
Word Senses, WordNet and the Ontologies Groupings

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Annotation procedure, WSJ

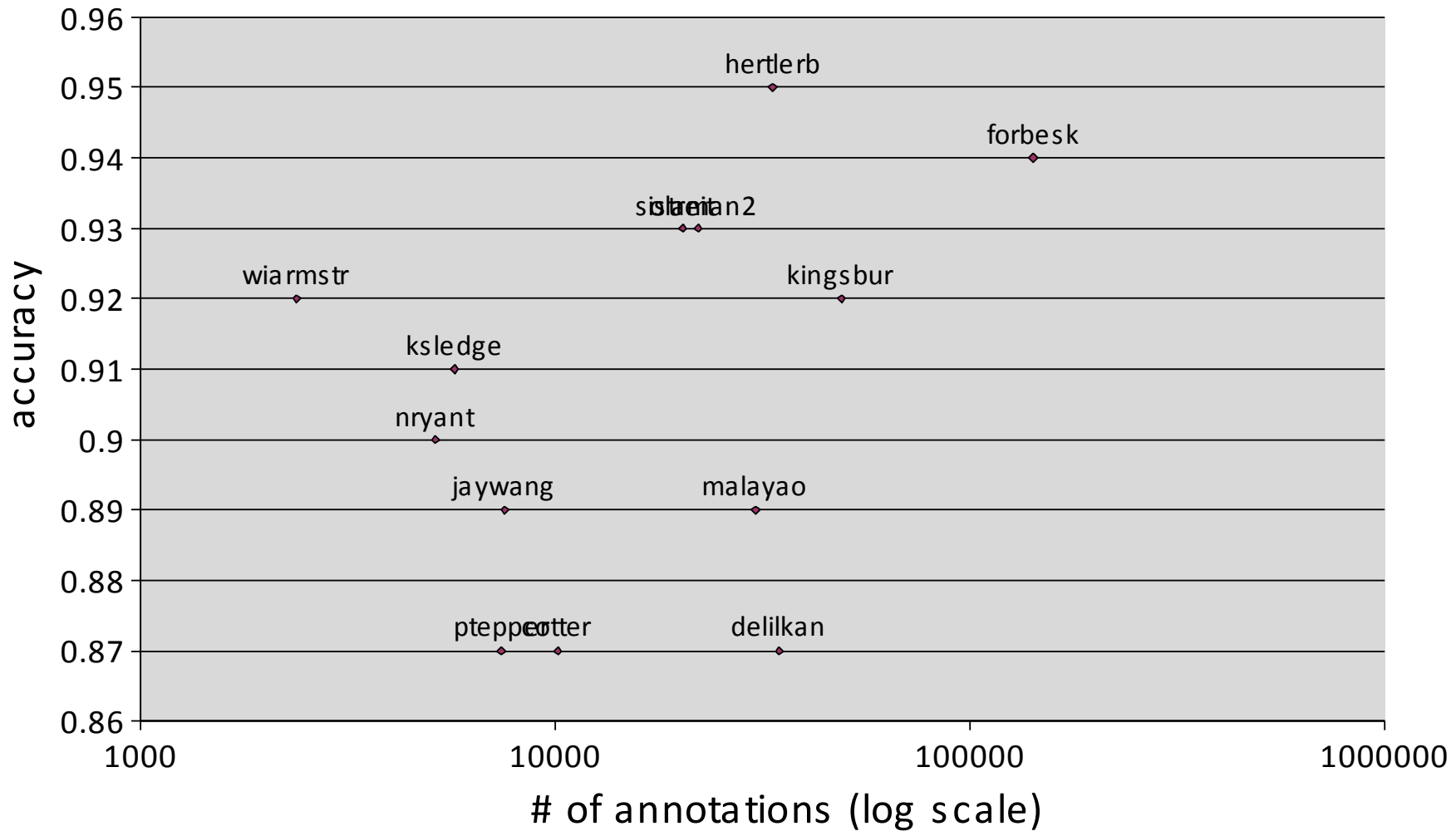
PropBank

Palmer, et. al., 2005

- PTB II - Extraction of all sentences with given verb
- Create Frame File for that verb *Paul Kingsbury*
 - (3100+ lemmas, 4400 framesets, 118K predicates)
 - Over 300 created automatically via VerbNet
- First pass: Automatic tagging (*Joseph Rosenzweig*)
 - <http://www.cis.upenn.edu/~josephr/TIDES/index.html#lexicon>
- Second pass: Double blind hand correction
- Tagging tool highlights discrepancies *Scott Cotton*
- Third pass: *Solomonization* (adjudication)
 - *Betsy Klipple, Olga Babko-Malaya, Claire Bonial, Katie Conger, Julia Bonn, ...*

