Lexical Tools for UMLS Developers

November 4, 2001

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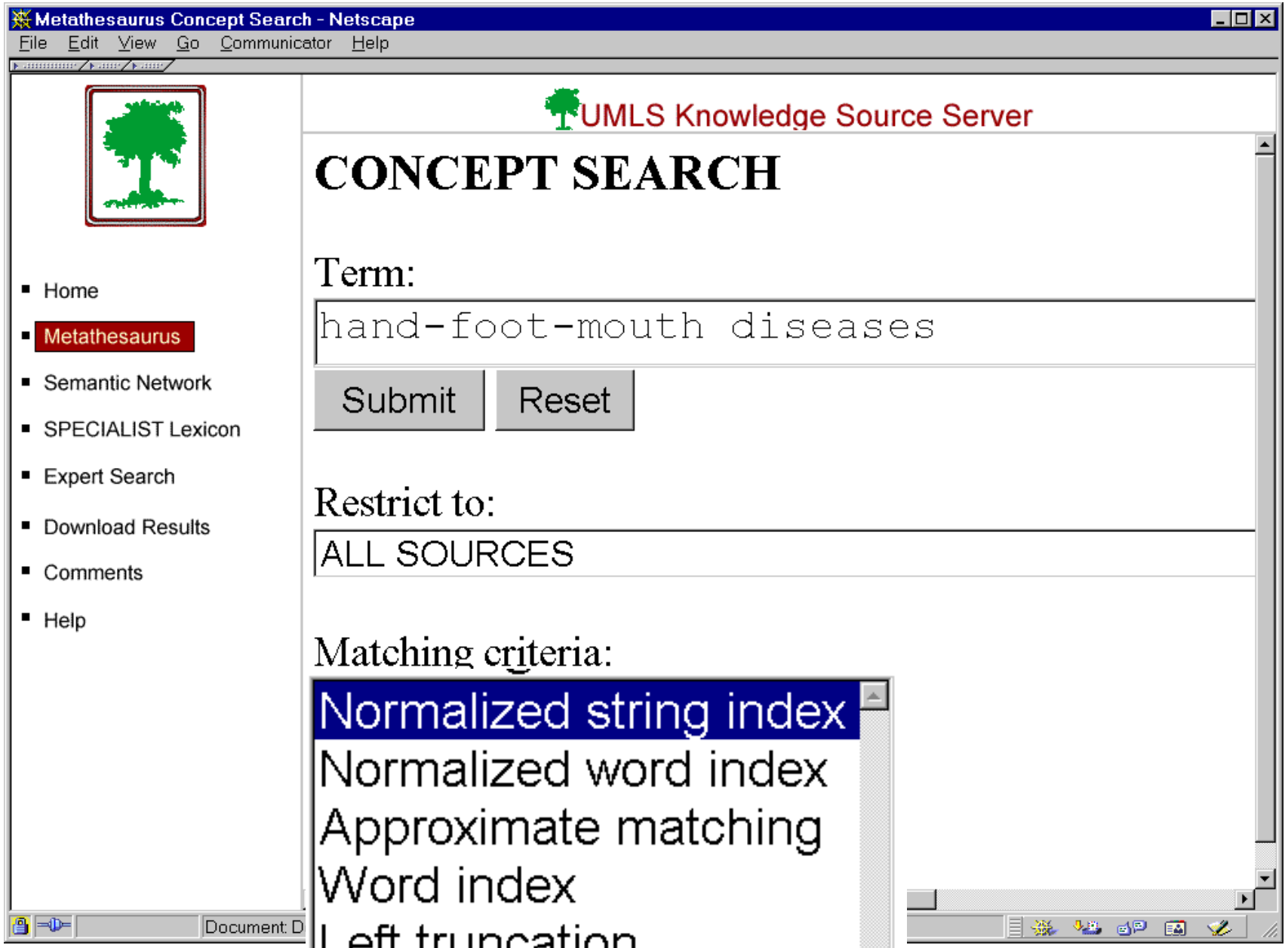
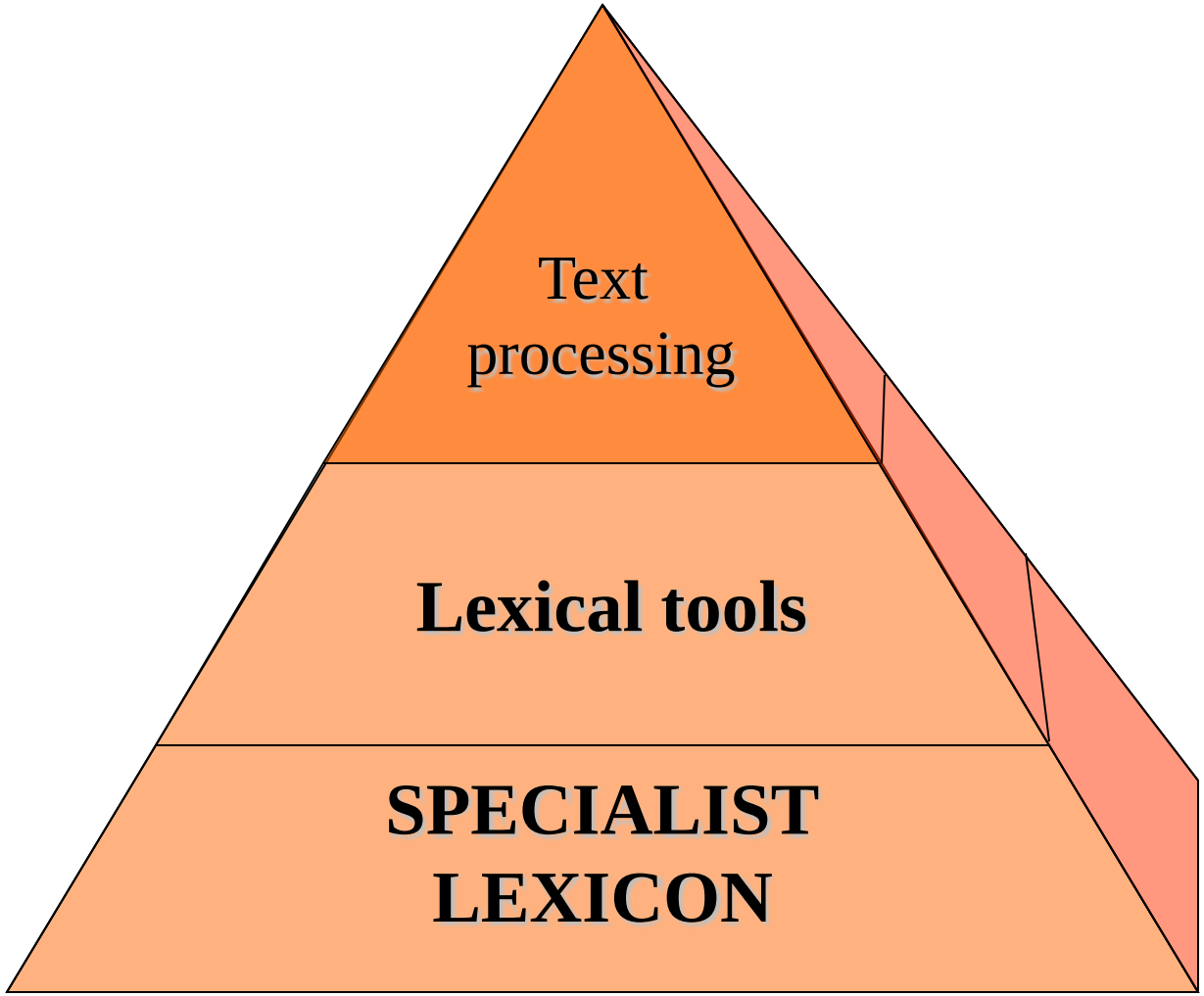
National Library of Medicine


Metathesaurus Concept Search - Netscape
File Edit View Go Communicator Help
UMLS Knowledge Source Server
CONCEPT SEARCH
Home
Metathesaurus
Semantic Network
SPECIALIST Lexicon
Expert Search
Download Results
Comments
Help
Term:
hand-foot-mouth diseases
Submit
Reset
Restrict to:
ALL SOURCES
Matching criteria:
Normalized string index
Normalized word index
Approximate matching
Word index
Left truncation
Right truncation
Document: D

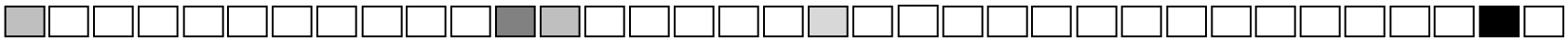
Lexical Tools for UMLS Developers

- The SPECIALIST lexicon – Browne
- The lexical tools – Divita/Lu
- Coffee Break– 10:00 - 10:30
- Lexical tools cont. – Divita/Lu


Text
processing
Lexical tools
SPECIALIST
LEXICON

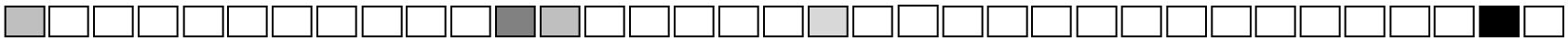
The SPECIALIST Lexicon

- A syntactic lexicon
- Biomedical and general English
- Over 160,000 records

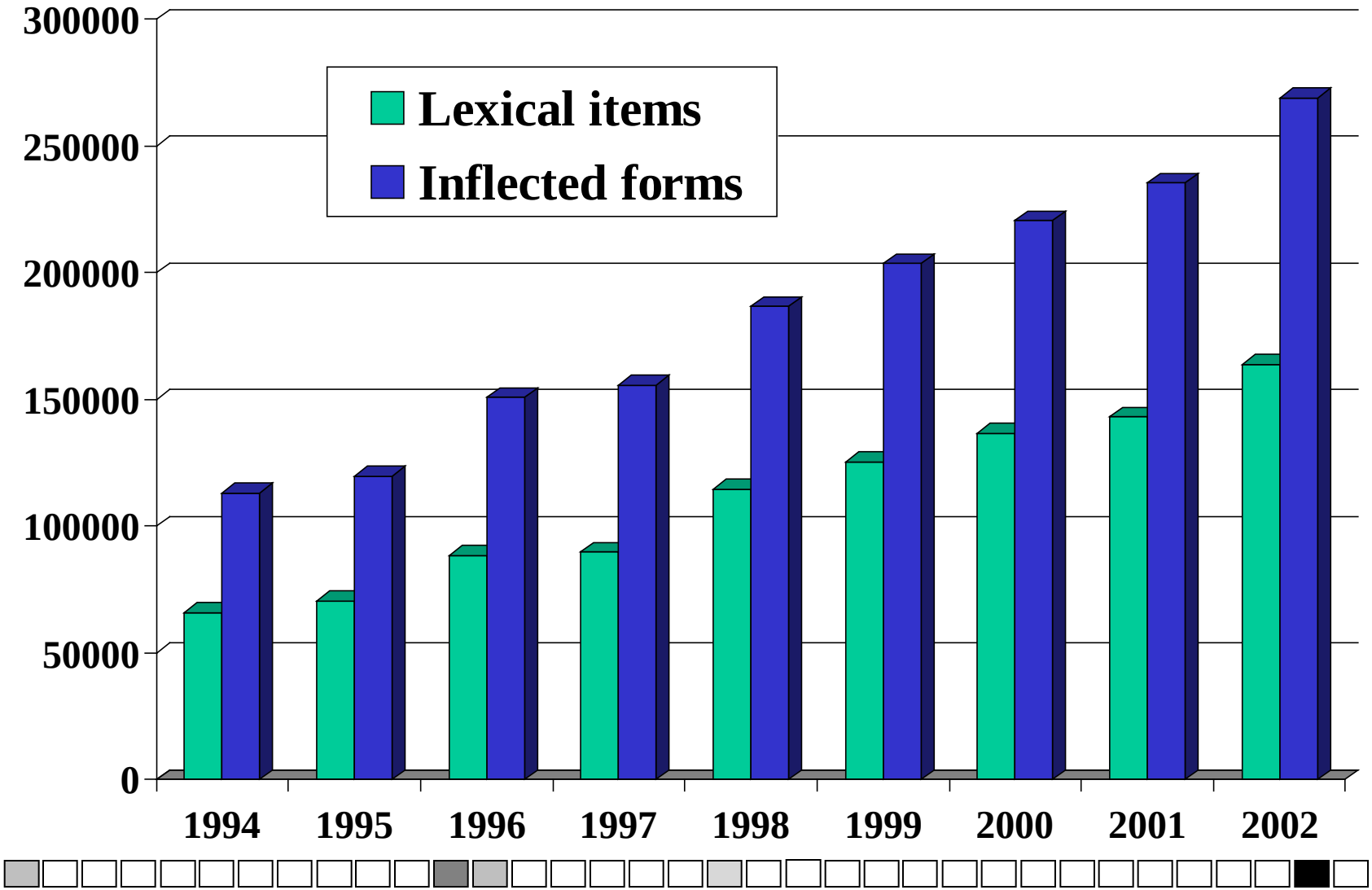


The SPECIALIST Lexicon

- General English:
- 10,000 most frequent words from the American Heritage word frequency list
- 2,000 words used by Longman's Dictionary of Contemporary English
- Verbs and adjectives identified by heuristics



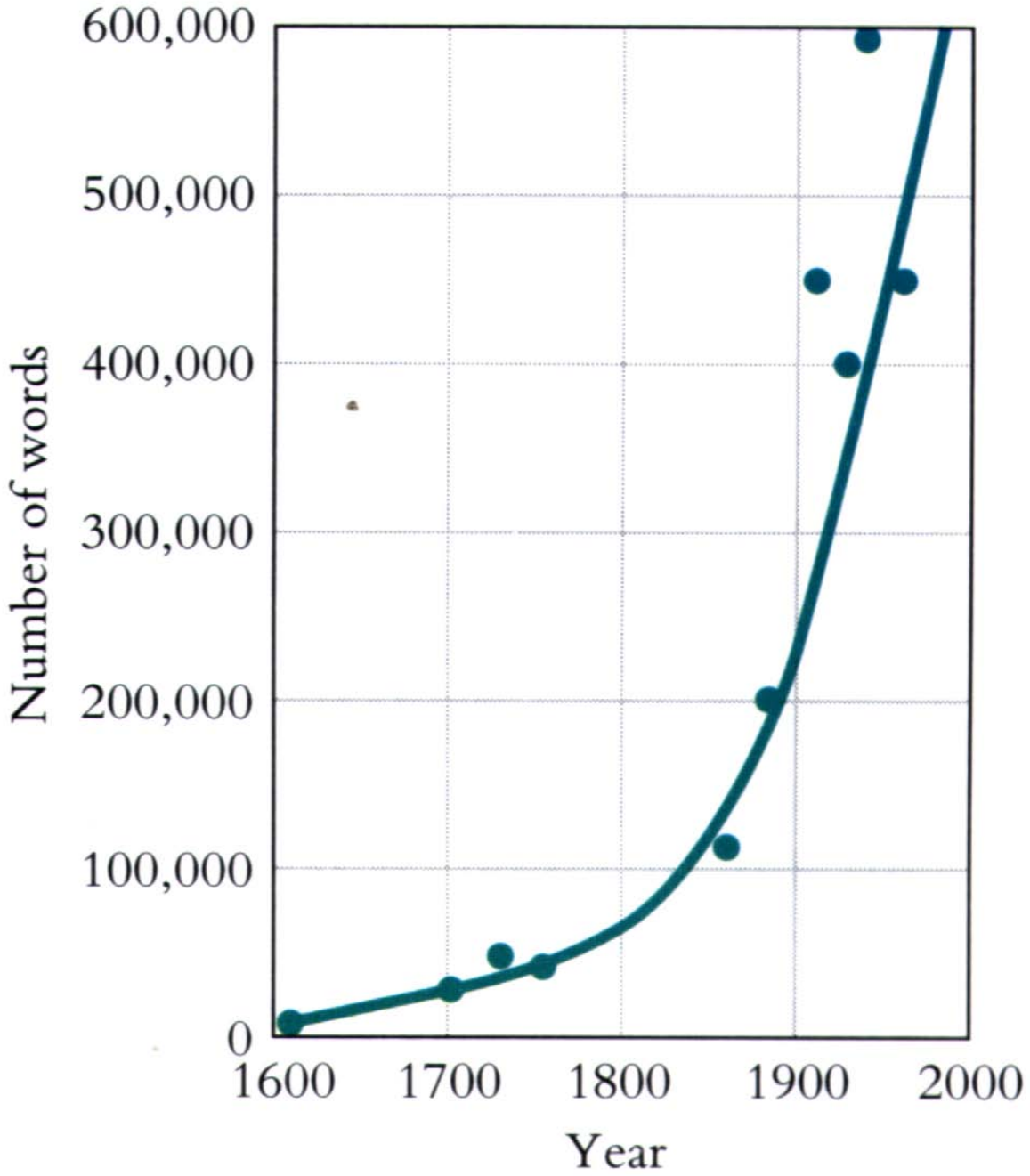
Lexicon Growth



George A. Miller

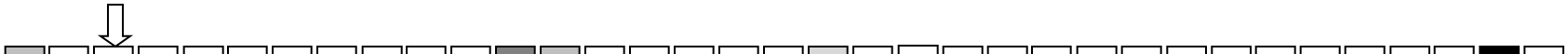
The Science of Words

1991



The SPECIALIST Lexicon

- Morphology
  - Inflection
  - Derivation
- Orthography
  - Spelling variants
- Syntax
  - Complementation for verbs, nouns, and adjectives



Morphology

- Inflectional
  - nucleus -- nuclei
  - cauterize, cauterizes, cauterized, cauterizing
  - red, redder reddest
- Derivational
  - laryngeal -- larynx
  - transport -- transportation

Orthography

Spelling Variation

- **align -- aline**
- **Grave’s disease -- Graves’s disease -- Graves’ disease**
- **anesthetize -- anesthetise**
- **esophagus -- oesophagus**

British and American Spelling

- Criticise -- criticize
- naturalise --naturalize
- centre -- center
- foetus -- fetus

Try This Test

Which of the variant spellings below do you, accept as standard American English? After making your choices, consult the pages of this book to see what the dictionaries say. You are due for some astonishments.

A Comparative Study of Spellings in four major collegiate dictionaries,
by Lee C Deighton,
Hardscrabble Press 1972.

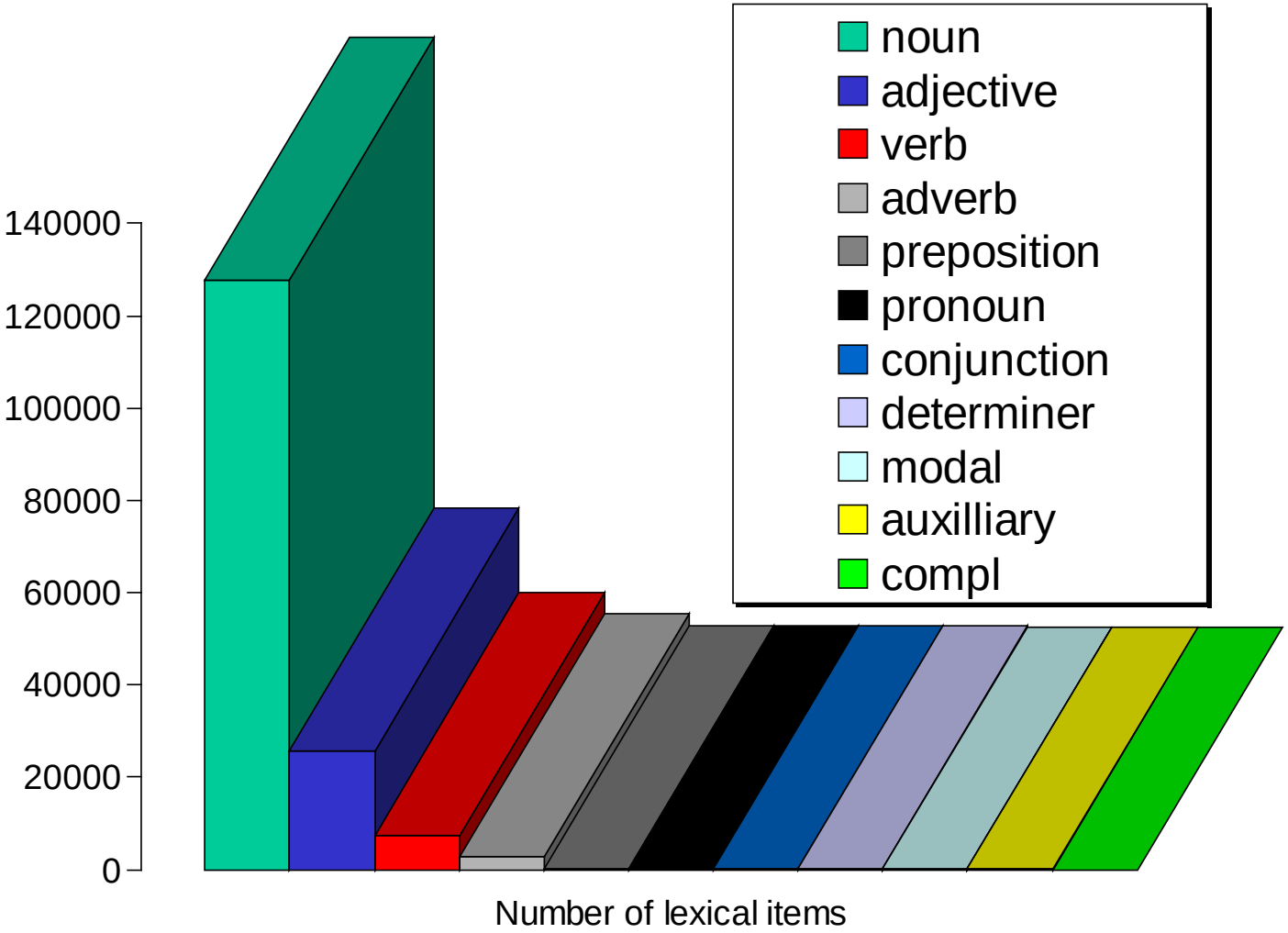
Syntax -- Verb Complements

- Intran
  - I’ll treat.
- tran=np
  - He treated the patient.
- ditran=np,pphr(with,np)
  - She treated the patient with the drug.

Syntax -- Verb Complements

{base=treat
entry=E0061964
cat=verb
variants=reg
intran
tran=np
tran=pphr(with,np)
tran=pphr(of,np)
ditran=np,pphr(to,np)
ditran=np,pphr(with,np)
ditran=np,pphr(for,np)
cplxtran=np,advbl
nominalization=treatment|noun|E0061968
}

The 2002 SPECIALIST Lexicon



village square the circle

square square

fair and square root

Lexicon Unit Records

{**base=**Kaposi's sarcoma
spelling_variant=Kaposi sarcoma
entry=E0003576
cat=noun
variants=uncount
variants=reg
variants=glreg
}

{**base**=chronic
entry=E0016869
cat=adj
variants=inv
position=attrib(1)
position=pred
stative
}

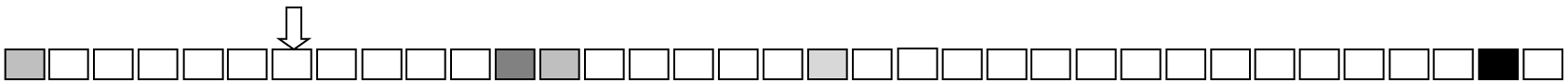
{**base**=aspirate
entry=E0010803
cat=verb
variants=reg
tran=np
nominalization=aspiration|noun|E0010804
}

{**base**=in
entry=E0033870
cat=prep
}

Noun Variants

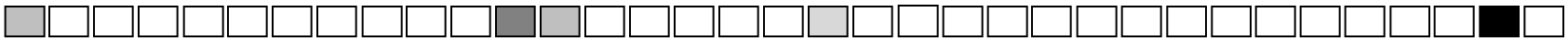
{base=Kaposi's sarcoma
spelling_variant=Kaposi sarcoma
entry=E0003576
cat=noun
variants=uncount
variants=reg
variants=glreg
}

- Kaposi’s sarcoma
- Kaposi’s sarcomas
- Kaposi’s sarcomata
- Kaposi sarcoma
- Kaposi sarcomas
- Kaposi sarcomata



Regular Nouns

The plural suffix is *s*.
y becomes *ie* following a consonant before *s*.
e is inserted before s if the base ends in *s*, *z*, *x*, *ch*, or *s*

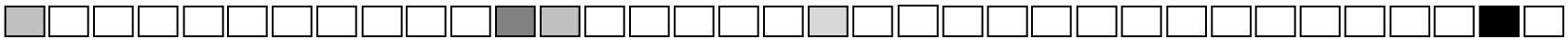


Regular Nouns

Base ends with	Plural ends with	Examples
Cy	Cies	fly: flies
-s	-ses	illness: illnesses
-z	-zes	waltz: waltzes
-x	-xes	box: boxes
-ch	-ches	match: matches
-sh	-shes	splash: splashes
X	Xs	book: books

Greco-latin Regular nouns

singular ends with:	plural ends with:	Examples
–us	–i	focus/foci
–ma	–mata	trauma/traumata
–a	–ae	larva/larvae
–um	–a	ilium/ilia
–on	–a	taxon/taxa
–sis	–ses	analysis/analyses
–is	–ides	cystis/cystides
–men	–mina	foramen/foramina
–ex	–ices	index/indices
–x	–ces	matrix/matrices



Uncount Nouns
(abstract or mass)

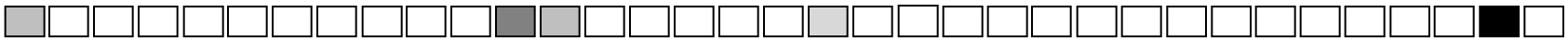
```
{base=smallpox
entry=E0056359
        cat=noun
        variants=uncount
}
{base=potassium
entry=E0049387
        cat=noun
        variants=uncount
}
```

- * a smallpox
- * two smallpoxes
- much smallpox
- * a potassium
- * two potassiums
- much potassium

Fixed Plural Nouns

{base=police
entry=E0048616
cat=noun
variants=plur
}

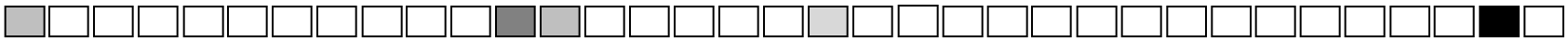
{base=scissors
entry=E0054633
cat=noun
variants=plur
}



Irregular Nouns

{base=corpus
entry=E0019113
cat=noun
variants=irreg|corpora|
variants=reg
}

{base=larynx
entry=E0036919
cat=noun
variants=irreg|larynges|
variants=reg
}



Regular Verbs

- The third person present tense suffix is *s*.
  - *y* becomes *ie* following a consonant before *s*.
  - *e* is inserted between z, x, ch, or sh and *s*.
- The past tense suffix is *ed*.
  - *y* becomes *ie* following a consonant before *ed*.
  - Final *e* is deleted before *ed*.

