The Cyc Lexicon

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Overview

- Natural language microtheories
- Kinds of semantic predicates
- Inflectional and derivational morphology

Themes

- How to modify / add to the Cyc lexicon
- The *generative* nature of the Cyc lexicon: use of inference rules for deriving new entries

Language Microtheories

- GeneralEnglishMt
  - AmericanEnglishMt
  - BritishEnglishMt
  - IrishEnglishMt
  - NewZealandEnglishMt
- SlovenianMt
- PolishMt
- ...

Favour-TheWord

Mt : BritishEnglishMt
infinitive : "favour"

Mt : GeneralEnglishMt
infinitive : "favor"

Mt : BritishEnglishMt
massNumber : "favour"

Mt : GeneralEnglishMt
massNumber : "favor"

Lexicon Microtheories

- GeneralLexiconMt
  - EnglishLexiconMt
  - SloveneLexiconMt

- for defining (language-specific) lexicon *predicates*, e.g. **dual**
- *not* for lexical mappings

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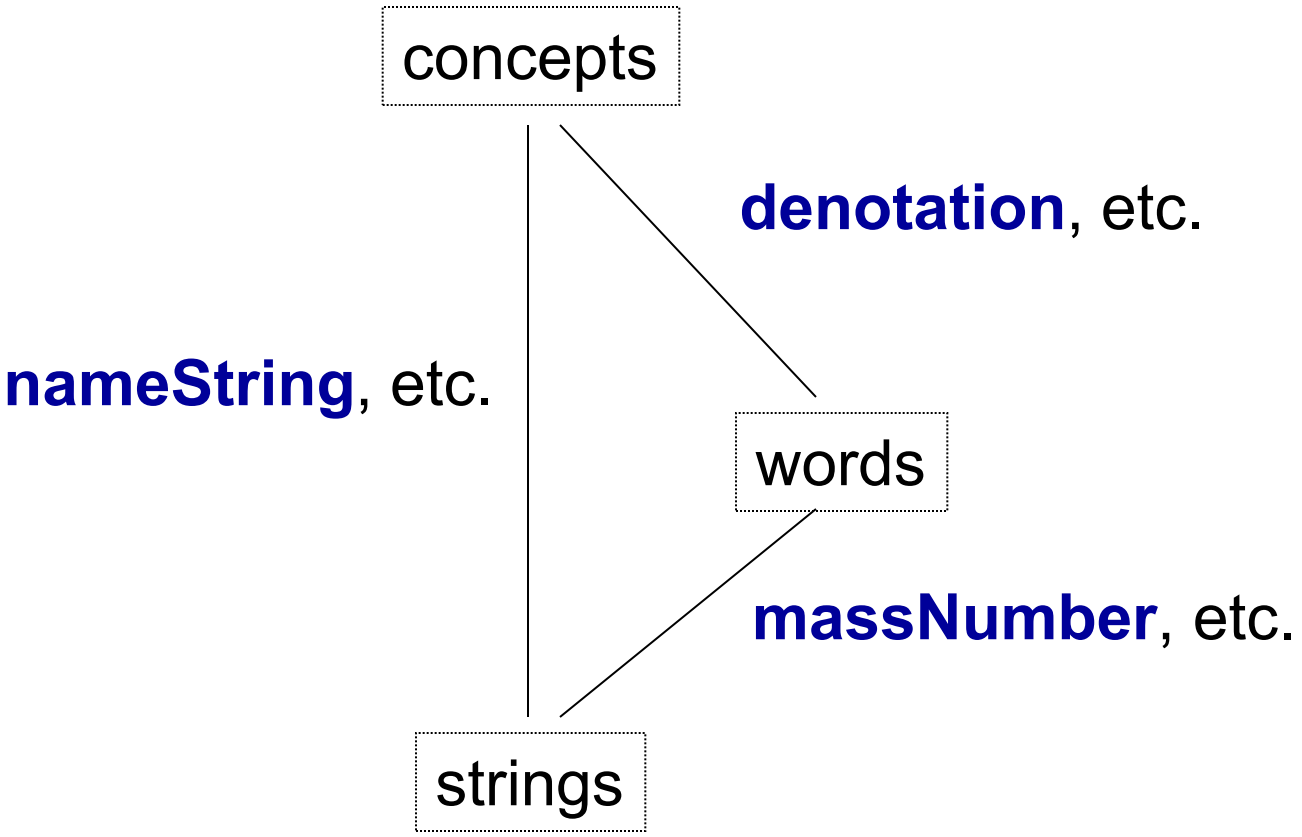
Two string-concept routes



Kinds of semantic predicates

- **nameString**-like:
  - string ~ concept
- **denotation**-like:
  - word ~ concept
- ***semTrans** (**verbSemTrans**, etc.)**:**
  - word ~ semantic template
- **genTemplate**, **assertTemplate**:
  - sentence template ~ concept

nameString

```
(nameString MarkTwain "Mark Twain")
(nameString MarkTwain "Samuel Clemens")
```

nameString-like predicates

familyName
lastName
middleName
firstName
fullName
nickNames
formerName
hipHopMoniker

accessFilename
atomicSymbol
countryCodeDigraph
internetCountryCode
airportHasIATACode
cwEntitled
movieTitleString
sectionTitle

Lexical Info for ECoppock:

Default generated phrase: "Elizabeth Coppock" (#$nameString)

Mt: EnglishMt

(familyName ECoppock "Coppock")

(givenNames ECoppock "Elizabeth")

M(nameString ECoppock "Elizabeth Coppock")

(nameString ECoppock "Liz Coppock")

Mt: (MtSpace CyclishMt (MtTimeDimFn (IntervalStartedByFn-Inclusive (YearFn 2009))))

(nameString ECoppock "Elizabeth Coppock, Ph.D.")