Annotator accuracy – ITA 84%

Annotator Accuracy-primary labels only



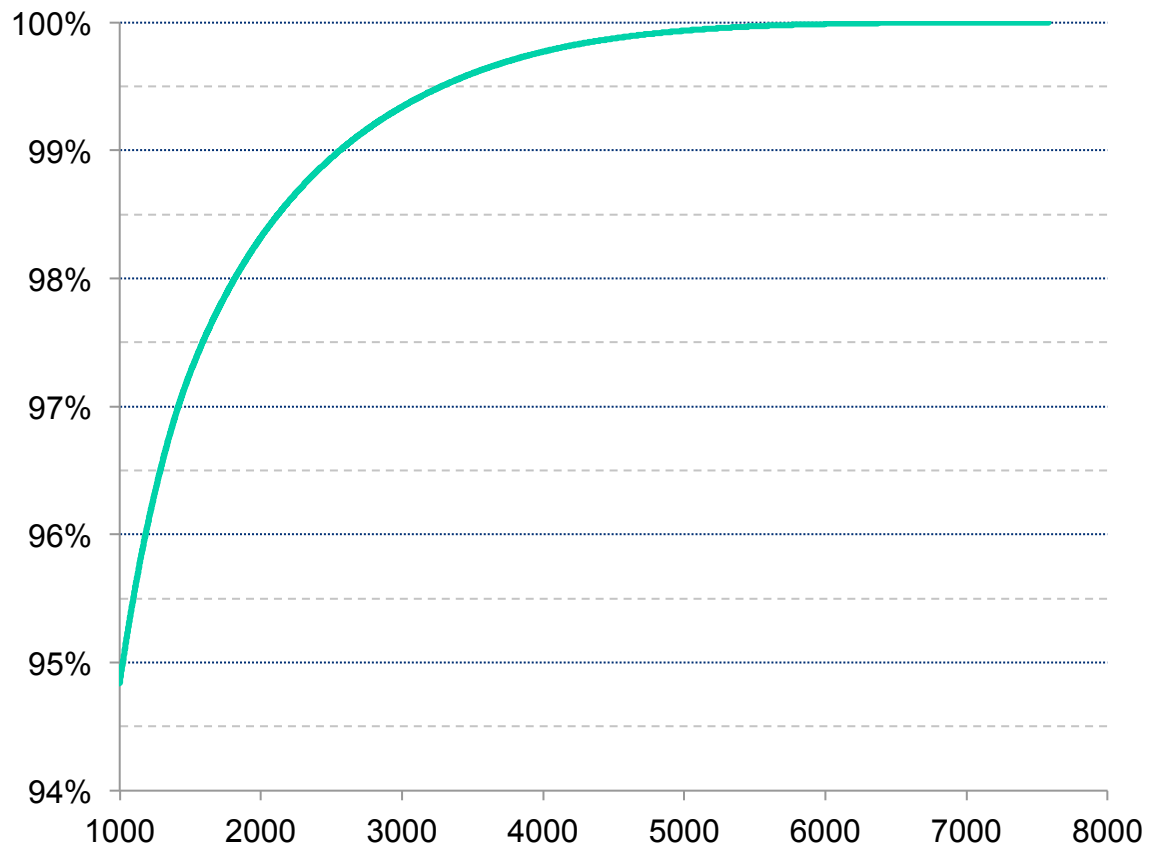
Current PropBank Status

Pradhan, et.al., IJSC 2007, Albright, et. al., JAMIA, 2013, Palmer, et. al., ICON-09

- DARPA-GALE, OntoNotes 5.0
 - BBN, Brandeis, **Colorado**, Penn
 - Multilayer structure: NE, TB, **PB**, **WS**, Coref
 - Three languages: **English**, **Arabic**, Chinese
 - Several Genres (@ \geq 200K): NW, BN, BC, WT
 - Close to 2M words @ language (less PB for Arabic)
 - Parallel data, E/C, E/A
 - PropBank frame coverage for rare verbs
 - Recent PropBank extensions
- Clinical Notes – 400K available, goal is 700K
- Hindi/Urdu PropBank, 400K Hindi, 200K Urdu
- BOLT – discussion forums, SMS, email, Egyptian

PropBank Verb Frames Coverage

- The set of verbs is open
- But the distribution is highly skewed
- For English, the 1000 most frequent lemmas cover 95% of the verbs in running text.
 - Graphs show counts over English Web data containing 150 M verbs.



Verb Frames Coverage By Language – Current Count of Senses (lexical units)

<i>Language</i>	<i>Final Count</i>	<i>Estimated Coverage in Running Text</i>
English	10,615*	99%
Chinese	24,642	98%
Arabic	7,015	99%

- Only 111 English adjectives

Word Senses in PropBank

- Orders to ignore word sense not feasible for 700+ verbs
 - *Mary left the room*
 - *Mary left her daughter-in-law her pearls in her will*

Frameset **leave.01** "move away from":

Arg0: entity leaving

Arg1: place left

Frameset **leave.02** "give":

Arg0: giver

Arg1: thing given

Arg2: beneficiary

How do these relate to word senses in other resources?

WordNet – Princeton

(Miller 1985, Fellbaum 1998)

On-line lexical reference (dictionary)

- Nouns, verbs, adjectives, and adverbs grouped into synonym sets
- Other relations include hypernyms (ISA), antonyms, meronyms
- Typical top nodes - 5 out of 25
 - *(act, action, activity)*
 - *(animal, fauna)*
 - *(artifact)*
 - *(attribute, property)*
 - *(body, corpus)*

WordNet – Princeton – *leave, n.4, v.14*

(Miller 1985, Fellbaum 1998)

- Limitations as a computational lexicon
 - Contains little syntactic information
 - No explicit lists of participants
 - Sense distinctions very fine-grained,
 - Definitions often vague
- Causes problems with creating training data for supervised Machine Learning – SENSEVAL2
 - Verbs > 16 senses (including *call*)
 - Inter-annotator Agreement ITA 71%,
 - Automatic Word Sense Disambiguation, WSD 64%