Regular Verbs

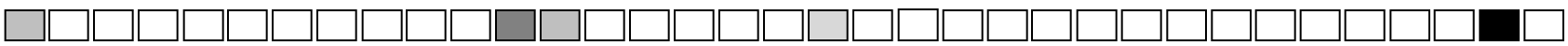
- dismiss:dismisses, dismissed, dismissing
- agree: agrees; agreed; agreeing
- dry: dries, dried, drying

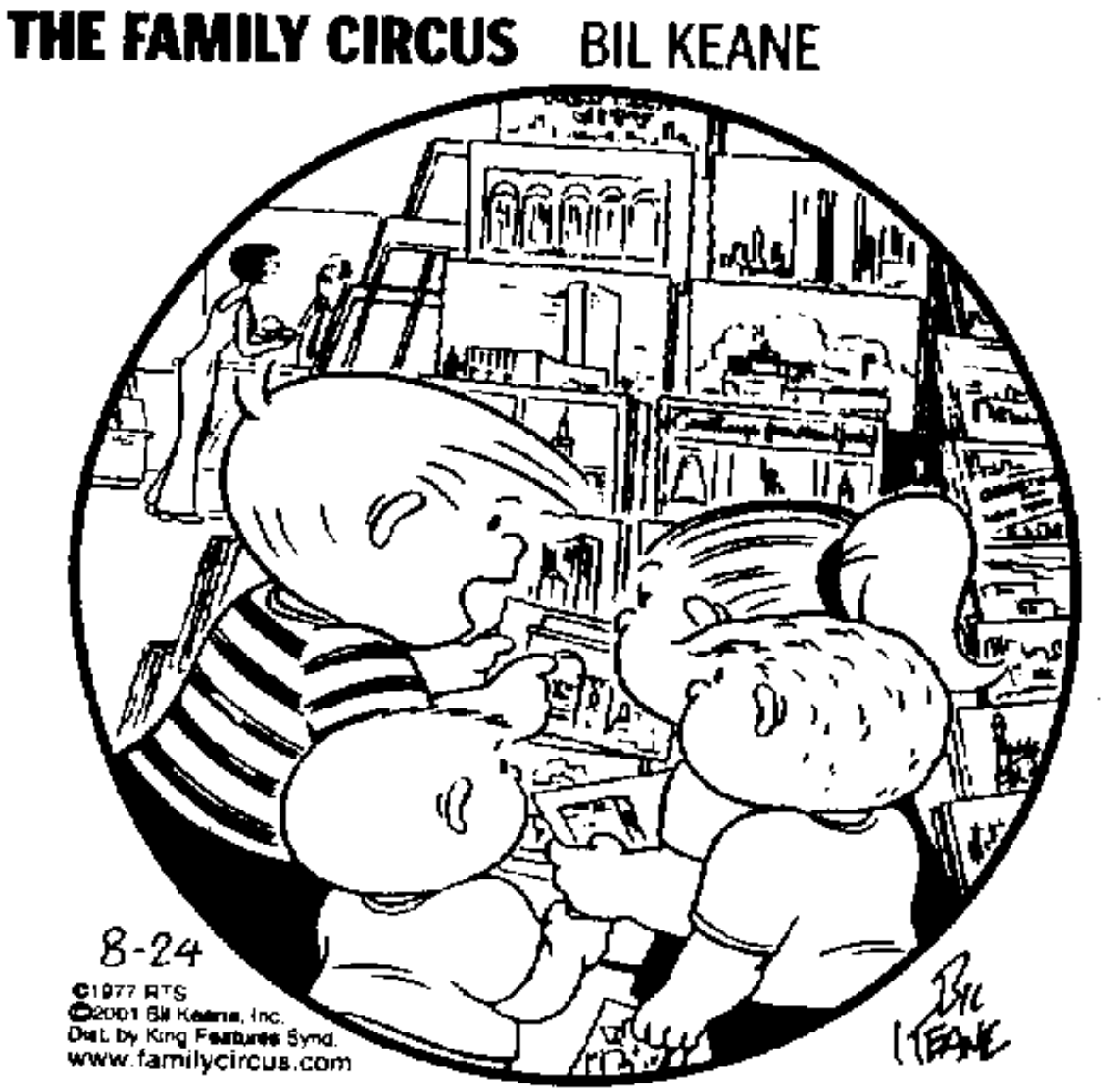
Regular Doubling Verbs

- End in a CVC pattern
- Double the final consonant before *ed* and *ing*.
- Are otherwise regular
- variants=regd
- e.g. control: controls, controlled, controlling

Irregular Verbs

{base=dive
cat=verb
variants=reg
variants=irreg|dives|dove|dove|diving|
intran
intran;part(in)
...
}





"There's the place we sightsaw yesterday."

Defective Verb

sightsee
***sightsees**
***sightsaw**
***sightseen**
sightseeing

Regular Adjectives and Adverbs

- The comparative suffix is *er*.
- The superlative suffix is *est*.
  - *y* become *ie* after a consonant before *er* or *est*.
  - Final *e* is deleted before *er* or *est*.
- e.g. green: greener, greenest

Regular Doubling Adjectives and Adverbs

- CVC final pattern
- Final consonant is doubled before ed or est.
- Otherwise regular
- e.g. red: redder, reddest

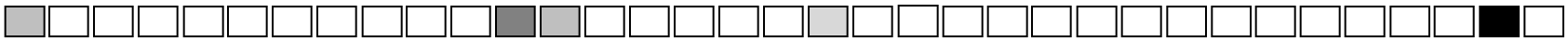
Ancillary Data Bases

- Synonymy
  - sm.db
- Derivation
  - dm.db, dm.rules
- Inflection
  - im.rules
- Neoclassical compounds
  - nc.db

Derivational Facts and Rules

dm.facts

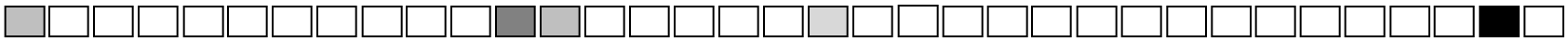
treatment|noun|treat|verb
prohibition|noun|prohibitive|adj
cell lineage|noun|cell line|noun
photochemotherapeutic|adj|photochemotherapy|noun
pharmacotherapeutic|adj|pharmacotherapy|noun



Derivational Facts and Rules

dm.rules

 # e.g. alienation|alienate
ation$|noun|ate|verb
ration|rate; station|state;



Inflectional Facts and Rules

im.rules

```
# Noun rules (glreg)
us$|noun|singular|i$|noun|plural
    antus|anti;
ma$|noun|singular|mata$|noun|plural
a$|noun|singular|ae$|noun|plural
um$|noun|singular|a$|noun|plural
on$|noun|singular|a$|noun|plural
sis$|noun|singular|ses$|noun|plural
is$|noun|singular|ides$|noun|plural
men$|noun|singular|mina$|noun|plural
ex$|noun|singular|ices$|noun|plural
x$|noun|singular|ces$|noun|plural
```

Neoclassical compounds

nc.db

abdomin(o)|abdomen|root
ab|away from|prefix
acanth(o)|prickle|root
acar(o)|mite|root
acetabul(o)|acetabulum|root
ad|towards|prefix
agogue|inducing|terminal
albumin(o)|albumin|root
sis|condition|terminal
stomy|surgical opening|terminal

Synonyms

sm.db

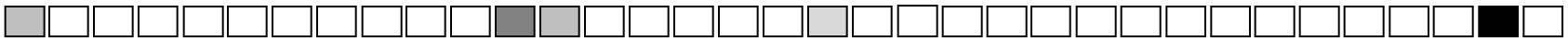
alar|adj|wing|noun
amygdaline|adj|tonsil|noun
articular|adj|joint|noun
bulbar|adj|medulla oblongata|noun
fununcular|adj|boil|noun
genicular|adj|knee|noun
hepatocellular|adj|liver cells|noun
lazar|adj|leprosy|noun
lenticular|adj|crystalline lens|noun
ypsiliform|adj|upsiloid|adj
wolfram|noun|tungsten|noun
double vision|noun|diplopia|noun

Relational Tables

- One line records
- Pipe separated Fields -- “|”
- Keyed to EUI
- LRAGR matches forms to EUIs
- Word index: LRWD

Relational Tables

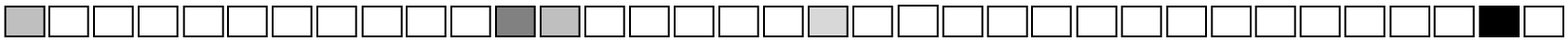
- LRAGR - Agreement
- LRCMP - Complements
- LRFIL - Files
- LRFLD - Fields
- LRMOD - Modification
- LRNOM - Nominalization
- LRPRN - Pronouns
- LRPRP - Properties
- LRSPL - Spelling
- LRTRM - Trademarks
- LRWD - Word index



LRAGR

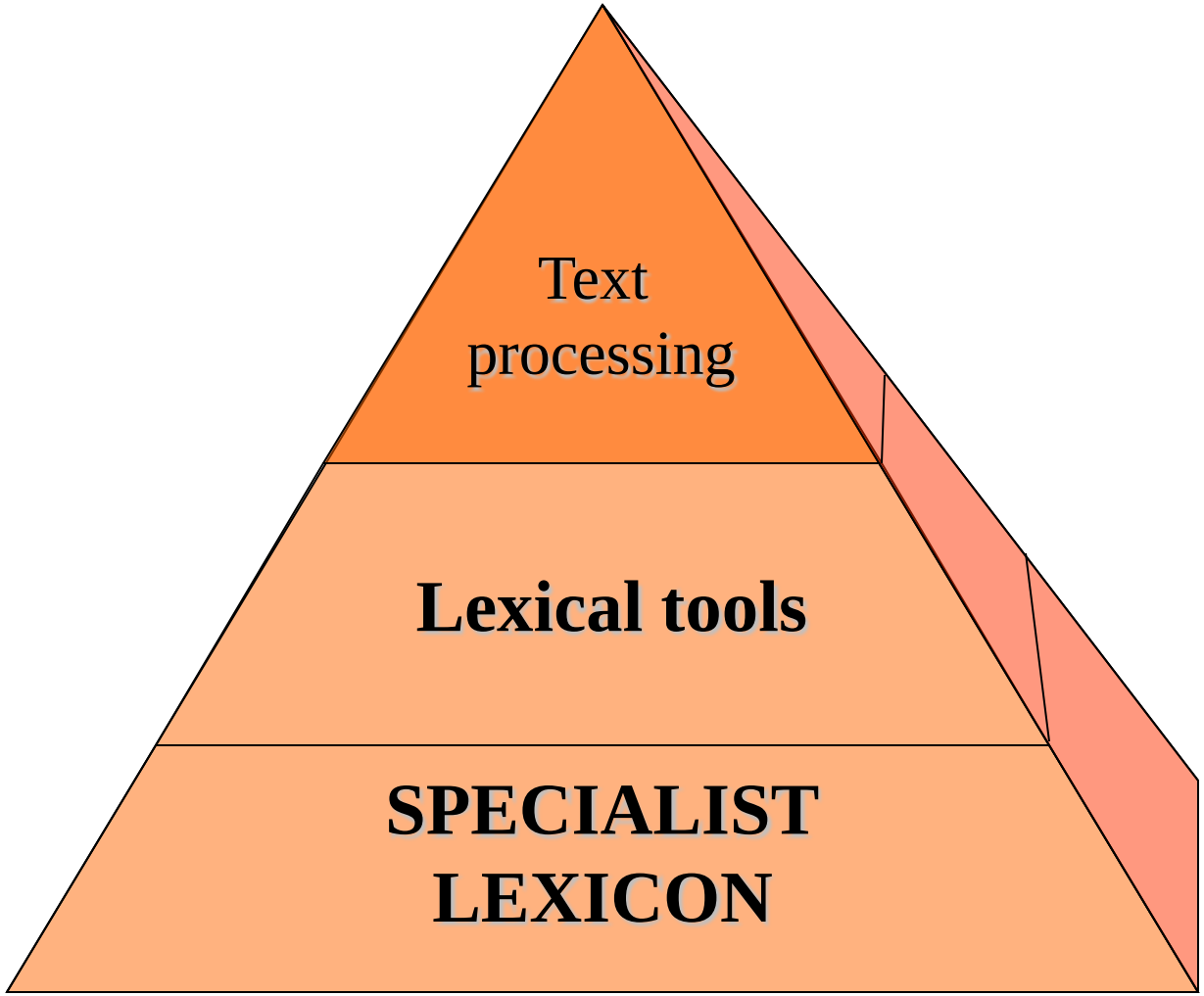
Agreement and Inflection

- EUI - Entry ID
- STR - Inflected form
- SCA - Syntactic category
- AGR - agreement information
- BAS - Base form (morphological)
- CIT - Citation form (base=)



LRAGR

E0003576| Kaposi sarcomas| noun| count(thr_plur)| Kaposi sarcoma| Kaposi's sarcoma|
E0003576| Kaposi sarcomata| noun| count(thr_plur)| Kaposi sarcoma| Kaposi's sarcoma|
E0003576| Kaposi sarcoma| noun| count(thr_sing)| Kaposi sarcoma| Kaposi's sarcoma|
E0003576| Kaposi sarcoma| noun| uncount(thr_sing)| Kaposi sarcoma| Kaposi's sarcoma|
E0003576| Kaposi's sarcomas| noun| count(thr_plur)| Kaposi's sarcoma| Kaposi's sarcoma|
E0003576| Kaposi's sarcomata| noun| count(thr_plur)| Kaposi's sarcoma| Kaposi's sarcoma|
E0003576| Kaposi's sarcoma| noun| count(thr_sing)| Kaposi's sarcoma| Kaposi's sarcoma|
E0003576| Kaposi's sarcoma| noun| uncount(thr_sing)| Kaposi's sarcoma| Kaposi's sarcoma|


Text
processing
Lexical tools
SPECIALIST
LEXICON

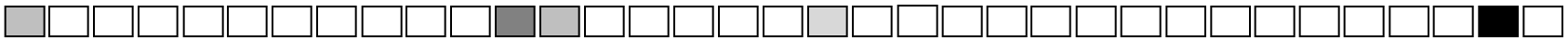
Lexical Tools

- Wordind -- breaks strings into words
  - Produces the Metathesaurus word indexes (MRXW)
- LVG -- performs various lexical transformations
- NORM -- a selection of LVG transformations,
  - Used for Metathesaurus indexing
  - Produces the Metathesaurus Normalized word and string indexes (MRXNW & MRXNS)
  - Used to access those indexes

Normalization

- **Hodgkin Disease**
- **HODGKINS DISEASE**
- **Hodgkin's Disease**
- **Disease, Hodgkin's**
- **HODGKIN'S DISEASE**
- **Hodgkin's disease**
- **Hodgkins Disease**
- **Hodgkin's disease NOS**
- **Hodgkin's disease, NOS**
- **Disease, Hodgkins**
- **Diseases, Hodgkins**
- **Hodgkins Diseases**
- **Hodgkins disease**
- **hodgkin's disease**
- **Disease;Hodgkins**
- **Disease, Hodgkin**

- **Disease hodgkin**



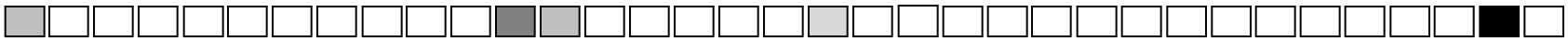
Lexical Tools

The Lexical Tools

- Introduction
- Norm/WordInd/Lvg
- Details, Details and More Details …
- Installation
- Embedding This into Your Application
- Using The Lexical Tools with The Metathesaurus
- Building an Index Using The Lexical Tools
- Plans for 2003 and Beyond

Lexical Tools: Introduction

- These tools:
  - Includes Norm,WordInd, and Lvg
  - Pure Java based
  - Command line tools
  - Java APIs



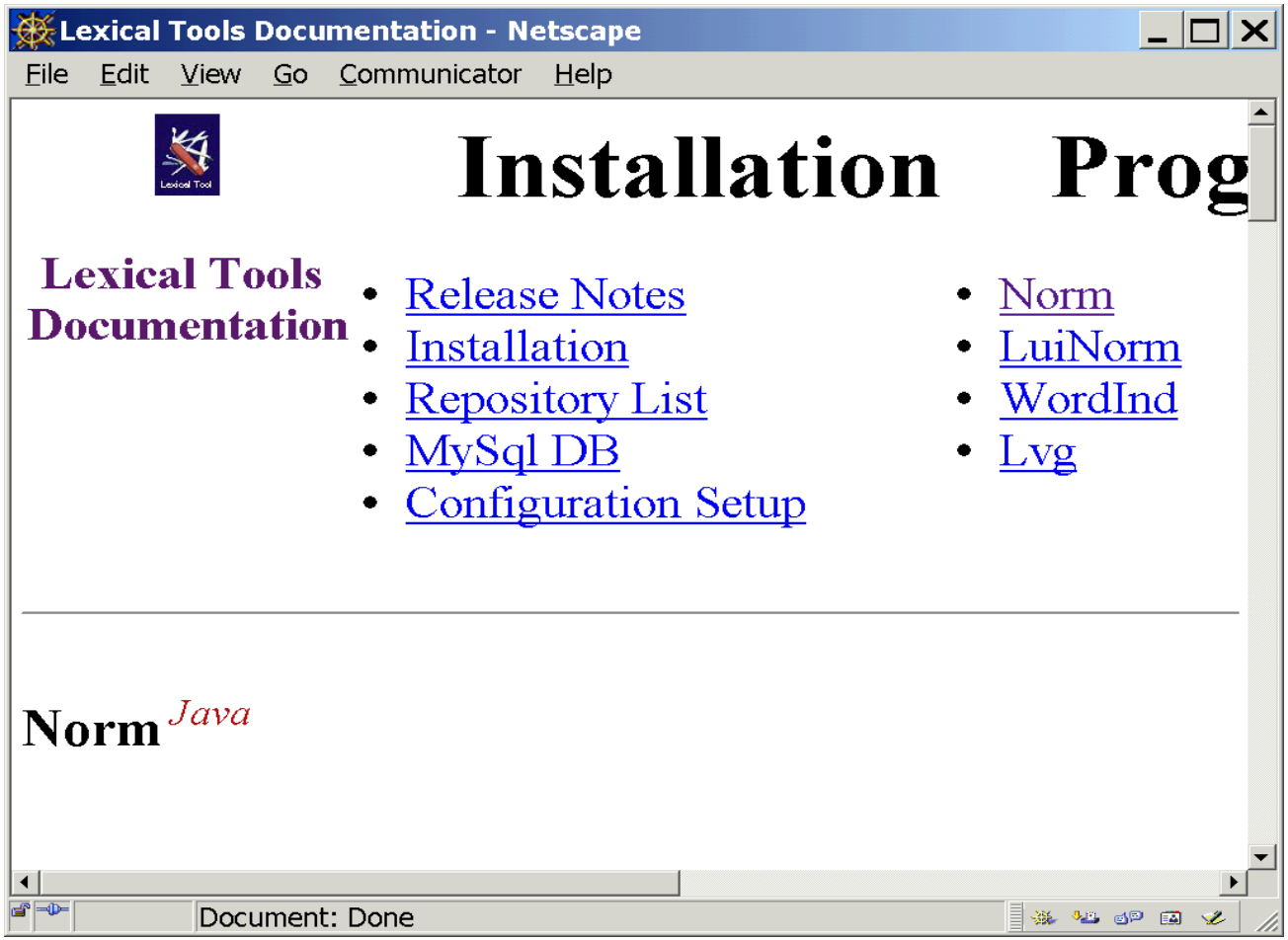
Lexical Tools: Introduction

- These tools are good for
  - aggressive text pattern matching
  - making word, term, phrase indexes
  - matching queries with indexed entries
  - increasing recall and/or precision

Lexical Tools: Introduction

- Characteristics of all the command line tools
  - take input from the screen or a file
  - put their results to the screen or a file
  - Interpret fielded text
    - Can be told which fields contain what type of information

Lexical Tools: Norm

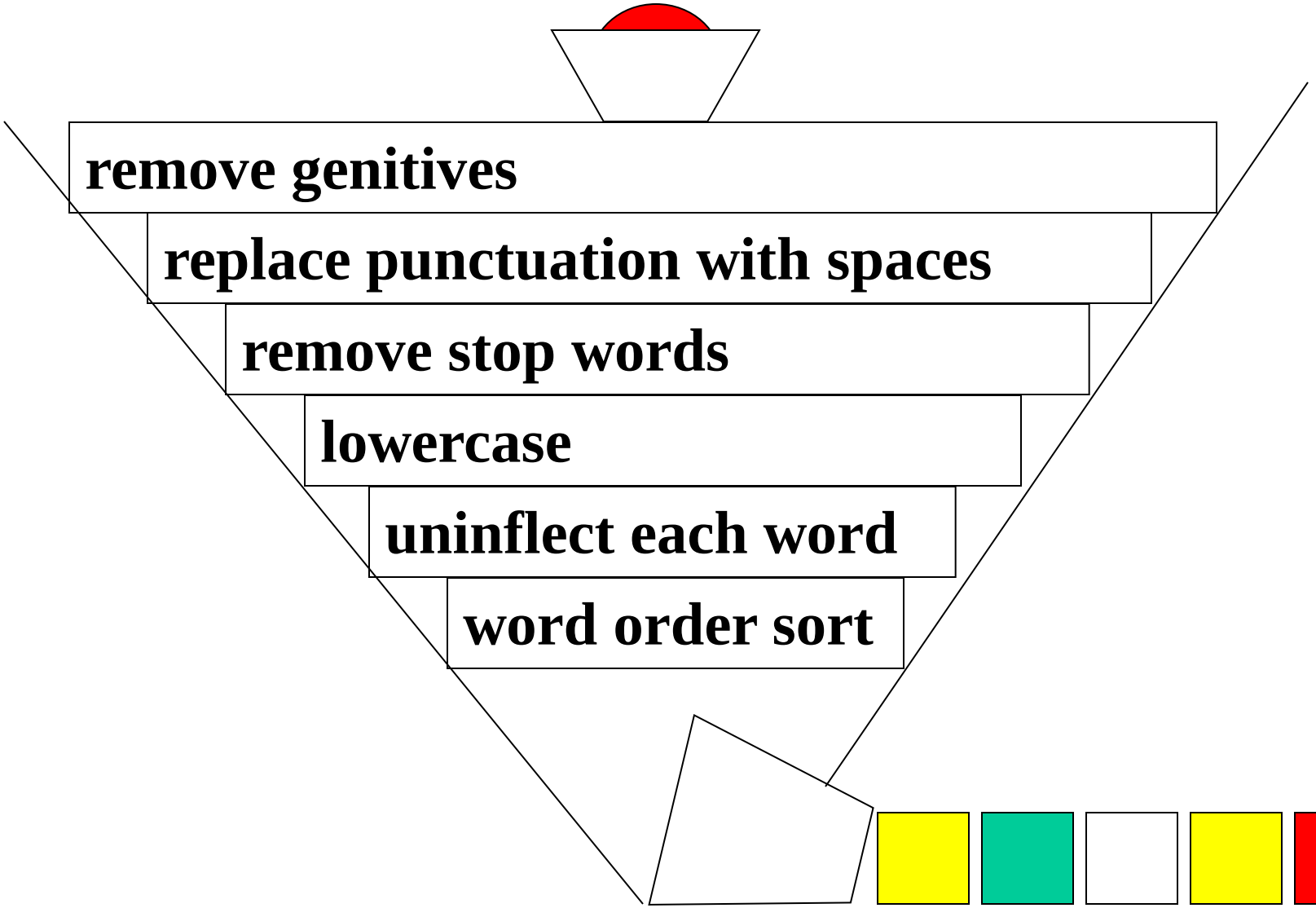


Lexical Tools: Norm

- Norm abstracts away from:
  - case
  - Punctuation
  - word order
  - possessive forms
  - inflectional variation

