Printed-Source Analysis for PanLex

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The Long Now Foundation

PanLex

http://panlex.org

First PanLex Summer Internship

29 July 02013

Summary

- Printed sources
- PanLex collection at Internet Archive
- Analytical tasks
- Tools
- Opportunities

Printed sources

70 formats

PanLex 3.4

source — edit

choose | source

file — kind

change

PanLex 3.4

source — aak-eng:Speece — file — kind

GDN	☐	PCS
Geiriadur	☐	NIL; #<DICTIONARY:LOOKUP-PROXY; []
JMdict	☐	<!DOCTYPE JMdict; <entry>; <sense>; <gloss xml:lang=
LL-LIFT	☐	linguist-lift-schemas/linguist-lift
LTRC	☐	"_ಅಂತ","अव्यय","avy","_के_जैसा"

Printed sources

Printed formats

pdf	☐	
pdf-img	☐	
pdf-lock/encrypt	☐	
png	☐	
po	☐	
popdict	☐	
prc	☐	
prt	☐	✏ @ ⊕
prt@Plx	☐	✏
ps	☐	

Printed sources

Printed sources in the source archive

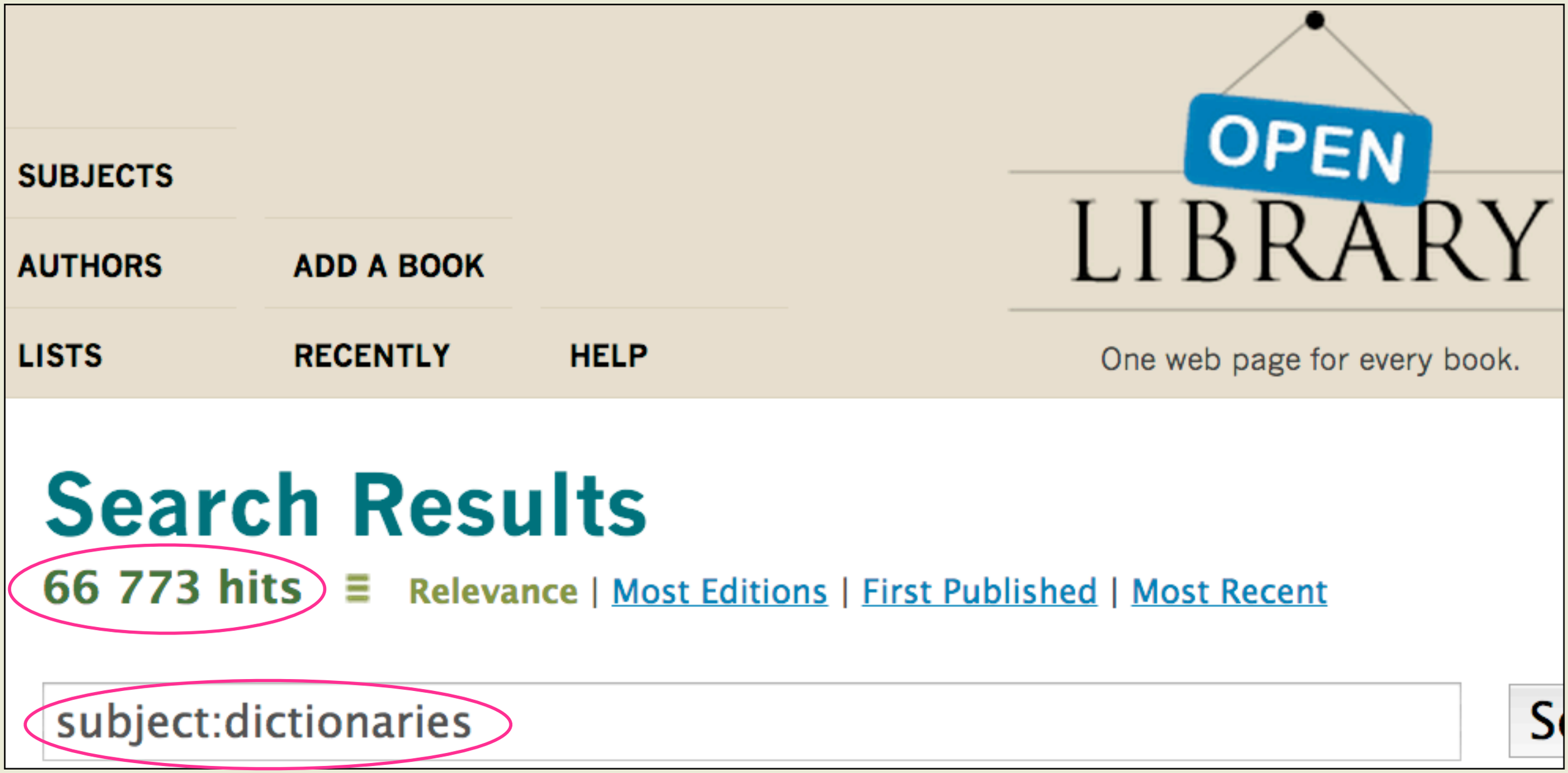
```
plx=# select count (ap) from ap;
 count
-------
  3993
```

274 printed-only

```
plx=# select count (ap) from
(select ap from ap except select
af.ap from af, fm where fm.fm =
af.fm and (tt like 'pdf-%' or tt
like 'prt%')) as tbl;
 count
-------
  3719
```

