1nv}{lugu:lugu/tv-part-1d-3s-fut}

{bottom}{existence; is}{custom; way; habit; manner of doing s.t.}{existence; is}{part. future: while we (two) ...him/her/it}

atausiulugu

{ata:ata/1n}{u:u/1nv}{si:siq/2vn}{u:u/1nv}{lugu:lugu/tv-part-2d-3s-fut}

{bottom}{existence; is}{custom; way; habit; manner of doing s.t.}{existence; is}{part. future: while you (two) ...him/her/it}

atausiulugu

{ata:ata/1n}{u:u/1nv}{si:siq/2vn}{u:u/1nv}{lugu:lugu/tv-part-4d-3s-fut}

{bottom}{existence; is}{custom; way; habit; manner of doing s.t.}{existence; is}{part. future: while they (two) ...him/her/it}

atausiulugu

{ata:ata/1n}{u:u/1nv}{si:siq/2vn}{u:u/1nv}{lugu:lugu/tv-part-1p-3s-fut}

{bottom}{existence; is}{custom; way; habit; manner of doing s.t.}{existence; is}{part. future: while we (many) ...him/her/it}

atausiulugu

{ata:ata/1n}{u:u/1nv}{si:siq/2vn}{u:u/1nv}{lugu:lugu/tv-part-2p-3s-fut}

{bottom}{existence; is}{custom; way; habit; manner of doing s.t.}{existence; is}{part. future: while you (many) ...him/her/it}

atausiulugu

{ata:ata/1n}{u:u/1nv}{si:siq/2vn}{u:u/1nv}{lugu:lugu/tv-part-4p-3s-fut}

{bottom}{existence; is}{custom; way; habit; manner of doing s.t.}{existence; is}{part. future: while they (many) ...him/her/it}

atausiulugu

{ata:ata/1n}{u:u/1nv}{si:siq/2vn}{u:u/1nv}{lu:luk/3vv}{gu:guk/tv-imp-2s-3s}

{bottom}{existence; is}{custom; way; habit; manner of doing s.t.}{existence; is}{to perform an action in a poor or bad manner}{order: you ...him/her/it}

atausiulugu

{ata:ata/1n}{u:u/1nv}{si:si/2vv}{u:uq/3vv}{lu:luk/3vv}{gu:guk/tv-imp-2s-3s}

{bottom}{existence; is}{the action is being done now, where it was not the case before; readiness, commencement of action or motion}{frequentative: many subjects; many objects}{to perform an action in a poor or bad manner}{order: you ...him/her/it}

atausiulugu

{ata:ata/1n}{u:ut/2nn}{si:liq/2nv}{u:uq/3vv}{lu:luk/3vv}{gu:guk/tv-imp-2s-3s}

{bottom}{bag, container for; s.t. which has...}{to provide, supply; to put s.t. (trans.: to, on s.o.)}{frequentative: many subjects; many objects}{to perform an action in a poor or bad manner}{order: you ...him/her/it}

atausiulugu

{ata:ata/1n}{u:u/1nv}{si:siq/1vv}{u:uq/3vv}{lu:luk/3vv}{gu:guk/tv-imp-2s-3s}

{bottom}{existence; is}{to put or bring out, to be put or brought up for some natural process; to be waiting for an action to be performed or completed}{frequentative: many subjects; many objects}{to perform an action in a poor or bad manner}{order: you ...him/her/it}

**Modelling challenge:** Encode ambiguity in derivation

* Many morphemes are ambiguous
* It would be good to have a compact representation where all possible segmentations are represented in a directed acyclic graph (DAG) rather than as a sequence.
* If not, we run into a combinatoric explosion, here;
  + Given *abcedefg*
  + If the sequence *bc* can always be analysed as either *b-c* or *bc*
    - *8,7,7,7,6,6,6,5*
  + And the sequence *def* can always be analysed as either *d-e-f* or *de-f*  or *d-ef* or *def*
  + And everything else is unambiguous
  + Then a there are 2 \* 4 possible morphological analyses, with 52 (!) different morphological segments
  + But as a DAG, this can be represented as one path (here using | to separate possible alternative sub-paths):
    - *a-(b-c|bc)-e-(d-e|de-f|de-f|d-ef|def)-g*
    - This requires only 15 morphological segments (and clever compression can reduce that a bit mit)

## For modelling: Necessary morphemes and allomorphs

Data from <http://www.inuktitutcomputing.ca/DataBase/info.php> (does not contain inflectional morphemes)

### Roots

{ata:ata/1n}

ata ᐊᑕ

Meaning bottom

Type nominal root

Source Spalding, Alex, "Inuktitut - A Multi-Dialectal Outline Dictionary". Nunavut Arctic College, Iqaluit, Nunavut, Canada, 1998.