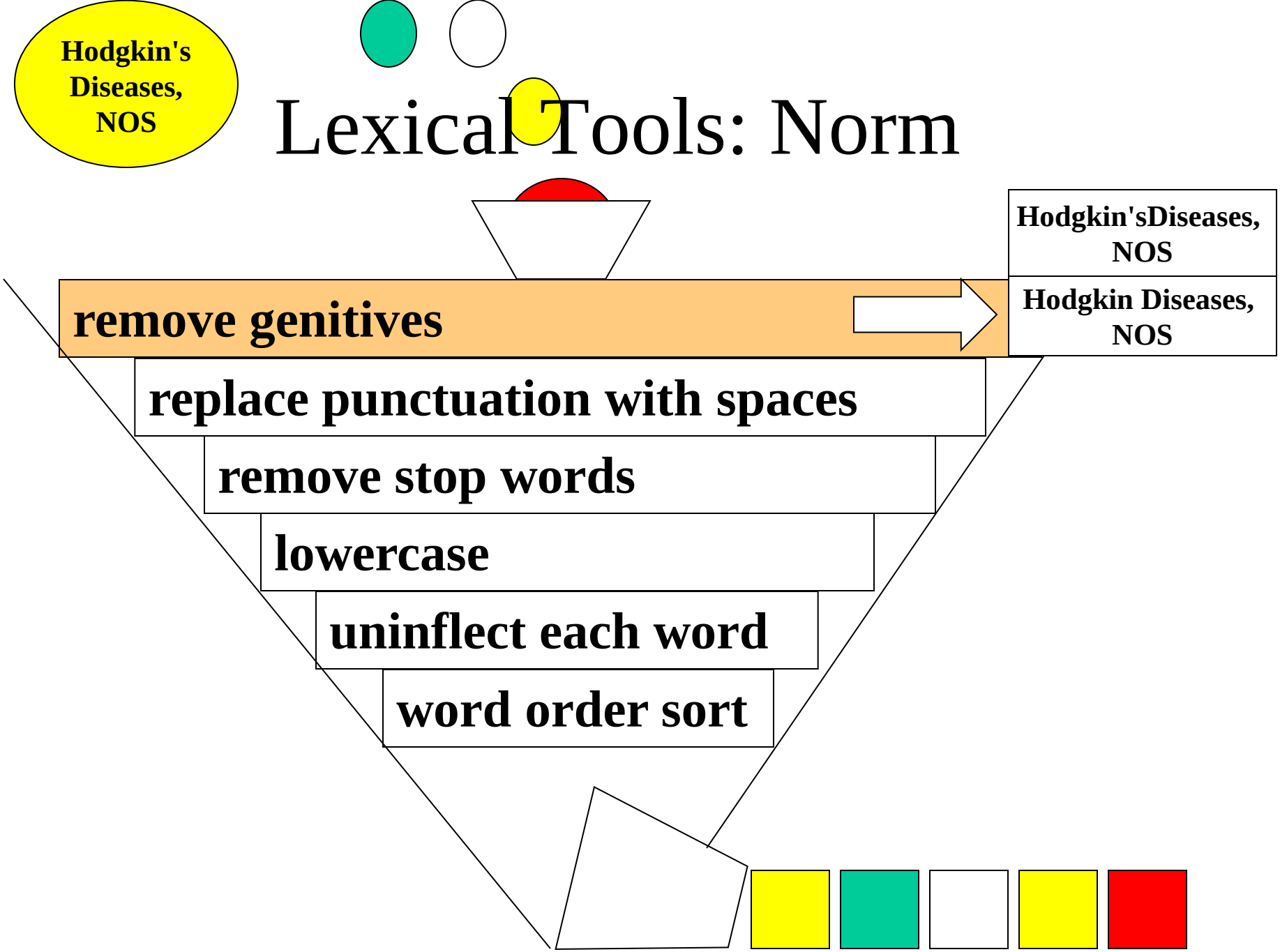
Hodgkin's Diseases, NOS

Lexical Tools: Norm



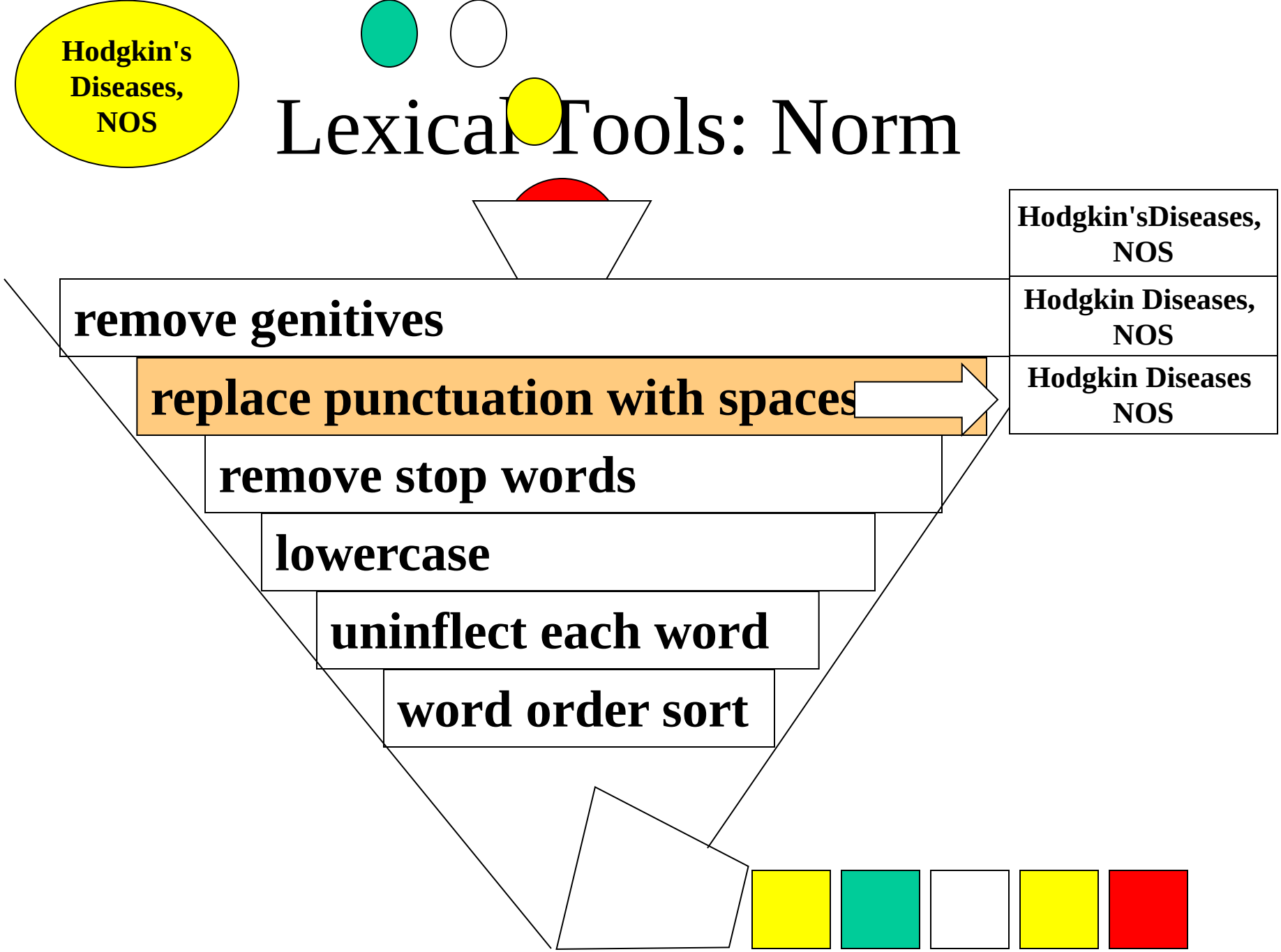
Hodgkin's Diseases, NOS

Lexical Tools: Norm



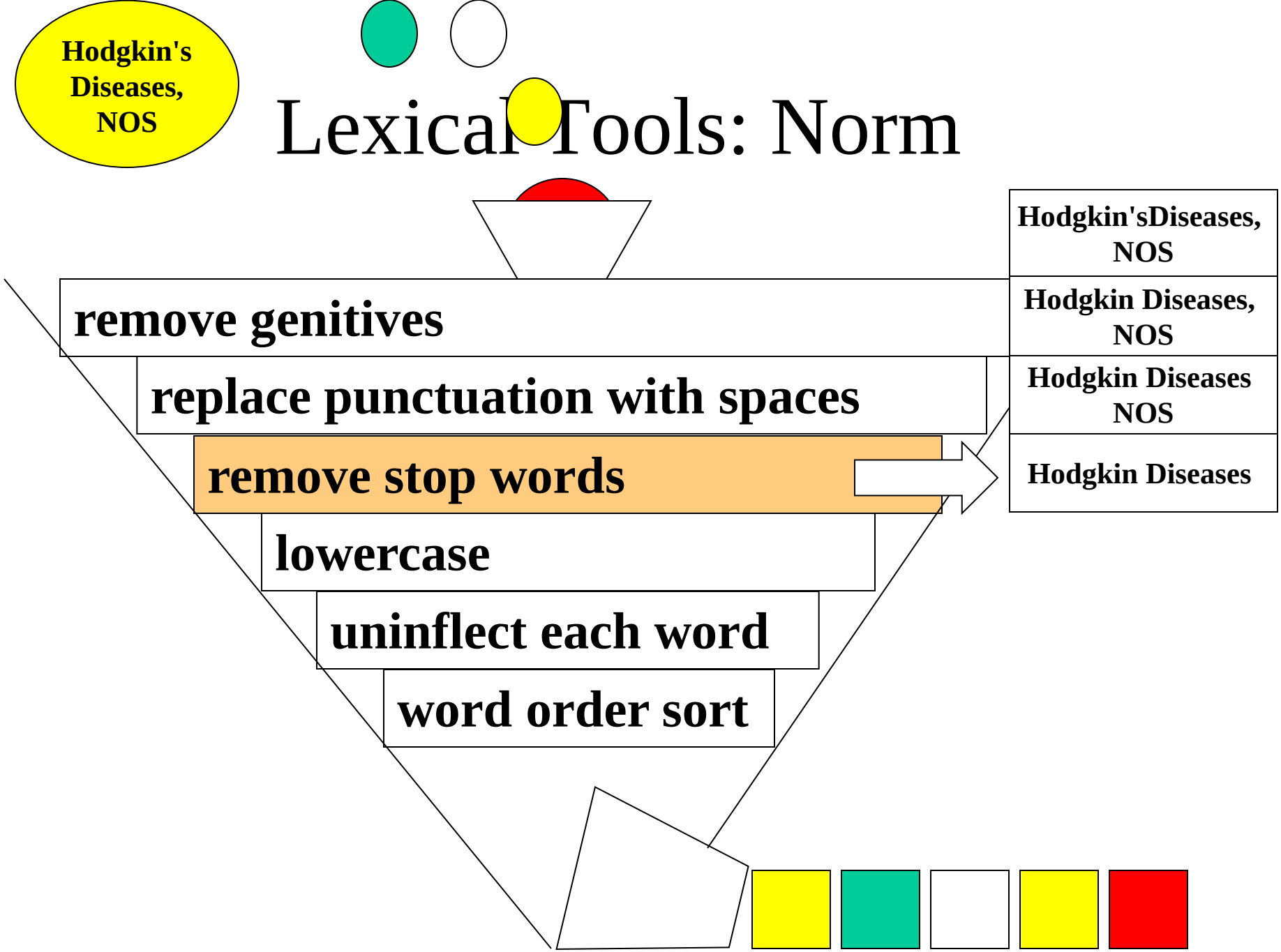
Hodgkin's Diseases, NOS

Lexical Tools: Norm



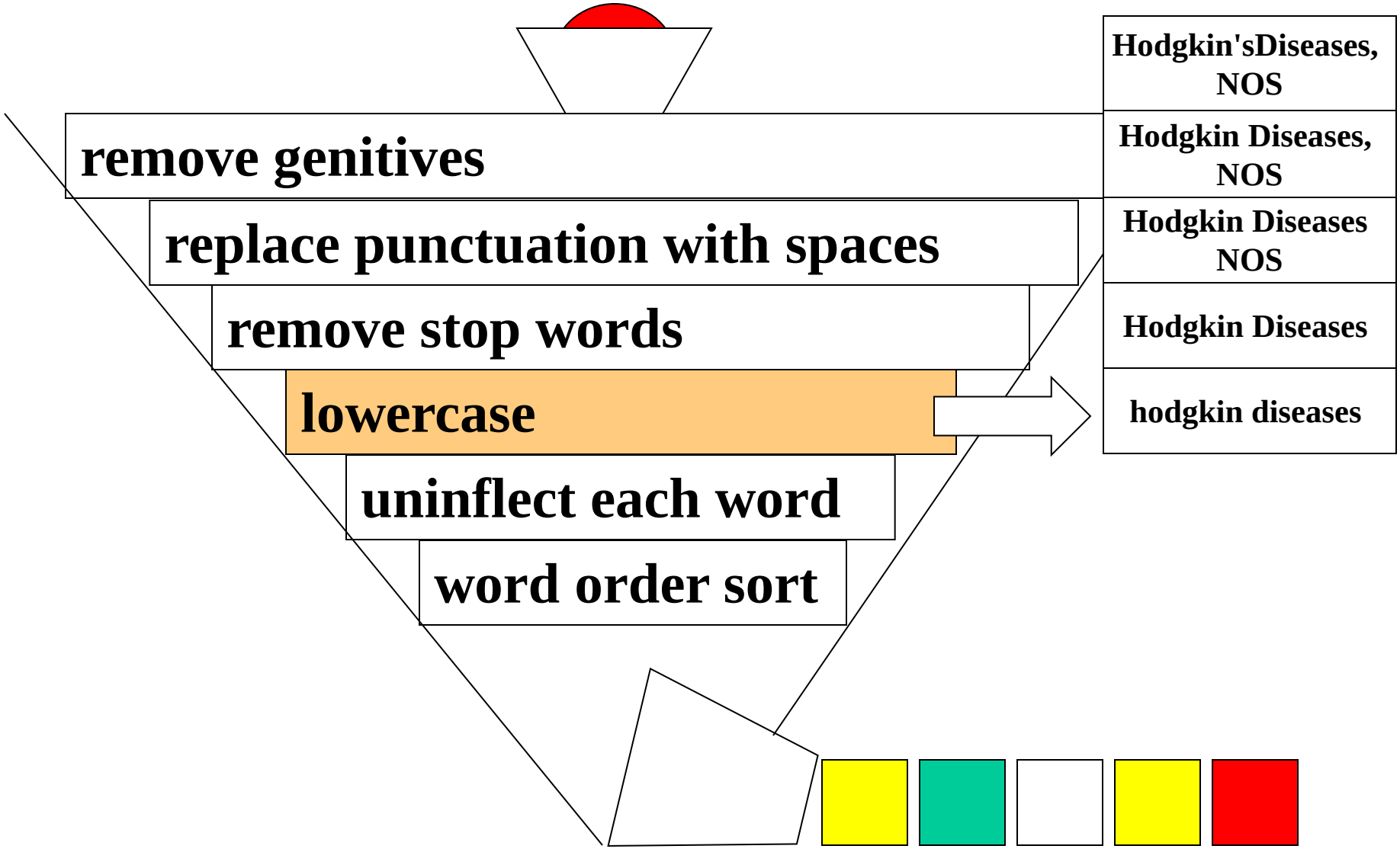
Hodgkin's Diseases, NOS

Lexical Tools: Norm



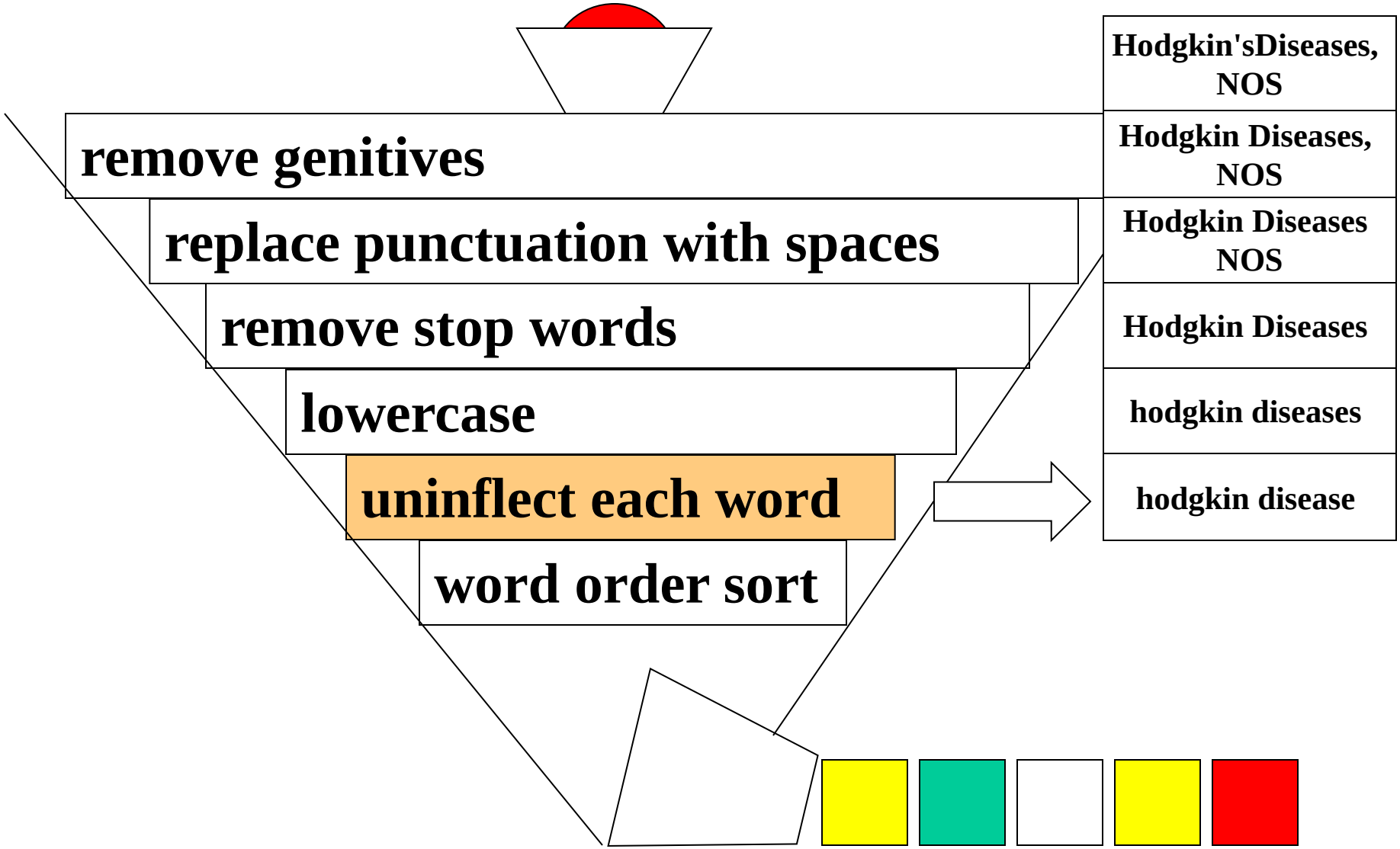
Hodgkin's Diseases, NOS

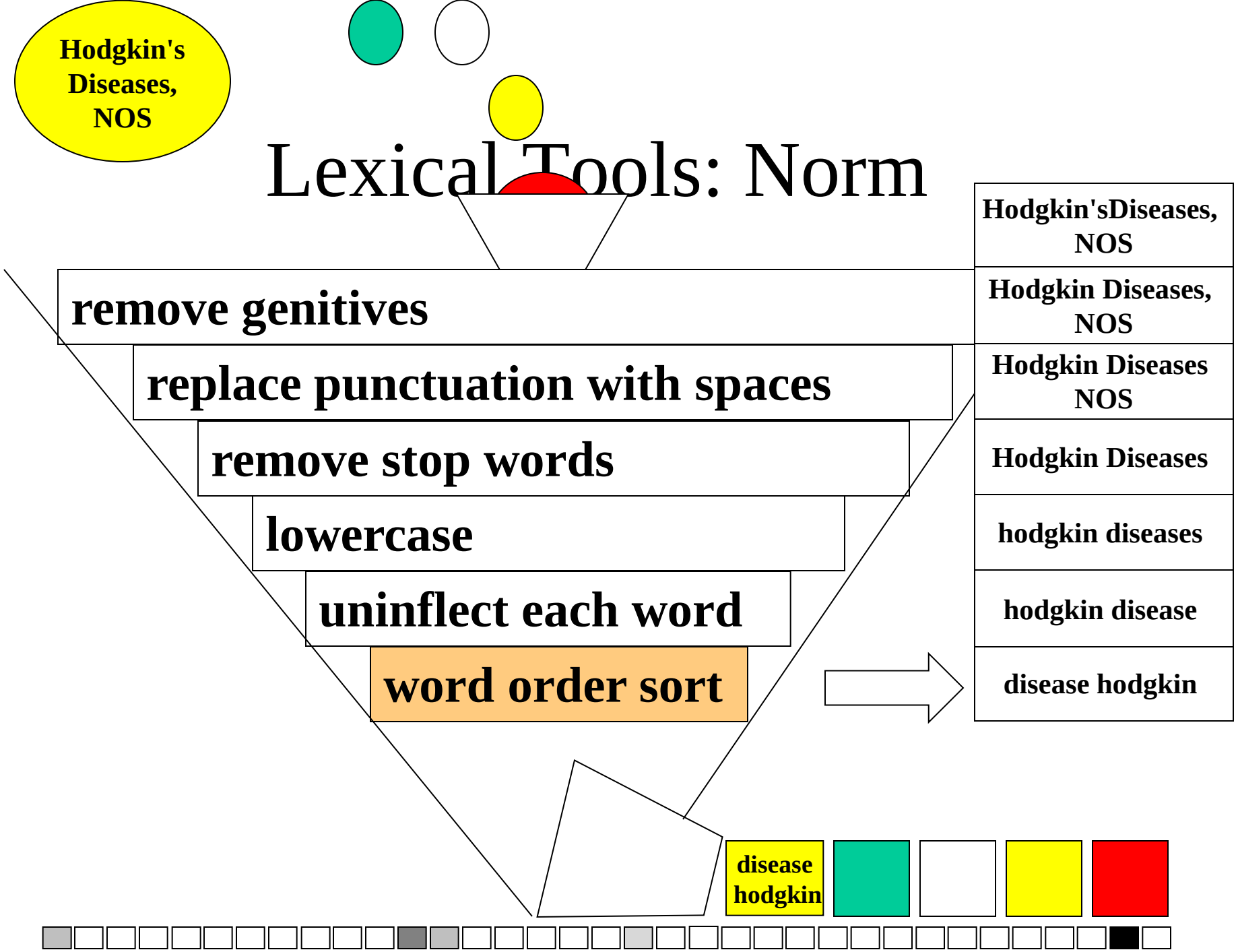
Lexical Tools: Norm



Hodgkin's Diseases, NOS

Lexical Tools: Norm




Hodgkin's Diseases, NOS
Lexical Tools: Norm
remove genitives
replace punctuation with spaces
remove stop words
lowercase
uninflect each word
word order sort
Hodgkin'sDiseases, NOS
Hodgkin Diseases, NOS
Hodgkin Diseases NOS
Hodgkin Diseases
hodgkin diseases
hodgkin disease
disease hodgkin
disease hodgkin

Lexical Tools: Norm

Down's Syndrome Down Syndrome	down syndrome
Acetolyses acetolysis	acetolysis
Lung cancer Cancer, lung	cancer lung

Norm to

Lexical Tools: Norm

> norm

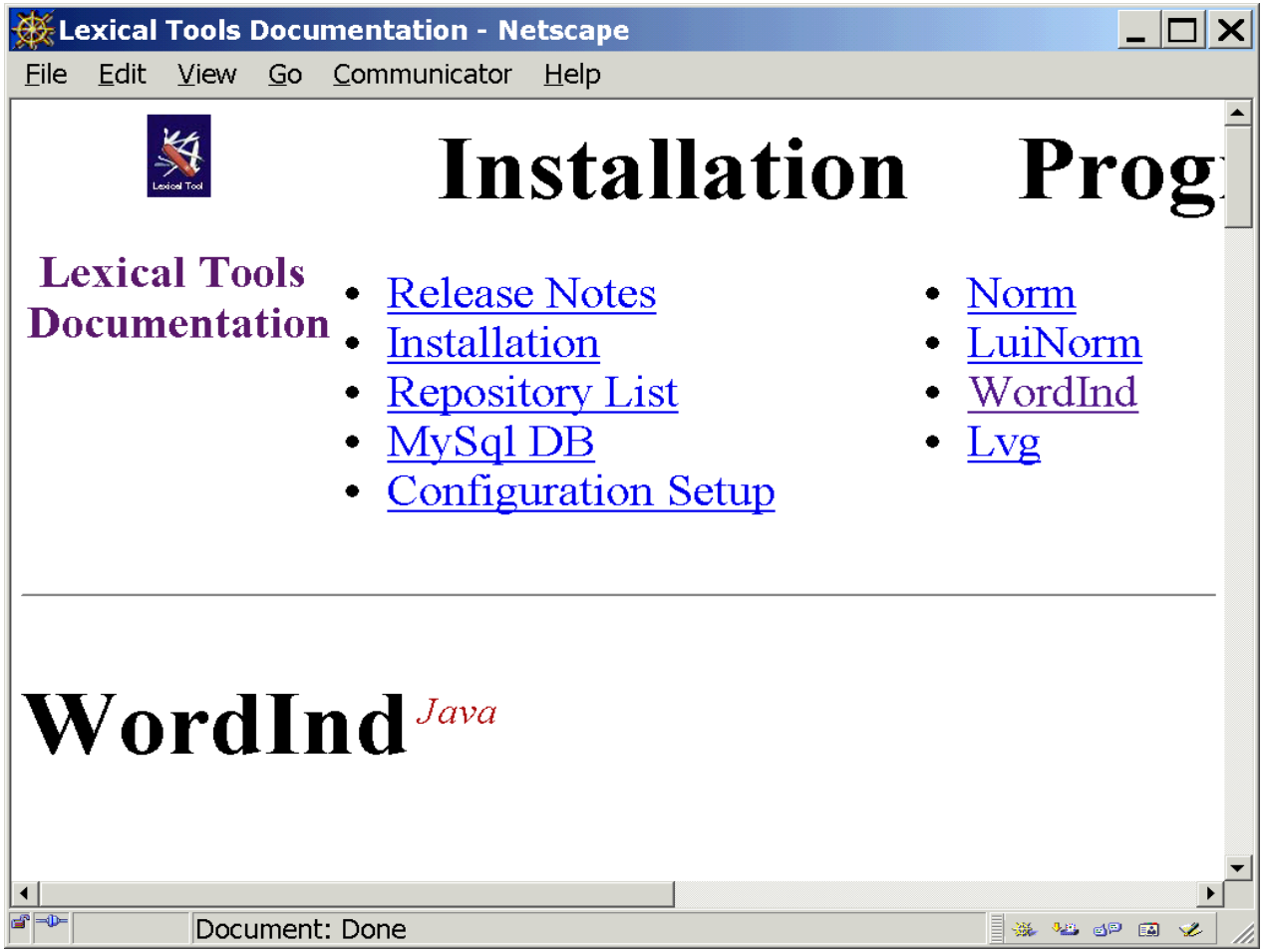
Paget’s disease-scapula

Paget's disease-scapula|**disease paget scapula**

Scapula, Paget Disease

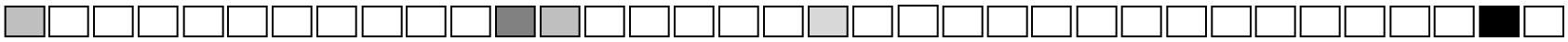
Scapula, Paget Disease|**disease paget scapula**

Lexical Tools: WordInd



Lexical Tools: WordInd

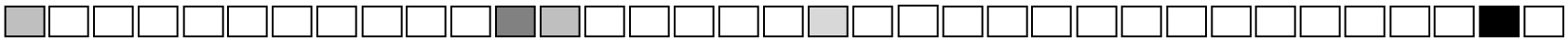
- Breaks words into tokens
- Passes other fields to output, untouched
- Lowercases
- Removes white space and punctuation



Lexical Tools: WordInd

Useful command line options for wordInd

-t[:Num]	Defines what field to tokenize
-f[:Num[:Num]]	Defines what fields get passed through



Lexical Tools: WordInd

> wordInd –t:7 –F:1:6

C0185495|ENG|P|L0223844|PF|S0298948|**Denis-Browne splint strapping**|3|

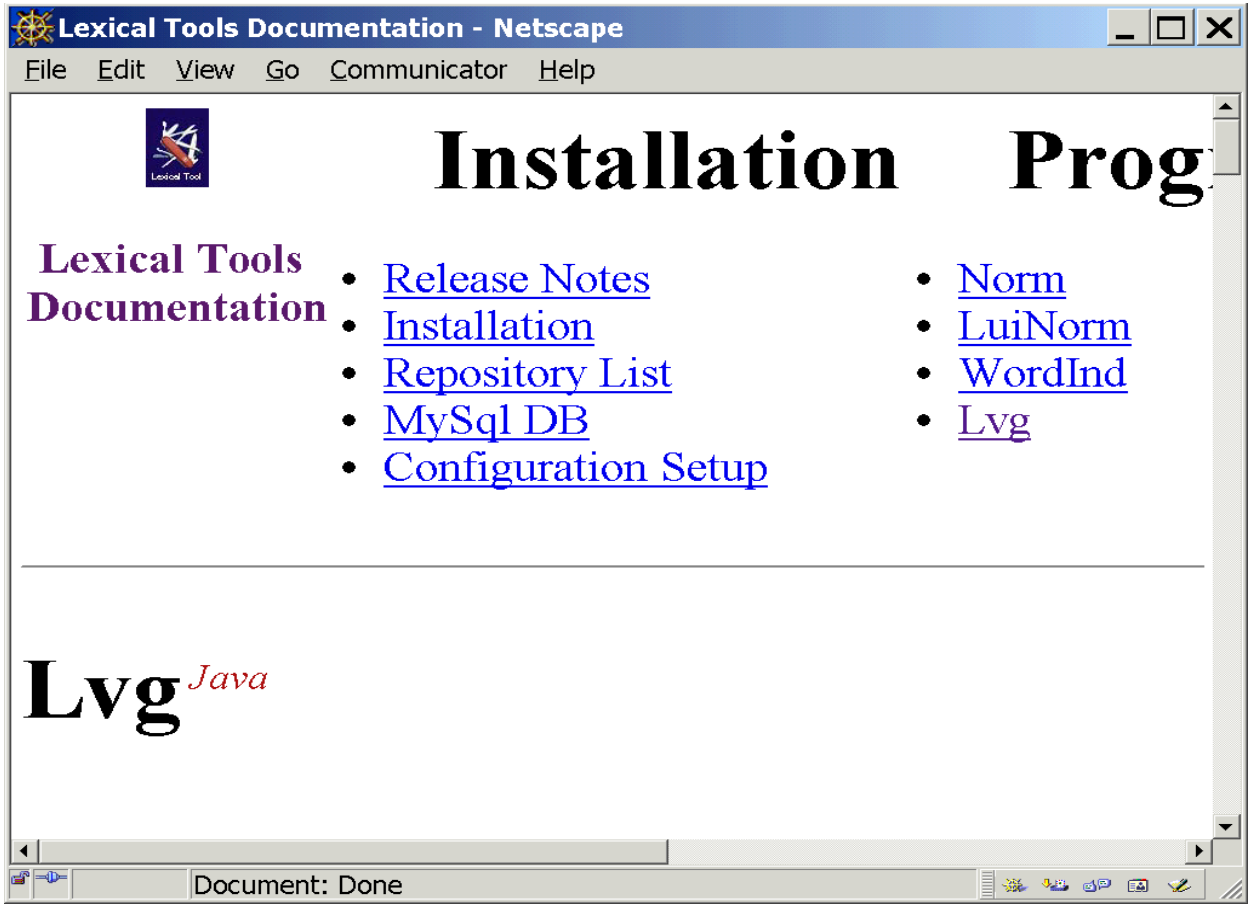
C0185495|S0298948|**denis**

C0185495|S0298948|**browne**

C0185495|S0298948|**splint**

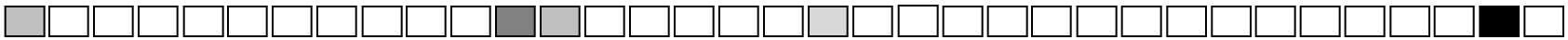
C0185495|S0298948|**strapping**

Lexical Tools: Lvg



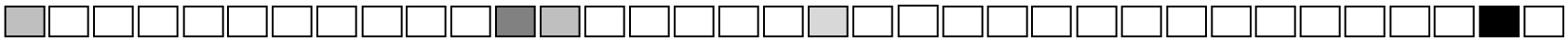
Lexical Tools: Flow Components

Mnemonic	Tool
A	**Return known acronyms**
a	**Return known acronym expansions**
B	**Uninflect words in a term**
b	**Uninflect a term**
C	**Canonicalize**
Ct	**Retrieve the citation term**



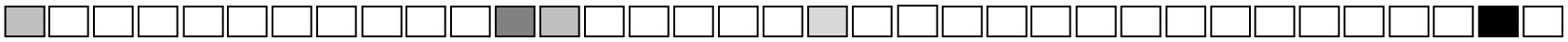
Lexical Tools: Flow Components

Mnemonic	Tool
c	**Tokenize a term into "words"**
ca	**Tokenize, keep everything**
ch	**Tokenize without breaking hyphens**
d	**Generate derivational variants**
dc~N	**Generate derivational variants with specifying output categories**



Lexical Tools: Flow Components

Mnemonic	Tool
E	**Retrieve the unique EUI for a term**
f	**Filter output to contain only forms from lexicon**
Gn	**Generate known fruitful variants**
g	**Remove genitive**
i	**Generate inflectional variants**
ici~Cats+Infls	**Generate inflectional variants, by Categories and inflections**