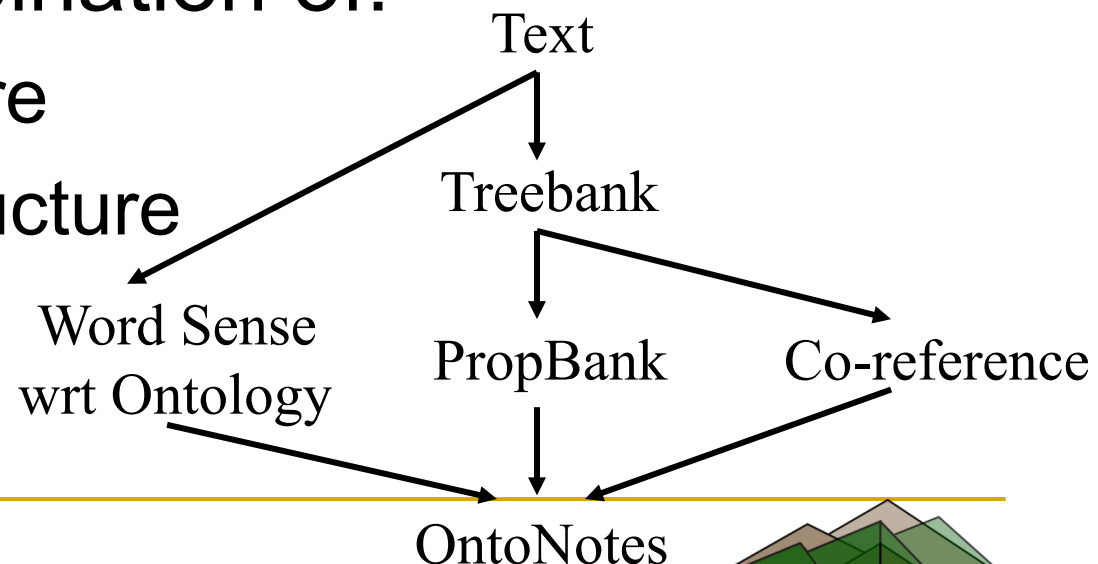
Dang & Palmer, SIGLEX02

Creation of coarse-grained resources

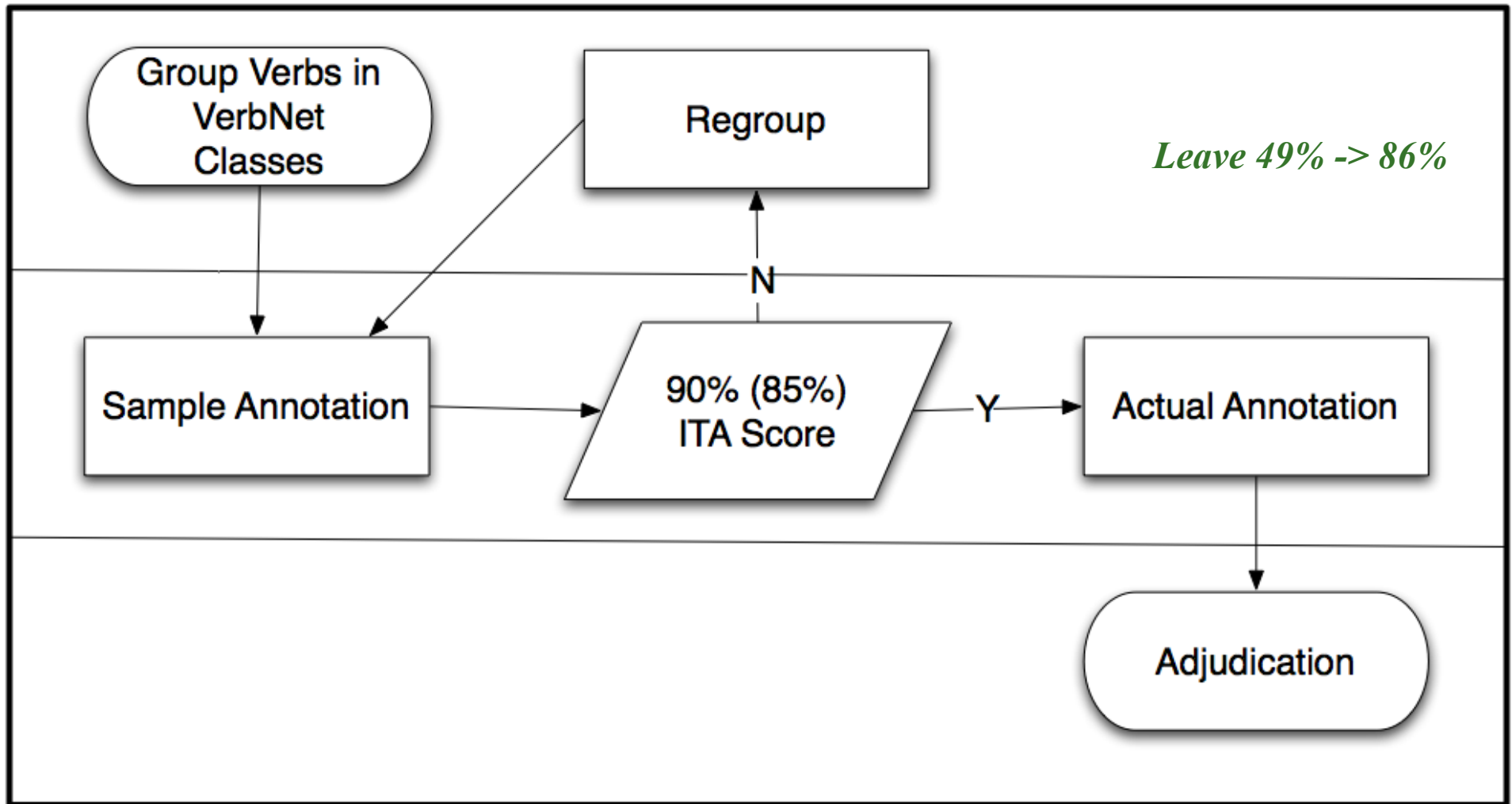
- Unsupervised clustering using rules (Mihalcea & Moldovan, 2001)
- Clustering by mapping WN senses to ODE (Navigli, 2006).
- OntoNotes - Manually grouping WN senses and annotating a corpus (Weischedel et al., 2011)
- Supervised clustering WN senses using OntoNotes and another set of manually tagged data (Snow et al., 2007) .

OntoNotes Goal: Modeling Shallow Semantics DARPA-GALE

- AGILE Team: BBN, Colorado, ISI, Penn
- Skeletal representation of literal meaning
- Synergistic combination of:
 - Syntactic structure
 - Propositional structure
 - Word sense
 - Coreference



Empirical Validation – Human Judges



Groupings Methodology – Human Judges (w/ Dang and Fellbaum)

- Double blind groupings, adjudication
- Syntactic Criteria (VerbNet was useful)
 - Distinct subcategorization frames
 - *call him an idiot*
 - *call him a taxi*
 - Recognizable alternations – regular sense extensions:
 - *play an instrument*
 - *play a song*
 - *play a melody on an instrument*

SIGLEX01, SIGLEX02, JNLE07, Duffield, et. al., CogSci 2007

Groupings Methodology (cont.)