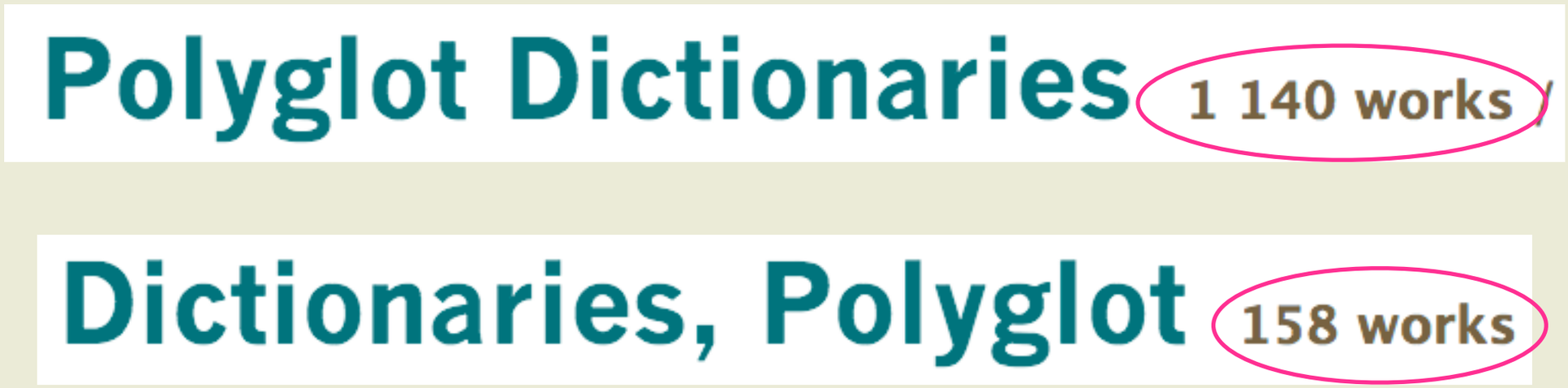
Printed sources

Printed sources in the world



Printed sources

Printed sources in the world



Internet Archive PanLex collection

Internet Archive PanLex collection

- **A comparative vocabulary of Formosan languages and dialects** - Ogawa, Naoyoshi
  Keywords: Austronesische talen
  Downloads: 2
- **The Chimwiini lexicon exemplified** - Kisseberth, Charles W
  Includes bibliographical references (p. xxxiv)
  Keywords: Mwini dialect; Swahili language
  Downloads: 3
- **A classified vocabulary of the Punu language** - 880-01 Yukawa, Yasutoshi, 1941-
  Includes index
  Keywords: Punu language; Punu language; Punu language; English language; French language; Punu (African people); Punu
  Downloads: 1
- **Degema-English dictionary with English index** - Kari, Ethelbert E
  Includes bibliographical references (p. xliii-xliv) and index
  Keywords: Degema language; English language; Lengua degema; Lengua inglesa; Lengua degema; Lengua inglesa
  Downloads: 2
- **EG-Woerterbuch mathematischer Begriffe = EK-vortaro de mathematikaj terminoj** - Hilgers-Yashovardhan, R. edt
  Keywords: Mathematik; Europäische Gemeinschaft; Mathematik; Wissenschaftliche Bibliothek
  Downloads: 1
- **Gendai Uigurugo shojiten = Concise modern Uyghur-Japanese dictionary** - 880-01 Sugawara, Jun, 1966-
  Parallel title also in Uighur
  Keywords: Uighur language; Uigurugo
  Downloads: 4
- **『ヒンディー語動詞基礎語彙集』 = Hindi - Japanese dictionary of selected verbs with illustrative sentences** - 町田和彦/Kazuhiko Machida
  Downloads: 4
- **A Jita vocabulary** - Kagaya, Ryohei
  Keywords: Jita language; Jita language; Jita language; English language; Japanese language; Jita; Engels; Japans
  Downloads: 2
- **Guyish-i Gilaki-i Lahijan : vazhahnamah va parahi vizhagiha-yi avayi va sakhtavazhahi** - Jahangiri, Nader
  jild-i 1. Vizhagiha-yi avayi va sakhtavazhahi -- jild-i 2. Vazhagan-i Alif ta Sin -- jild-i 3. Vazhagan-i Shin ta Ya
  Keywords: Gilaki language; Gilaki language; Gilaki; Gilaki language
  Downloads: 1
- **Gendai Chibettogo doshi jiten : Rasa hogen = A verb dictionary of the modern spoken Tibetan of Lhasa, Tibetan-Japanese** - 880-01 Hoshi, Izumi
  Dictionary entries in Tibetan script with romanization
  Keywords: Tibetan language
  Downloads: 1
- **Kainanto hogen kiso goishu** - 880-01 Nakajima, Motoki, 1942-
  Includes bibliographical references (p. 8) and index
  Keywords: Chinese language
  Downloads: 1
- **AA諸言語教育基本語彙表（入門期の学習に必要な基礎語彙600項目試案）** - 梅田博之
  Downloads: 4
- **The Pyen (or Phen) language : its classified lexicon** - 880-01 Shintani, Tadahiko, 1946-
  Downloads: 3

Internet Archive PanLex collection

Gendai Uigurugo shojiten = Concise modern Uyghur-Japanese dictionary (2009)

Title (alternate script): = Concise modern Uyghur-Japanese dictionary
Author: 880-01 Sugawara, Jun, 1966-
Subject: Uighur language; Uigurugo
Publisher: Fuchu-shi : Tokyo Gaikokugo Daigaku Ajia Afurika Gengo Bunka Kenkyujo
Language: Japanese; Uighur
Digitizing sponsor: Jonathan Pool
Book contributor: The Long Now Foundation, PanLex Project
Collection: lendinglibrary; browserlending; panlex; longnow; americana
Notes: some content may be lost due to the binding of the book.

Full catalog record: MARCXML

This book has an editable web page on Open Library.

Description

Parallel title also in Uighur

Includes bibliographical references (p. xxii-xxiv)

Internet Archive PanLex collection

Selected metadata

Isbn:	9784863370265
Lccn:	2010428072
Page-progression:	lr
Scanningcenter:	sanfrancisco
Mediatype:	texts
Shiptracking:	y0599
Identifier:	gendaiuigurugosh008800
Scanner:	scribe5.sanfrancisco.archive.org
Ppi:	500
Camera:	Canon EOS 5D Mark II
Operator:	associate-lan-zhu@...
Scandate:	20130408202946
Republisher:	associate-karina-martinez@...
Imagecount:	788
Identifier-access:	http://archive.org/details/gendaiuigurugosh008800
Identifier-ark:	ark:/13960/t8ff5b645
Bookplateleaf:	0004
Ocr:	ABBYY FineReader 8.0
Sponsordate:	20130430

Internet Archive PanLex collection

PanLex 3.4

source — 3317 — jpn-uig:菅原

number	3317
PanLex — beginning	2011-04-25
name	jpn-uig:菅原
World Wide Web	http://www.aa.tufs.ac.jp/en/publications/lexicon
ISBN	9784863370265
author	菅原純(編)
title	『現代ウイグル語小辞典』 = Concise modern Uyghur-Japanese dictionary
publisher	アジア・アフリカ言語文化研究所
year	2009
person — good	6
person — number	
fact — other	アジア・アフリカ基礎語彙集/Asian and African Lexicon, 53 (B026)
permission — kind	na
right — text	
right — person — name	
permission — email — address	
good — number — edit — necessary — 1/0	0
file — difficult	8
file — submit — necessary — 1/0	1
expression — edit — necessary — 1/0	0
expression — edit — done — language — (aaa,bbb,ccc)	
file — address	jpn-uig-菅原
fact — other	book donated by ILCAA

translation — count

language

jpn-000	日本語
uig-000	ئۇيغۇرچە
uig-001	Uyghurche

file — kind

prt@Plx

edit — person

Internet Archive PanLex collection

file — difficult	8
file — submit — necessary — 1/0	1
expression — edit — necessary — 1/0	0
expression — edit — done — language — (aaa,bbb,ccc)	
file — address	jpn-uig-菅原

Internet Archive PanLex collection

stop
beginning
back

PanLex 3.4

[PanLem (usred6w)]
[9.1.9]

you — testintern

source — edit — permission

change	source	language — necessary	file — kind	difficult	title
±	nan-eng:Nakajima	nan-000	pdf-img	8	『海南島方言基礎語彙集』
±	eng-jpn-rus-niv:丹菊逸治	niv-000; jpn-002	pdf-img	8	ニヴフ語サハリン方言基礎語彙集（ノグリキ周辺地域）＝Basic vocabulary of the Sakhalin dialect of Nivkh language : Nogliki dialect
±	nsz-eng:Kroeber	nsz-000	pdf-img	4	The Valley Nisenan
±	ood-eng:Allison	ood-000	pdf-img	4	O'otham Ñiokĭ Haichu A:ga
±	eng-mya-shn-pce:Shin	pce-002; pce-001; mya-002; shn-000; pce-003; pce-004; pce-005	pdf-img	7	The Palaung Language: Comparative Lexicon of its Southern Dialects (I)

Analytical tasks

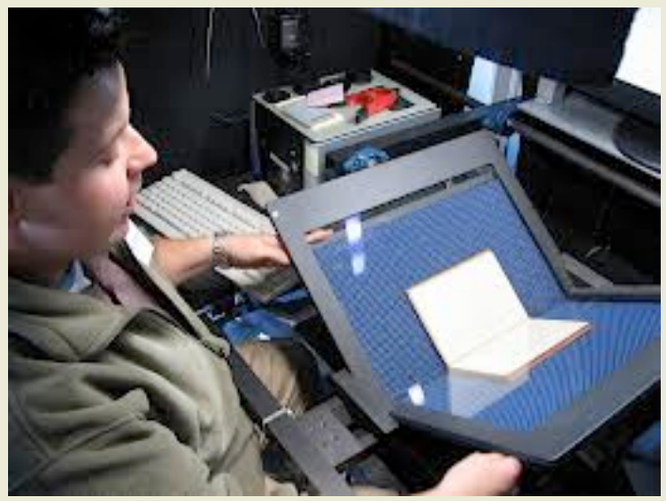
Same as for digital text, plus:

- Page imaging
- Spatial structural analysis
- Text identification and sequencing
- Script identification
- Font identification
- Face identification
- Character segmentation and sequencing
- Character identification