(nameString ECoppock "Elizabeth Coppock, PHD")

Mt: EnglishMt

(genStringAssertion ECoppock

M(nameString ECoppock "Elizabeth Coppock"))

Assertion :

(nameString ECoppock "Elizabeth Coppock, PHD")
in (MtSpace CyclishMt (MtTimeDimFn (IntervalStartedByFn-Inclusive (YearFn 2009))))

Arguments Supporting Assertion :

Argument : Deduction #3497335

```
(implies
    (and
        (isa ?PERSON PhDLevel)
        (givenNames ?PERSON ?GIVEN-NAME)
        (familyName ?PERSON ?FAMILY-NAME)
        (concatenateStrings ?NAME-PLUS ?GIVEN-NAME " " ?FAMILY-NAME ", " "PHD"))
    (nameString ?PERSON ?NAME-PLUS)) in EnglishMt
(familyName ECoppock "Coppock") in EnglishMt
(givenNames ECoppock "Elizabeth") in EnglishMt
(isa ECoppock PhDLevel)
in (MtSpace CyclistsMt (MtTimeDimFn (IntervalStartedByFn-Inclusive (YearFn 2009))))
```

:OPAQUE (concatenateStrings "Elizabeth Coppock, PHD" "Elizabeth" " " "Coppock" ", " "PHD") i

Predicate : denotation

arg1Isa : LexicalWord
arg2Isa : SpeechPart
arg3Isa : Integer
arg4Isa : Thing

Last query in EverythingPSC :
(isa ?ARG1 SpeechPart)

121 answers for ?ARG1 :
Adjective Adjective-Ed Adjective-Gradable Adjective-Ing Adverb AdverbOfFrequency AdverbOfManner AdverbOfPlace AdverbOfTime AgentiveNoun AttributiveOnlyAdjective Aux-Negated AuxVerb BeAux CommonNoun ComparativeAdjective Complementizer ConjunctAdverb Conjunction CoordinatingConjunction CountNoun CountNoun-Feminine CountNoun-Generic CountNoun-Masculine CountNoun-Neuter DeAdjectivalAdjective DeAdjectivalAdverb DeAdjectivalNoun DeAdjectivalVerb DeVerbalNoun DenominalAdjective DenominalAdverb DenominalNoun DenominalVerb Determiner Determiner-Central Determiner-ClassA Determiner-ClassB Determiner-ClassC Determiner-Definite Determiner-Indefinite DeverbalAdjective DoAux DualPronoun ExpletivePronoun FemininePronoun GerundiveCountNoun GerundiveNoun GerundiveNoun-NumberAgnostic HaveAux IndefinitePronoun InfinitiveComp Interjection-SpeechPart MainVerb MasculinePronoun MassNoun MassNoun-Generic Modal Modal-Contracted Modal-Negated NLWordForm NeuterPronoun NonIntersectiveAdjective NongradableAdjective Noun Number-SP ObjectPronoun OrdinalAdjective PluralPronoun PositiveAdjective PossessiveMarker PossessiveMarker-Pl PossessiveMarker-Sg PossessivePronoun PossessivePronoun-Post PossessivePronoun-Pre PostQuant-SP Postdeterminer PredicativeOnlyAdjective Preposition Preposition-Directional Preposition-Directional-Atelic Preposition-Directional-Telic Preposition-Duration Preposition-Duration-Atelic Preposition-Duration-Telic Preposition-Locative Preposition-Of Preposition-Spatial Preposition-Temporal Preposition-TimePoint Pronoun Pronoun-SubjectOrObject ProperCountNoun ProperMassNoun ProperNoun Punctuation-SP Quantifier-SP QuantifyingIndexical ReciprocalPronoun ReflexivePronoun SingularPronoun SubjectPronoun SubordinatingConjunction SuperlativeAdjective ThePrototypicalSpeechPart There-Existential Verb Verb-Contracted VerbParticle WHAdverb WHDeterminer WHPronoun WHPronoun-Object WHPronoun-Possessive WHPronoun-Subject WHWord

Predicate : speechPartPreds

GAF Arg : 1

Mt : UniversalVocabularyMt

comment : "This predicate expresses the relation between parts of speech and the corresponding syntactic predicates. The first argument is a part of speech, i.e., a collection that is a specialization of SpeechPart. The second argument is a SpeechPartPredicate (q.v.). For instance, (speechPartPreds CountNoun singular) means that the predicate singular only applies to words that have CountNoun forms."