■ Semantic Criteria

- Differences in semantic classes of arguments
 - Abstract/concrete, human/animal, animate/inanimate, different instrument types,...
- Differences in the number and type of arguments
 - Often reflected in subcategorization frames
 - *John left the room.*
 - *I left my pearls to my daughter-in-law in my will.*
- Differences in entailments
 - Change of prior entity or creation of a new entity?
- Differences in types of events
 - Abstract/concrete/mental/emotional/....
- Specialized subject domains

WordNet: - call, 28 senses, 9 groups

WN5, WN16, WN12

Loud cry

WN15 WN26

Bird or animal cry

WN3 WN19

WN1 WN22

Label

WN4 WN7 WN8 WN9

Request

WN20 WN25

Call a loan/bond

WN18 WN27

Challenge

WN2 WN13

Phone/radio

WN28

WN6 WN23

Visit

WN17, WN11

WN24,

WN10, WN14, WN21,

Bid

OntoNotes Status

- More than 2,500 verbs grouped
- Average ITA per verbs = 89%
- http://verbs.colorado.edu/html_groupings/
- More than 150,000 instances annotated
- WSJ, Brown, ECTB, EBN, EBC, WebText
- Training and Testing
- *How do the groupings connect to PropBank?*

Sense Hierarchy

(Palmer, et al, SNLU04 - NAACL04, NLE07, Chen, et. al, NAACL06)

- PropBank Framesets – ITA >90%

coarse grained distinctions

20 Senseval2 verbs w/ > 1 Frameset

Maxent WSD system, 73.5% baseline, 90%

- Sense Groups (Senseval-2) - ITA 82%
Intermediate level
(includes Levin classes) – 71.7%

- WordNet – ITA 73%
fine grained distinctions, 64%

*Tagging w/groups,
ITA 90%, 200@hr,
Taggers - 86.9%
Semeval07*

*Chen, Dligach & Palmer, ICSC 2007
Dligach & Palmer, ACL-11, - 88%*

SEMLINK-PropBank, VerbNet,

FrameNet, WordNet, OntoNotes

Palmer; Dang & Fellbaum, NLE 2

PropBank
Groupings
Frameset1*

cost-54.2, ON2

fit-54.3, ON3

carry

WN1 WN2

WN5 WN20 WN22 WN24

WN24 WN31 WN33 WN34

WN1 WN3 WN8

WN11 WN 23

WN9 WN16 WN17 WN19

WN27 WN37 WN38

WN28 WN32 WN35 WN36

ON4 – win election

carry-11.4, CARRY,-FN, ON1

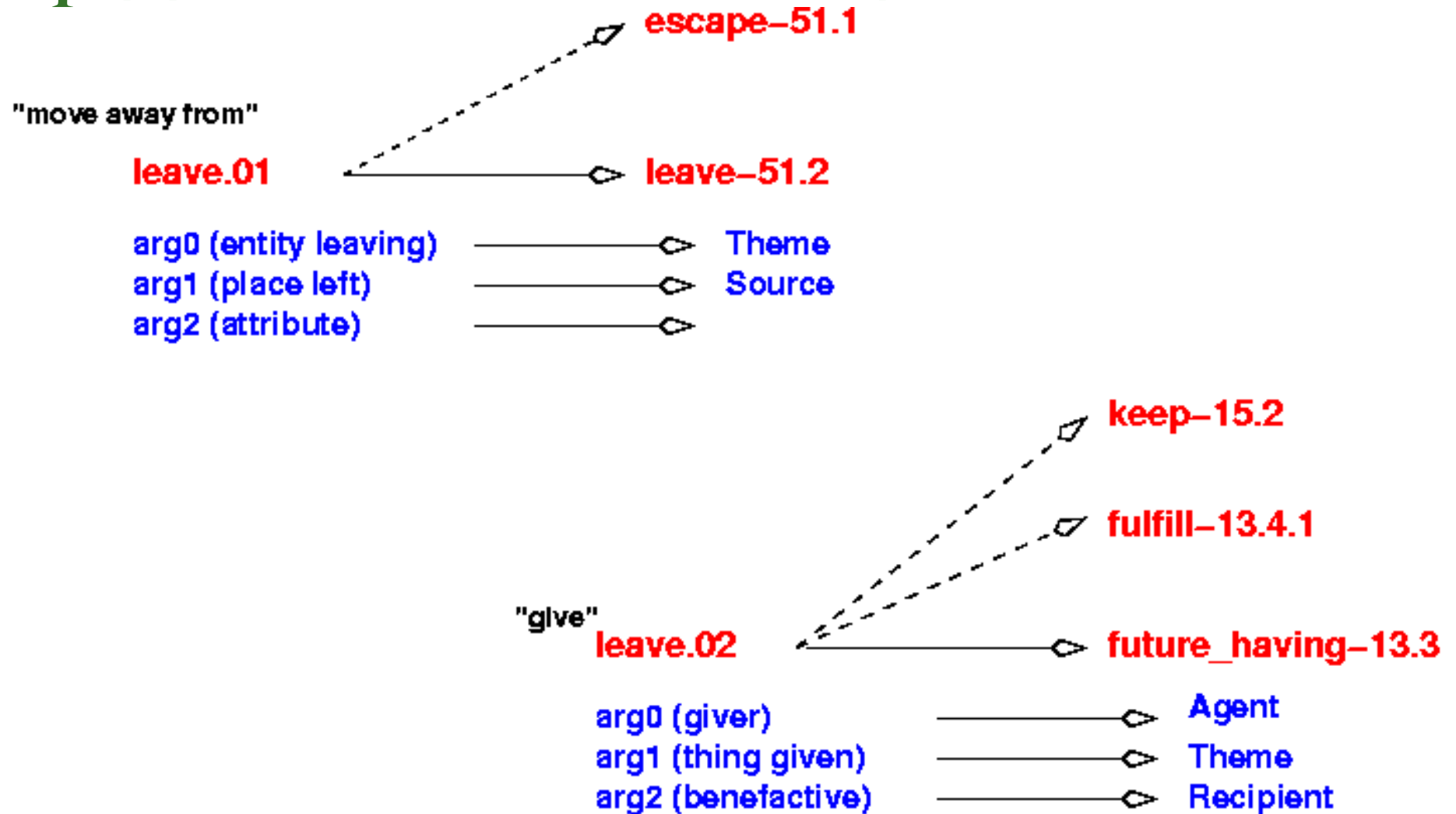
**ON5-ON11 carry oneself, carried away/out/off, carry to term*