Analytical tasks

Page imaging

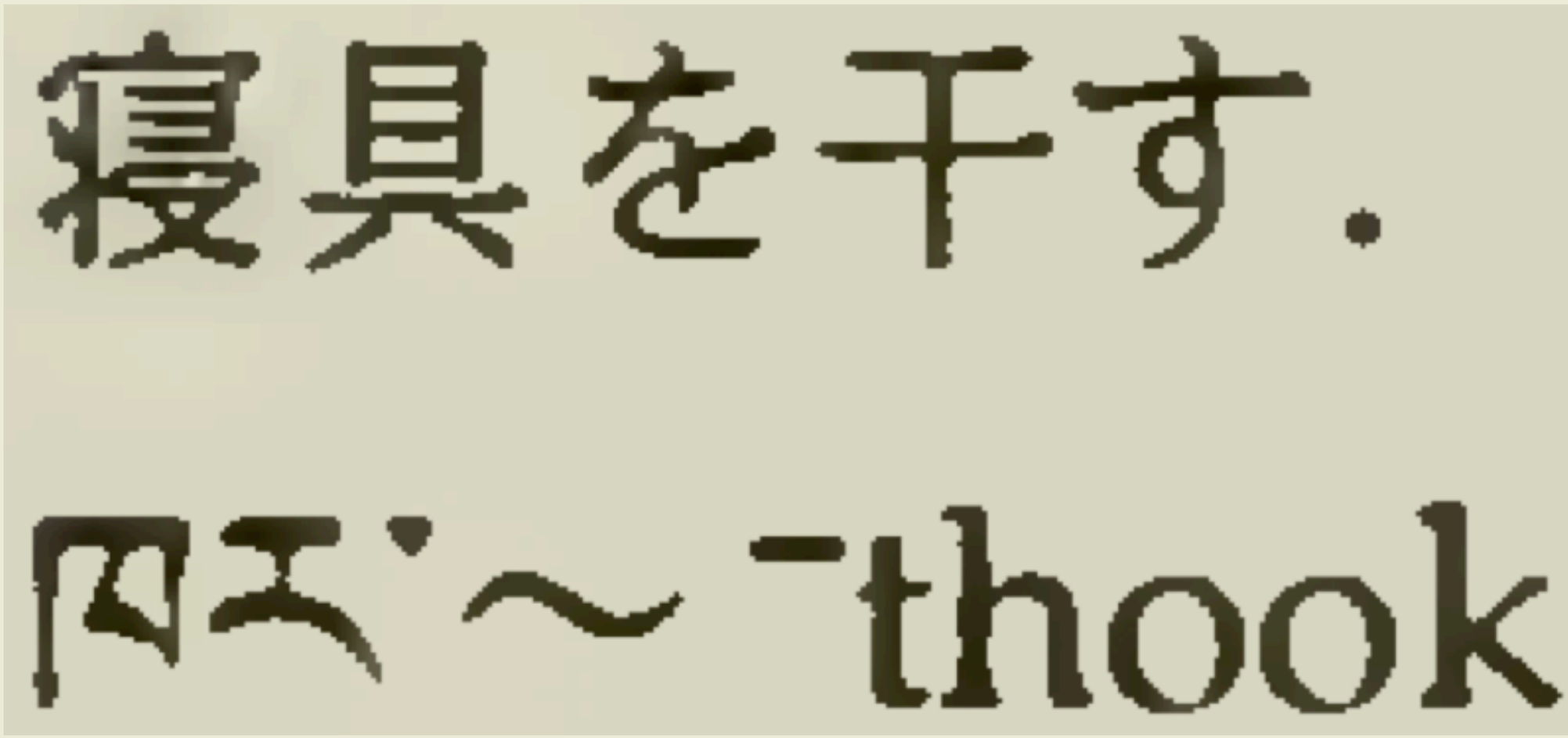
- Produces image file(s)
- Internet Archive produces JPG2000, PDF/A, Djvu, and Ebook files (in color)
- PanLex collection: format changes from “prt@Plx” to “PDF-img”



Analytical tasks

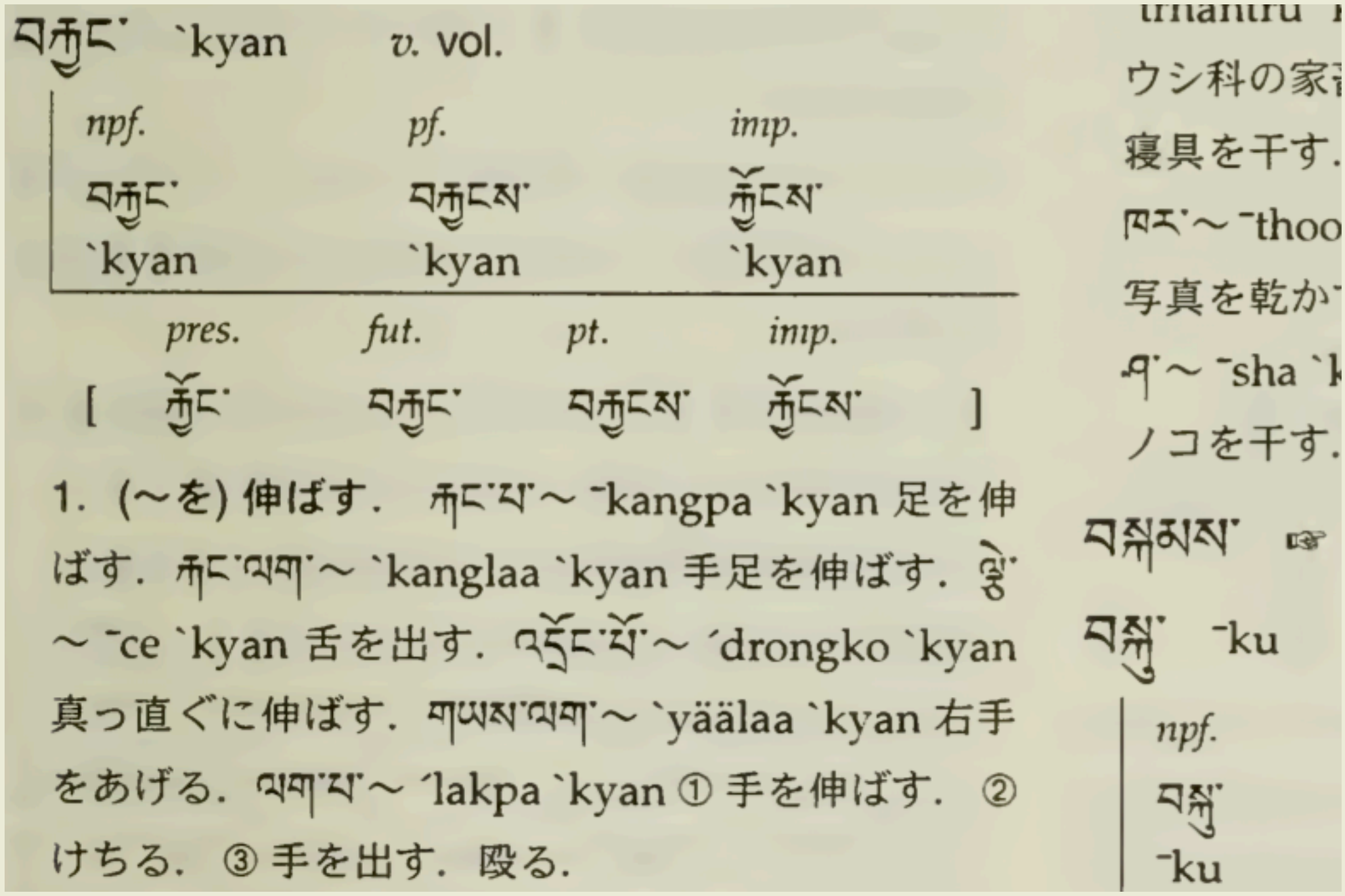
Page imaging

- Internet Archive resolution



Analytical tasks

Spatial structural analysis



བཀྱང་ `kyan *v.* vol.

npf.	*pf.*	*imp.*
བཀྱང་	བཀྱངས་	ཀྱངས་
`kyan	`kyan	`kyan

pres.	*fut.*	*pt.*	*imp.*
[ཀྱང་	བཀྱང་	བཀྱངས་	ཀྱངས་]

1. (～を) 伸ばす. ཀང་པ་～ ¯kangpa `kyan 足を伸ばす. ཀང་ལག་～ `kanglaa `kyan 手足を伸ばす. ལྕེ་～ ¯ce `kyan 舌を出す. འདྲོང་པོ་～ ´drongko `kyan 真っ直ぐに伸ばす. གཡས་ལག་～ `yäälaa `kyan 右手をあげる. ལག་པ་～ ´lakpa `kyan ① 手を伸ばす. ② けちる. ③ 手を出す. 殴る.

thantru

ウシ科の家

寝具を干す.

ཐང་～ ¯thoo

写真を乾か

ཤ་～ ¯sha `k

ノコを干す.

