Word Sense Annotation of Polysemous Words by Multiple Annotators

Rebecca J. Passonneau, Ansaf Salleb-Aoussi, Vikas Bhardwaj
Columbia University, New York, NY
Nancy Ide
Vassar College, Poughkeepsie, NY

Outline

- Word senses
- MASC word sense annotation
- Interannotator agreement: word/pos dependent
- Exploring the data
  - InterSense Similarity Measures (ISSM)
  - Association rules among annotators
- Future work

Word Senses: Theoretical Issues

- Synchronic variation
  - *Selected for* by the sentence/utterance context
  - Generative (Pustejovsky)
  - Many contexts are essentially *the same (Kilgariff)*
- Diachronic variation
  - Changes in senses over time
  - Changes in sense frequency over time
- Situational/sociolinguistic variation
  - Different usage likelihoods in distinct corpora
  - Differences across language users

Annotation Issues

- How much context is enough?
- How much training for annotators?
- How much agreement is possible among annotators? (Fellbaum; Ng; Pedersen; Palmer)
- Sense inventories

  Con: Arbitrary

  Con: No degrees of specificity, e.g., *"a long chapter"*

  – Other methods (Erk & McCarthy, ratings of all senses)

  Pro: Understandable

  Pro: Convenient annotation labels

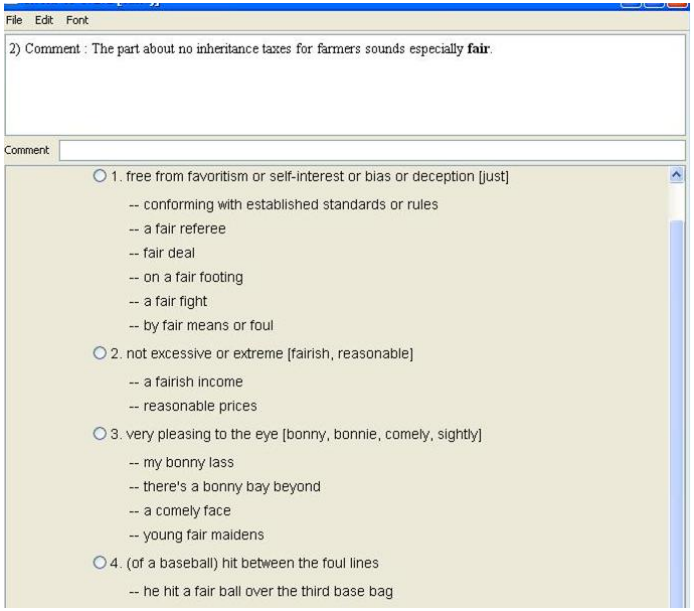
  ⇒ Explore label usage among many annotators

MASC Word Sense Annotation

- MASC Corpus (May release): Ide et al. 2010 ACL
- Word Sense annotation goals:
  - Harmonize WordNet/FrameNet senses
  - Provide manually annotated data for supervised WSD
- Five rounds to date, a sixth underway
  - MASC subcorpus from OANC: open, heterogeneous
  - WordNet sense labels on 1000 sentences/word
  - Sentences in context (annotator can adjust)
  - Trained annotators at Vassar, Columbia
  - Annotation tool: SATANiC

Round 2.2

- 10 polysemous words (9.5 senses per word on avg.)
- Balanced for POS
  - 3 Adj
  - 3 Nouns
  - 4 Verbs
- Sample of 100 sentences
  - Three Columbia undergraduates
  - Three Vassar undergraduates
  - Same training, same annotation tool
- Interannotator agreement: Krippendorff's Alpha
  - Wide range of agreement results
  - Word dependent



Interannotator Agreement

Word-POS	Senses in WN	Senses Assigned	Annotators	Alpha
LONG-J	9	4	6	0.67
FAIR-J	10	6	5	0.54
QUIET-J	6	5	6	0.49
TIME-N	10	8	5	0.68
WORK-N	7	7	5	0.62
LAND-N	11	9	6	0.49
SHOW-V	12	10	5	0.46
TELL-V	8	8	6	0.46
KNOW-V	11	10	6	0.37
SAY-V	11	10	6	0.37

Observations on IA

- Agreement is less good on V than N and J
- Most senses are used; sense frequency does not correlate exactly with WN predictions
- Agreement does not degrade as number of senses increases
- Within each part-of-speech, IA varies with no discernible cause other than the word itself
- Words differ with respect to concreteness (e.g., “long” versus “fair” – SEW 2009)