Constant : Ring-TheWord
isa : EnglishWord

Mt : EnglishMt
singular : "ring"
infinitive : "ring"

(denotation Ring-TheWord Verb 1 **EmittingSound)**

(denotation Ring-TheWord CountNoun 1 **AudibleSound)**

(denotation Ring-TheWord CountNoun 0 **RingShapedObject)**

(denotation Ring-TheWord CountNoun 2 **Ring-Jewelry)**

Constant : Coke-TheWord
isa : EnglishWord

Mt : EnglishMt
singular : “coke” **pnSingular :** “Coke”
massNumber : “coke” **pnMassNumber :** “Coke”

(**denotation Coke-TheWord ProperCountNoun 0 (ServingFn CocaCola)**)

(**denotation Coke-TheWord ProperMassNoun 0 CocaCola**)

(**denotation Coke-TheWord MassNoun 0 Cocaine-Powder**)

(**denotation Coke-TheWord MassNoun 2 ColaSoftDrink**)

(**denotation Coke-TheWord SimpleNoun 0 (ServingFn ColaSoftDrink)**)

(**denotation Coke-TheWord MassNoun 1 CokeFuel**)

Mass nouns vs. Count nouns

- Only count nouns can be plural
  - one ring, two rings [count]
  - one sand, *two sands [mass]
  - one coke, two cokes [ambiguous]
- Only mass nouns take determiner *some*
  - *Can I have some ring? [count]
  - Can I have some sand? [mass]
  - Can I have some coke? [ambiguous]

Multi-word lexical entries

- The **denotation** predicate maps single words to concepts.
- What about phrases like "Clinton joke" and "joke about Clinton"?
  - **multiWordString** for head-final phrases
  - **compoundString** for head-initial phrases

Predicate : multiWordString

arg1Isa : (ListOfTypeFn ControlCharacterFreeString)
arg2Isa : LexicalWord
arg3Isa : SpeechPart
arg4Isa : Thing

Mt : AllEnglishLexicalMicrotheoryPSC

(multiWordString
(TheList "Clinton") Joke-TheWord CountNoun
(JokeAboutFn BillClinton))

Mt : AllEnglishLexicalMicrotheoryPSC

(multiWordString
(TheList "Clinton") Joke-TheWord CountNoun
(JokeAboutFn BillClinton))

head of the phrase, so plural = "Clinton jokes"

Predicate : compoundString

arg1Isa : LexicalWord
arg2Isa : (ListOfTypeFn ControlCharacterFreeString)
arg3Isa : SpeechPart
arg4Isa : Thing

CompoundString or **MultiWordString**?

Example:

one joke about Clinton
*two joke**s** about Clinton*
two joke about Clintons***

→ *joke* is the head of the phrase
→ use **CompoundString** instead of **MultiWordString**

What if I can't remember this?

- In many cases, you can just use the Dictionary Assistant.

Dictionary Assistant

Specify the term and phrase for the lexical mapping

Complete **Term :** AdultMaleHuman Clear Term

Phrase : guy Clear Phrase

Reset OK

Dictionary Assistant

Checking phrase ambiguity

In addition to 'man', phrase "guy" also refers to the following:

male person
Guy Steele
Sir ovadia
Sir ovadia
Sergeant First Class Guy Hasson
Guyana

Is that OK?

Yes No

Dictionary Assistant

Checking whether the phrase is a proper name

Is the phrase "guy" a name?

Yes No

Dictionary Assistant

Checking usage of 'guy'

Which of the following sounds best?

- (●) many guys; a guy: countable noun like 'book'
- ( ) much guy; some guy: uncountable noun like 'sand'

OK

What about relational nouns like *mother* and *temperature*?

- Three options:
  - **denotesArgInReIn**
  - **RelationParaphraseMt**
  - **nounSemTrans**

denotesArgInReIn

(denotesArgInReIn Mother-TheWord CountNoun mother 2)

This says: One denotation of the word *mother* qua **CountNoun** is the collection of things M such that:

(relationExistsInstance mother Thing M)

i.e. the set of all mothers

RelationParaphraseMt

Mt : RelationParaphraseMt

(denotation Income-TheWord CountNoun 1 income)

nounSemTrans

```
(nounSemTrans
  (WordWithSuffixFn Assassinate-TheWord Ion_AbstractNounProducing-TheSuffix) 132 GenitiveFrame
  (and
    (isa :NOUN AssassinatingSomeone)
    (victim :NOUN :POSSESSOR))) in GeneralEnglishMt
```

verbSemTrans

Mt : AllEnglishValidatedLexicalMicrotheoryPSC

```
(verbSemTrans Scratch-TheWord 0 IntransitiveVerbFrame
  (and
    (isa :ACTION ScratchingOneself)
    (primaryObjectMoving :ACTION :SUBJECT)))
(verbSemTrans Scratch-TheWord 0 TransitiveNPFrame
  (and
    (isa :ACTION ScratchingOneself)
    (objectOfStateChange :ACTION :OBJECT)
    (doneBy :ACTION :SUBJECT)))
```

verbSemTrans-Canonical

- (verbSemTrans-Canonical Assassinate-TheWord 0 TransitiveNPFrame AssassinatingSomeone (TheList perpetrator victim)) in GeneralEnglishMt