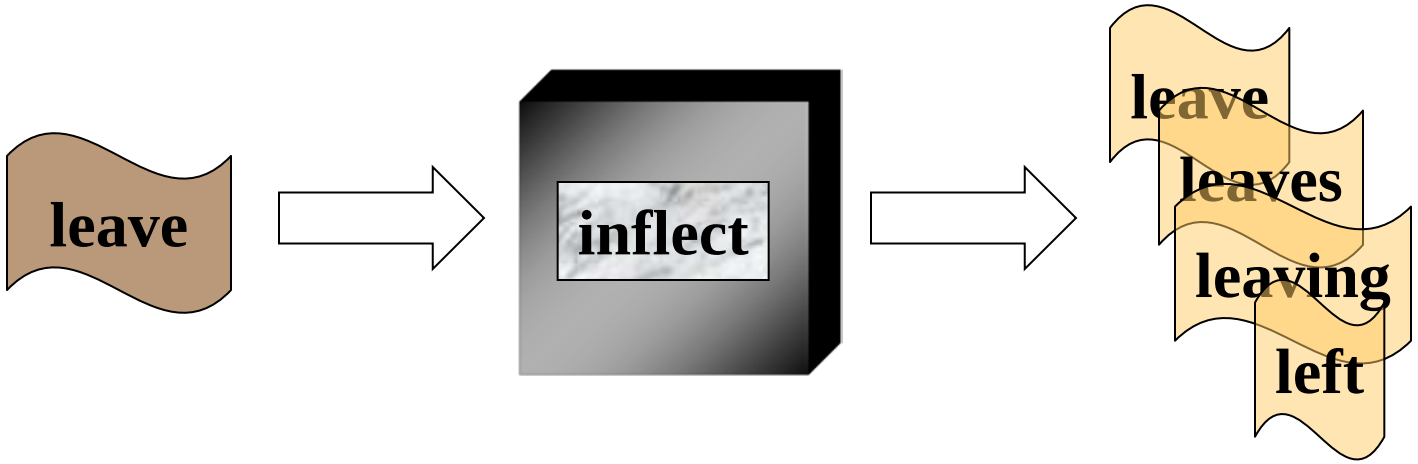
Lexical Tools: Flow Components

Mnemonic	Tool
L	**Retrieve category and inflection for a term**
l	**Lowercase**
N	**Normalize the input text in a non-canonical way (Norm)**
o	**Replace punctuations with spaces**
p	**Strip Punctuation**
q	**Strip diacritics**
R	**Generate derivational variants, recursively**
r	**Generate synonyms, recursively**

Lexical Tools: Flow Components

Mnemonic	Tool
s	**Generate known spelling variants**
t	**Strip stop words**
u	**Uninvert the input phrase around commas**
w	**Sort words by order**
y	**Generate synonyms**

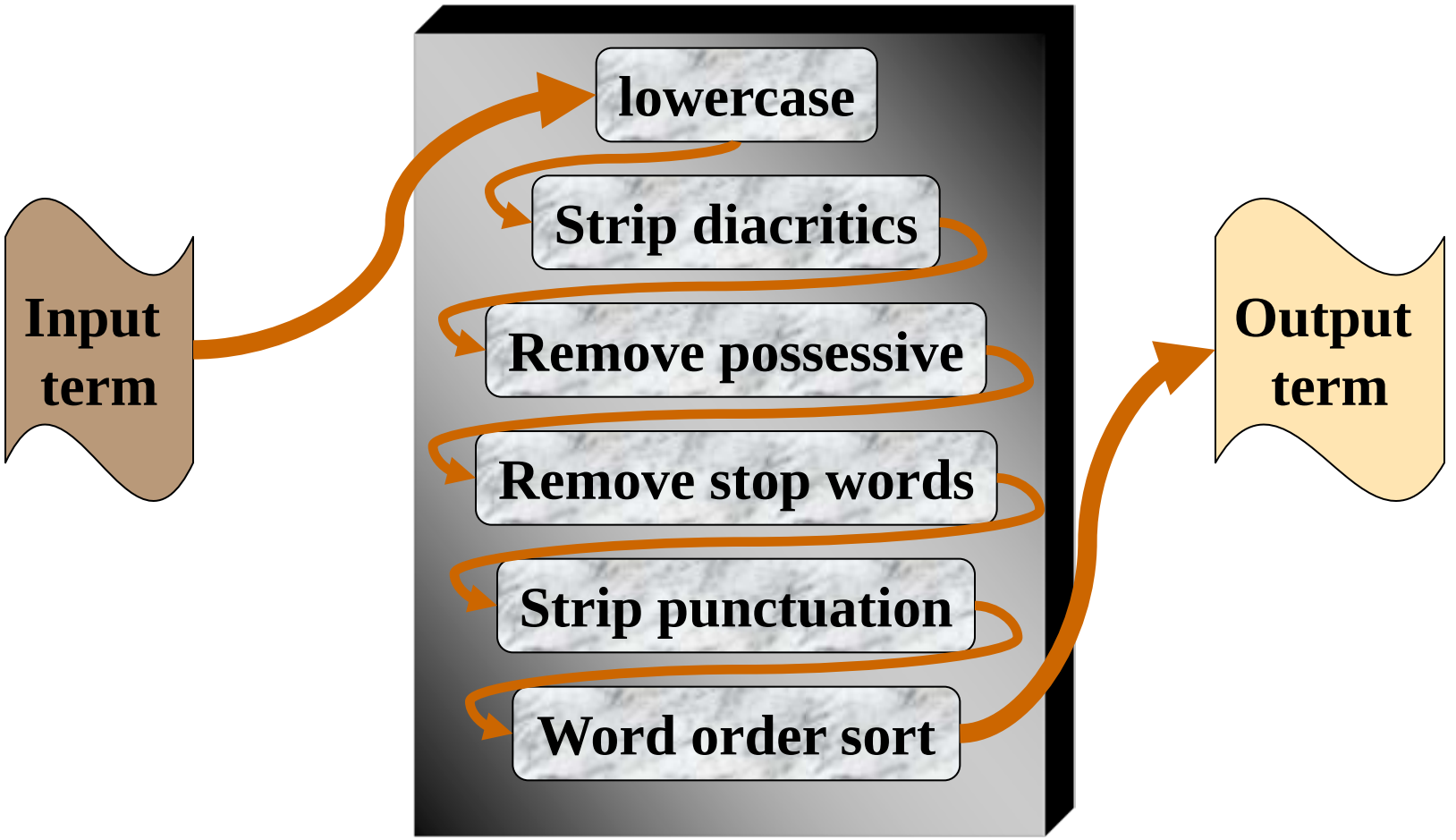
Lexical Tools: Flows



Lexical Tools: Flows

> lvg –f:i
leave
leave|**leave**|128|1|i|1|
leave|**leave**|128|512|i|1|
leave|**leaves**|128|8|i|1|
leave|**left**|1024|64|i|1|
leave|**left**|1024|32|i|1|
leave|**leave**|1024|1|i|1|
leave|**leave**|1024|262144|i|1|
leave|**leave**|1024|1024|i|1|
leave|**leaves**|1024|128|i|1|
leave|**leaving**|1024|16|i|1|

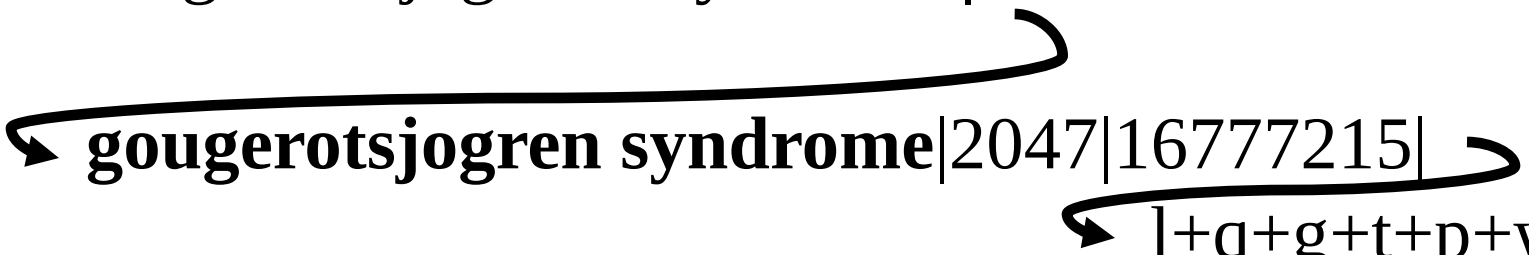
Lexical Tools: A Serial Flow



Flow components can be arranged so that the output of one is the input to another.

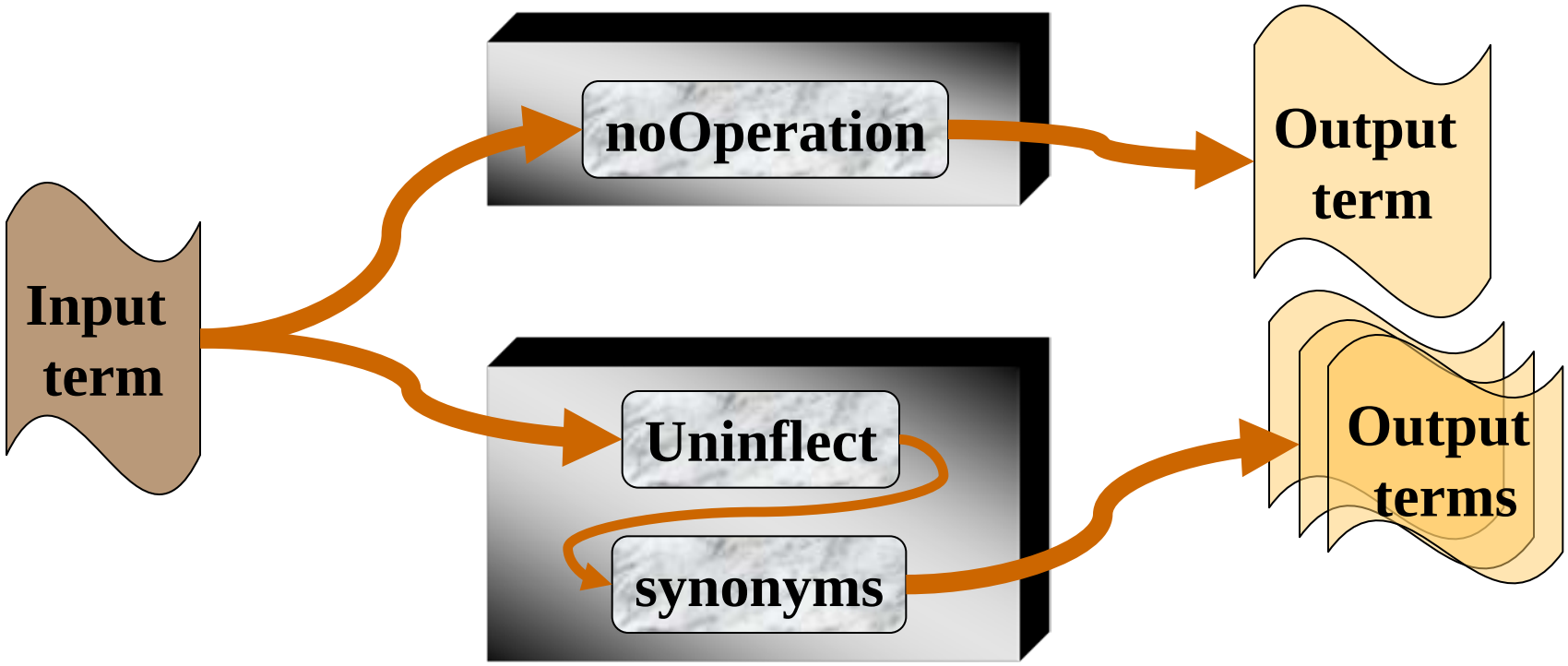
Lexical Tools: A Serial Flow

> lvg –f:l:q:g:t:p:w
The Gougerot-Sjögren's Syndrome
The Gougerot-Sjögren's Syndrome|



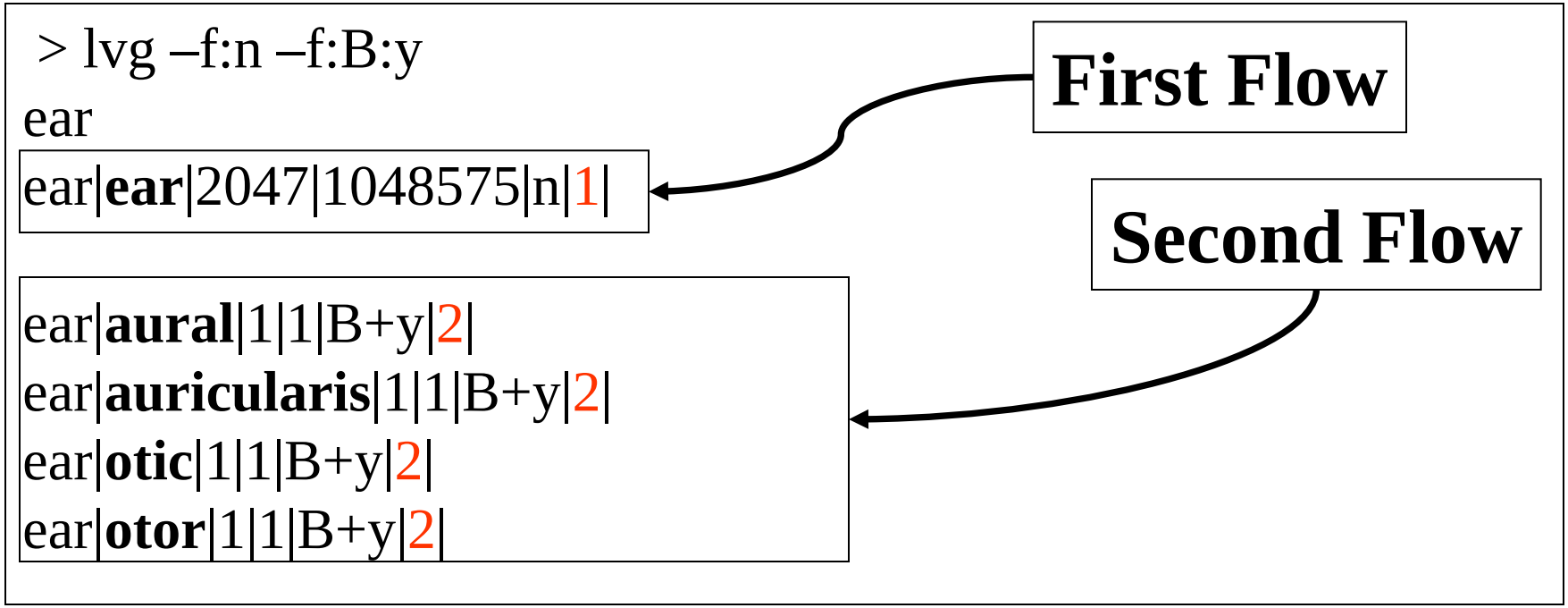
gougerotsjogren syndrome|2047|16777215|
l+q+g+t+p+w|1|

Lexical Tools: Parallel Flows



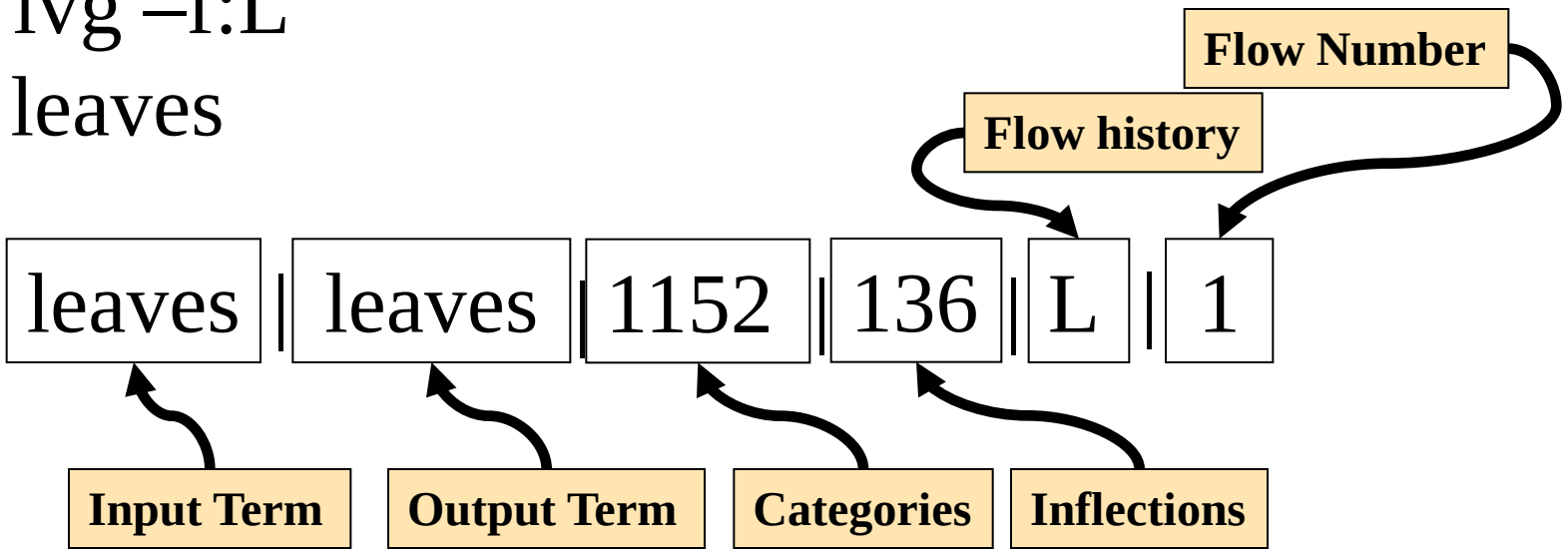
Multiple flows can be defined

Lexical Tools: Parallel Flows

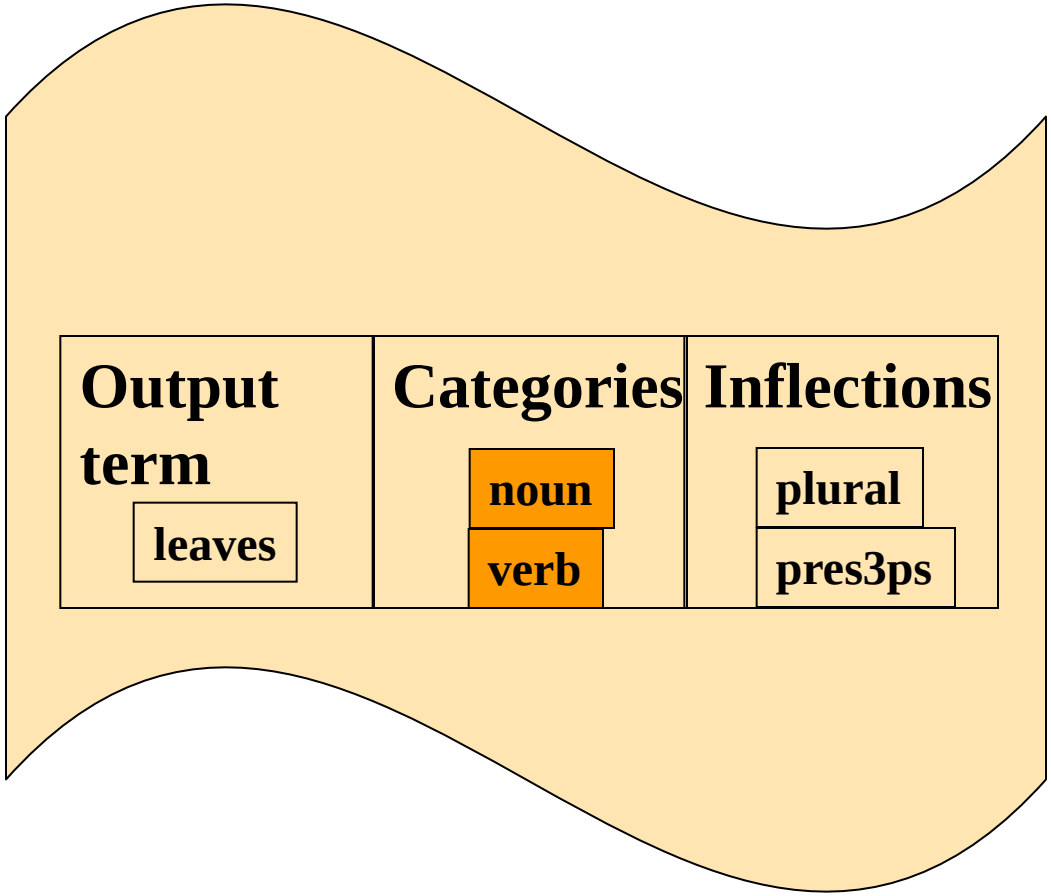


Lexical Tools: Fielded Output

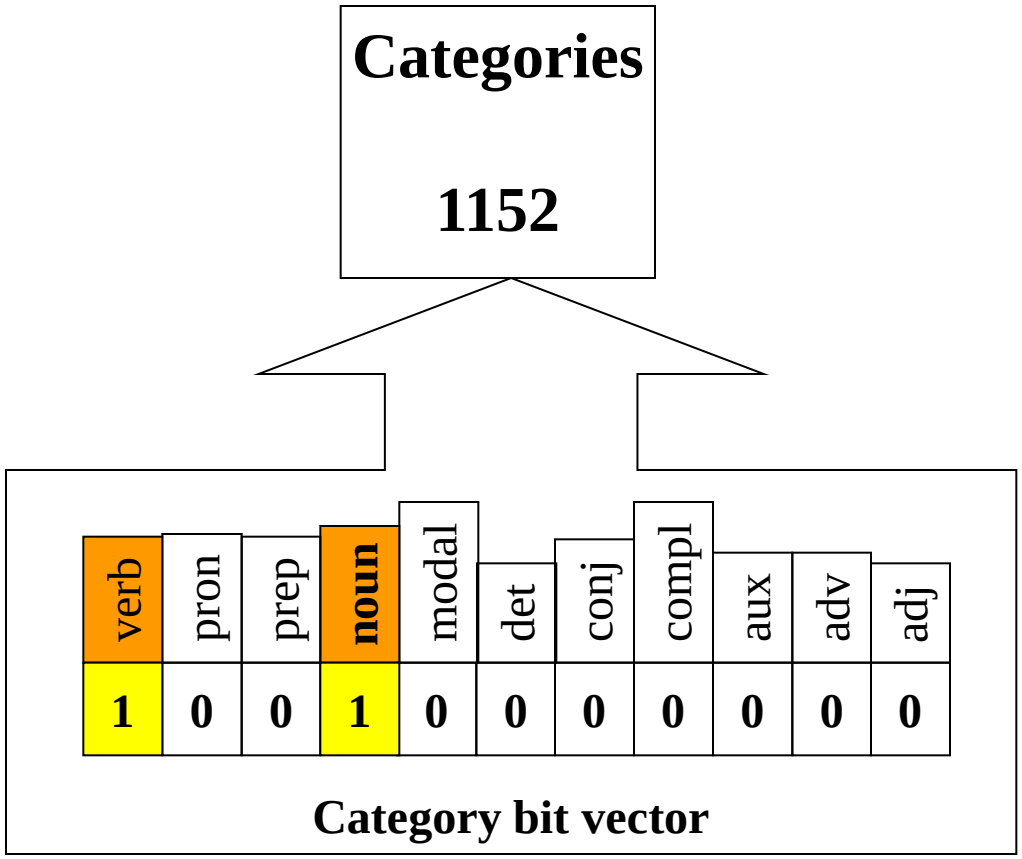
> lvg –f:L
leaves



Lexical Tools: Fielded Output



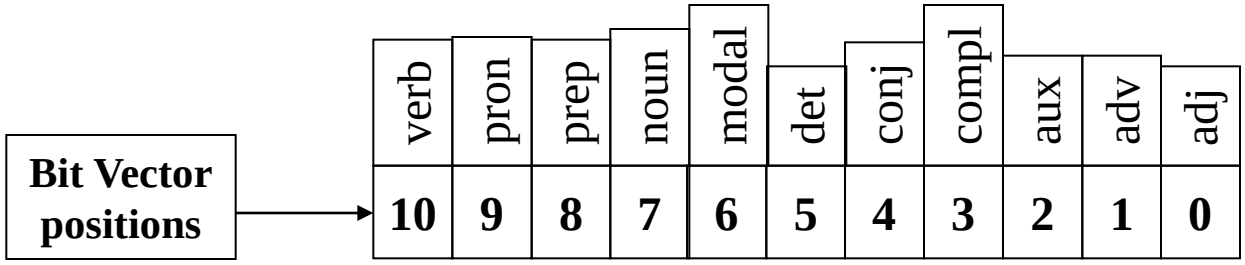
Lexical Tools: Categories



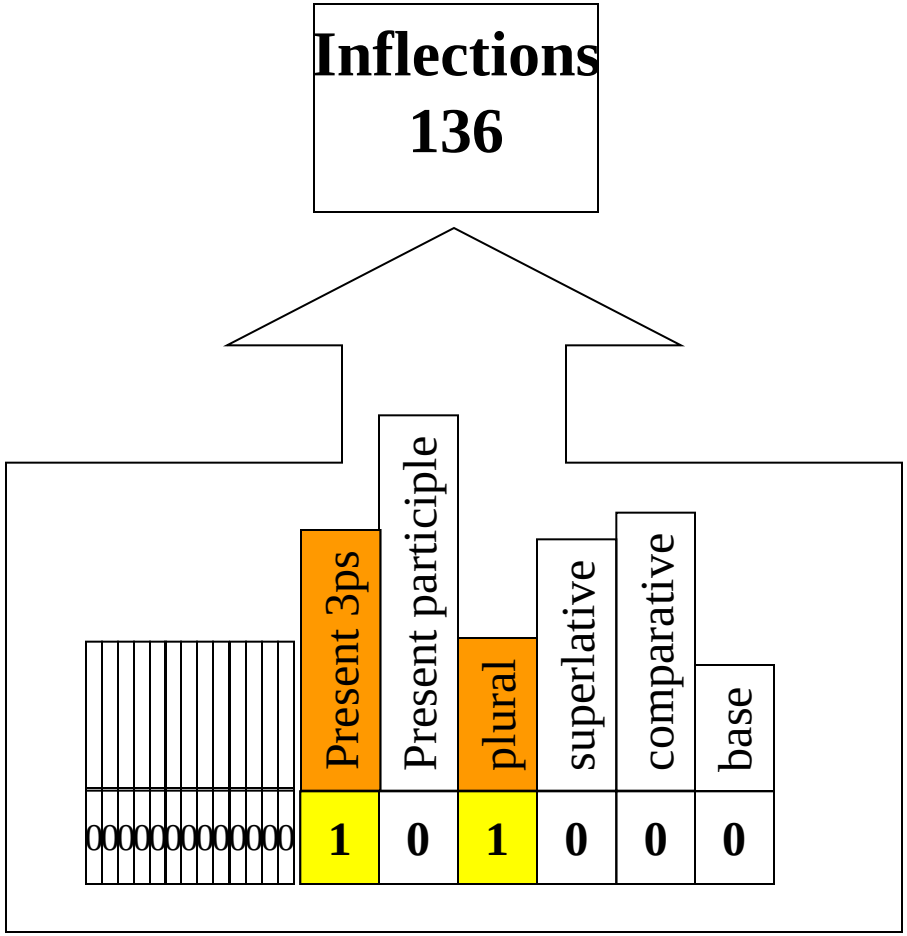
Lexical Tools: Categories

Adjective	1
Adverb	2
Auxiliary	4
Complement	8
Conjunction	16
Determiner	32

Modal	64
Noun	128
Preposition	256
Pronoun	512
Verb	1024



Lexical Tools: Inflections

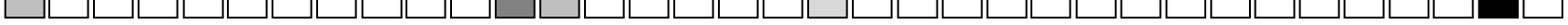


Lexical Tools: Inflections

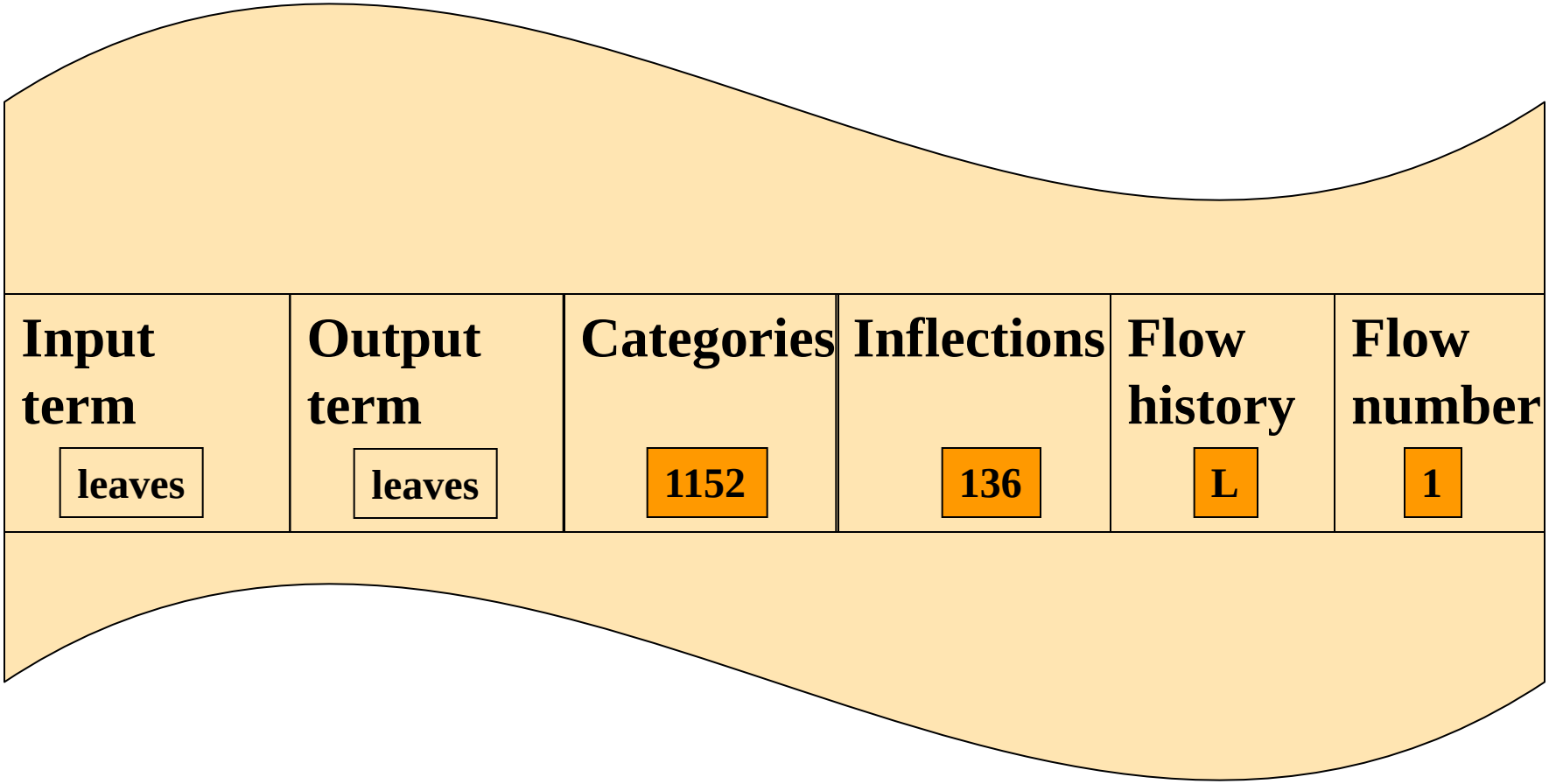
Base	1
Comparative	2
Superlative	4
Plural	8
Present Participle	16
Past	32
Past Participle	64
Present 3rd Person Singular	128