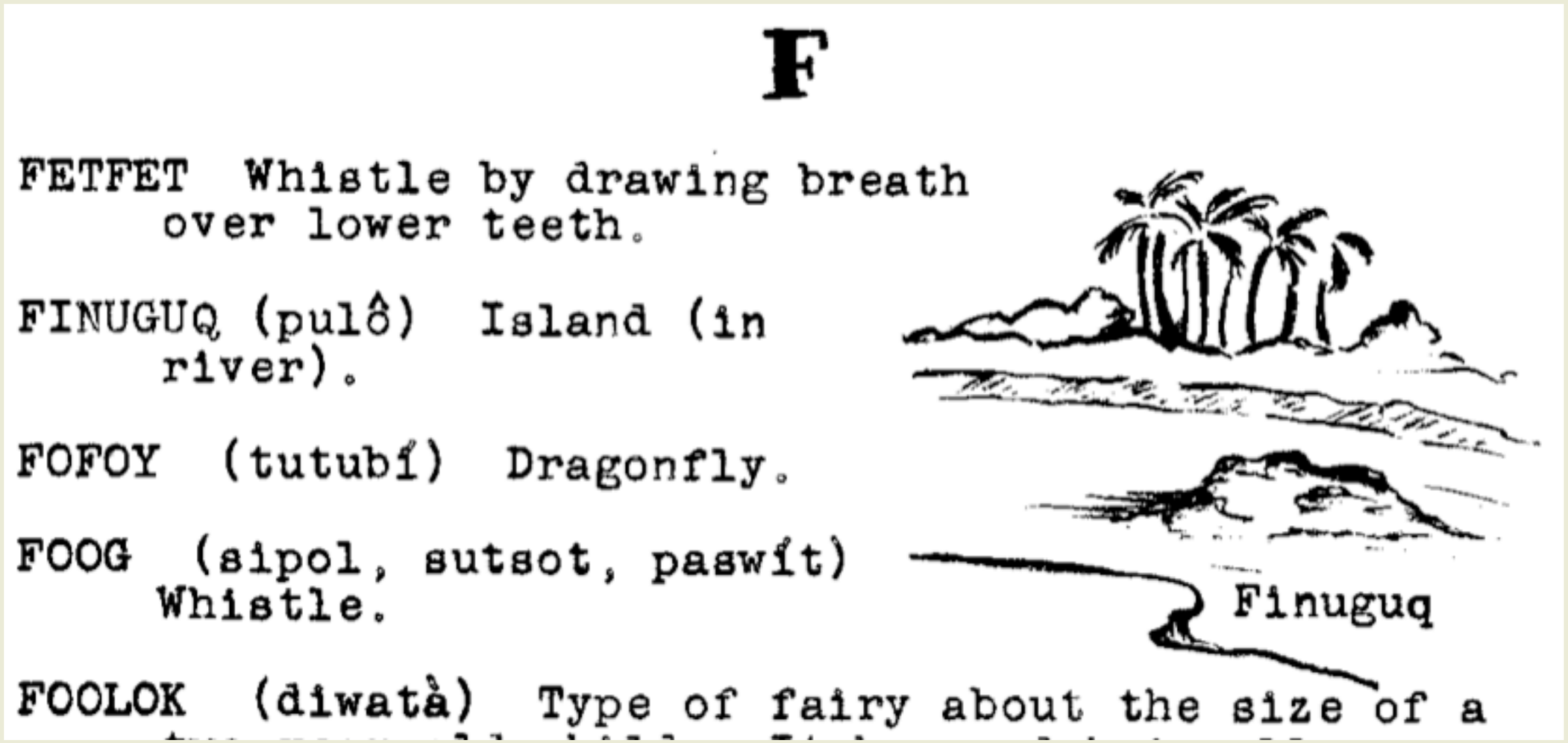
བསྐམས་ ☞

བསྐུ་ ¯ku

npf.
བསྐུ་
¯ku

Analytical tasks

Text identification and sequencing



F

FETFET Whistle by drawing breath over lower teeth.

FINUGUQ (pulô) Island (in river).

FOFOY (tutubí) Dragonfly.

FOOG (sipol, sutsot, paswít) Whistle.

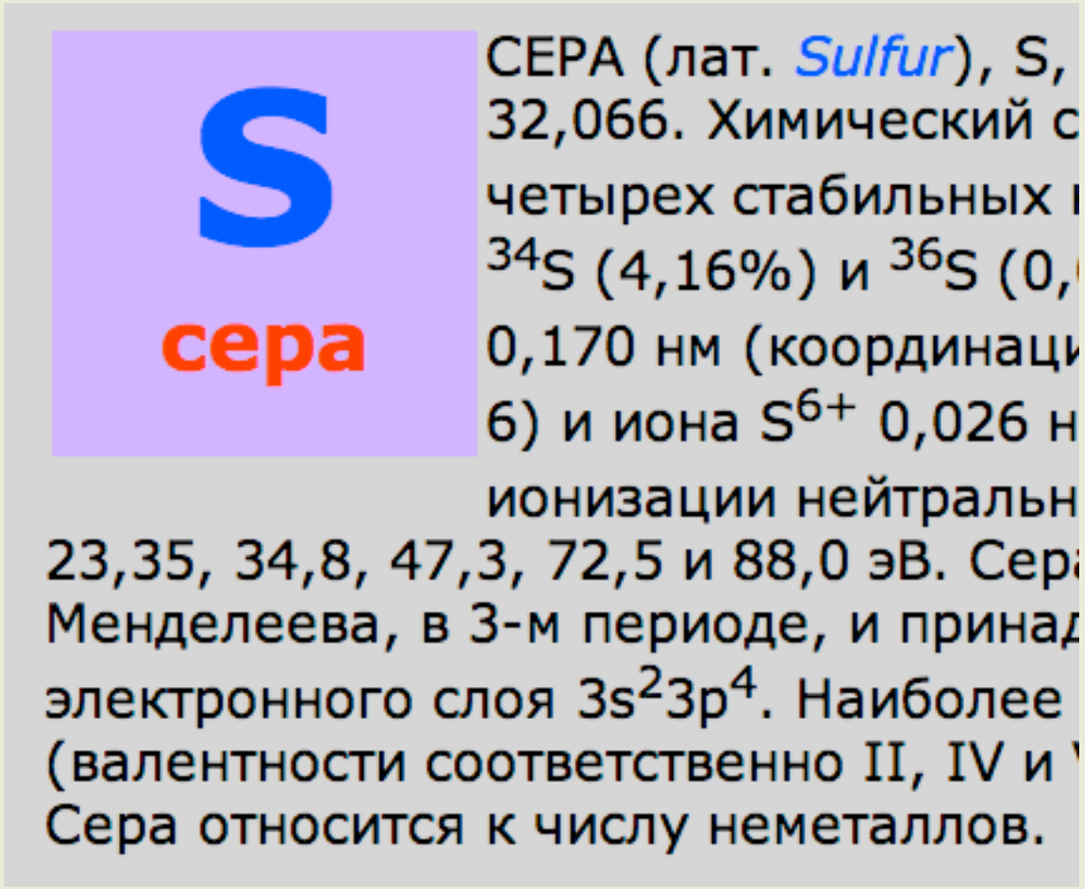
FOOLOK (diwatà) Type of fairy about the size of a