Intersense Similarity

- Hypothesis: words more confusable senses have lower IA
- Measure sense relatedness: Lesk Similarity (Banerjee & Pedersen 2002)
- $ISM_{w(S1,S2)}$=Lesk similarity(S1,S2)
- Confusion threshold CT for w:

$$CT_w = \mu ISM_w + \sigma ISM_w$$

- Only partial correlation (for adjectives $\varrho = 0.73$), but very few datapoints; overall correlation: $\varrho = 0.59$)

ISMs Round 2 Words

Word-POS	Pairs of Senses	Alpha	% > CT
LONG-J	36	0.67	0.17
FAIR-J	45	0.54	0.18
QUIET-J	15	0.49	0.20
TIME-N	45	0.68	0.11
WORK-N	21	0.62	0.14
LAND-N	54	0.49	0.07
SHOW-V	28	0.46	0.07
TELL-V	66	0.46	0.12
KNOW-V	55	0.37	0.18
SAY-V	55	0.37	0.09

Association Rules

- Association rules express relations among *instances* in a dataset, based on their *attributes* (Agrawal et al. 1993; Borgelt's *Apriori*)
- An association rule is an expression C1 → C2, where C1 and C2 express conditions on features describing the instances

Measuring strength of association rules:

- Supp(C) is the fraction of instances satisfying C
- Supp(C1 → C2) = Supp(C1)
- Conf(C1 → C2) = Supp(C1 ∧ C2)/Supp(C1)

Association Rules: Annotators & Senses

- The word sense data is a 3D matrix of instances, annotators, senses
- *Flatten* the data to a 2D form with Annotator_SenseLabel as an attribute
- Mine association rules among annotators' choices of senses
- Mining agreement on '*time*' (*IA=0.68): strongest rules for sense 3*
  - 101.S3 → 105.S3 with 36% supp. and 77.8% conf.
  - 105.S3 → 101.S3 with 34% supp. and 82.4% conf.

Long (IA=0.67)

$Ann_i.S_j \longrightarrow$	$Ann_m.S_n$	Supp	Conf
Long			
102.Coll	108.S1	60.0	55.0
108.S2	102.Coll	37.0	89.2

- If 102 assigns a collocation, 108 assigns sense 1
  primarily temporal sense; being or indicating a relatively great or greater than average duration or passage of time or a duration as specified: *"a long life"; "a long boring speech"; . . .*
- If 108 assigns sense 2, 102 assigns a collocation
  primarily spatial sense; of relatively great or greater than average spatial extension or extension as specified: *"a long road"; "a long distance"*

Fair (IA=0.54)

$Ann_i.S_j \longrightarrow$	$Ann_m.S_n$	Supp	Conf
Fair			
107.S2	102.S1	56.0	28.6
102.S1	107.S2	31.0	51.6

- If 107 assigns sense 2, 102 assigns sense 1
- If 102 assigns sense 1, 107 assigns sense 2

Sense 1: free from favoritism or self-interest or bias or deception; conforming with established standards or rules: *"a fair referee"; "fair deal"; "on a fair footing"; "a fair fight"; "by fair means or foul"*

Sense 2: not excessive or extreme: *"a fairish income"; "reasonable prices"*

Quiet (IA=0.49)

$Ann_i.S_j \longrightarrow$	$Ann_m.S_n$	Supp	Conf
Quiet			
107.S3	103.S1	58.0	34.5
103.S1	107.S3	36.0	55.6

- If 107 assigns sense 3, 103 assigns sense 1
- If 103 assigns sense 1, 107 assigns sense 3

Sense 1: characterized by an absence or near absence of agitation or activity:*"a quiet life"; "a quiet throng of onlookers"; "quiet peace-loving people"; "the factions remained quiet for almost 10 years"*

Sense 3: not showy or obtrusive:*"clothes in quiet good taste"*

Conclusions and Future Work

- Good agreement among annotators on word senses can be achieved for polysemous words
- Two annotators may be insufficient
- Disagreements can include systematic patterns of difference due to, e.g., subjectivity in meaning
- Future work:
  - Measurement (LAW IV)
    - Drop outliers (e.g, 102 for "*long*")
    - Identify confusable senses
    - Identify systematic differences among subsets of annotators
    - Compare trained and a larger number of untrained annotators
  - Allow annotators to assign multiple senses