Positive	256
Singular	512
Infinitive	1024
Pres 123p	2048
Past Neg	4096
pres123pNeg	8192
Pres1s	16384
past1p23pNeg	32768
past1s3sNeg	65536

pres1p23p	131072
pres1p23p	262144
pres1p23pNeg	524288
past1s3s	1048576
pres	2097152
pres3sNeg	4194304
presNeg	8388608
all	16777215

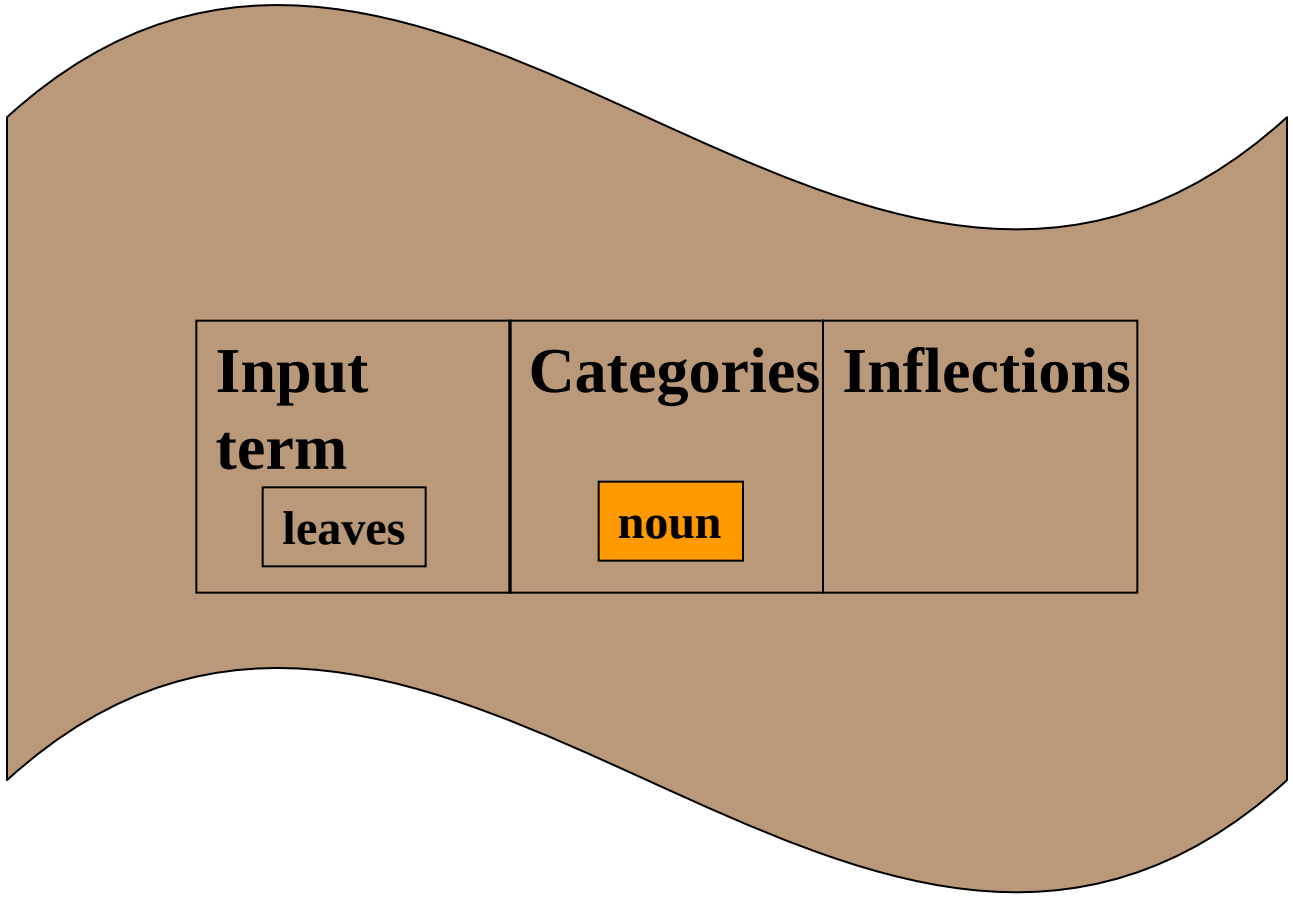


Lexical Tools: Fielded Output

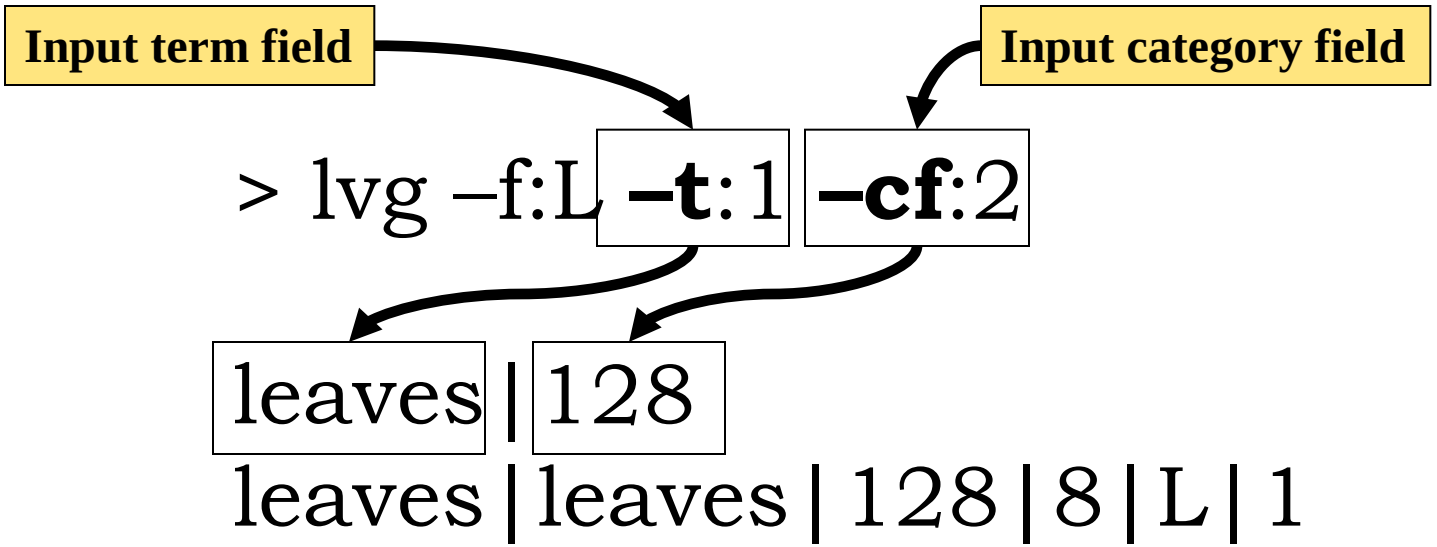


Input term	Output term	Categories	Inflections	Flow history	Flow number
leaves	leaves	1152	136	L	1

Lexical Tools: Fielded Input

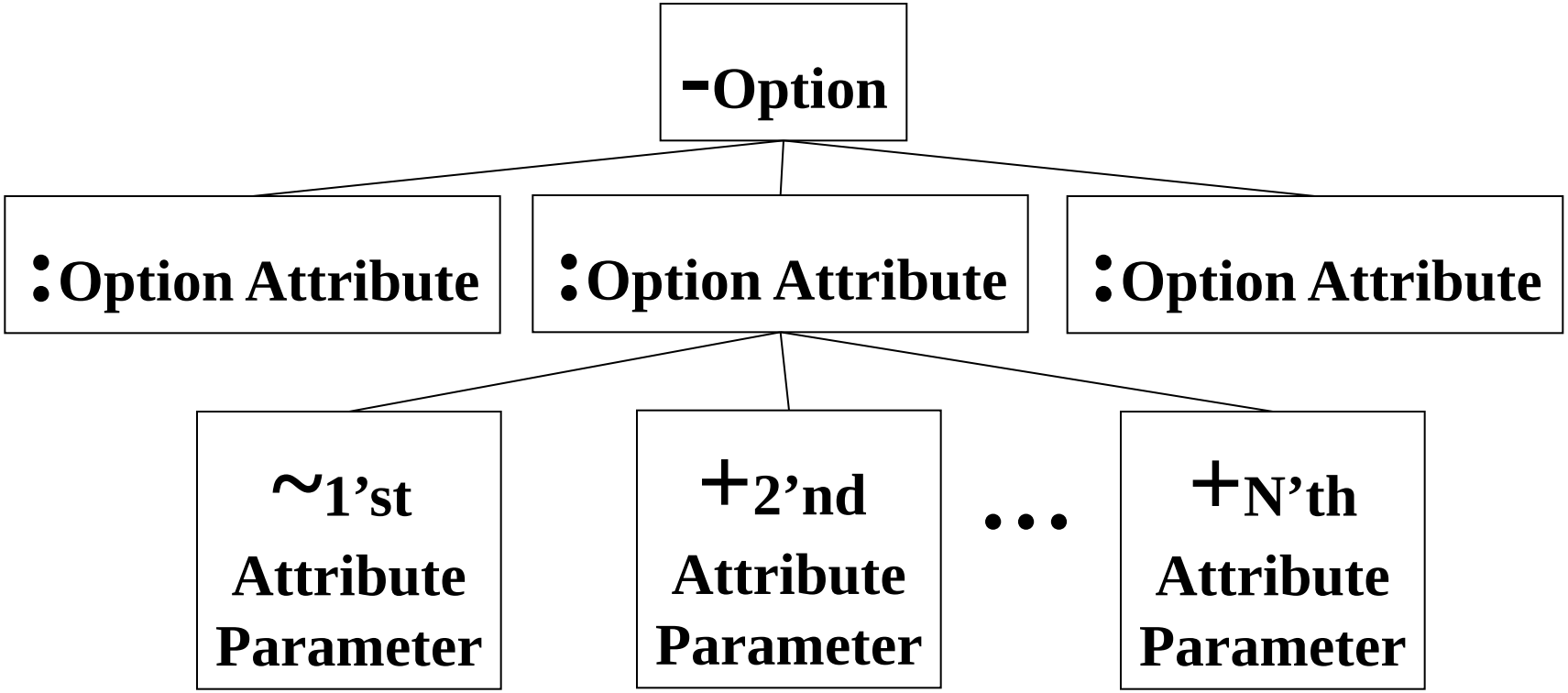


Lexical Tools: Fielded Input



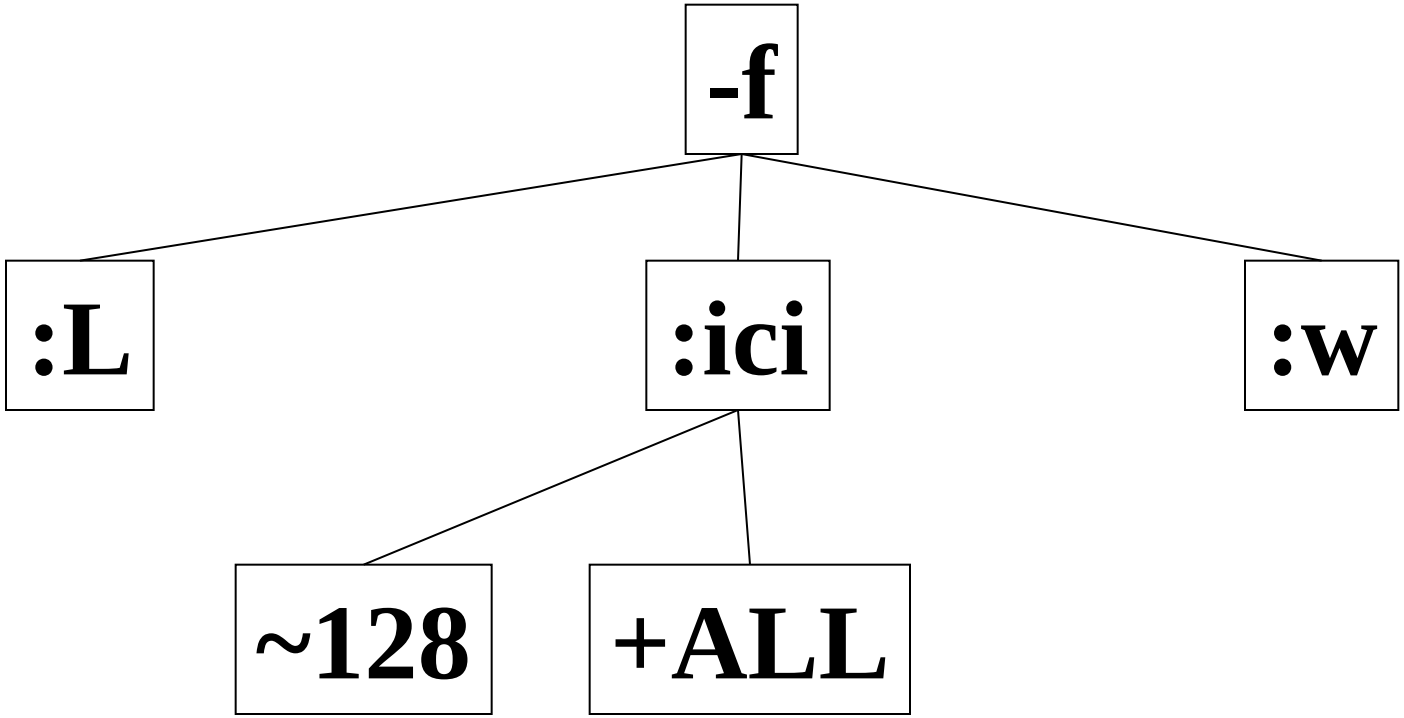
Lexical Tools: Command Line Syntax

- Hierarchical structure

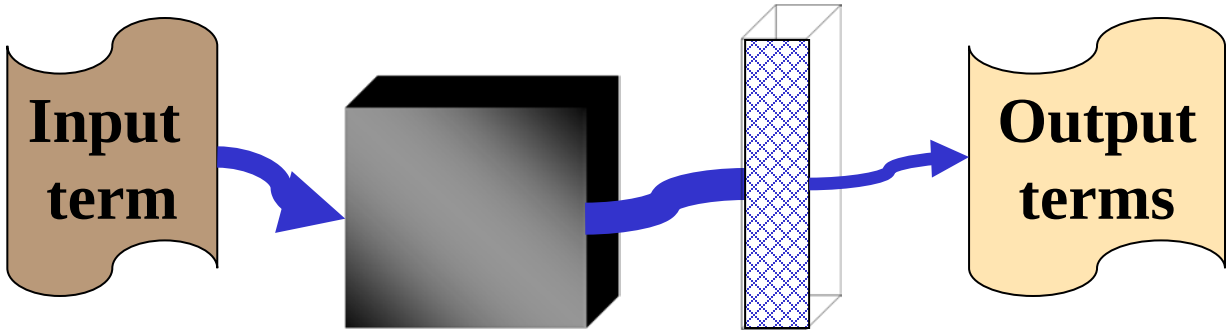


Lexical Tools: Command Line Syntax

-f:L:ici~128+ALL:w



Lexical Tools: Post Flow Options



SC	**Show category names**
SI	**Show inflection names**
ccgi	**Mark the end of the set of variants returned**
F:*Int[:Int]*	**Specify fields for outputs**
ti	**Display the only input term in the output when using fielded input**
R:*Int*	**Restrict the number of variants returned**

Lexical Tools: Post Flow Options

Show category names

Show inflection names

> lvg -f:L **-SC -SI**

phosphoprotein

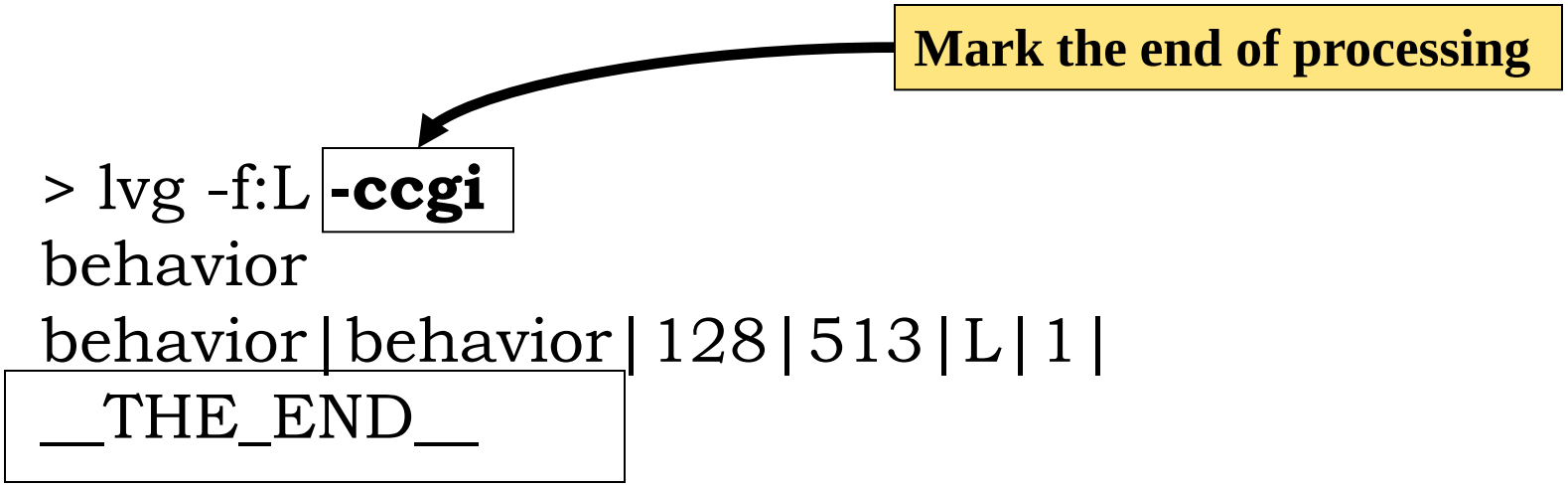
phosphoprotein|phosphoprotein|**<noun>**|**<base+singular>**|L|1|

sclerosing

sclerosing|sclerosing|**<adj+verb>**|**<base+presPart+positive>**|L|1|

Lexical Tools: Post Flow Options

Mark the end of the set of variants returned



Lexical Tools: Post Flow Options

Specify fields for outputs

Display only the 8th and 6th field from the output

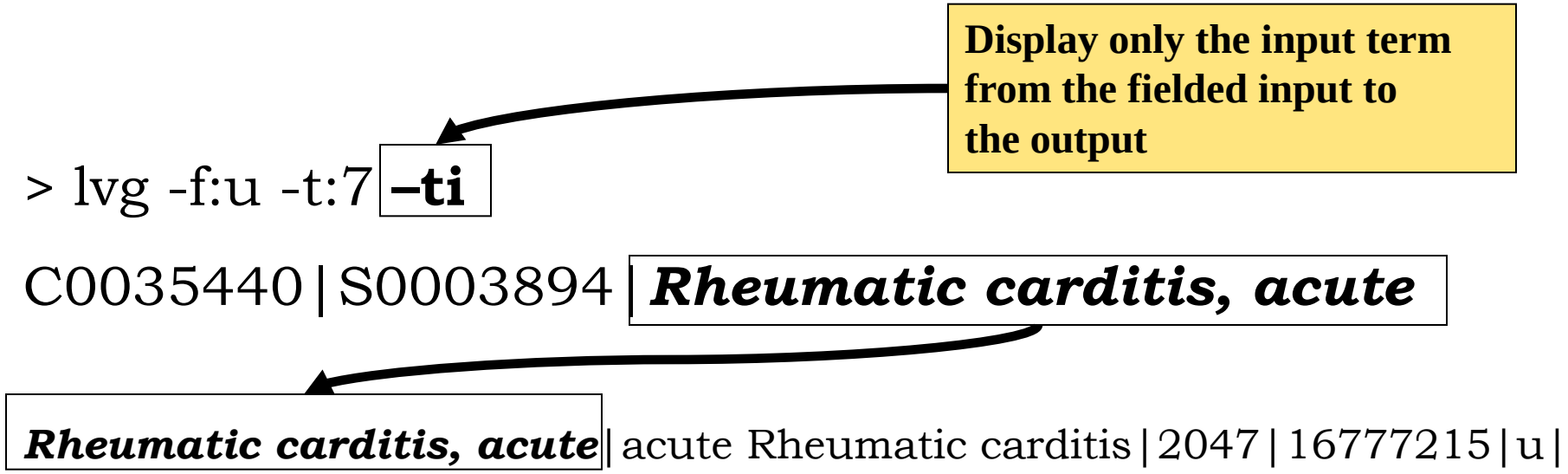
> lvg -f:u -t:7 **-F:8:6**

C0035440|ENG|S|L0035434|VW|S0003894|Rheumatic carditis, acute

acute Rheumatic carditis|S0003894

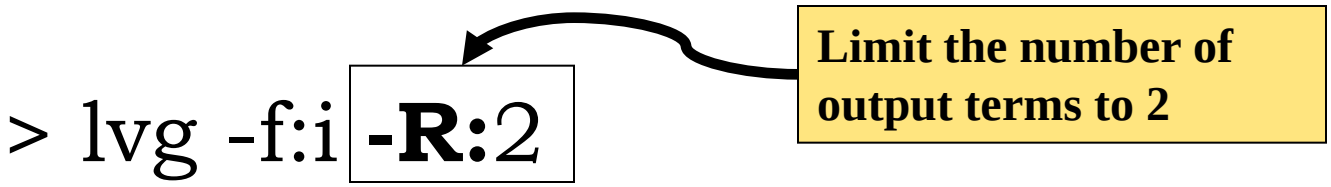
Lexical Tools: Post Flow Options

Display only the input term field when using fielded input



Lexical Tools: Post Flow Options

Restrict the number of variants returned

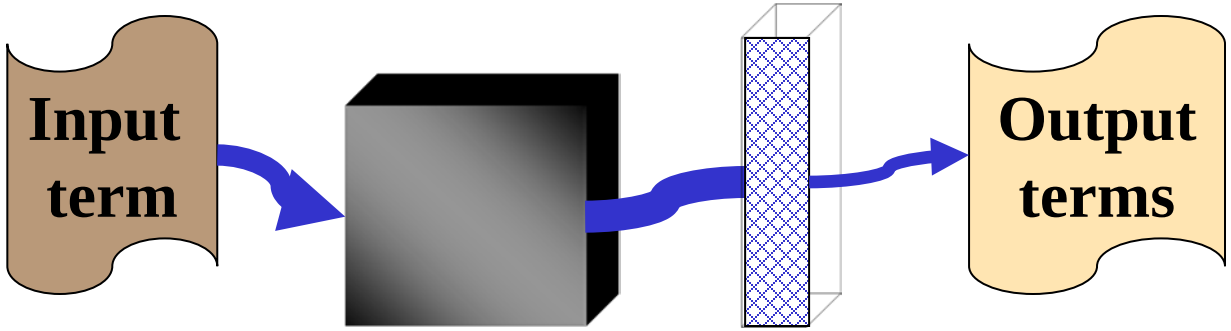



```
> lvg -f:i -R:2
foo
foo|foo|128|1|i|1|
foo|foos|128|8|i|1|
```

Note: Dangerous!
Do not try this at home!