Finuguq

Analytical tasks

Script identification

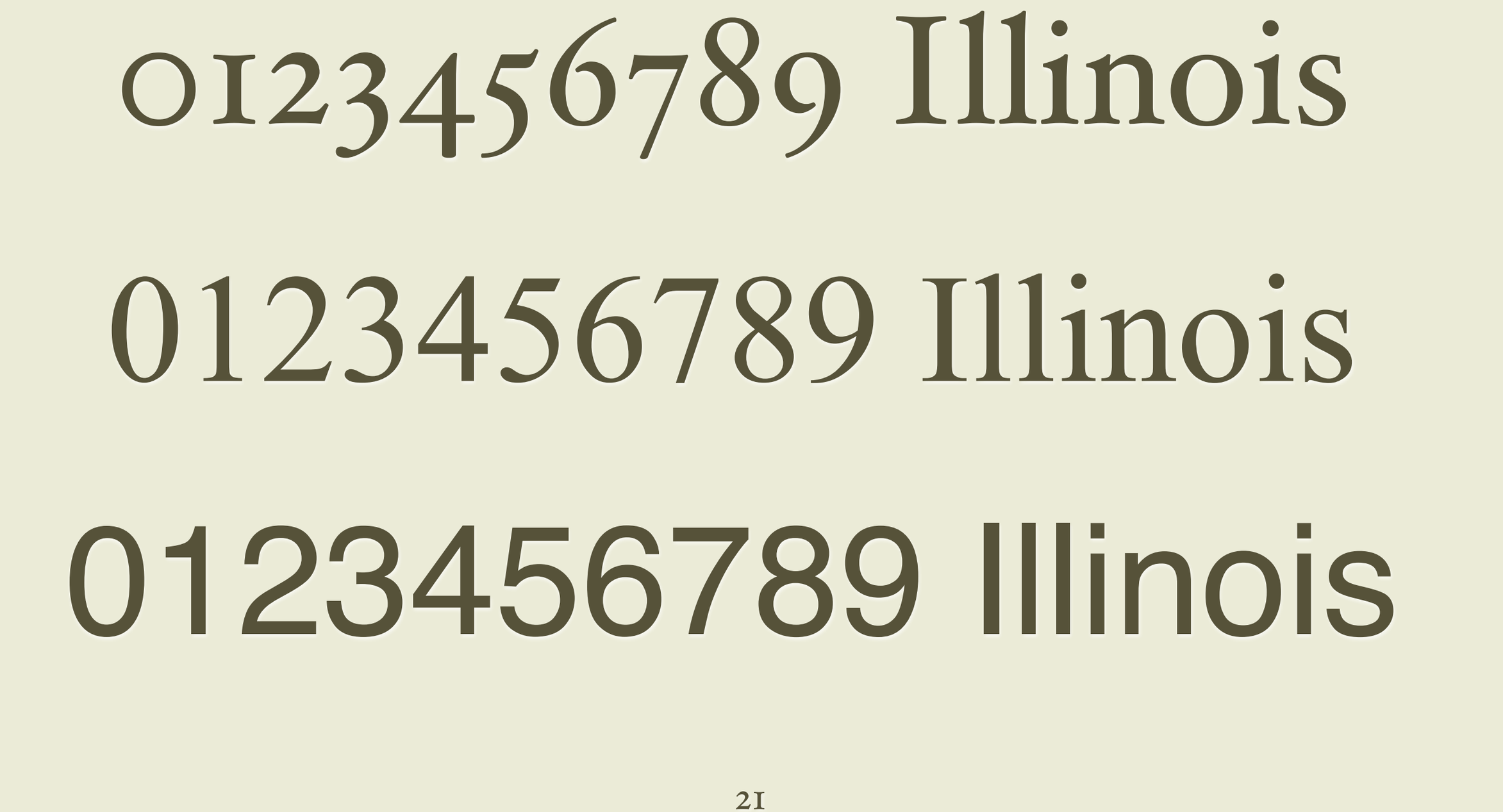
CEPA



CEPA

Analytical tasks

Font identification



Analytical tasks

Face identification

0123456789 Illinois

0123456789 Illinois

Analytical tasks

Character segmentation and sequencing

m m

Analytical tasks

Character identification

one ell

Tools

Image-to-text conversion ("optical character recognition") tools: competitors

- Nicomsoft
- Tesseract
- OCRopus
- Abby FineReader
- Adobe Acrobat
- OmniPage
- Readiris
- GOCR
- LEADTOOLS
- Many others

Tools

Image-to-text conversion ("optical character recognition") tools: properties

- Commercial versus open-source
- Script-specific versus multiscriptal
- Language-specific versus multilingual
- Diaglottal versus synglottal (language-mixing)
- Immutable versus trainable
- Isolated versus integratable
- Fossilized versus actively developed

Tools

Prior research

- Christa Mabee, “Optical Character Recognition in Multilingual Text: A Brief Survey”, 02012
- Christa Mabee, “Report on Internship Project: Optical Character Recognition in Multilingual Text”, 02012
- Marcin Heliński, Miłosz Kmieciak, Tomasz Parkoła, “Report on the comparison of Tesseract and ABBYY FineReader OCR engines”, 02012 (PanLex copy)
- Ray Smith, Daria Antonova, and Dar-Shyang Lee, “Adapting the Tesseract Open Source OCR Engine for Multilingual OCR”, 02009

Tools

Prior research: conclusions

- Page imaging is hard
- Tool training is necessary but expensive
- Non-dictionary corpus integration has not been tried
- PanLex requires multiscriptal, multilingual, synglottal, trainable, integratable, actively developed tools
- Few (≅ 2) tools even aspire to all of these properties
- Most likely candidates now: ABBYY FineReader 11 Professional Edition, ABBYY FineReader Engine, Tesseract

Tools

ABBYY FineReader 11 Professional Edition

- Application
- Commercial
- SKU FRPFWA11E
- Windows 8 / 7 / Vista / XP; Windows Server 2012 / 2008 / 2008 R2 / 2003
- Express edition (Windows and Macintosh) and web service are more limited
- Price per license: list $300, street $270+, direct (through 31 July) $180 (or $120 for “upgrade”)

Tools

ABBYY FineReader Engine

- SDK
- Commercial
- Version 10: Windows 7 / Vista / XP / 2000; Windows Server 2003
- Version 9: Linux (GCC 2.95–4)
- Version 8: Macintosh (OS X 10.4–10.8)
- Prices not published

Tools

Tesseract

- SDK and command-line application
- Open-source (Apache License)
- Partly sponsored by Google
- Version 3.02: Linux, OS X
- Additional OSs: Windows with VC++ or CygWin, iOS, Android
- Used by about 40 other tools and projects

Tools

Script identification

	AFRP 11	*AFRE 10*	*AFRE 9*	*AFRE 8*	*Tesseract*
Latin	◉	◉	◉	◉	◉
Cyrillic	◉	◉	◉	◉	◉
Greek	◉	◉	◉	◉	◉
Armenian	◉	◉	◉	◉	
Hebrew	◉	◉		◉	◉
Han	◉	◉	◉		◉
Hiragana/Katakana	◉	◉	◉		◉
Hangul	◉	◉	◉		◉
Thai	◉	◉	◉		◉
Arabic	◉	(◉)			◉
Devanagari					◉
Telugu					◉
Tamil					◉
Malayalam					◉
Kannada					◉
Bengali					◉
Cherokee					◉

Tools

Quality comparison

- Heliński et al.:
  - FineReader was better on average than Tesseract, but worse on some tasks
  - Test was entirely on Polish (thus Latin-script) text
- Mabee:
  - FineReader was better on average than Tesseract
  - Test was on Latin, Thai, Arabic, and Tibetan scripts

Tools

Training comparison

- Both FineReader and Tesseract can (in principle) be trained, but:
  - Bugs prevented Mabee from training FineReader
  - Mabee found Tesseract training tedious and useless
- Approximate training costs for 1 font per Heliński et al.:
  - FineReader by ABBYY: $40,000
  - FineReader in-house: 25 person-days
  - Tesseract in-house: 8 person-days

Tools

Extensibility comparison

- Tesseract operates on more scripts than FineReader
- But both omit Georgian, Sinhala, Lao, Tibetan, Burmese, Khmer, Ethiopic, etc.
- So both need to be extended for PanLex
- Both permit defining new languages and providing new dictionaries

Tools

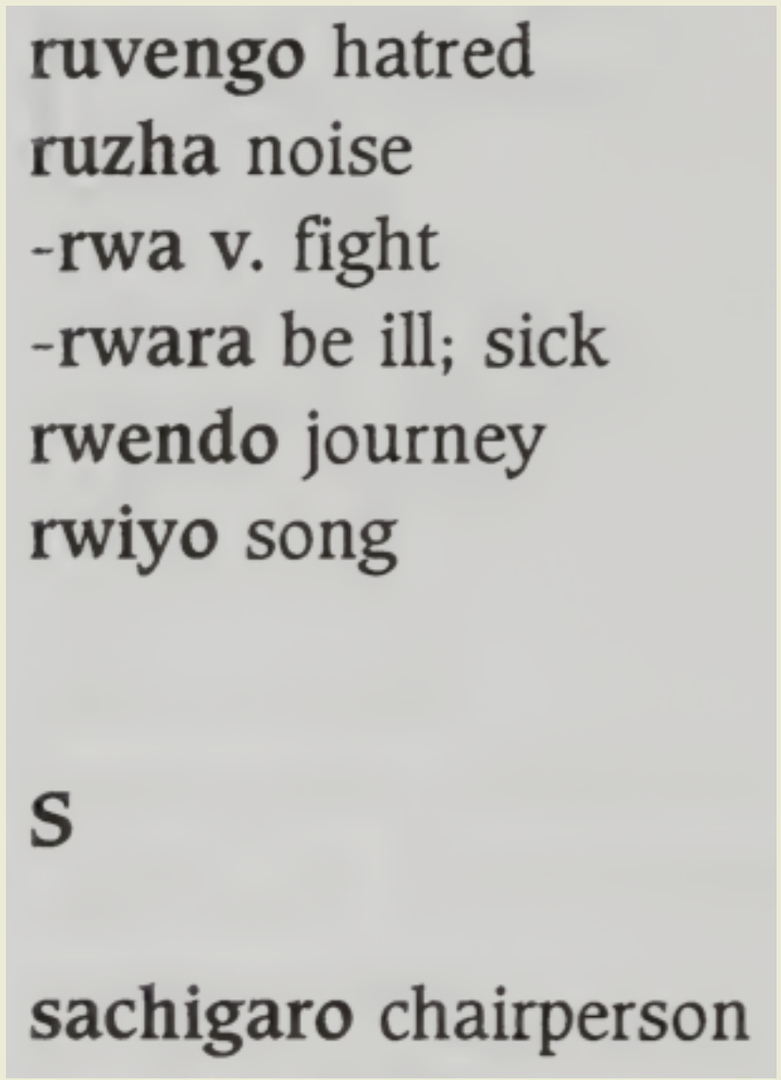
Integratability comparison

- Desiderata for PanLex:
  - Dynamic integration of expression corpus (ex table)
  - Dynamic integration of approved characters (cu and cp tables)
- ABBYY FineReader 11 Professional Edition: no
- ABBYY FineReader Engine: maybe
- Tesseract: probably