VerbNet – based on Levin, B.,93

- Class entries: *Kipper, et. al., LRE08*
 - Capture generalizations about verb behavior
 - Organized hierarchically
 - Members have common semantic elements, semantic roles, syntactic frames, predicates
- Verb entries:
 - Refer to a set of classes (different senses)
 - each class member linked to WN synset(s), ON groupings, PB frame files, FrameNet frames,

Mapping from PB to VerbNet

<http://verbs.colorado.edu/semlink>



FrameNet: Telling *inform*

Time	In 2002,
Speaker	the U.S. State Department
Target	INFORMED
Addressee	North Korea
Message	that the U.S. was aware of this program , and regards it as a violation of Pyongyang's nonproliferation commitments

Mapping from PropBank to VerbNet (similar mapping for PB-FrameNet)

Frameset id = <i>leave.02</i>	Sense = <i>give</i>	VerbNet class = <i>future-having 13.3</i>
Arg0	Giver	Agent/Donor*
Arg1	Thing given	Theme
Arg2	Benefactive	Recipient

*FrameNet Label

*Baker, Fillmore, & Lowe, COLING/ACL-98
Fillmore & Baker, WordNetWKSHP, 2001*

PropBank/VerbNet/FrameNet

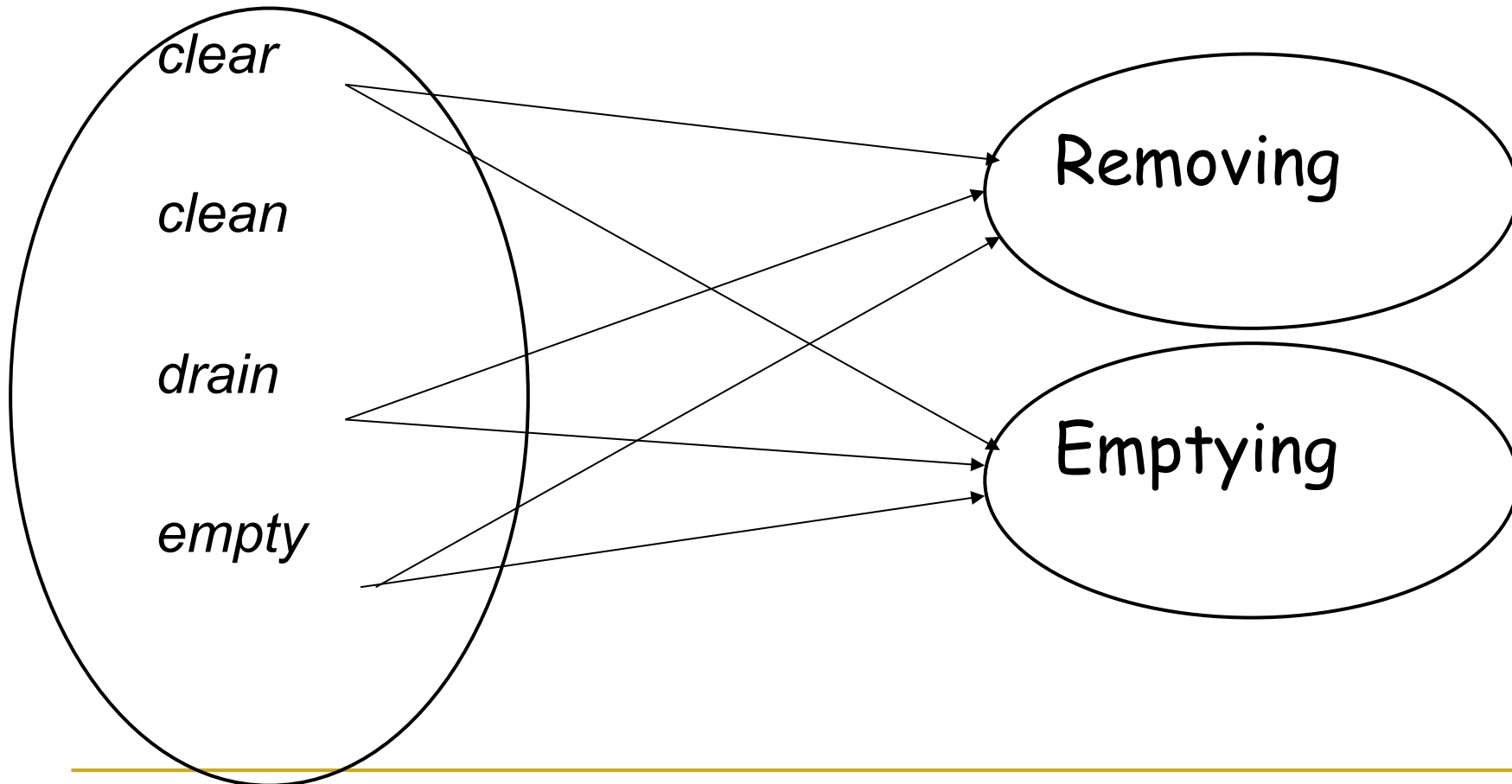
- Complementary
- Redundancy is harmless, may even be useful
- PropBank provides the best training data
- VerbNet provides the clearest links between syntax and semantics
- FrameNet provides the richest semantics
- Together they give us the most comprehensive coverage
- So.... We're also mapping VerbNet to FrameNet

Mapping Issues (2)

VerbNet verbs mapped to FrameNet

- *VerbNet clear-10.3*

- FrameNet Classes



Mapping Issues (3)

VerbNet verbs mapped to FrameNet

VN Class: *put 9.1*

Members: *arrange**, *immerse*,
lodge, *mount*, *sling***

Thematic roles:

- agent (+animate)
- theme (+concrete)
- destination (+loc, -region)

Frames:

- ...