{atausi:atausiq/1n}

atausiq ᐊᑕᐅᓯᖅ

Meaning one

Semantic category number; quantity;

Type nominal root

Source Spalding, Alex, "Inuktitut - A Multi-Dialectal Outline Dictionary". Nunavut Arctic College, Iqaluit, Nunavut, Canada, 1998.

### Verbal inflection

{gu:guk/tv-imp-2s-3s}

[abbrev means transitive verb + 2s subject/ergative argument + 3s object/abs argument]

{order: you ...him/her/it}

### Derivation and incorporation

#### Sample entry

{lu:luk/3vv}

luk ᓗᒃ

Meaning to perform an action in a poor or bad manner

Type verb-to-verb (VV) suffix: attaches to a verb root or verb stem, and produces a verb stem

Mobility this suffix is mobile: it can be used at will with all roots and stems of the proper type

Position this suffix must be followed by another suffix, i.e. it cannot occur in word-final position

Forms and Behaviours

After 'a', 'i', 'u' When the stem ends with 'a', 'i' or 'u', this affix takes the form luk ; it has no effect on the stem.

After 't' When the stem ends with 't', this affix takes the form luk ; it deletes the end character of the stem [\_t + luk → \_luk].

After 'k' When the stem ends with 'k', this affix takes the form luk ; it deletes the end character of the stem [\_k + luk → \_luk].

After 'q' When the stem ends with 'q', this affix takes the form luk ; it deletes the end character of the stem [\_q + luk → \_luk].

**Modelling challenges**:

* allomorphy rules
* Cardinality and type restrictions (vn morpheme requires verb and produces n, [most] verbal morphemes cannot be final, etc.)

#### Incorporation (basically a verbal derivation from a noun):

{si:liq/2nv}

{u:u/1nv}

[read: if applied to a noun, return a verb; number is number of lexical entry for a particular lemma]

#### Verb-to-verb derivations:

{si:si/2vv}

{si:siq/1vv}

{u:uq/3vv}

#### Verb-to-noun derivations:

{si:siq/2vn}

#### Noun-to-noun derivations:

{u:ut/2nn}

# FYI: Other data

Not for modelling but FYI

* FYI: Corpus data (CoNLL data, not to be modelled, but the individual morphemes and their combinatorics need to be modelled

# Hansard

1 Hansard Hansard \_ \_

# nunavut kanata

1 nunavut nunavut {nunavut:nunavut/1n} {Nunavut}

1 nunavut nunavut {nuna:nuna/1n}{vut:vut/tn-nom-s-1p} {(1) land (2) country}{nominative: our (one thing to us many) }

1 nunavut nunavut {nuna:nuna/1n}{vut:vut/tn-nom-p-1p} {(1) land (2) country}{nominative: our (many things to us many) }

2 kanata kanata {kanata:kanata/1n} {Canada}

# nunavut maligaliurvia

1 nunavut nunavut {nunavut:nunavut/1n} {Nunavut}

1 nunavut nunavut {nuna:nuna/1n}{vut:vut/tn-nom-s-1p} {(1) land (2) country}{nominative: our (one thing to us many) }

1 nunavut nunavut {nuna:nuna/1n}{vut:vut/tn-nom-p-1p} {(1) land (2) country}{nominative: our (many things to us many) }

2 maligaliurvia maligaliurvia {maligaliurvi:maligaliurvik/1n}{a:nga/tn-nom-s-4s} {legislative assembly}{nominative: his;her;its (one thing, different person) }

2 maligaliurvia maligaliurvia {maliga:maligaq/1n}{liur:liuq/1nv}{vi:vik/3vn}{a:nga/tn-nom-s-4s} {bill}{construction in progress: 'to be building s.t.' (trans.: for s.o.)}{place where the action of the verb takes place}{nominative: his;her;its (one thing, different person) }

2 maligaliurvia maligaliurvia {maliga:maligaq/1n}{li:li/3nv}{ur:uq/3vv}{vi:vik/3vn}{a:nga/tn-nom-s-4s} {bill}{to build, make something (trans.: for s.o.); with certain words: find s.t.}{frequentative: many subjects; many objects}{place where the action of the verb takes place}{nominative: his;her;its (one thing, different person) }

2 maligaliurvia maligaliurvia {maliga:maligaq/1n}{li:lik/3nv}{ur:uq/3vv}{vi:vik/3vn}{a:nga/tn-nom-s-4s} {bill}{to give, to provide, to offer, to fetch s.t. (trans.: to s.o.)}{frequentative: many subjects; many objects}{place where the action of the verb takes place}{nominative: his;her;its (one thing, different person) }

2 maligaliurvia maligaliurvia {maliga:maligaq/1n}{li:lik/2nv}{ur:uq/3vv}{vi:vik/3vn}{a:nga/tn-nom-s-4s} {bill}{to go to; to have gone to; to come to; to find by chance}{frequentative: many subjects; many objects}{place where the action of the verb takes place}{nominative: his;her;its (one thing, different person) }