Tools

Performance on an easy source

- FineReader



ruvengo hatred
ruzha noise
-**rwa** v. fight
-**rwara** be ill; sick
rwendo journey
rwiyo song

S

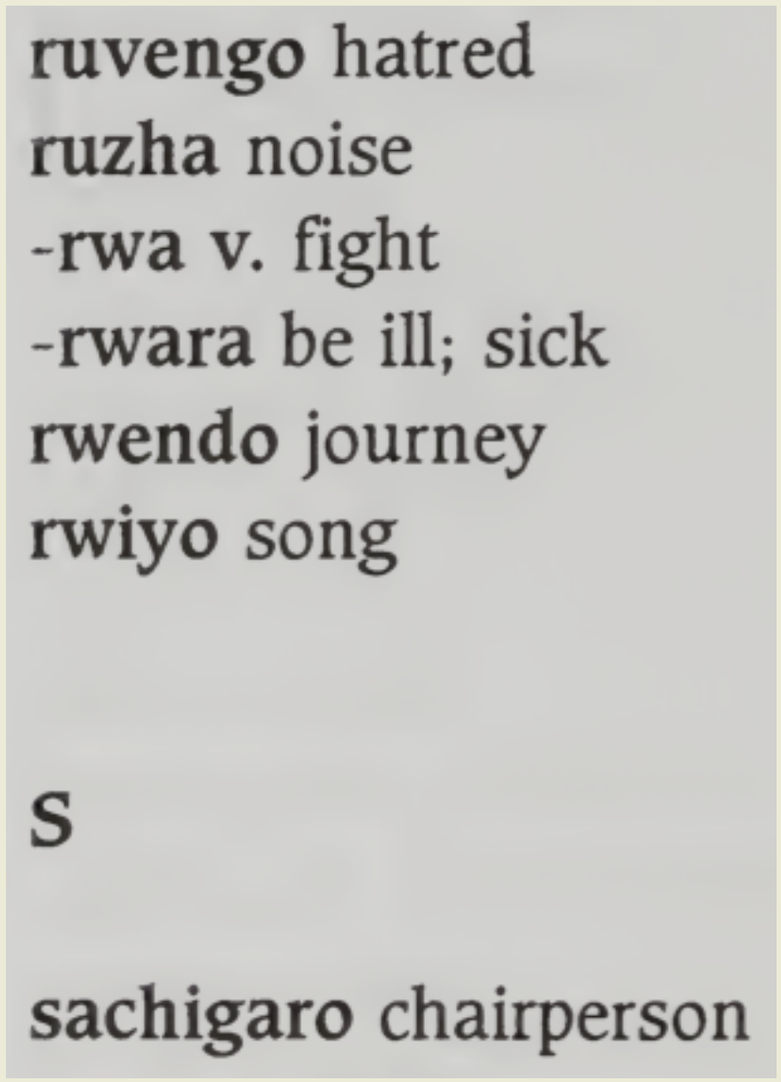
sachigaro chairperson

```
ruvengo hatred
ruzha noise
-rwa v. fight
-rwara be ill; sick
rwendo journey
rwiyo song



sachigaro chairperson
```

Tools

Performance on an easy source

- Tesseract

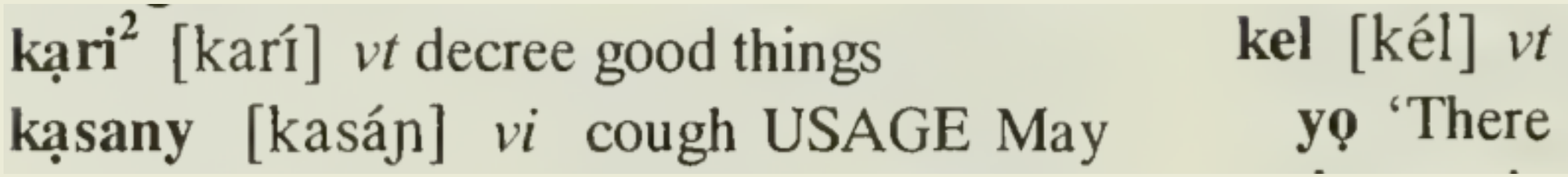



```
ruvengo hatred
ruzha noise
-rwa v. fight
-rwara be ill; sick
rwendo journey
rwiyo song
S
sachigaro chairperson
```

Tools

Performance on a more complex source

- FineReader

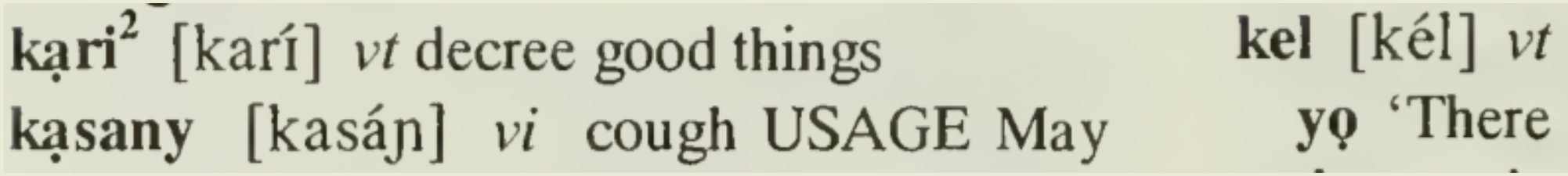


```
kari 2 [kari] vt decree good things
kasany [kasan] vi cough USAGE May
```

Tools

Performance on a more complex source

- Tesseract

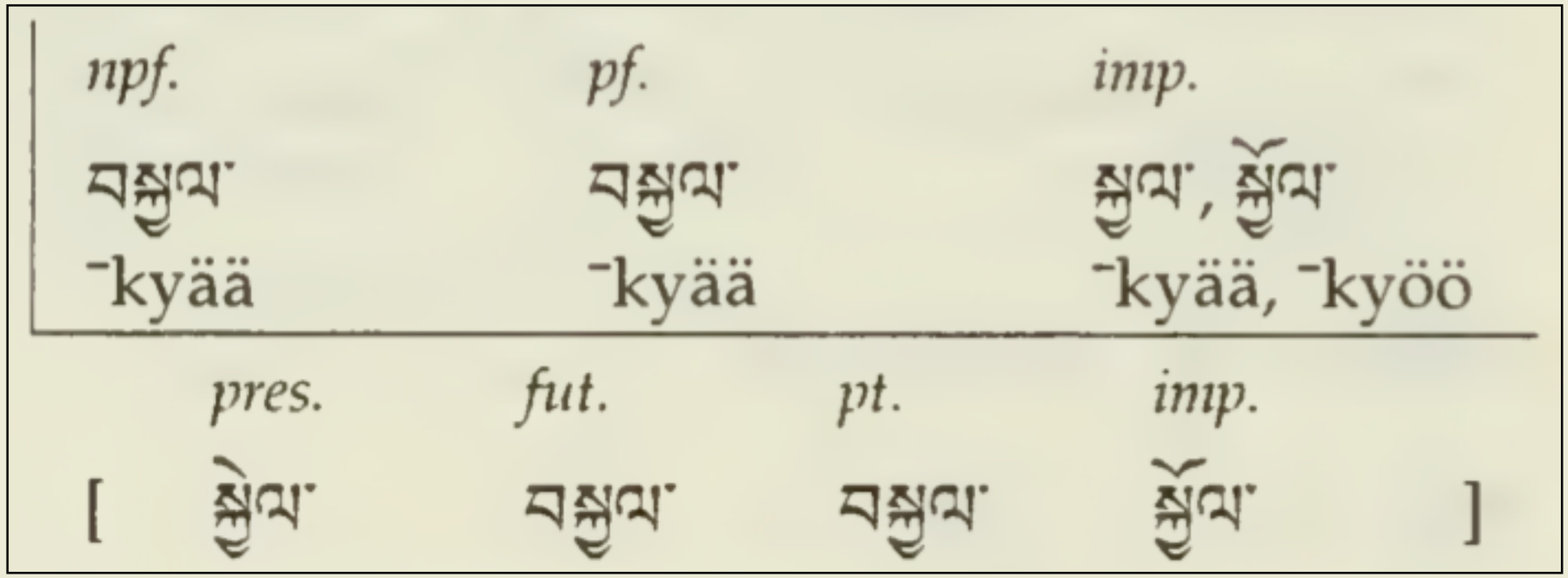


```
kariz [kari] vt decree good things
kasany [kasap] vi cough USAGE May
```