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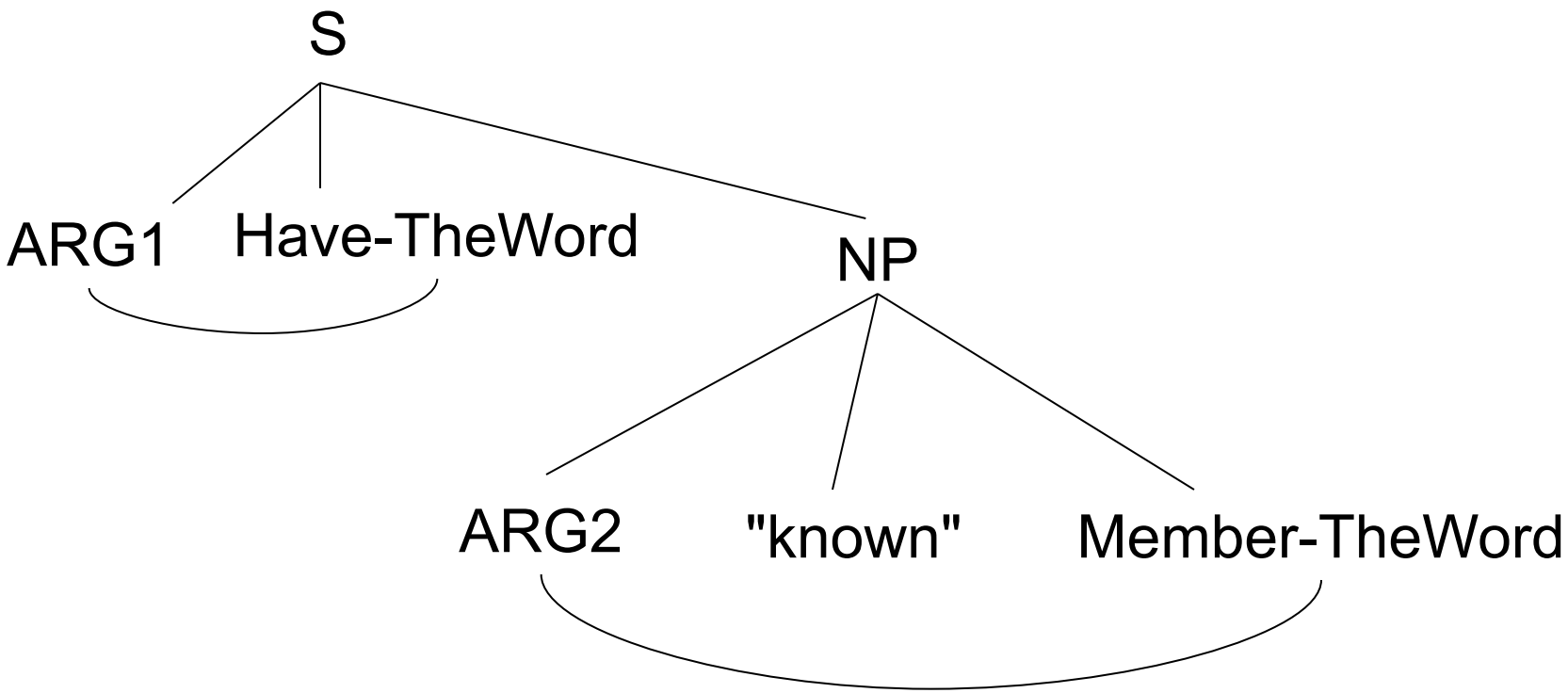
genTemplate

Mt : EnglishParaphraseMt

```
(genTemplate extentCardinality
    (ConcatenatePhrasesFn
        (TermParaphraseFn-NP :ARG1)
        (BestHeadVerbForInitialSubjectFn Have-TheWord)
        (BestDetNbarFn
            (TermParaphraseFn :ARG2)
            (ConcatenatePhrasesFn
                (BestNLPhraseOfStringFn "known")
                (HeadWordOfPhraseFn
                    (BestNLWordFormOfLexemeFn-Constrained CountNoun Member-TheWord))))))
```

That **genTemplate** in tree form



Deriving **genTemplates**

- Usually, **genTemplate** assertions are hand-written for each predicate
- But in principle, they could be derived by rule using facts about the predicate
- There are some examples of this

Assertion :

(genTemplate biologicalGrandfathers
  (BasicTransitiveSentenceFn
    (BestDetNbarFn
      (TermParaphraseFn-Possessive :ARG1)
      (TermParaphraseFn-Constrained plural-Generic biologicalGrandfathers)) Include-TheWord
    (TermParaphraseFn-NP :ARG2))) in EnglishParaphraseMt

Arguments Supporting Assertion :

Argument : Deduction #2835950

M(implies
  (isa ?PRED FamilyRelationSlot)
  (genTemplate ?PRED
    (BasicTransitiveSentenceFn
      (BestDetNbarFn
        (TermParaphraseFn-Possessive :ARG1)
        (TermParaphraseFn-Constrained plural-Generic ?PRED)) Include-TheWord
      (TermParaphraseFn-NP :ARG2)))) in EnglishParaphraseMt