*different sense
** not in FrameNet

FrameNet frame: *place*

Frame Elements:

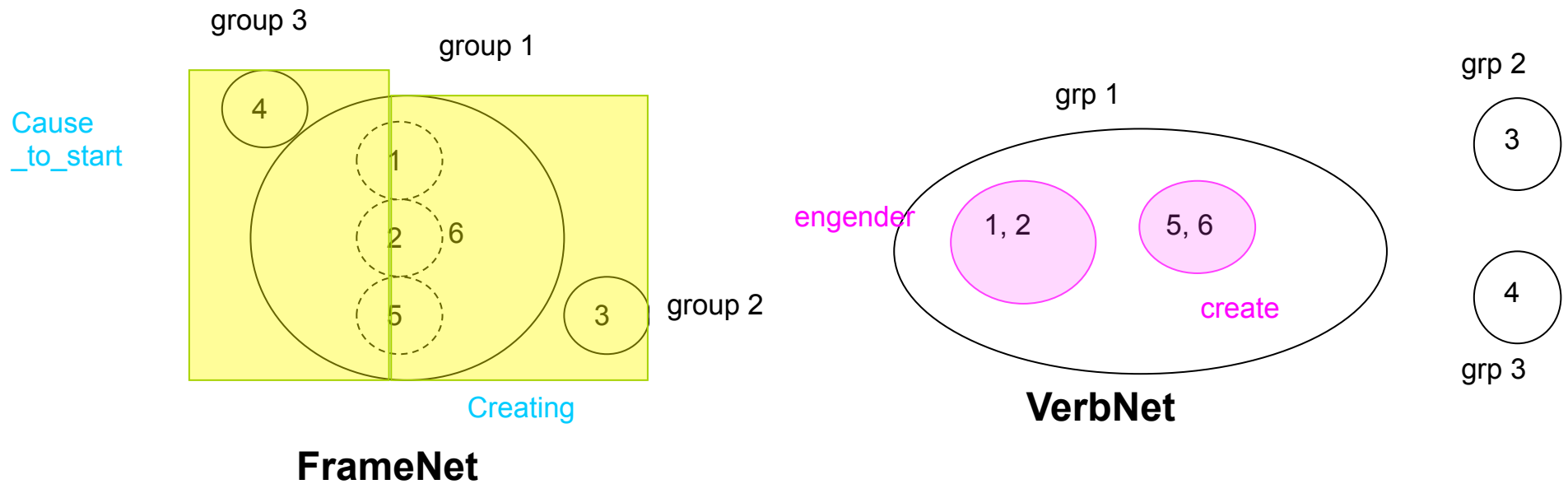
- Agent
- Cause
- Theme
- Goal

Examples:

- ...

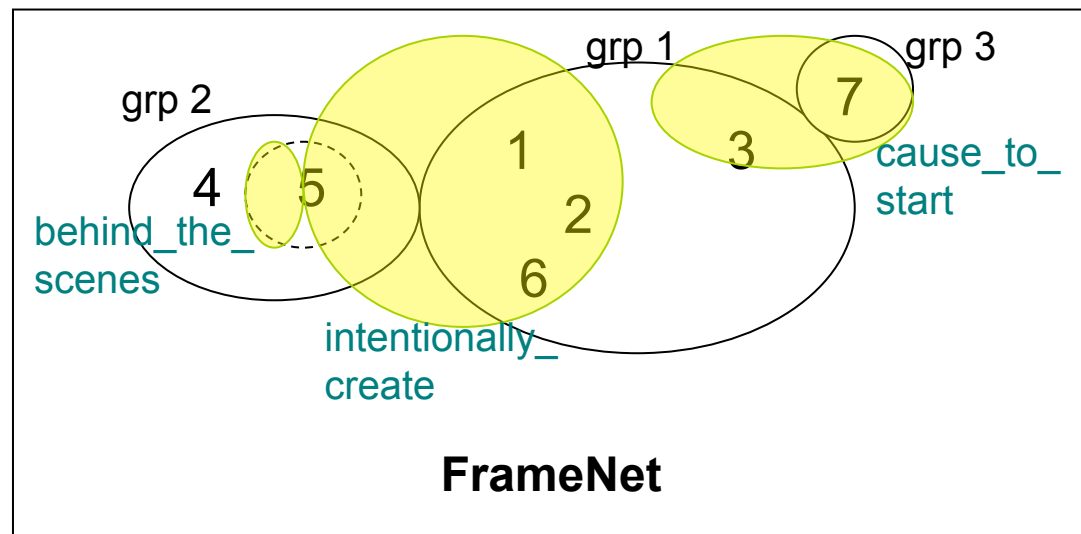
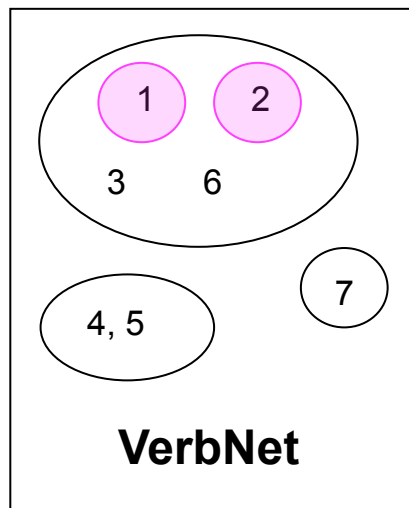
Class formation Issues: *create*