Tools

Performance on a very complex source

- FineReader



npf.	*pf.*	*imp.*
བསྒྲུལ་	བསྒྲུལ་	སྒྲུལ་, སྒྲོལ་
⁻kyää	⁻kyää	⁻kyää, ⁻kyöö

pres.	*fut.*	*pt.*	*imp.*
[སྒྲོལ་	བསྒྲུལ་	བསྒྲུལ་	སྒྲོལ་]

```
  npf.  P/
  "kyaa "kyaa
imp.
"kyaa, "kyoo
[    gar          qgar       qsp-         gar          ]
```

Tools

Performance on a very complex source

- FineReader (“Finnish”)

npf.	*pf.*	*imp.*
བསྒྲུལ་	བསྒྲུལ་	སྒྲུལ་, སྒྲོལ་
⁻kyää	⁻kyää	⁻kyää, ⁻kyöö

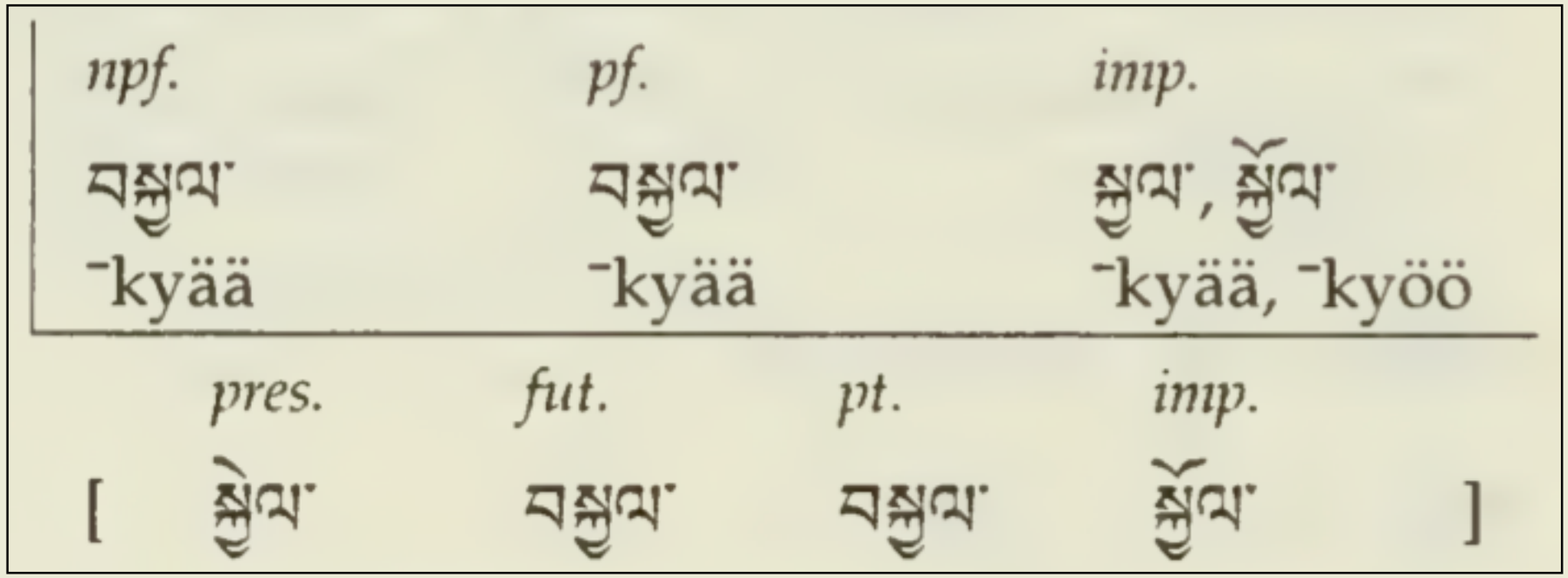
pres.	*fut.*	*pt.*	*imp.*
[སྒྲོལ་	བསྒྲུལ་	བསྒྲུལ་	སྒྲོལ་]

```
   npf. Pf-
   qg^' "kyää   qspr "kyää
imp.
go,-,lq-
"kyää, "kyöö
[      lar          qgof         qgq-         laj-          ]
```

Tools

Performance on a very complex source

- FineReader (“Finnish”, HTML output)



npf.	*pf.*	*imp.*
བསྒྲུལ་	བསྒྲུལ་	སྒྲུལ་, སྒྲོལ་
⁻kyää	⁻kyää	⁻kyää, ⁻kyöö

	pres.	*fut.*	*pt.*	*imp.*	
[	སྒྲོལ་	བསྒྲུལ་	བསྒྲུལ་	སྒྲོལ་	]

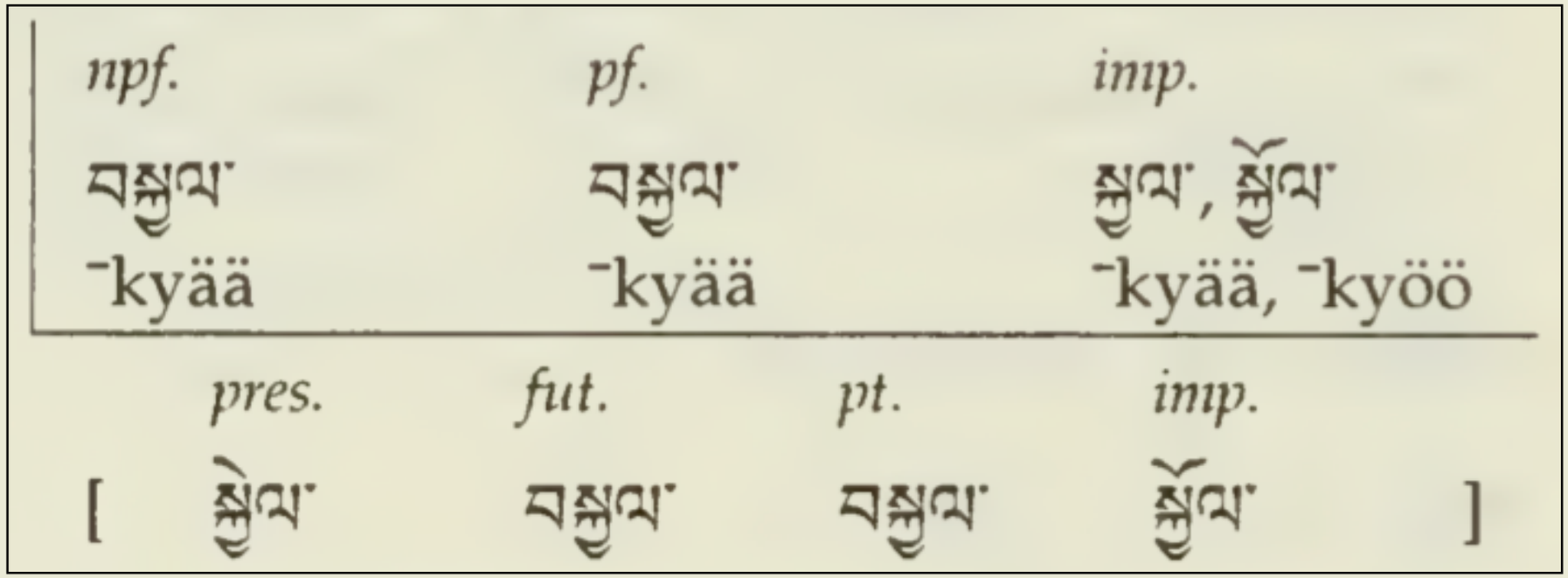
npf.	*Pf-*	*imp.*
qg^'	qspr	go,-,|q-
"kyää	"kyää	"kyää, "kyöö