:ISA (isa biologicalGrandfathers FamilyRelationSlot) in UniversalVocabularyMt

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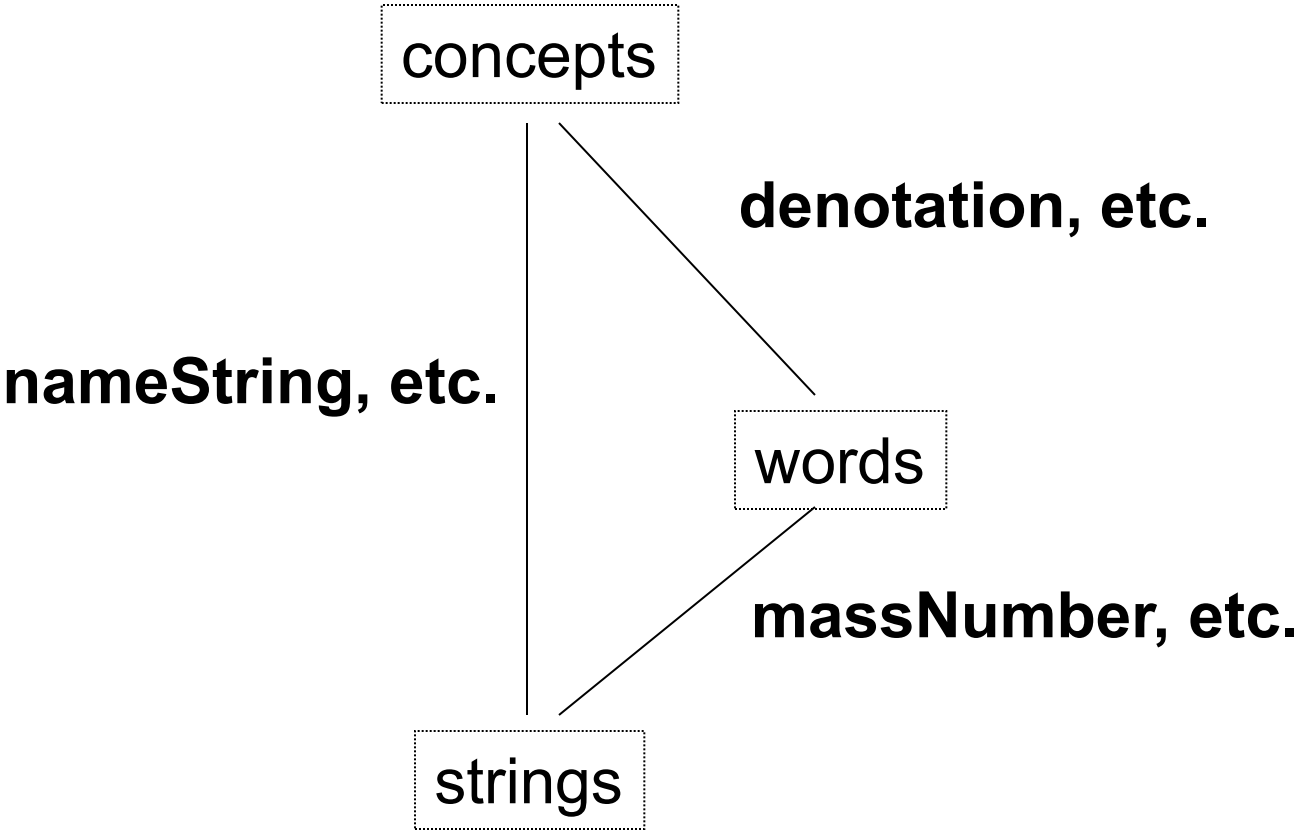


Two kinds of morphology

- **Inflectional**: relates multiple forms of the same word, e.g.

  (**singular Dog-TheWord** "dog")

  (**plural Dog-TheWord** "dogs")

- **Derivational**: relates one word to another, e.g. **Wonder-TheWord** ~ **Wonderful-TheWord**

Protoypical Inflectional Morphology

- tense (past, present, futu□re, perfect)
- aspect (progressive, etc.)
- mood (conditional, imperative)

- person (first, second, third)
- number (singular, plural)
- gender (masculine, feminine, neuter)

Inflectional Morphology in Cyc

- Inflectional suffixes are not reified individuals in the KB; their orthographic content is indicated with **regularSuffix** assertions.
- Rules attach the string to the first form to produce the second form.

Inflectional Morphology in Cyc

- M(implies
  (and
    (infinitive ?WU ?BSTRING)
    (evaluate ?ENGLISHSUFFIXFN
      (EnglishSuffixationFn ?BSTRING "ed")))
  (pastTense-Universal ?WU ?ENGLISHSUFFIXFN))
- M(implies
  (and
    (infinitive ?WU ?BSTRING)
    (evaluate ?ENGLISHSUFFIXFN
      (EnglishSuffixationFn ?BSTRING "s")))
  (thirdPersonSg-Present ?WU ?ENGLISHSUFFIXFN))
- M(implies
  (and
    (infinitive ?WU ?BSTRING)
    (evaluate ?ENGLISHSUFFIXFN
      (EnglishSuffixationFn ?BSTRING "ing")))
  (presentParticiple ?WU ?ENGLISHSUFFIXFN))

EnglishSuffixationFn

- Defined in code
- Not pure concatenation:
  - "wait" + "ed" = "waited"
  - "gate" + "ed" = "gated" (not "gateed")

  - "plate" + "s" = "plates"
  - "glass" + "s" = "glasses"

Mt : EnglishLexiconMt

- (regularSuffix gerund-Plural gerund "s")
- (regularSuffix gerund-Plural presentParticiple "s")
- (regularSuffix gerund-Singular presentParticiple "")
- (regularSuffix pluralVerb-Present infinitive "")
- (regularSuffix passiveParticiple perfect "")
- (regularSuffix firstPersonSg-Present infinitive "")
- (regularSuffix gerund presentParticiple "")
- (regularSuffix perfect pastTense-Universal "")
- (regularSuffix secondPersonSg-Present infinitive "")
- (regularSuffix superlativeAdverb regularAdverb "est")
- (regularSuffix comparativeAdverb regularAdverb "er")
- (regularSuffix agentive-Sg infinitive "er")
- (regularSuffix pastTense-Universal infinitive "ed")
- (regularSuffix thirdPersonSg-Present infinitive "s")
- (regularSuffix pnPlural pnSingular "s")
- (regularSuffix agentive-Pl agentive-Sg "s")
- (regularSuffix plural singular "s")
- (regularSuffix presentParticiple infinitive "ing")