Susan Brown



Class formation Issues: *produce*

Susan Brown

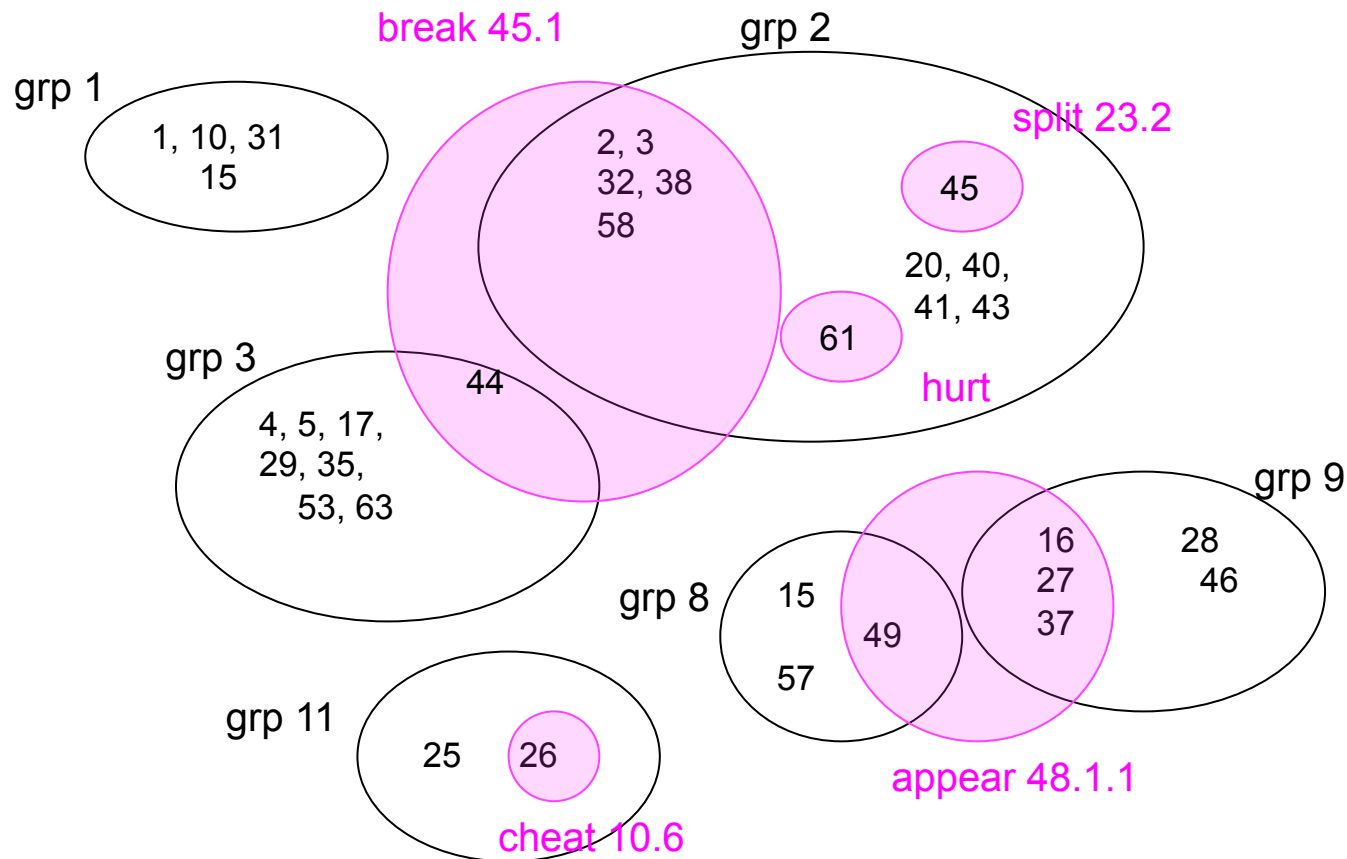


Class formation Issues: *break*/Verbnet

Susan Brown

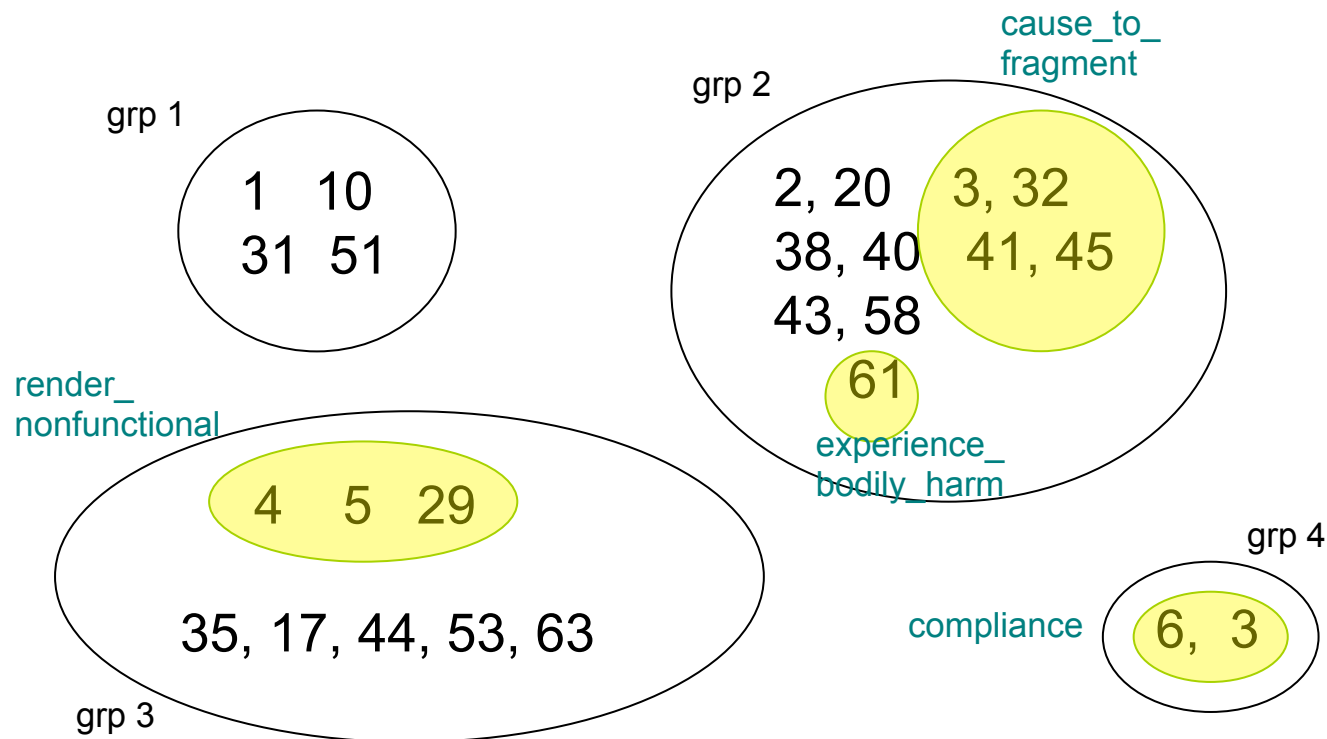
WN44 – *the skin broke*

WN49 – *the simple vowels broke in many Germanic languages*



Class Formation Issues: *break*/FrameNet

Susan Brown



WordNet: - leave, 14 senses, groups,

PB

WN1, WN5, WN8

Depart, a job, a room, a dock, a country (for X)

4

WN6 WN10 WN2 WN4 WN9 WN11 WN12

WN14 WNleave_off2,3 WNleave_behind1,2,3

Leave behind, leave alone

WNleave_alone1 WN13

WN3 WN7

Create a State /cause an effect:

Left us speechless, leave a stain

WNleave_off1

WNleave_out1, WNleave_out2

exclude

stop, terminate:

the road leaves off, not

leave off your jacket, the result

Leave behind, leave alone...