[|ar	qgof	qgq-	|aj-	]

Tools

Performance on a very complex source

- Tesseract



npf.	*pf.*	*imp.*
བསྒྲལ་	བསྒྲལ་	སྒྲལ་, སྒྲོལ་
⁻kyää	⁻kyää	⁻kyää, ⁻kyöö

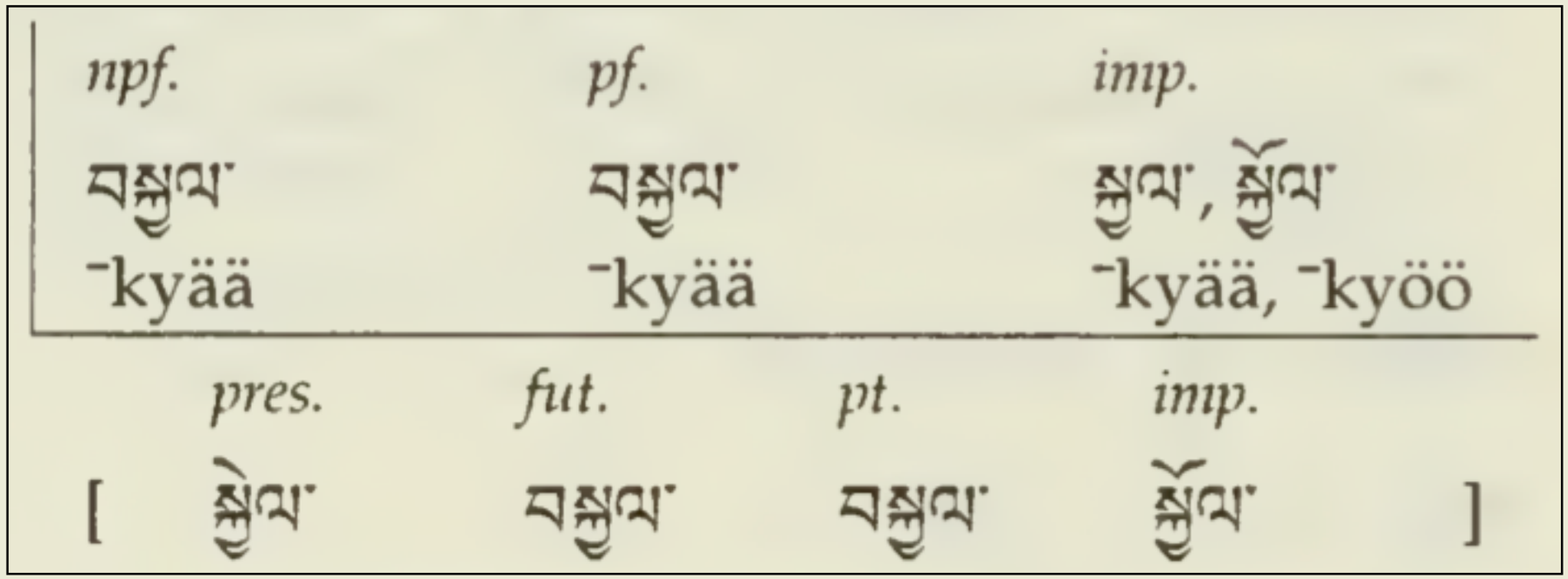
pres.	*fut.*	*pt.*	*imp.*
[སྒྲོལ་	བསྒྲལ་	བསྒྲལ་	སྒྲོལ་]

```
npf. pf. Imp.
magma" r1504" gm", §m'
'kyééi 'kyéi5 ‘kyéiéi, ‘ky66
pres. fut. pt. mzp.
[ gar agar qgw"
\F
```

Tools

Performance on a very complex source

- Tesseract (“Finnish”)



npf.	*pf.*	*imp.*
བསྒྲུལ་	བསྒྲུལ་	སྒྲུལ་, སྒྲོལ་
⁻kyää	⁻kyää	⁻kyää, ⁻kyöö

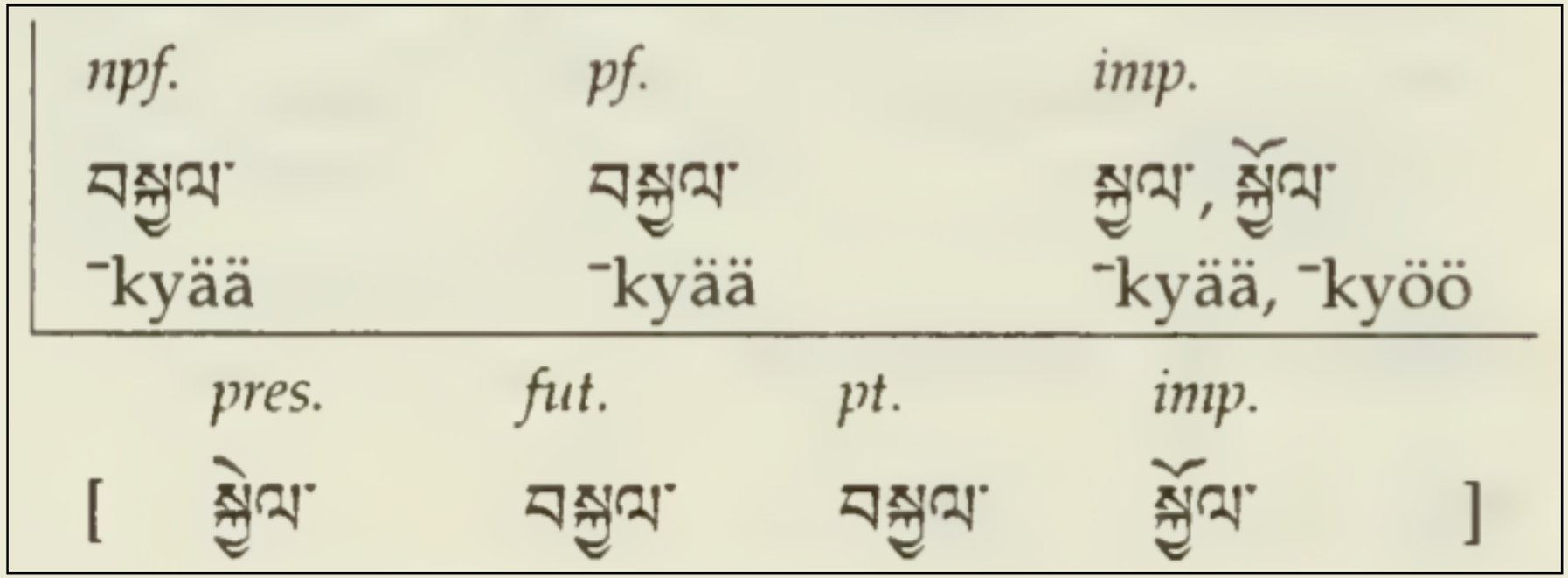
	pres.	*fut.*	*pt.*	*imp.*	
[	སྒྲེལ་	བསྒྲུལ་	བསྒྲུལ་	སྒྲོལ་	]

```
npf. pf. ımp.
mgflı' rıgfıı' gfır, šfıı'
-kyää -kyää -kyää, -kyöö
pres. fııl. pt. mıp.
[ àfıı' ngfıı' fıgw'
`f
```

Tools

Performance on a very complex source

- Tesseract (“Finnish”, HTML output)



npf.	*pf.*	*imp.*
བསྒྲུལ་	བསྒྲུལ་	སྒྲུལ་, སྒྲོལ་
⁻kyää	⁻kyää	⁻kyää, ⁻kyöö

	pres.	*fut.*	*pt.*	*imp.*	
[	སྒྲེལ་	བསྒྲུལ་	བསྒྲུལ་	སྒྲོལ་	]

npf. pf. ımp. mgflı' rıgfıı' gfir, šfıı'

-kyää -kyää -kyää, -kyöö

pres. fııl. pt. mıp.

[àfıı' ngfıı' fiıgw'

`f

Opportunities

PanLex and image-to-text conversion tools

- Benefits to PanLex from tool extensions
- Benefits from PanLex for tool extensions
- Which tool(s) to use and support?
- Multiple tools?
  - Advantages: federation, complementarity, independence
  - Disadvantages: expense, forfeiture of expertise

Opportunities

Partnerships for tool development

- Tool developers
- Possessors of lexical data
- Tool consumers
  - Internet Archive
  - HathiTrust
  - Google
  - Project Gutenberg