Prototypical Derivational Morphology

- Deverbal nouns like "embarrass<u>ment</u>", "assassinat<u>ion</u>", "grow<u>th</u>"
- Denominal verbs like "null<u>ify</u>", "scrutin<u>ize</u>"
- Denominal adjectives like "wonder<u>ful</u>", "love<u>ly</u>", "boor<u>ish</u>"
- Deadjectival nouns like "happi<u>ness</u>"

Derivational Morphology in Cyc

- Reified suffixes, associated with
  - a string
  - POS category of base word
  - POS category of derived word
- According to a Cyc rule, attach to the **baseForm** form of the base word.

Individual : Ion_AbstractNounProducing-TheSuffix

GAF Arg : 1

Mt : UniversalVocabularyMt
isa : LexicalSuffix Individual

Mt : EnglishLexiconMt
isa : LevelOneAffix DeverbalAbstractNounProducingSuffix EnglishDerivationalSuffix

Mt : UniversalVocabularyMt
quotedIsa : NLMorphologyTerm

Mt : BookkeepingMt
quotedIsa : ResearchCycConstant-NLRelated-BreakLinkForOpenCycBuild NLIKBConstant CycSecureFORT

Mt : EnglishLexiconMt
comment : "The suffix "ion" ("ation", "ition") means something like *the process or state of*. It converts Verbs to Nouns, generally to MassNouns. Example: (derivedUsingSuffix #$Exploration-TheWord Ion_AbstractNounProducing-TheSuffix)."

```
(nounSemTrans
  (WordWithSuffixFn Assassinate-TheWord Ion_AbstractNounProducing-TheSuffix) 132 GenitiveFrame
  (and
    (isa :NOUN AssassinatingSomeone)
    (victim :NOUN :POSSESSOR))) in GeneralEnglishMt
```

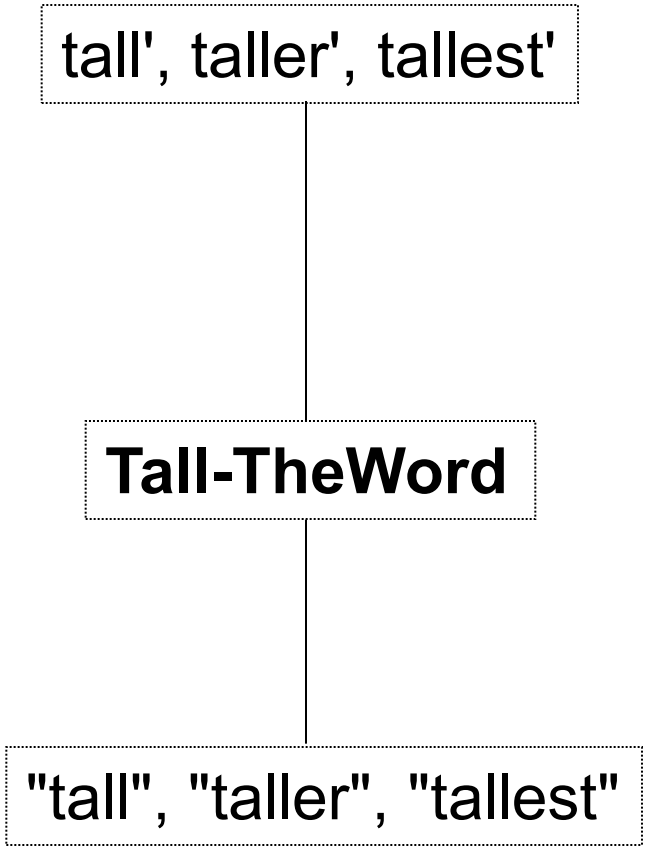
Comparatives and superlatives: Inflectional or Derivational?

- The do not change the category of stem (much): "nice", "nicer" both adjectives
- Can attach to derived words, e.g. "luck+y+er"