- *John left his keys at the restaurant.*

We left behind all our cares during our vacation.

They were told to leave off their coats.

Leave the young fawn alone.

Leave the nature park just as you found it.

I left my shoes on when I entered their house.

When she put away the food she left out the pie.

Let's leave enough time to visit the museum.

He'll leave the decision to his wife.

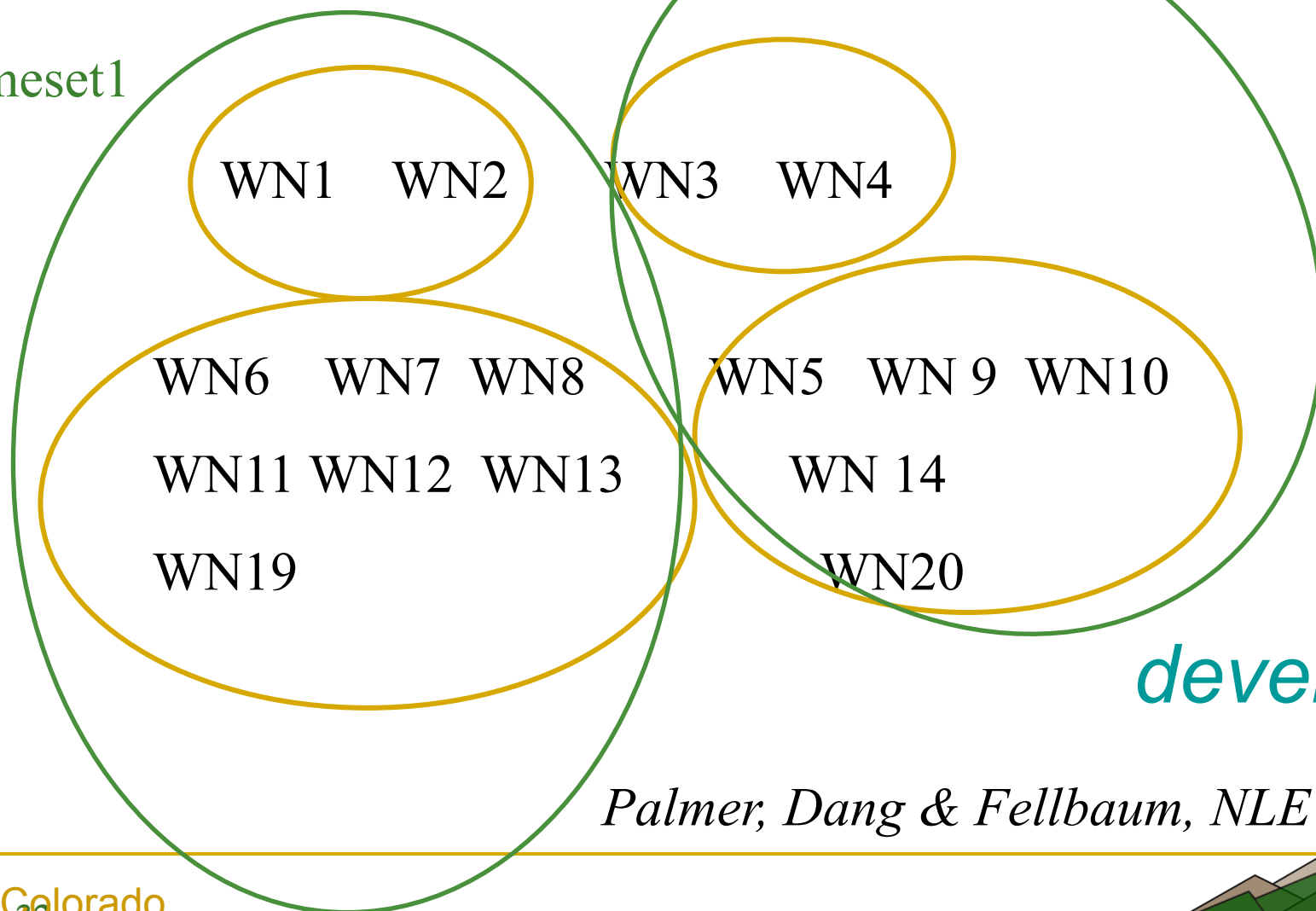
When he died he left the farm to his wife.

I'm leaving our telephone and address with you.

Overlap between Groups and PropBank Framesets – 95%

Frameset1

Frameset2



develop

Palmer, Dang & Fellbaum, NLE 2007

Broader coverage still needed

- Only ~~78%~~ 82%? of PropBank verbs included in VN (but many senses of those types are missing)
- Most classes focused on verbs with NP and PP complements
- Neglected verbs that take adverbial, adjectival, and sentential complements

SEMLINK

- Extended VerbNet: 5,391 senses (91% PB)
- Type-type mapping PB/VN, VN/FN
 - (100+ new classes from *(Korhonen and Briscoe, 2004; Korhonen and Ryant, 2005)*)
- Semi-automatic mapping of WSJ PropBank instances to VerbNet classes and thematic roles, hand-corrected. (now FrameNet also)
- VerbNet class tagging as automatic WSD

Brown, Dligach, Palmer, IWCS 2011

- Run SRL, map Arg2 to VerbNet roles, Brown performance improves

Summary

- Reviewed available lexical resources
 - WordNet, Groupings, PropBank, VerbNet, FrameNet
- We need a whole that is greater than the sum of the parts – Semlink
- Greater coverage, greater richness, increased training data over more genres, opportunities for generalizations

Lexical resources can provide

- Generalizations about subcat frames & roles
- Backoff classes for OOV items for portability
- Semantic similarities/"types" for verbs
- Event type hierarchies for inferencing
- Need to be unified and empirically validated and extended: Semlink+
 - VN & FN need PB like coverage, and techniques for automatic domain adaptation - **Lexlink**
- ***Hybrid lexicons – symbolic and statistical lexical entries?***