Note: The unrestricted output would have produced 12 rows otherwise

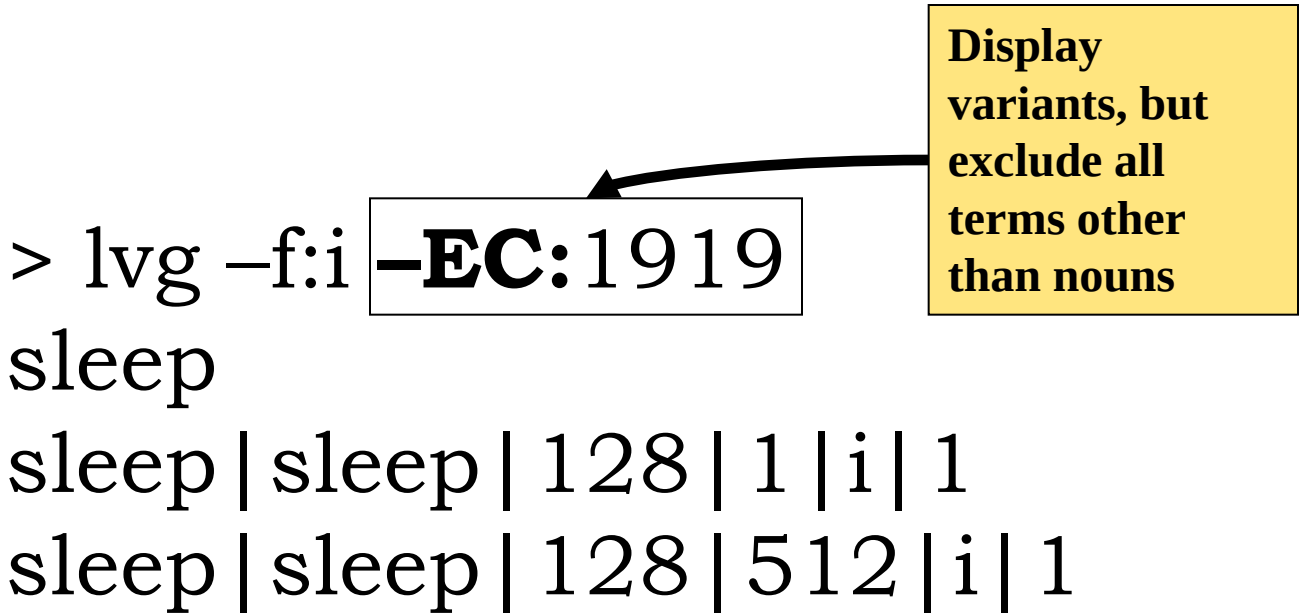
Lexical Tools: Post Flow Options



EC:*Long*	**Display variants: exclude categories specified**
EI:*Long*	**Display variants: exclude inflections specified**
DC:*Long*	**Display variants that only contain the categories specified**
DI:*Long*	**Display variants that only contain the inflections specified**

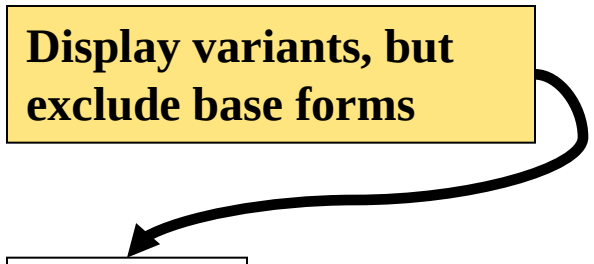
Lexical Tools: Post Flow Options

Display variants: exclude categories specified



Lexical Tools: Post Flow Options

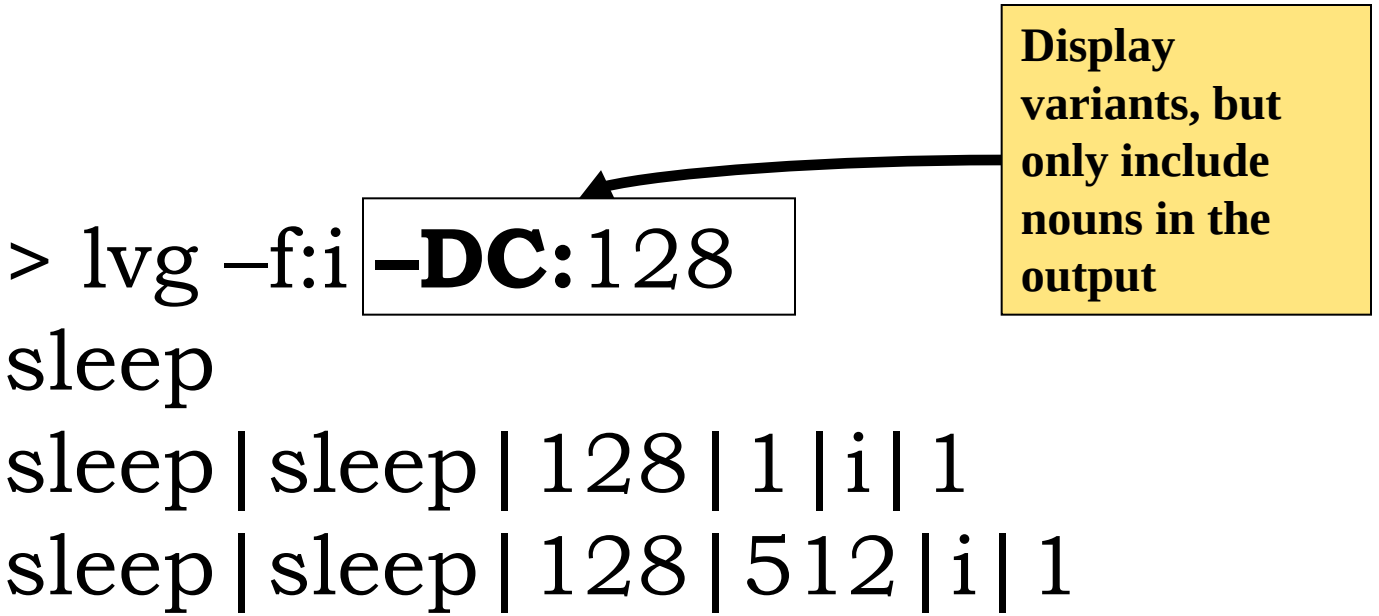
Display variants exclude inflection specified



> lvg –f:i –EC:1919 **–EI:**1
sleep
sleep|sleep|128|512|i|1

Lexical Tools: Post Flow Options

Display variants contain category specified

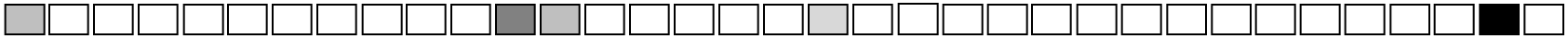


Lexical Tools: Post Flow Options

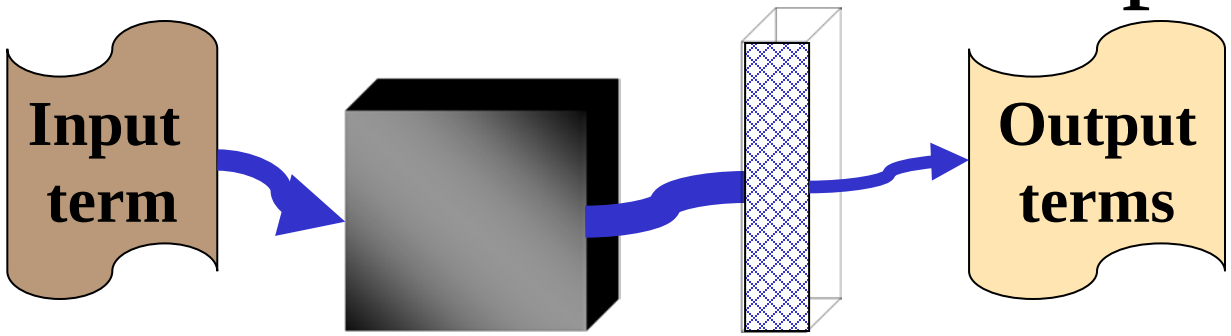
Display variants contain inflection specified

```
> lvg –f:i –DI:255
sleep
sleep|sleep|128|1|i|1|
sleep|sleep|1024|1|i|1|
sleep|slept|1024|64|i|1|
sleep|slept|1024|32|i|1|
sleep|sleeps|1024|128|i|1|
sleep|sleeping|1024|16|i|1|
```

Display variants, but only include “simplified” inflections



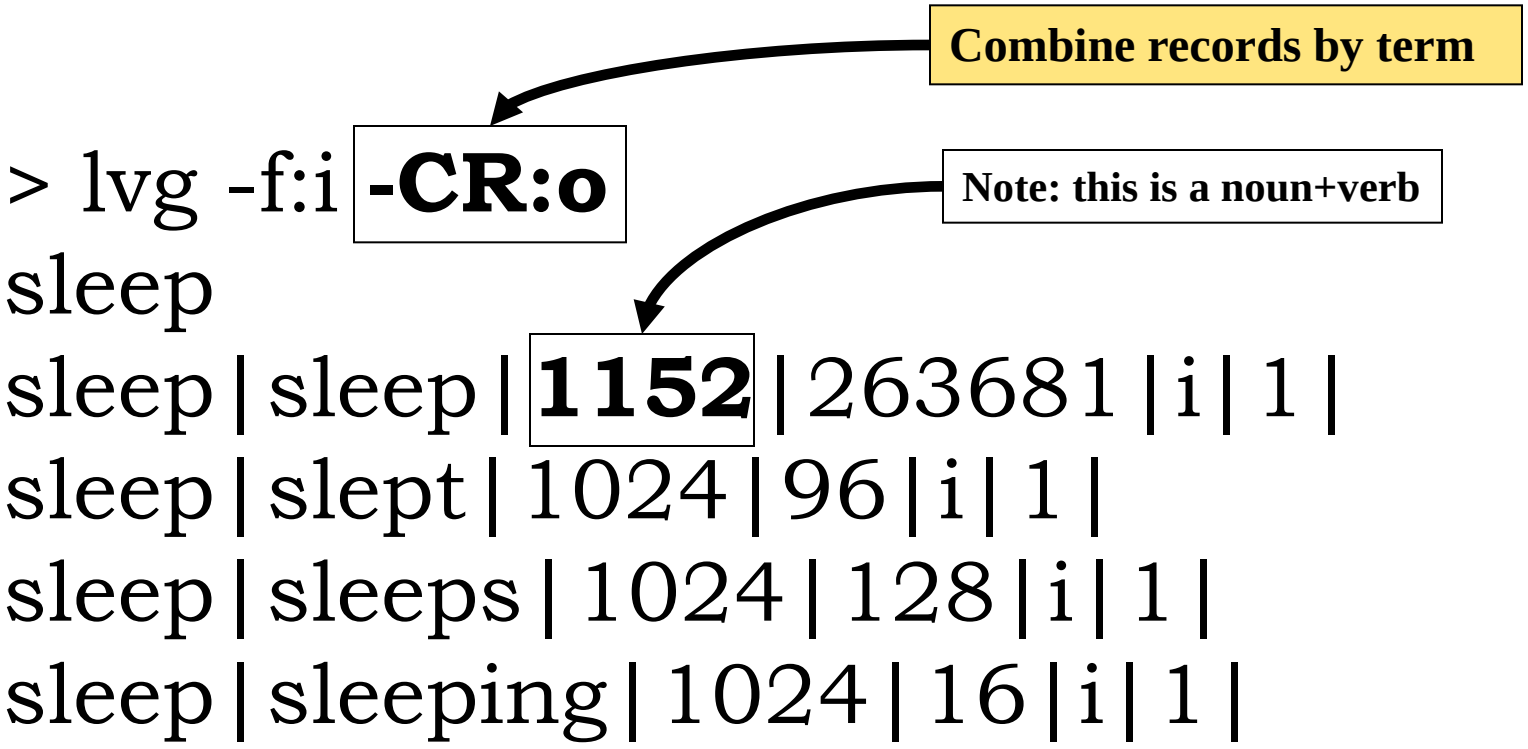
Lexical Tools: Post Flow Options



CR:o	**Combine record by output term**
CR:oc	**Combine record by output term and category**
CR:oi	**Combine record by output term and inflection**
St:o	**Sort outputs by terms in an alphabetical order**
St:oc	**Sort outputs by term and category**
St:oci	**Sort outputs by term, category, and inflection**

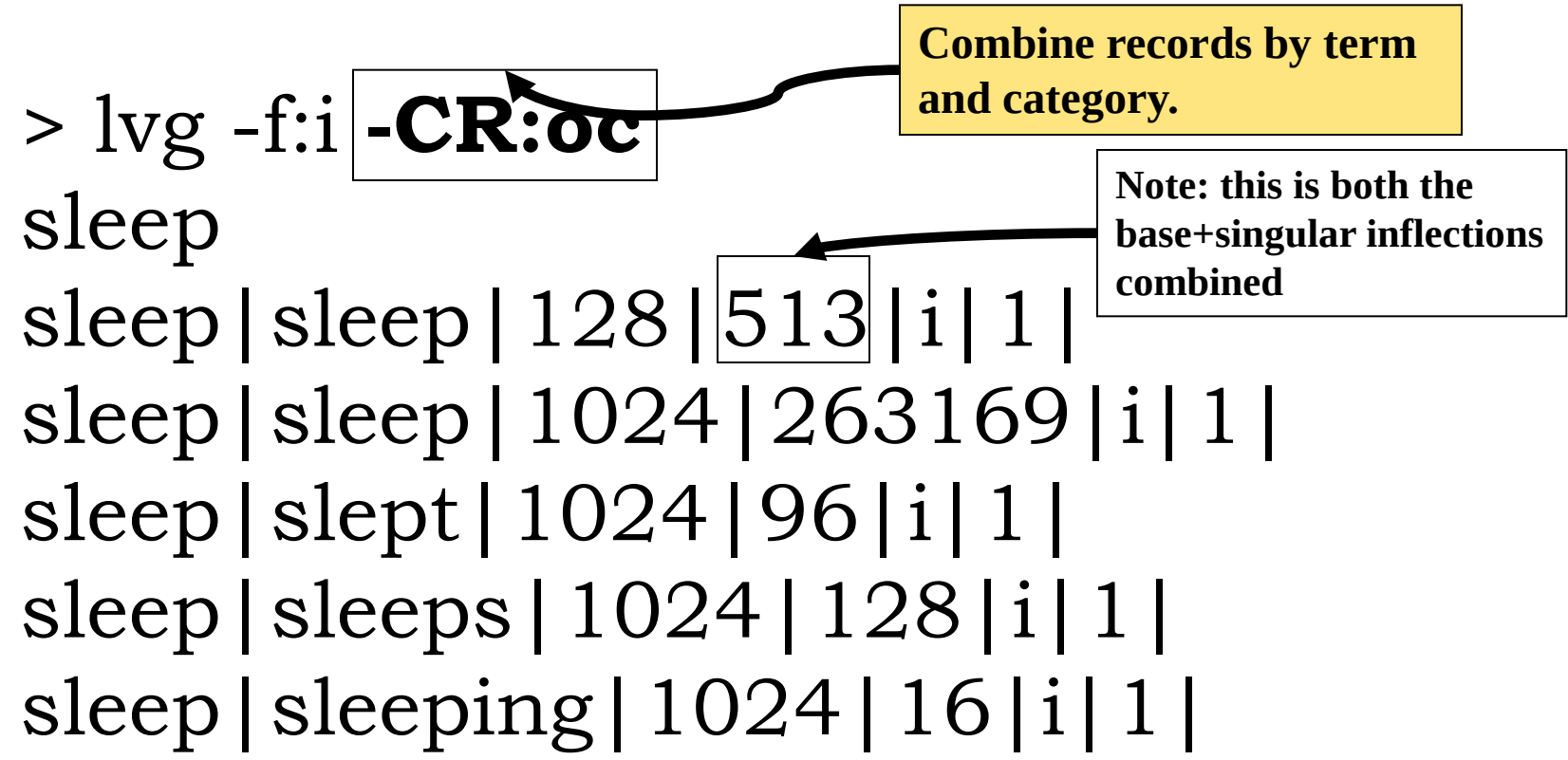
Lexical Tools: Post Flow Options

Combine record by output term



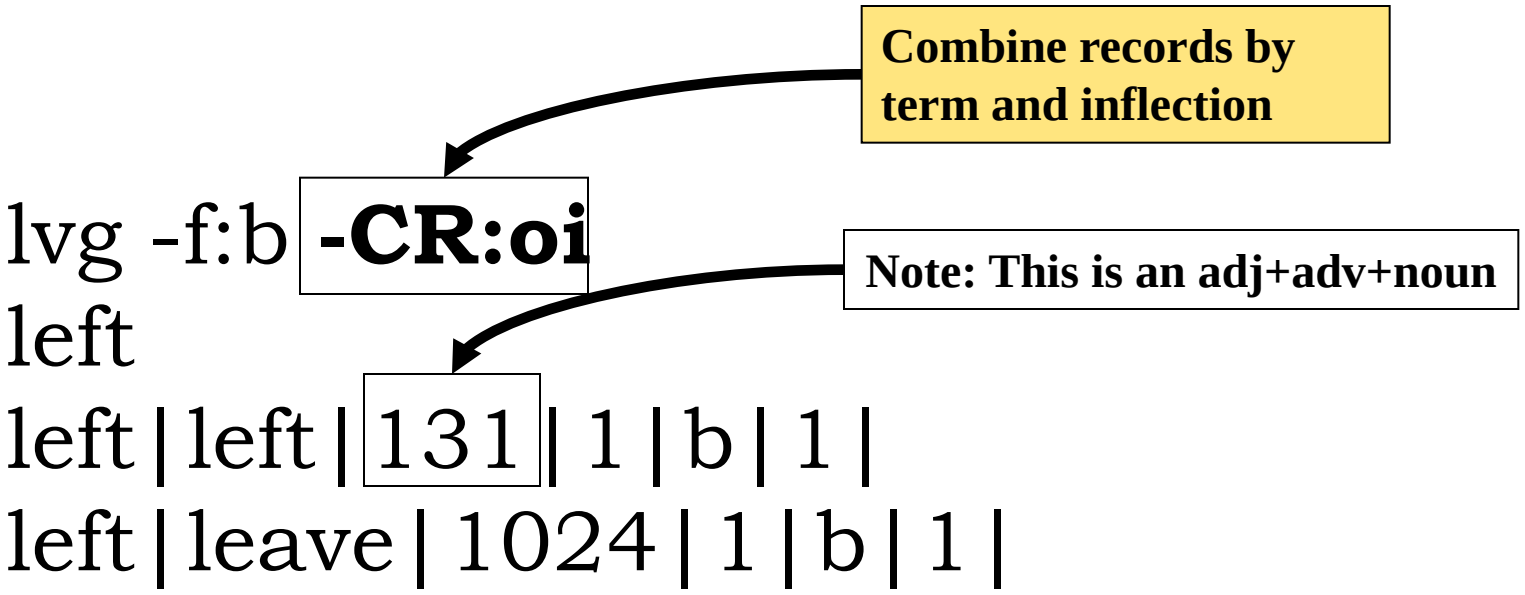
Lexical Tools: Post Flow Options

Combine record by output term and category



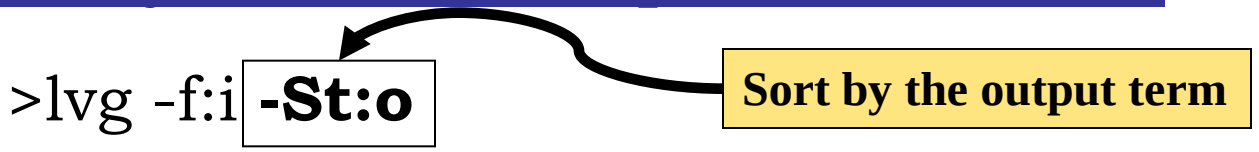
Lexical Tools: Post Flow Options

Combine record by output term and inflection



Lexical Tools: Post Flow Options

Sort outputs by terms in an alphabetical order




```
>lvg -f:i -St:o
see
see|saw|1024|32|i|1|
see|see|1024|1|i|1|
see|see|1024|262144|i|1|
see|see|1024|1024|i|1|
see|seeing|1024|16|i|1|
see|seen|1024|64|i|1|
see|sees|1024|128|i|1|
```

Lexical Tools: Post Flow Options

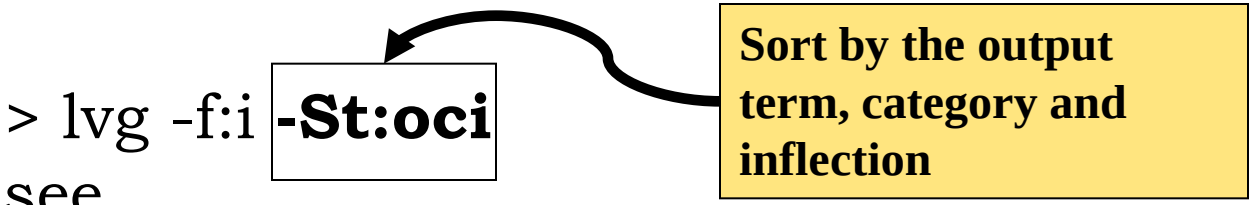
Sort outputs by term and category

```
> lvg -f:i -St:oc
left
...
left|left|1|1|i|1|
left|left|1|256|i|1|
left|left|2|1|i|1|
left|left|2|256|i|1|
left|left|128|1|i|1|
left|left|128|512|i|1|
left|left|128|8|i|1|
left|left|1024|64|i|1|
left|left|1024|32|i|1|
left|lefts|128|8|i|1|
```

Sort by the output term and category

Lexical Tools: Post Flow Options

Sort outputs by term, category, and inflection




```
> lvg -f:i -St:oci
see
see|saw|1024|32|i|1|
see|see|1024|1|i|1|
see|see|1024|1024|i|1|
see|see|1024|262144|i|1|
see|seeing|1024|16|i|1|
see|seen|1024|64|i|1|
see|sees|1024|128|i|1|
```

Lexical Tools: Why Base+Singular

- Base form for Nouns:
  - Singular form
    - There are exceptions:
      - Police

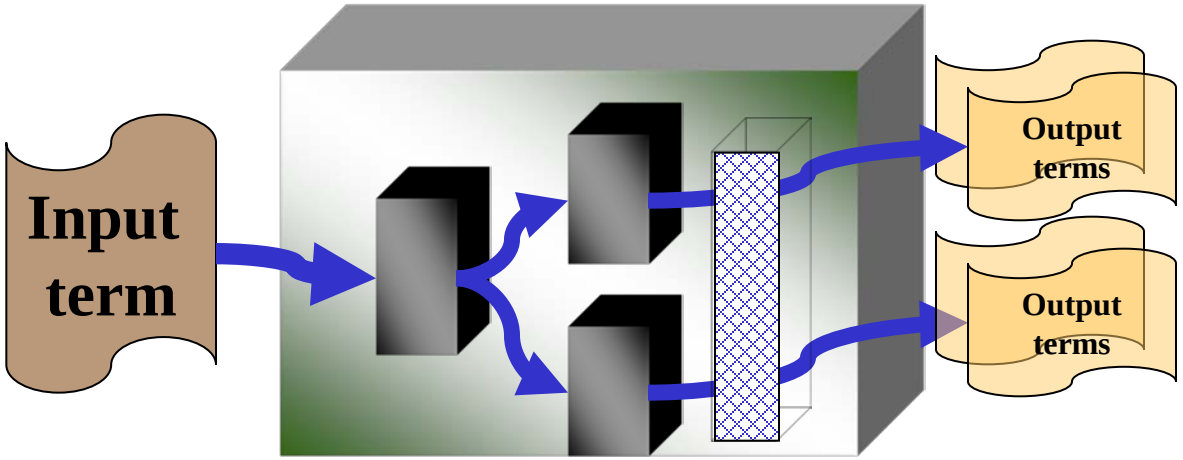
      lvg -f:i -SC -SI -DC:128

      police

      police|police|<noun>|<base>|i|1|

      police|police|<noun>|<plural>|i|1|

Lexical Tools: Global Behaviors



i:*filename*	Define input file name
o:*filename*	Define output file name
x:*filename*	Loading an alternative configuration file
p	Interactive prompt
m	Print extra information of flow mutations
s:*Str*	Defines a field separator.

Lexical Tools: Global Behaviors

Interactive prompt

> lvg -f:s -CR:oc **-p**

- Please input a term (type "Ctl-d" to Quit) >

color

color|color|128|513|s|1|

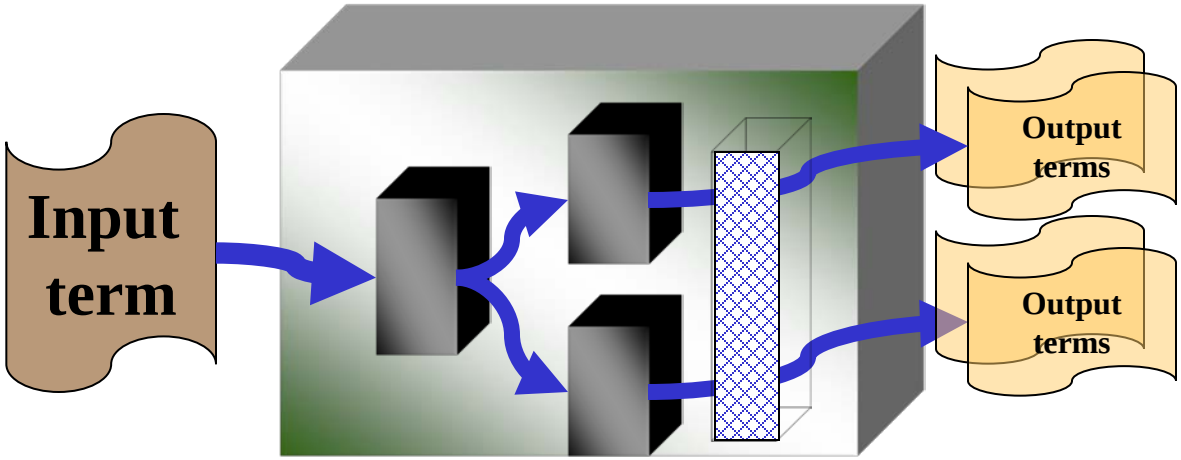
color|color|1024|263169|s|1|

color|colour|128|513|s|1|

color|colour|1024|263169|s|1|

- Please input a term (type "Ctl-d" to Quit) >

Lexical Tools: Global Behaviors



K:d*Int*	**Configure the derivation morphology behavior**
K:i*Int*	**Configure the inflection morphology behavior**

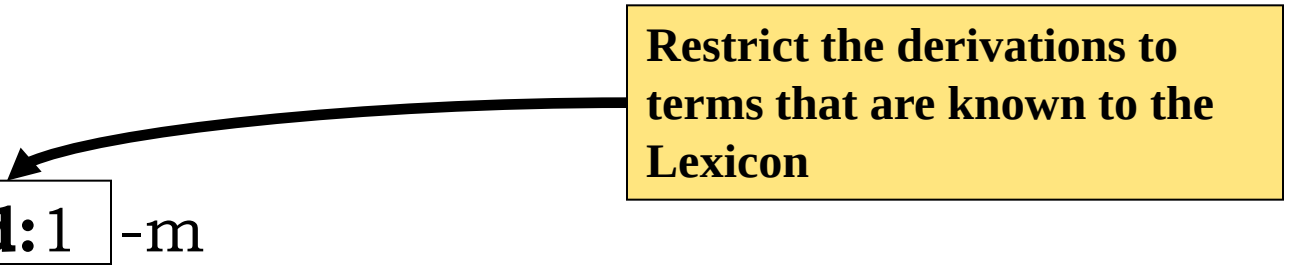
Lexical Tools: Global Behaviors

Configure the derivation morphology behavior

1	**Restrict the output to those variants which are known to the lexicon (default).**
2	**Restrict the output to those variants which are known to the lexicon, unless none of the variants are found in the lexicon, in which case the entire (rule-generated) list is returned.**
3	**No restriction on the output of the morphology. Both facts and rules generated variants are displayed.**

Lexical Tools: Global Behaviors

Configure the derivation morphology behavior



> lvg -f:d **-kd:**1 -m

breath

breath|breather|128|1|d|1|RULE|$|verb|base|er$|noun|base|

breath|breathy|1|1|d|1|RULE|$|noun|base|y$|adj|base|

breath|breathless|1|1|d|1|FACT|breath|128|breathless|1|

Lexical Tools: Global Behaviors

Configure the inflection morphology behavior

1	**Restrict the output to those variants which are known to the lexicon.**
2	**Restrict the output to those variants which are known to the lexicon, unless none of the variants are found in the lexicon, in which case the entire (rule-generated) list is returned (Default).**
3	**No restriction on the output of the morphology. Both facts and rules generated variants are displayed**

Lexical Tools: Global Behaviors

Configure the inflection morphology behavior

```
> lvg -f:i -m -ki:3 -R:5 -F:1:2:7:3:4 -SC -SI
Amish
Amish|Amish|FACT|<noun>|<base>
Amish|Amish|FACT|<noun>|<plural>
Amish|Amishs|RULE|<noun>|<plural>
Amish|Amishes|RULE|<noun>|<plural>
Amish|Amishs|RULE|<verb>|<pres>
```

Return all inflected variants, both fact and rule generated

Lexical Tools: No Operation

-f:n	**Copies the input term to the output with no transformation**

> lvg -f:**n** -f:d -f:y -SC -SI
force
force|**force**|<all>|<all>|**n**|1|
force|forcefully|<adv>|<base>|d|2|
force|forceful|<adj>|<base>|d|2|
force|forcible|<adj>|<base>|d|2|
force|dynamic|<adj>|<base>|y|3|

Lexical Tools: Inflect

-f:i	**Generate inflectional variants**

> lvg -f**:i** -SC -SI

West Nile Virus

West Nile Virus|**West Nile virus**|<noun>|<base>|i|1|

West Nile Virus|**West Nile virus**|<noun>|<singular>|i|1|

West Nile Virus|**West Nile viruses**|<noun>|<plural>|i|1|

Lexical Tools: Inflect

-f:ici~cats+infls	**Generate inflections, filter by cat and/or inflection**

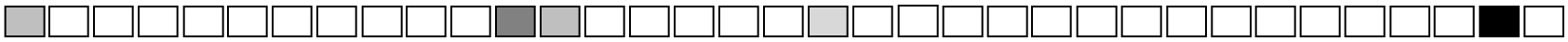
> lvg -f:**ici~128+ALL** -SC -SI

bioassay

bioassay|**bioassay**|<noun>|<base>|ici|1|

bioassay|**bioassay**|<noun>|<singular>|ici|1|

bioassay|**bioassays**|<noun>|<plural>|ici|1|



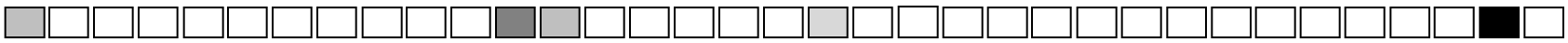
Lexical Tools: Uninflect by Term

-f:b	**Uninflect by term**

> lvg -f:**b** -SC -SI

left atria

left atria|**left atrium**|<noun>|<base>|b|1|



Lexical Tools: Derivations

-f:d	**Generate derivations**

> lvg -f:**d** -SC -SI

diagnostic

diagnostic|**diagnosis**|<noun>|<base>|d|1|

diagnostic|**diagnostics**|<noun>|<base>|d|1|

diagnostic|**diagnose**|<verb>|<base>|d|1|

diagnostic|**diagnostical**|<adj>|<base>|d|1|

Lexical Tools: Derivations

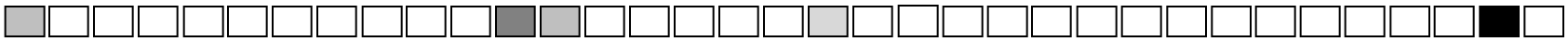
-f:dc~cats	**Generate derivations, filter by category**

> lvg -f:**dc~129** -SC -SI

reduce

reduce|**reduction**|<noun>|<base>|d|1|

reduce|**reducible**|<adj>|<base>|d|1|



Lexical Tools: Synonyms

-f:y	**Generate synonyms**

> lvg -f:**y** -SC -SI

kidney

kidney|**nephric**|<adj>|<base>|y|1|

kidney|**nephritic**|<adj>|<base>|y|1|

kidney|**renal**|<adj>|<base>|y|1|

Lexical Tools: Normalize (norm)

-f:N

Remove stop words, then remove genitives, then replace punctuation with spaces, then lowercase, then uninflect each word, then take each of the uninflected words, then word order sort.