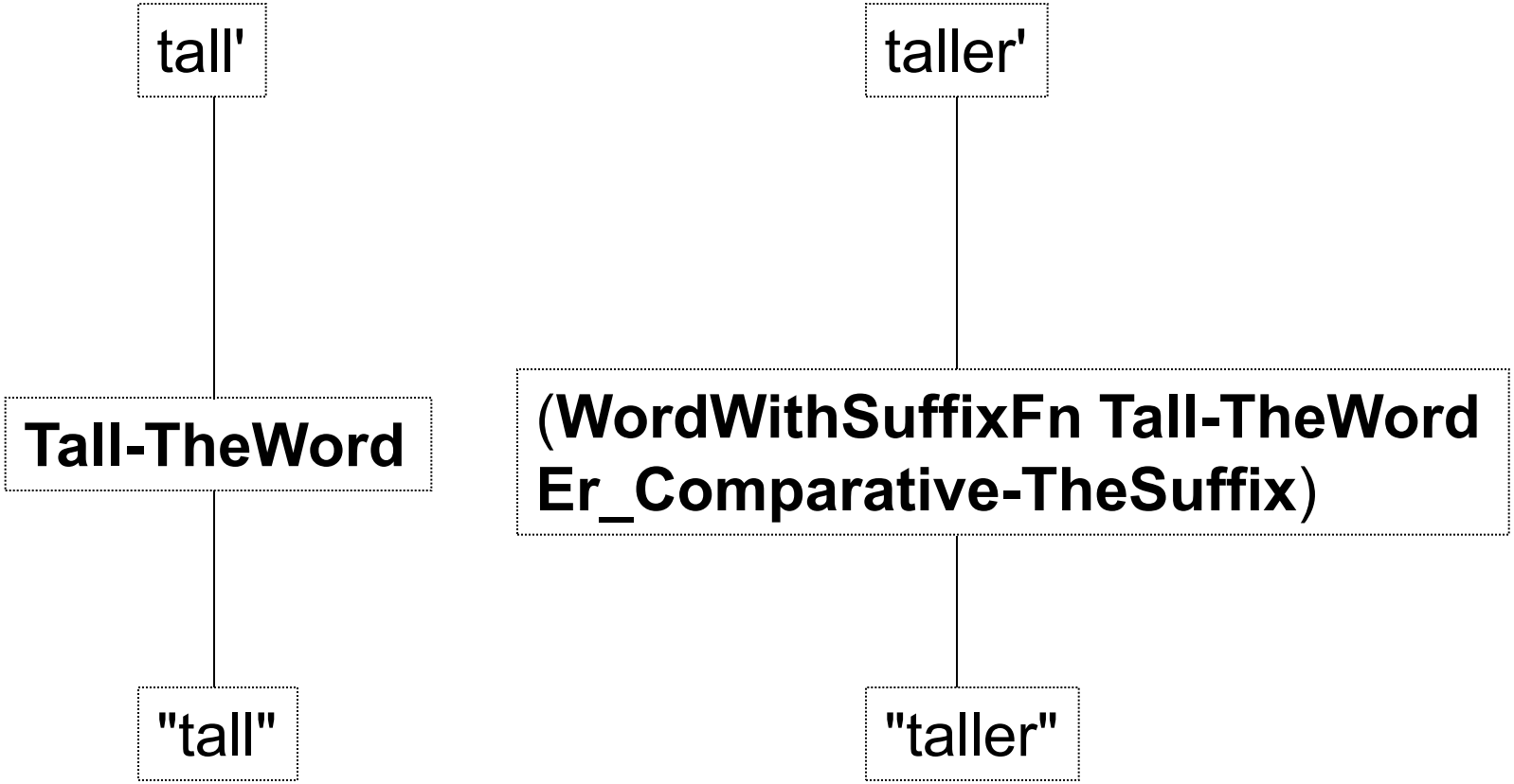
But:

- Many adjectives lack comparative form
- Killer argument: semantics

Inflectional Analysis of Comparatives



Derivational Analysis of Comparatives



Application: Interpreting queries

- Query: "patients heavier than 150 lbs"
- Does this mean:
  - patients who are heavy? No!
  - patients who weigh 150 pounds? No!
  - patients whose weight is greater than 150 pounds? Yes.

A rule for comparative semantics

```
(implies
  (and
    (adjectiveOfGenericValue ?SLOT veryLowToLowAmountOf ?WU)
    (termOfUnit ?WORDWITHSUFFIXFN
      (WordWithSuffixFn ?WU Er_Comparative-TheSuffix)))
  (adjSemTrans ?WORDWITHSUFFIXFN 27
    (PPCompFrameFn TransitivePPFrameType Than-TheWord)
    (and
      (lessThan ?X :OBLIQUE-OBJECT)
      (?SLOT :NOUN ?X)))) in GeneralEnglishMt
```

Assertion :

(adjSemTrans
  (WordWithSuffixFn Little-TheWord Er_Comparative-TheSuffix) 27
  (PPCompFrameFn TransitivePPFrameType Than-TheWord)
  (and
    (lessThan ?X :OBLIQUE-OBJECT)
    (sizeParameterOfObject :NOUN ?X))) in GeneralEnglishMt

Arguments Supporting Assertion :

Argument : Deduction #3949626

(implies
  (and
    (adjectiveOfGenericValue ?SLOT veryLowToLowAmountOf ?WU)
    (termOfUnit ?WORDWITHSUFFIXFN
      (WordWithSuffixFn ?WU Er_Comparative-TheSuffix)))
  (adjSemTrans ?WORDWITHSUFFIXFN 27
    (PPCompFrameFn TransitivePPFrameType Than-TheWord)
    (and
      (lessThan ?X :OBLIQUE-OBJECT)
      (?SLOT :NOUN ?X)))) in GeneralEnglishMt

(adjectiveOfGenericValue sizeParameterOfObject veryLowToLowAmountOf Little-TheWord) in GeneralEnglishMt

(termOfUnit
  (WordWithSuffixFn Little-TheWord Er_Comparative-TheSuffix)
  (WordWithSuffixFn Little-TheWord Er_Comparative-TheSuffix)) in BaseKB

To do:

- Improve semantic coverage for comparative adjectives
- Derive semantics for superlatives
- Develop analogous analysis for comparative and superlative adverbs (e.g. *she ran faster / the fastest*)

Nouns with arguments

- New York Times: "...the assassination of a senior Hamas official..."
  - There was an event of assassination
  - Hamas official: the **victim** or **perpetrator**?
- General problem: linking noun phrases in PP modifiers of nouns to the appropriate role

Do nouns have argument structure like verbs?