2 maligaliurvia maligaliurvia {maliga:maligaq/1n}{li:liq/3nv}{ur:uq/3vv}{vi:vik/3vn}{a:nga/tn-nom-s-4s} {bill}{to go to, toward}{frequentative: many subjects; many objects}{place where the action of the verb takes place}{nominative: his;her;its (one thing, different person) }

2 maligaliurvia maligaliurvia {maliga:maligaq/1n}{li:liq/2nv}{ur:uq/3vv}{vi:vik/3vn}{a:nga/tn-nom-s-4s} {bill}{to provide, supply; to put s.t. (trans.: to, on s.o.)}{frequentative: many subjects; many objects}{place where the action of the verb takes place}{nominative: his;her;its (one thing, different person) }

2 maligaliurvia maligaliurvia {mali:malik/1v}{ga:gaq/2vv}{li:li/2vv}{ur:uq/3vv}{vi:vik/3vn}{a:nga/tn-nom-s-4s} {(1) to follow (trans. [-mik]: s.o. or s.t.) (2) to obey (trans. [-mik]: s.o.)}{frequentative: several times}{to make that s.t. or s.o. ... (refl.: to become); to make s.t. (trans.: to s.o.)}{frequentative: many subjects; many objects}{place where the action of the verb takes place}{nominative: his;her;its (one thing, different person) }

2 maligaliurvia maligaliurvia {mali:malik/1v}{ga:gaq/1vn}{li:li/3nv}{ur:uq/3vv}{vi:vik/3vn}{a:nga/tn-nom-s-4s} {(1) to follow (trans. [-mik]: s.o. or s.t.) (2) to obey (trans. [-mik]: s.o.)}{forms a noun with an inherently passive meaning: someone/something that one ...}{to build, make something (trans.: for s.o.); with certain words: find s.t.}{frequentative: many subjects; many objects}{place where the action of the verb takes place}{nominative: his;her;its (one thing, different person) }

2 maligaliurvia maligaliurvia {mali:malik/1v}{ga:gaq/1vn}{li:lik/3nv}{ur:uq/3vv}{vi:vik/3vn}{a:nga/tn-nom-s-4s} {(1) to follow (trans. [-mik]: s.o. or s.t.) (2) to obey (trans. [-mik]: s.o.)}{forms a noun with an inherently passive meaning: someone/something that one ...}{to give, to provide, to offer, to fetch s.t. (trans.: to s.o.)}{frequentative: many subjects; many objects}{place where the action of the verb takes place}{nominative: his;her;its (one thing, different person) }

2 maligaliurvia maligaliurvia {mali:malik/1v}{ga:gaq/1vn}{li:lik/2nv}{ur:uq/3vv}{vi:vik/3vn}{a:nga/tn-nom-s-4s} {(1) to follow (trans. [-mik]: s.o. or s.t.) (2) to obey (trans. [-mik]: s.o.)}{forms a noun with an inherently passive meaning: someone/something that one ...}{to go to; to have gone to; to come to; to find by chance}{frequentative: many subjects; many objects}{place where the action of the verb takes place}{nominative: his;her;its (one thing, different person) }

2 maligaliurvia maligaliurvia {mali:malik/1v}{ga:gaq/1vn}{li:liq/3nv}{ur:uq/3vv}{vi:vik/3vn}{a:nga/tn-nom-s-4s} {(1) to follow (trans. [-mik]: s.o. or s.t.) (2) to obey (trans. [-mik]: s.o.)}{forms a noun with an inherently passive meaning: someone/something that one ...}{to go to, toward}{frequentative: many subjects; many objects}{place where the action of the verb takes place}{nominative: his;her;its (one thing, different person) }

2 maligaliurvia maligaliurvia {mali:malik/1v}{ga:gaq/2vv}{li:liq/1vv}{ur:uq/3vv}{vi:vik/3vn}{a:nga/tn-nom-s-4s} {(1) to follow (trans. [-mik]: s.o. or s.t.) (2) to obey (trans. [-mik]: s.o.)}{frequentative: several times}{on-going action; present progressive tense}{frequentative: many subjects; many objects}{place where the action of the verb takes place}{nominative: his;her;its (one thing, different person) }

2 maligaliurvia maligaliurvia {mali:malik/1v}{ga:gaq/1vn}{li:liq/2nv}{ur:uq/3vv}{vi:vik/3vn}{a:nga/tn-nom-s-4s} {(1) to follow (trans. [-mik]: s.o. or s.t.) (2) to obey (trans. [-mik]: s.o.)}{forms a noun with an inherently passive meaning: someone/something that one ...}{to provide, supply; to put s.t. (trans.: to, on s.o.)}{frequentative: many subjects; many objects}{place where the action of the verb takes place}{nominative: his;her;its (one thing, different person) }