> lvg -f:N

Syndrome, Dry Eyes

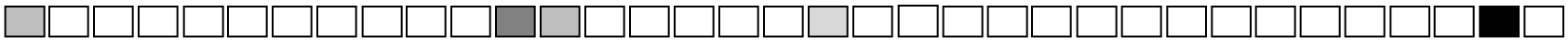
Syndrome, Dry Eyes|**dry eye syndrome**|2047|1|g+o+t+l+B+w|1|

Lexical Tools: Installation

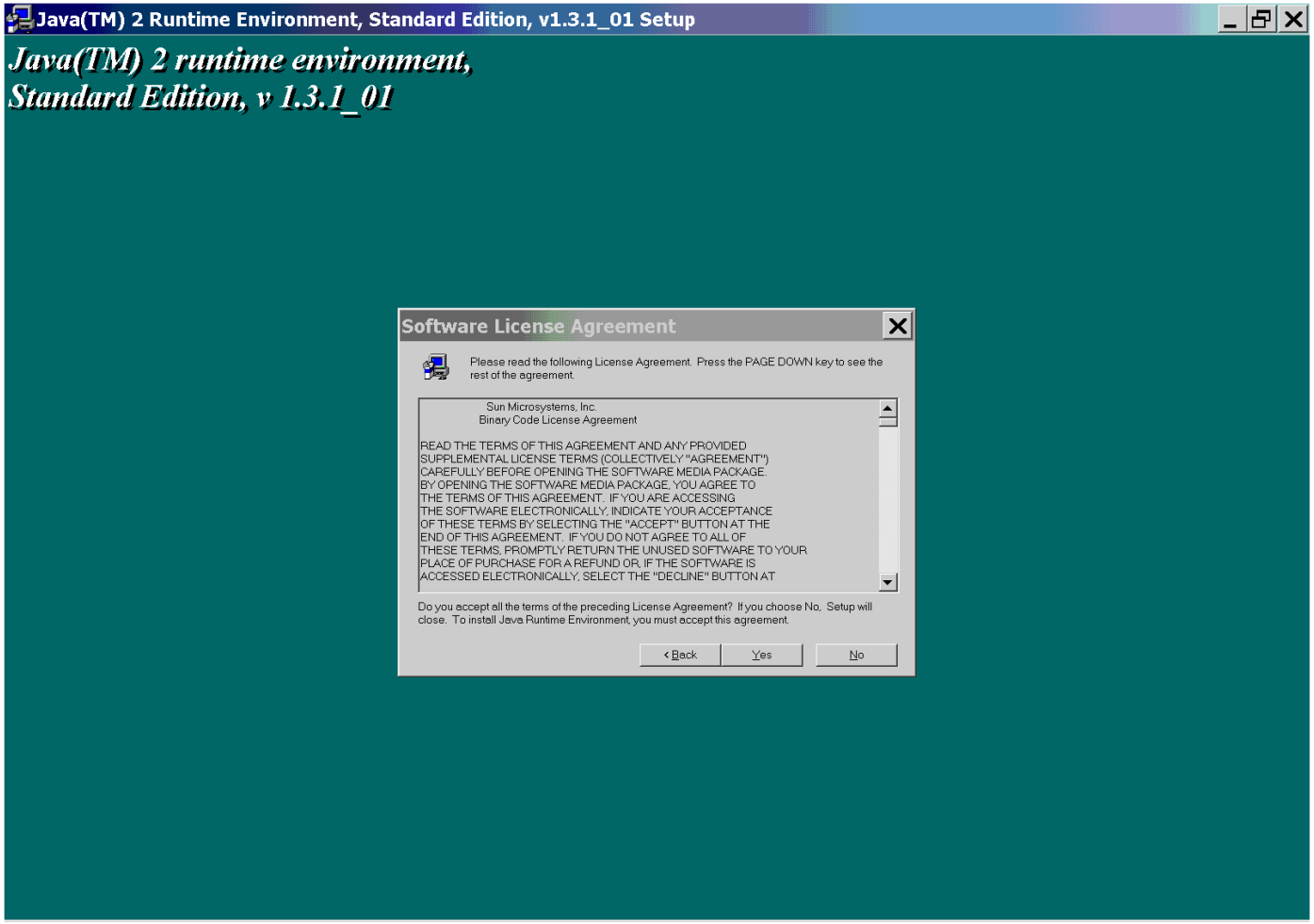
- Requirements
  - 1.6 gigabytes of space
  - Solaris/NT/Linux
  - Tar, gzip or WinZip
  - Minimum of 36 MB Memory
- Java JREs included

Lexical Tools: Installation

```
> ./install/bin/install_solaris_sparc.sh

> .\install\bin\install_win
```



Lexical Tools: Installation



Lexical Tools: Installation

Welcome to the Java Lexical Tools Installation!

Please read the ***installationNotes.html***
prior to invoking this script.

This script will configure the
_LVG_DIR_/data/config/lvg.properties
file.

This script will create configured
lvg, norm, luiNorm, and wordind
scripts in the _LVG_DIR_ directory.

This script, as an option, will configure
and load the lexical tools into a pre-existing
MySql database. This option is only available
if you already have a MySql database running.

~~~~~~

~~~~~~

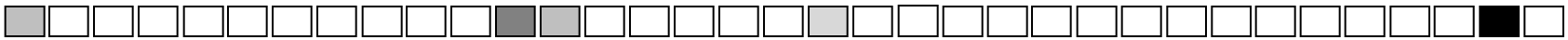
The Java Lexical tools use or (may use) the
following third party software packages:

- Instant DB from Enhydra.org
  (see http://instantdb.enhydra.org)
  This package is covered under an Enhydra
  Public License, which allows for redistribution
  and use with a "use notice".

- The installation script uses some GNU CYGWIN
  programs that have been distributed along with
  this script. These commands are only used when
  this installation is on a Windows platform.
  The commands that have been distributed
  include tar, gunzip, rm, find, hosthame,
  tee, and cmp.

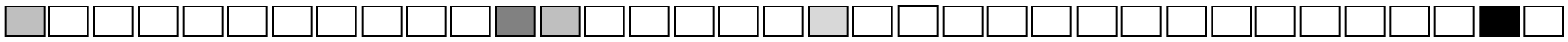
  The CYGWIN package is licensed under the
  GNU Public License. The entire CYGWIN package,
  along with the sources to these commands can be
  found at http://sources.redhat.com/cygwin/

Enhydra is a trademark of Lutris Technologies, Inc.



Lexical Tools: Installation

```
+----------------------Note---------------------------+
|Although we do not support this feature, and it      |
|is very likely that we will change the underlying    |
|implementation, we have found it useful for our      |
|applications to use an existing database system      |
|other than IDB. We often use Mysql as the underlying |
|database for our applications. Since we needed a     |
|way to get the lexical tools data into MySql, we     |
|figured that we would incorporate the MYSQL loader   |
|into this install.                                   |
|                                                     |
|This option requires that an existing mysql database |
|(version 3.23 or higher) have already been installed,|
|that you have database root access privileges,       |
|that the database has enough room to load this       |
|data, and that the database is running now.          |
+-----------------------------------------------------+

+-------------- Question -------------------+
|  Do you want to have the lexical tools use |
|  your mysql database [y/n]  [n]? n
```

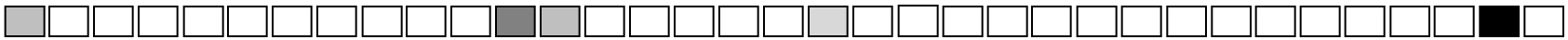


Lexical Tools: Installation

```
+-------------------------------------------+
| Verifying the installation ...            |
+-------------------------------------------+

Enhydra InstantDB - Version 3.26

The Initial Developer of the Original Code is Lutris Technologies
Inc. Portions created by Lutris are Copyright (C) 1997-2001
Lutris Technologies, Inc.  All Rights Reserved.

Database sample is shutting down...

Database sample shutdown complete.
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
```

Lexical Tools: Installation

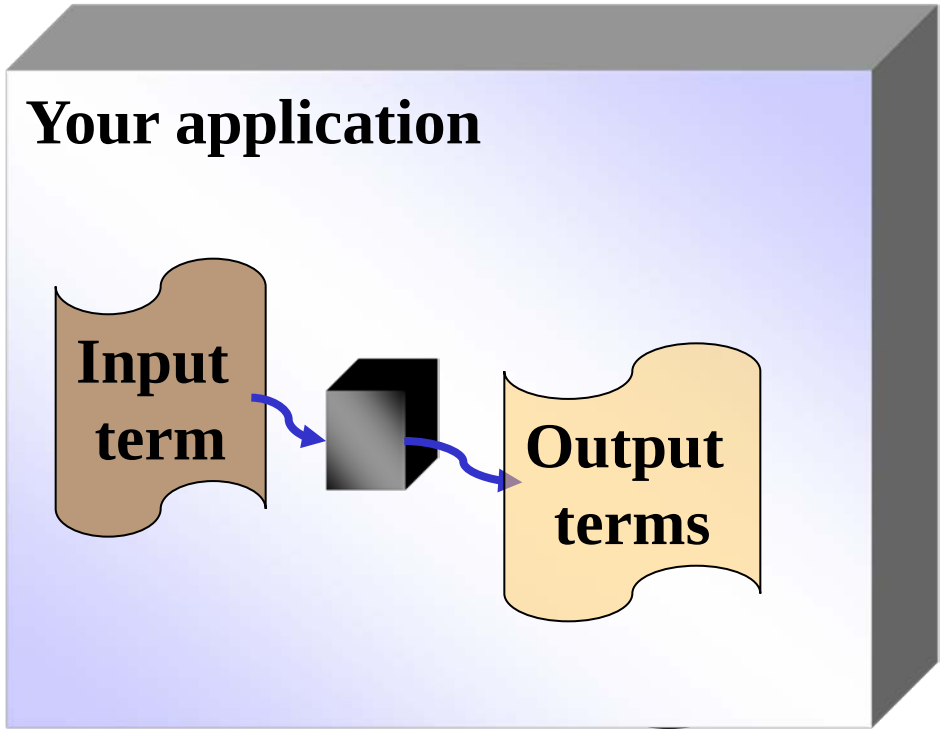
```
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
                    Congratulations!
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
  This script has completed configuring the java
  lexical tools. You may invoke these tools from a
  command line. These tools are found in the
  __LVG_DIR__/bin directory.
  You can add this __LVG_DIR__/bin path to your
  $PATH environment variable. This would enable
  you to find and run these tools from any location.
  In UNIX, this would be done by adding this
  path to your ~/.cshrc or ~/.profile startup script.

  In Windows, this would be done by appending
  this path to the PATH variable from the
  control panel/System/Environment variables menus.
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
  The lexical tools are ready to be used!
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
```



Lexical Tools:

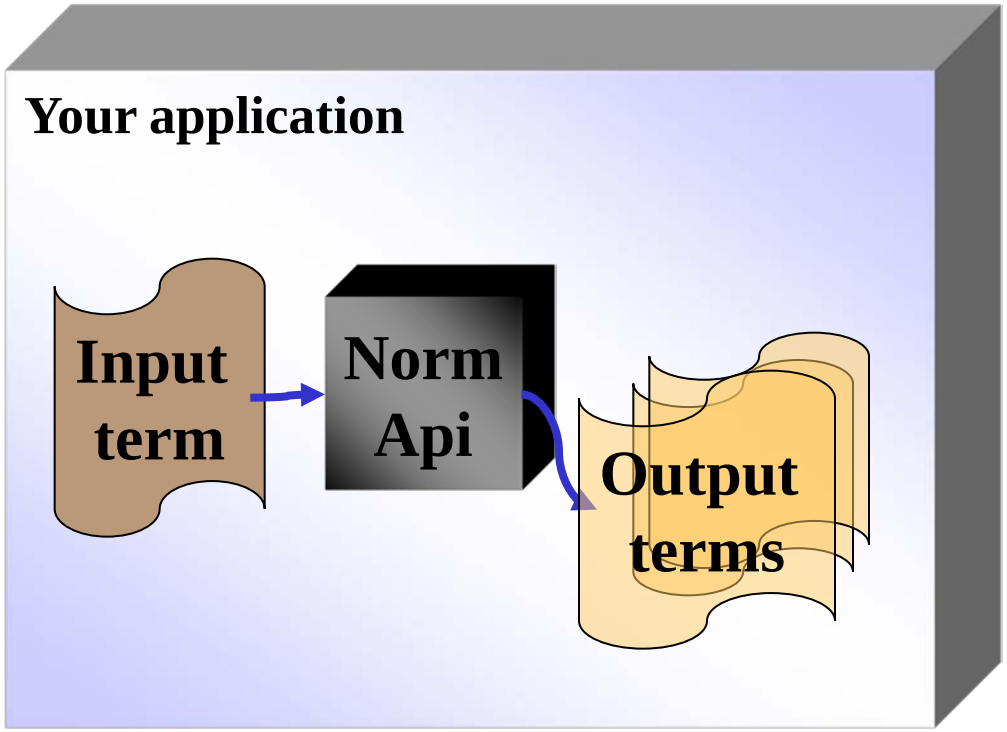
Embedding These Tools into Your Application

- Classpath
- NormApi()
- LvgCmdApi()
- LexItem
- LvgLexItemApi()



Lexical Tools:

Embedding Norm into Your Application



Lexical Tools:

Embedding These Tools into Your Application

CLASSPATH = ${CLASSPATH}:
${LVG_DIR}:
${LVG_DIR}/classes/*lvg2002.jar:*

${LVG_DIR}/classes/IDB/jta-spec1_0_1.jar:
${LVG_DIR}/classes/IDB/idb.jar:

${LVG_DIR}/classes/jdbcDrivers/mm.mysql-2.0.6

If you are using IDB

If you are using MySQL

Lexical Tools:

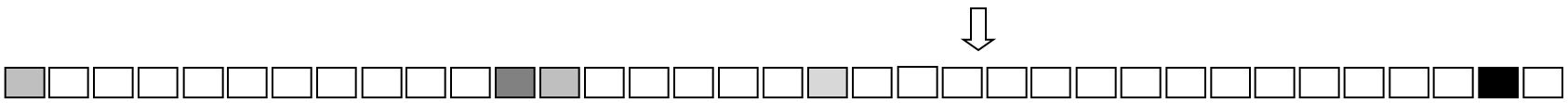
Embedding Norm into Your Application

```
import Lvg.Api.*;


NormApi       normalize = new NormApi();
String          input2Norm = null;
Vector  outputFromNorm = null;
```

Lexical Tools:

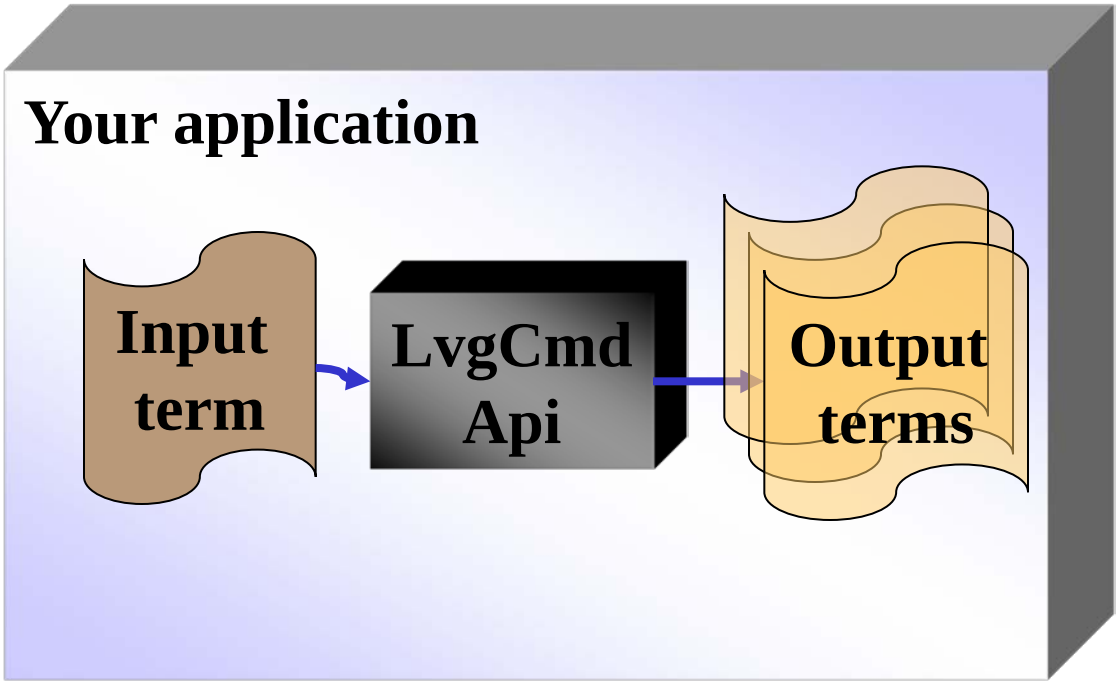
Embedding Norm into Your Application

```
while ( (input2Norm = stdIn.readLine() ) != null ) {

   outputFromNorm= normalize.Mutate(input2Norm);

   for ( int i = 0; i < outputFromNorm.size(); i++ ) {

       System.out.println((String) outputFromNorm.get(i));
    }
}
normalize.CleanUp();
```



Lexical Tools:

Embedding Lvg into Your Application



Lexical Tools:

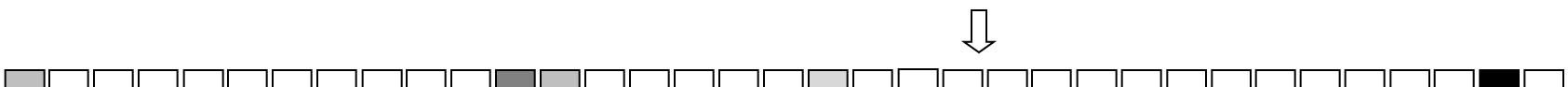
Embedding Lvg into Your Application

```
import Lvg.Api.*;

LvgCmdApi lvgApi = new LvgCmdApi("-f:b –CR:o –SC –SI");
String          input2Lvg = null;
Vector   outputFromLvg = null;
```

Lexical Tools:

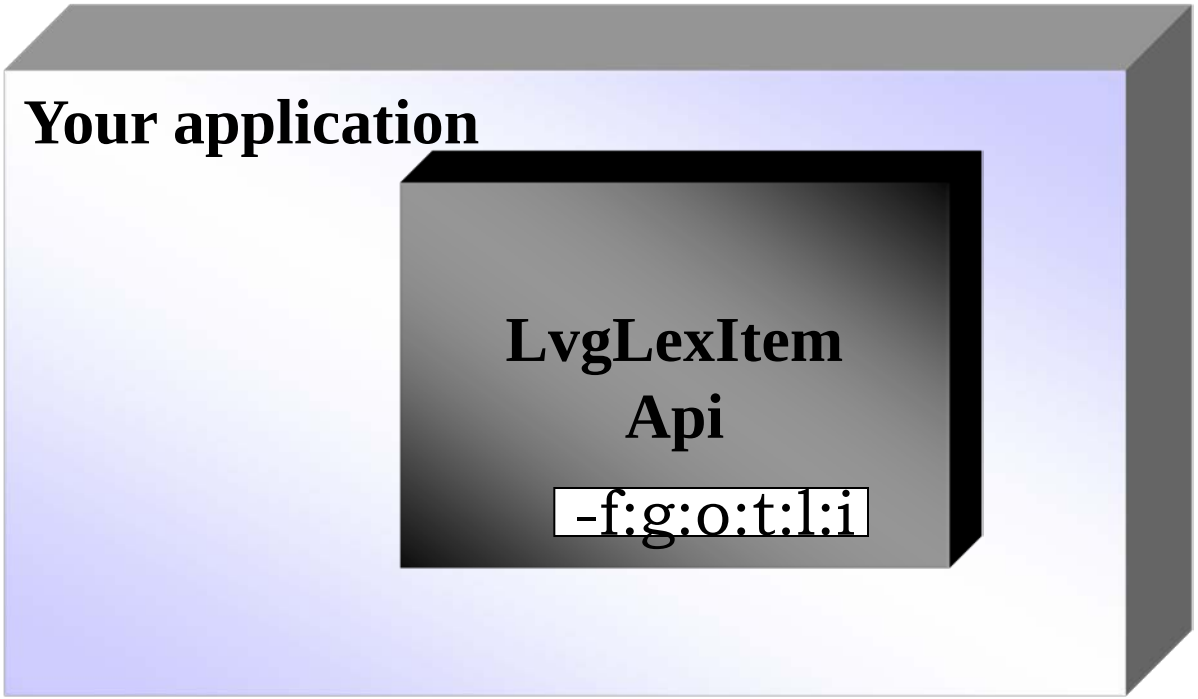
Embedding Lvg into Your Application

```
while ( (input2Lvg = stdIn.readLine() ) != null ) {
   outputFromLvg= lvgApi.Mutate(input2Lvg);
    for ( int i = 0; i < outputFromLvg.size(); i++ ) {
        System.out.println((String) outputFromLvg.get(i));
    }
}
lvgApi.CleanUp();
```



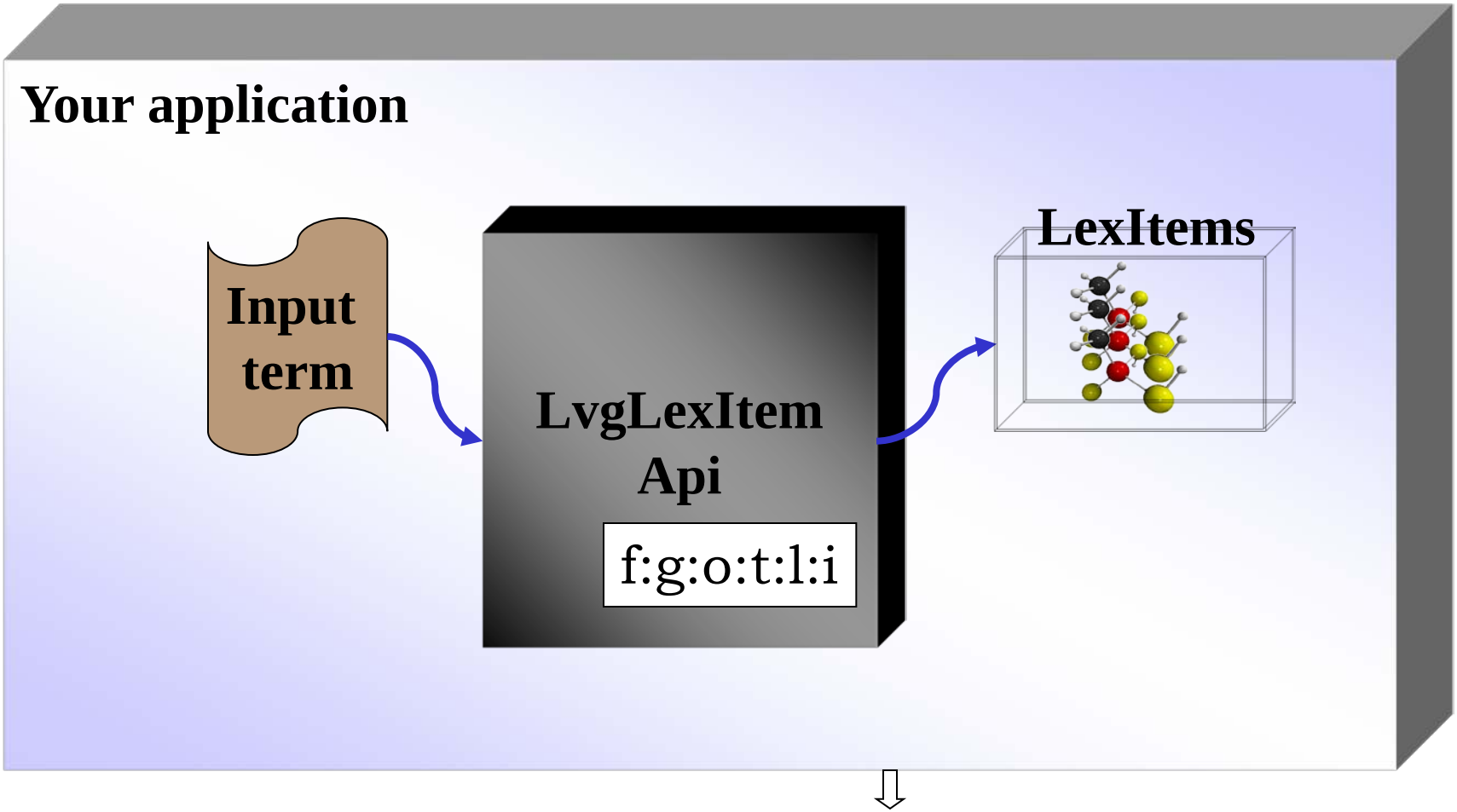
Lexical Tools:

Embedding Lvg into Your Application



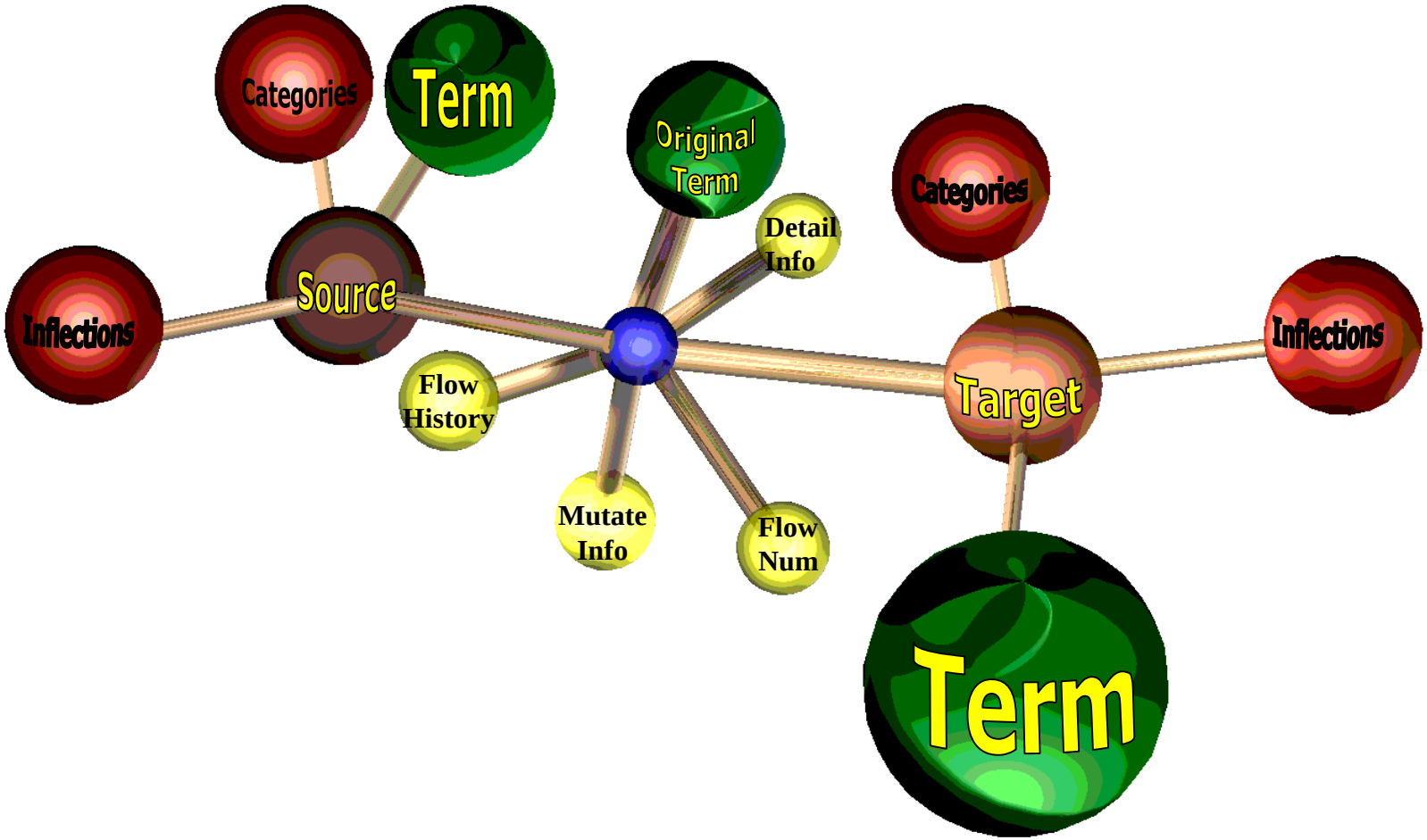
Lexical Tools:

Embedding Lvg into Your Application



Lexical Tools:

The LexItem Class



Lexical Tools:

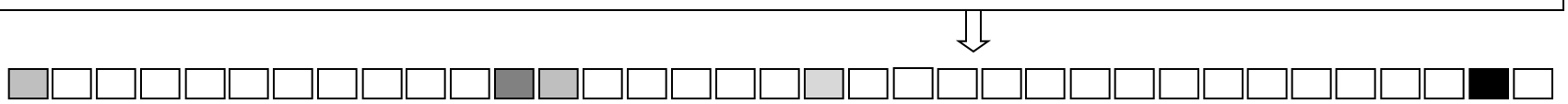
Embedding Lvg into Your Application

```
import Lvg.Api.*;
import Lvg.Lib.*;

LvgCmdApi    lvgApi = new LvgLexItemApi("-f:g:o:t:l:i");
String         input2Lvg = null;
Vector outputFromLvg = null;
LexItem        aLexItem = null;
```

Lexical Tools:

Embedding Lvg into Your Application

```
while ( (input2Lvg = stdIn.readLine() ) != null ) {

   outputFromLvg=lvgApi.MutateLexItem(input2Lvg);

    for ( int i = 0; i < outputFromLvg.size(); i++ ) {

       aLexItem = (LexItem) outputFromLvg.get(i);
       System.out.println(aLexItem.GetSourceTerm() + "|" +
              aLexItem.GetTargetTerm() + "|" +
              aLexItem.GetTargetCategory().GetName()+ "|" +
              aLexItem.GetTargetInflection().GetName() + "|" +
              aLexItem.GetTargetInflection().GetValue() );
    }
}
lvgApi.CleanUp();
```



Lexical Tools:

Java API Documentation

Packages	
Lvg.Api	This package provides APIs
Lvg.CmdLineSyntax	Provides Java classes necessary to create a command line system.
Lvg.Db	Provides a higher level interface to LVG database.
Lvg.Flows	This package provides API of all Lvg flow components.
Lvg.Lib	Contains LVG general library classes of BitMaskBase, Category, Gender, Inflection, Configuration, CombineRecords, OutputFilter, Flow, GlobalBehavior, LexItem, LexItemComparator
Lvg.Trie	Provides the classes necessary to generate inflections, uninflections, and derivations using LVG rules tries
Lvg.Util	Contains LVG general utility classes of comparators, Bit operations, Case, In, Out, Strip operations, token operation, Char, Str, and Word.