- Subject of theoretical importance since Chomsky (1970), *Remarks on Nominalization*
- Grimshaw (1990) argued that some nouns do (process nouns) and others don't (non-process nouns)

Nouns ~ Verbs

the enemy destroyed the city

the enemy's destruction of the city

the destruction of the city by the enemy

CP complements

The physicists claimed that the earth is round

the physicists' claim that the earth is round

Infinitival complements

They attempted to leave

their attempt to leave

Locative PP complement

The train arrived at the station

the train's arrival at the station

Nouns: optional arguments?

The doctor examined *(the patients)

The doctor's examination (of the patients) was successful

Result vs. Process Readings

John's examination was long

result reading, John can be exam taker

John's examination of the patients took a long time

process reading, John = agent

examination vs. *exam*

The examination/exam was long

result reading

The examination/*exam of the patients took a long time.

process reading

-ing: unambiguously process

They felled *(the trees)

the felling *(of the trees)

They destroyed *(the city)

the destroying *(of the city)

frequent: disambiguates

the expression (on her face) is good

the expression of one's feelings is good

*the frequent expression is good

the frequent expression of one's feelings is good

constant: also disambiguates

the assignment (on plurals) is annoying

the assignment of unsolvable problems is annoying

*the constant assignment is annoying

the constant assignment of unsolvable problems is annoying

role of possessors

The instructor's examination took a long time.

result reading, instructor = test-maker

The instructor's examination of the papers took a long time.

process reading, instructor = agent

agent-*by* makes *of* obligatory

the expression *(of agressive feelings) by patients

the examination *(of the papers) by the instructor

the development *(of inexpensive housing) by the city

So agent-*by* implies process reading

author-*by*: *of* optional

An examination by a competent instructor will reveal...

The assignment by Fred was no good.

Pine Tree Hollow -- a development by Holmes Associates

So: no *of* => *by* is author, not agent

Nouns vs. Verbs

- Like verbs, certain nouns have obligatory arguments. Namely, process nouns ("complex event nominals" according to Grimshaw 1990)
- The *of* phrase is obligatory on process readings (Grimshaw 1990)

What nouns have process readings?

- Any noun for which there is a corresponding verb?
  - No: *to mother a child*, but: *the mother of a child* cannot refer to an event of mothering a child. Zero-derived nouns are out.
- Only morphologically complex nouns, like *examin<u>ation</u>*, *assign<u>ment</u>*

Counterexample?

"Elders in Marjah, the former Taliban stronghold seized this month in a NATO offensive, gave President Hamid Karzai a piece of their minds this week during his first visit to the town. Sometimes shouting, tribal leaders complained of *excessive use of force by U.S. troops*"

The Week

A rule for deriving lexical entries for process nominals with *of* PPs

```
(implies
  (and
    (isa ?SUFFIX DeverbalAbstractNounProducingSuffix)
    (derivedUsingSuffix ?NOUN ?SUFFIX)
    (morphologicallyDerivedFrom ?NOUN ?WORD)
    (verbSemTrans-Canonical ?WORD ??NUM TransitiveNPFrame ?COL
      (TheList ??ROLE1 ?ROLE2)))
  (nounSemTrans ?NOUN 132 GenitiveFrame
    (and
      (isa :NOUN ?COL)
      (?ROLE2 :NOUN :POSSESSOR)))) in GeneralLexiconMt
```

Assertion :

(nounSemTrans
(WordWithSuffixFn Assassinate-TheWord Ion_AbstractNounProducing-TheSuffix) 132 GenitiveFrame
(and
(isa :NOUN AssassinatingSomeone)
(victim :NOUN :POSSESSOR))) in GeneralEnglishMt

Arguments Supporting Assertion :

Argument : Deduction #3767582

(implies
(and
(isa ?SUFFIX DeverbalAbstractNounProducingSuffix)
(derivedUsingSuffix ?NOUN ?SUFFIX)
(morphologicallyDerivedFrom ?NOUN ?WORD)
(verbSemTrans-Canonical ?WORD ??NUM TransitiveNPFrame ?COL
(TheList ??ROLE1 ?ROLE2)))
(nounSemTrans ?NOUN 132 GenitiveFrame
(and
(isa :NOUN ?COL)
(?ROLE2 :NOUN :POSSESSOR)))) in GeneralLexiconMt

(verbSemTrans-Canonical Assassinate-TheWord 0 TransitiveNPFrame AssassinatingSomeone
(TheList perpetrator victim)) in GeneralEnglishMt

(derivedUsingSuffix
(WordWithSuffixFn Assassinate-TheWord Ion_AbstractNounProducing-TheSuffix) Ion_AbstractNounProducing-TheSuffix) in EnglishLexiconMt

(morphologicallyDerivedFrom
(WordWithSuffixFn Assassinate-TheWord Ion_AbstractNounProducing-TheSuffix) Assassinate-TheWord) in GeneralLexiconMt

:ISA (isa Ion_AbstractNounProducing-TheSuffix DeverbalAbstractNounProducingSuffix) in EnglishLexiconMt

To do:

- Write rules for non-canonical verbSemTrans
- Write rules for *by* phrases, possessors, and combinations
- Capture relationship among *of* phrases, *by* phrases, and possessors
- Represent non-process readings

Conclusions

- Cyc lexicon uses cool OE stuff:
  - Microtheories, forward rules, evaluatable functions and predicates, exceptions
- Cyc lexicon is generative
- Lexicography can get interesting
- Plenty to do, even for English