Lexical Resources

- Home
- Metathesaurus
- Semantic Network
- SPECIALIST Lexicon
- Expert Search
- Download Results
- Comments
- Help

UMLS Knowledge Source Server

Other UMLS Resources	
Knowledge Sources	Source files for the Metathesaurus and Semantic Network and the SPECIALIST Lexicon.
Knowledge Source Server API	The UMLS Knowledge Source Server API and command line interface.
Lexical Tools	The Lexical Tools are utilities which manipulate lexical data in order to abstract away from a various kinds of lexical variation; inflection, inversion, alphabetic case, etc.

References

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McCray AT, Cheh ML, Bangalore AK, Rafei K, Razi AM, Divita G, Stavri PZ. Conducting the NLM/AHCPR Large Scale Vocabulary Test: a distributed Internet-based experiment. Proc AMIA Annu Fall Symp. 1997;:560-4.

McCray AT, Razi, AM, Bangalore AK, Browne AC, Stavri PZ. The UMLS Knowledge Source Server: A versatile Internet-based research tool. Proc AMIA Symp. 1996;164-8.

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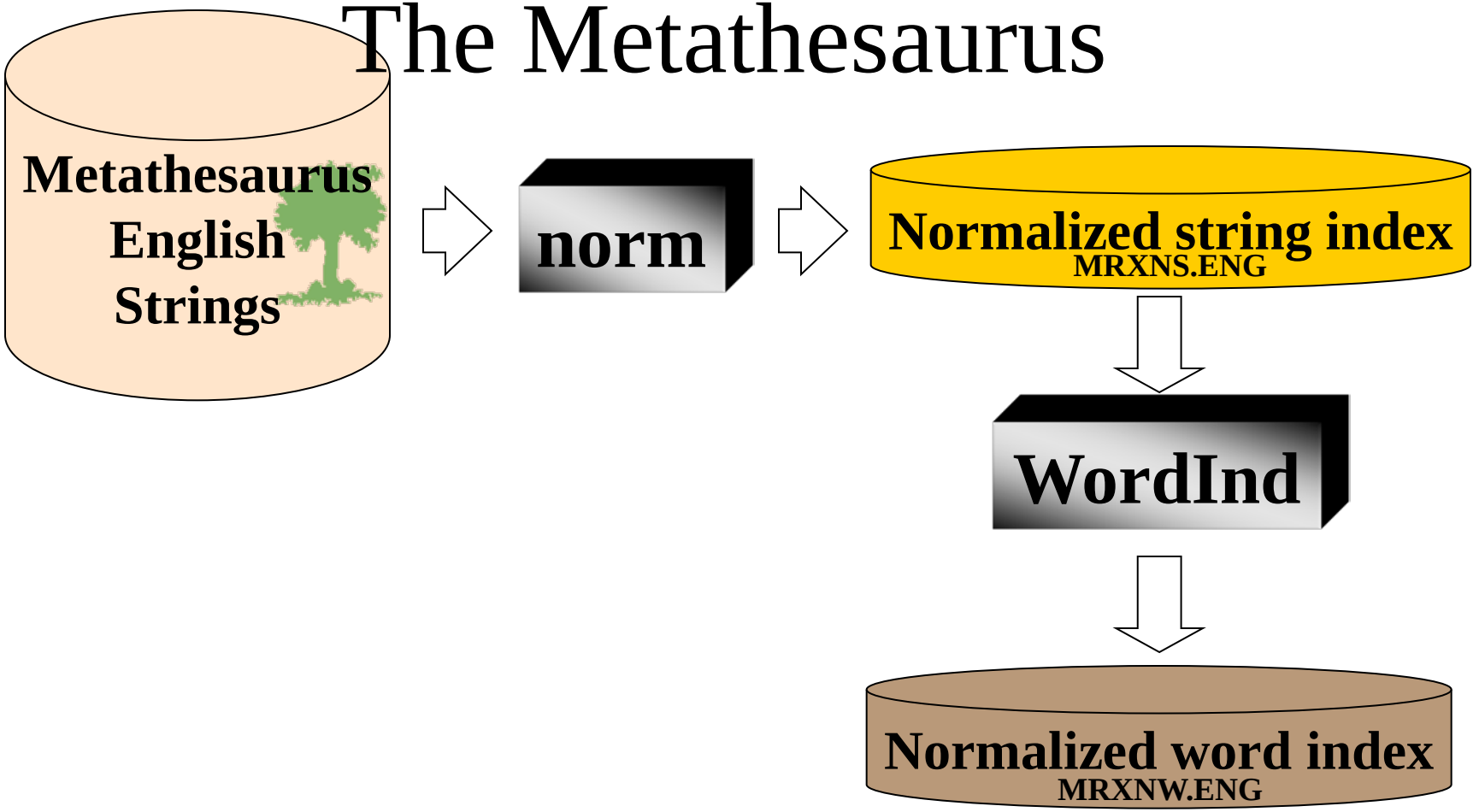
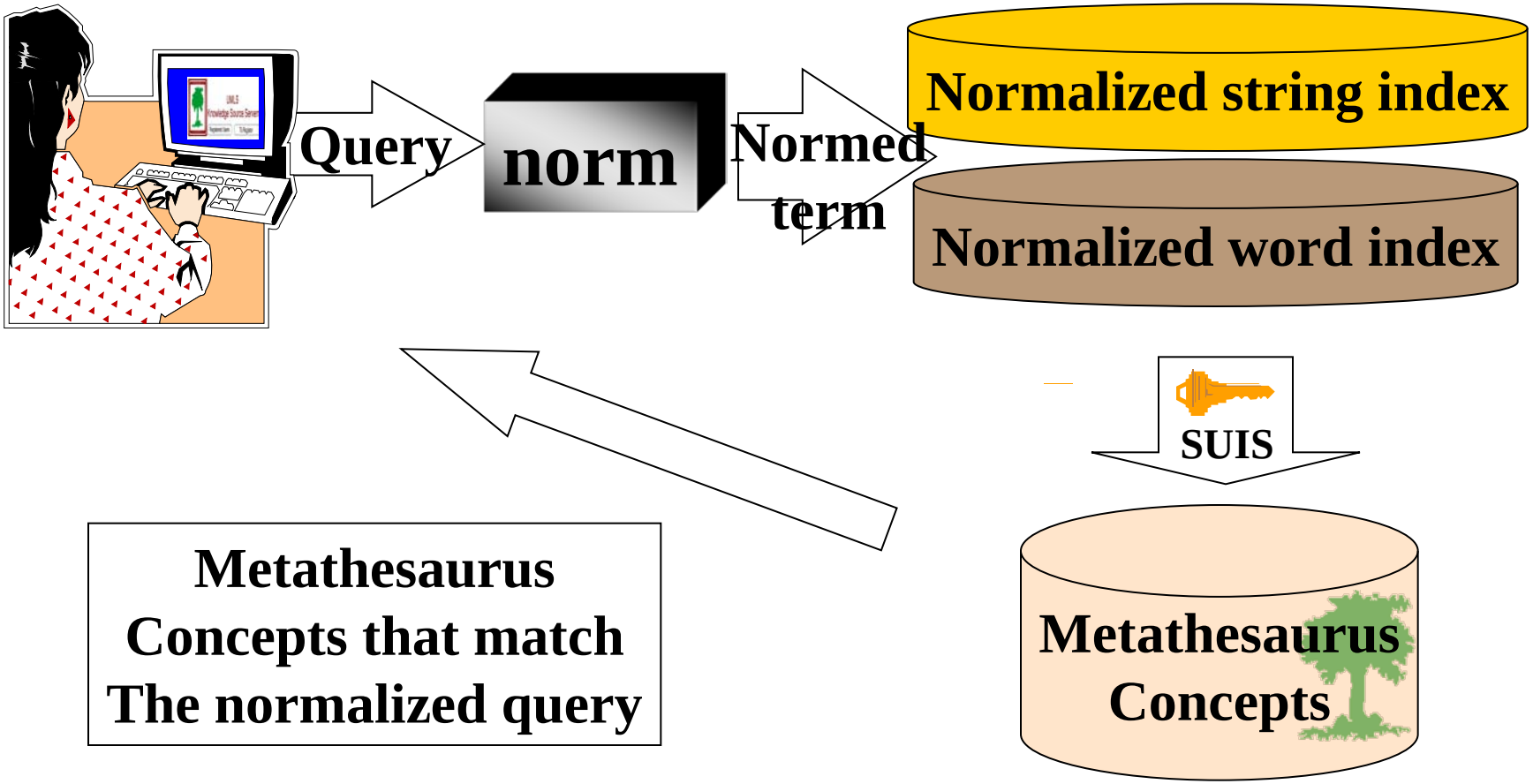
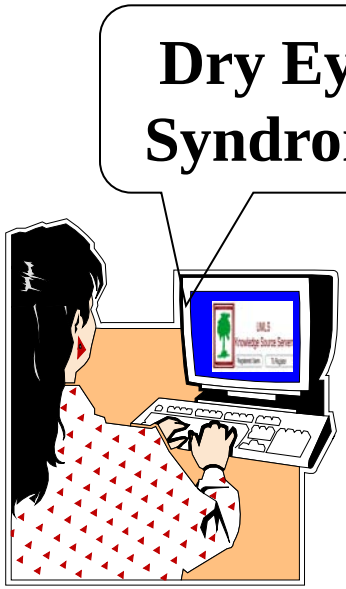
Using The Lexical Tools with The Metathesaurus



Using The Lexical Tools with The Metathesaurus

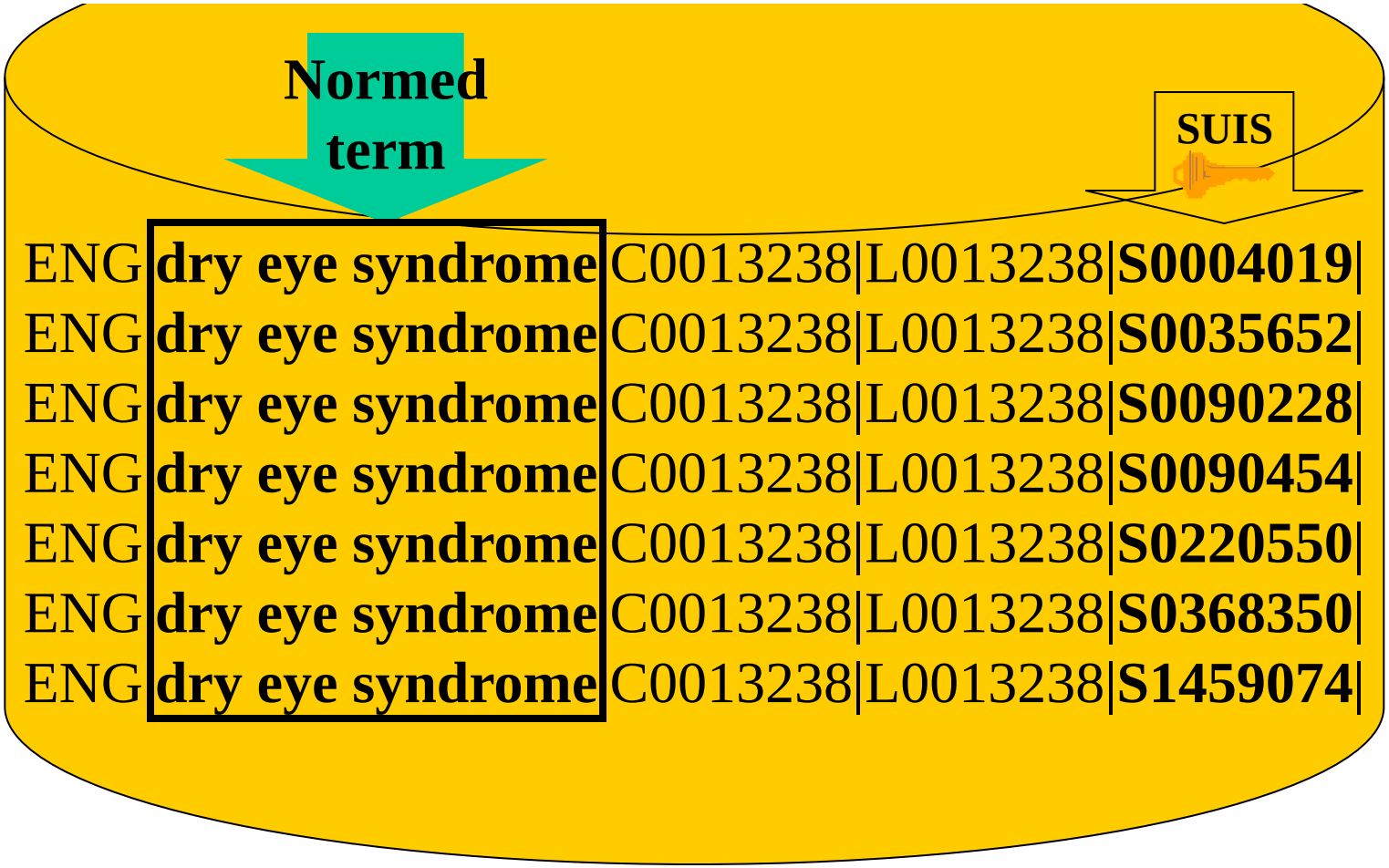


Using The Lexical Tools with The Metathesaurus

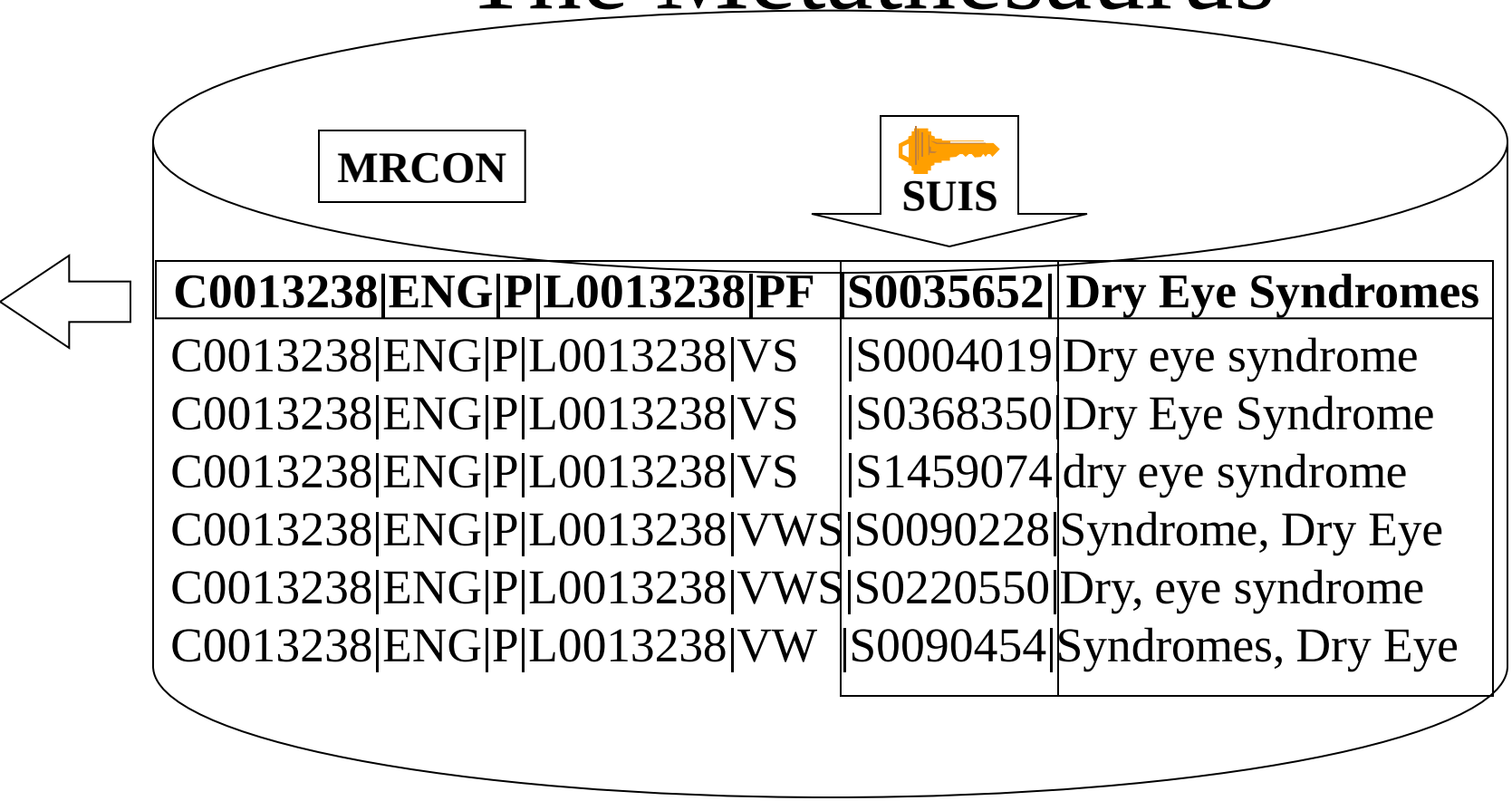


Query → **norm** → **Normed term** → **dry eye syndrome**

Using The Lexical Tools with The Metathesaurus



Using The Lexical Tools with The Metathesaurus



Building an Index Using The Lexical Tools

- Can we build a tool that increases recall?
- Can we build a tool that increases precision?

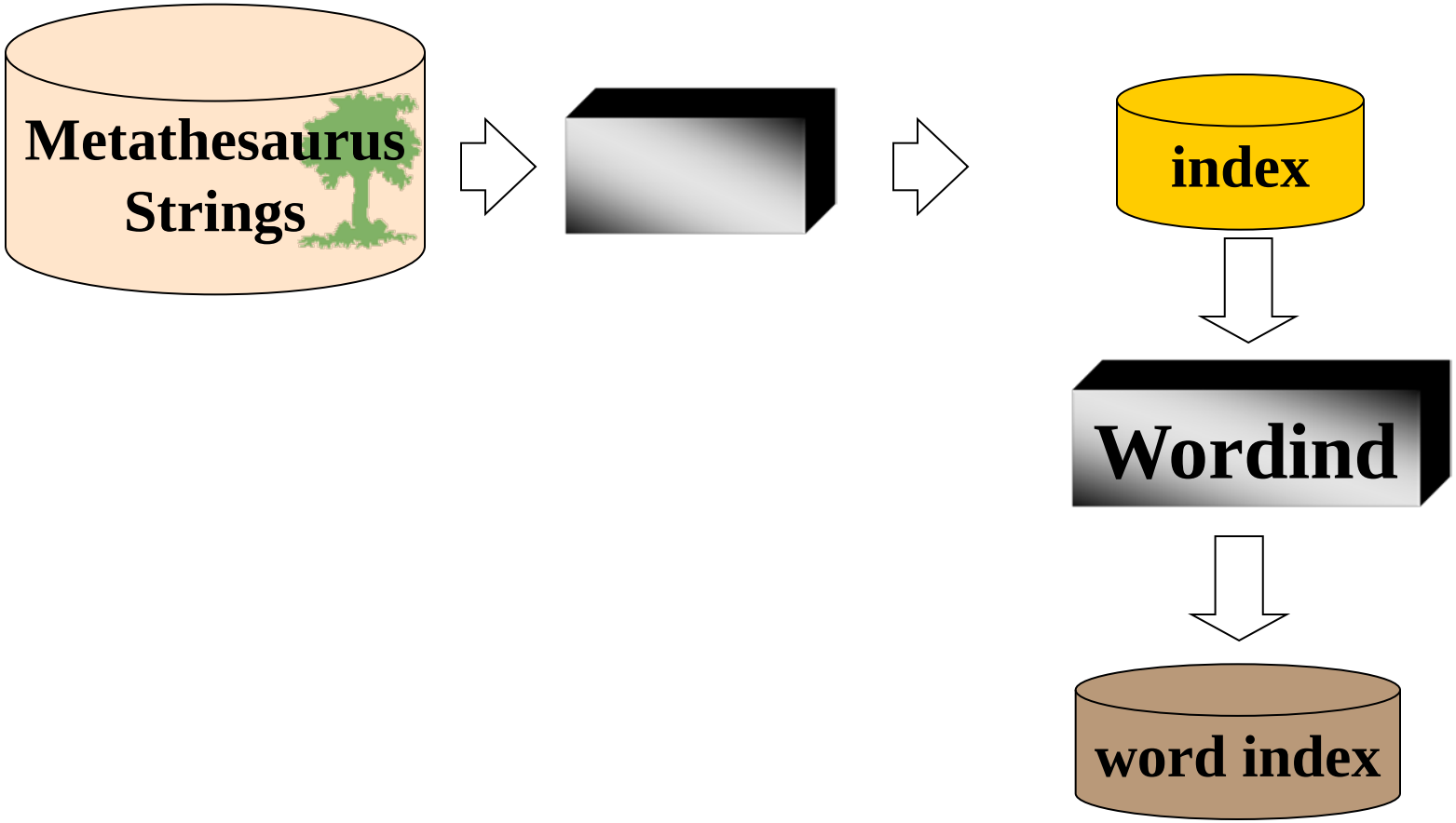
Building an Index Using The Lexical Tools

- Can we build a tool that increases precision?
  - Case
  - Constrain by part of speech
  - Filter to the lexicon

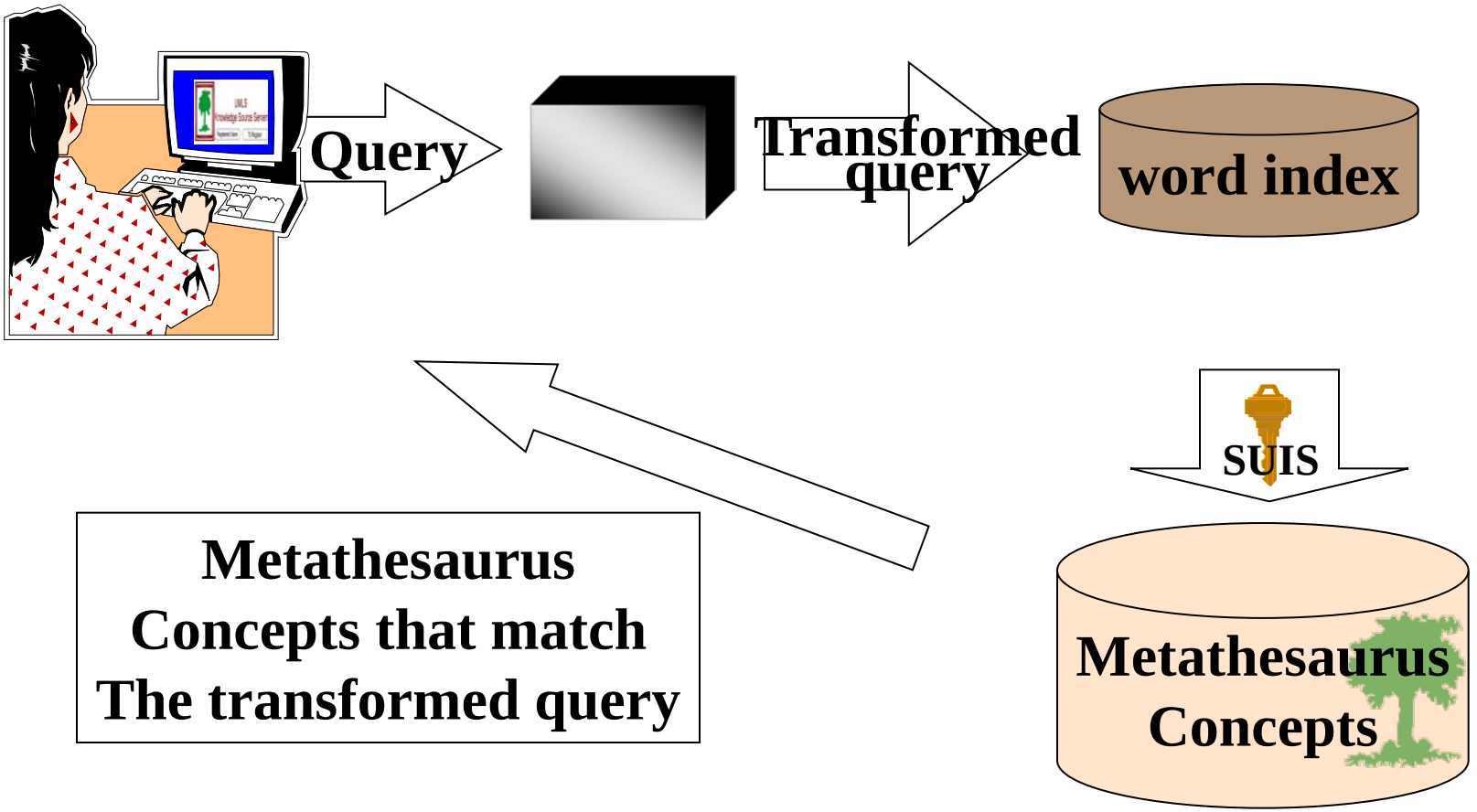
Building an Index Using The Lexical Tools

- Can we a tool that increases recall?
  - Include
    - synonyms
    - derivations
    - acronyms and their expansions
    - spelling variants

Building an Index Using The Lexical Tools

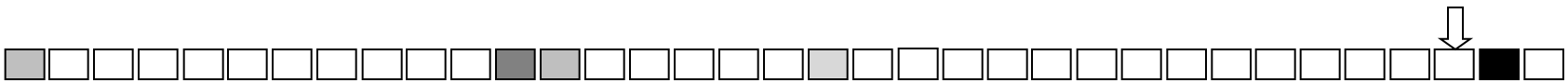


Building an Index Using The Lexical Tools



Lexical Tools:
2003 and Beyond

- Performance issues addressed
- Graphic User Interface
  - Lexical GUI tool
  - On-line Web based tool
- Enhance flow components
  - Norm improved
- New flow components
  - Nominalize, Complementation
- Additional functionalities
  - XML output option



Lexical Tools for UMLS Developers

November 4, 2001

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National Library of Medicine

Email: **umlslex.nlm.nih.gov**

Knowledge Source Server: **http://umlsks.nlm.nih.gov**

UMLS Information: **http://umlsInfo.nlm.nih.gov**

Appendix

NormExample.java

LvgExampleEasy.java

LvgExampleHarder.java

LvgExampleEvenHarder.java