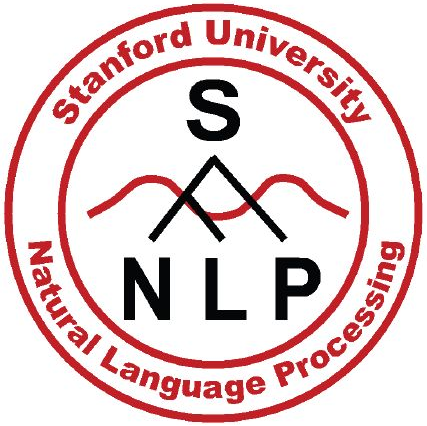
CS224N Interactive Session

Competitive Grammar Writing



Chris Manning

Goals

This is an interactive, hands-on chance to learn about:

- generative probabilistic models (PCFG's)
- parsing algorithms
- modeling the structure of a language
- parameter tuning (by hand)
- quantitative evaluation

Grammar Writing

- Probabilistic context-free grammar (PCFG) for a small subset of English (several hundred words)
- No programming (code provided)
- Many interesting insights into grammar construction, parsing, linguistics
- Prizes :)

Starter PCFG

Only 6 initial part of speech (POS) tags

- **Noun**: singular nouns
- **Det**: singular determiners (a, the, another, …)
- **Prep**: prepositions
- **Proper**: proper nouns
- **VerbT**: singular transitive verbs
- **Misc**: other words, *see commented sections in the Vocab.gr grammar file!*

Starter PCFG (S1.gr)

1 S1 → NP VP .

2 VP → VerbT NP

20 NP→ Det Nbar

1 NP → Proper

20 Nbar → Noun

1 Nbar → Nbar PP

1 PP → Prep NP

1 Noun → castle
1 Noun → king
…
1 Proper → Arthur
1 Proper → Guinevere
…
1 Det → a
1 Det → every
…
1 VerbT → covers
1 VerbT → rides
…
1 Misc → that
1 Misc → bloodier
1 Misc → does

Starter PCFG

20 NP⟶ Det Nbar

1 NP ⟶ Proper

This means that with p=20/21, you use the rule

NP⟶ Det Nbar

Intuition: Proper nouns are much less common

Starter PCFG

How well can your grammar parse a set of sentences?

Answer in the beginning: Not very well. Only 2/27 sentences in the dev set can be parsed by S1.gr:

- Arthur is the king .
- Arthur rides the horse near the castle .

If grammar fails entirely, it's really bad.

→ Backoff grammar!

Backoff Grammar S2!

These two rules are required; choose their weights carefully!
99 START -> S1 # mixture of English and backoff grammars
1 START -> S2

Backoff grammar capable of parsing anything (but not very intelligently!)

1 S2 -> Markov

1 Markov -> { Det | Misc | Noun | Prep | Proper | VerbT } (Markov)

Evaluation

- We will mostly evaluate your grammar's recall (productivity), but you also get points for weighting up grammatical sentences
- How well does your grammar anticipate unseen data that are truly grammatical?
  - i.e. your grammar's ability to predict word strings.
- Cross-entropy (log-perplexity): captures how close your grammar's distribution is to the true language distribution

Evaluation: Details

- **Log-perplexity:** lower is better
- P(*s*) – The probability of the string s is the sum of the probabilities of the trees which have that string as their yield

$$2^{\frac{-\log_2(p(s1))-\log_2(p(s2))-\log_2(p(s3)),\ldots}{|s1|+|s2|+|s3|+\ldots}}$$

Evaluation Twist

The standard evaluation: Unseen test set

Competition twist: Full test set comes from you, all the participants!

Your grammar should generate sentences that your opponents can't parse!

Only grammatical sentences will be considered (precision). No new words!

Where to start

Vocab.gr has very few POS => add more POS.

Procedure:

- Change POS in Vocab.gr
- Add new classes to backoff S2.gr
- Make new grammar rules using new classes in S1.gr

Next Class

- We will include some grammatical sentences of your grammar into a new dev set so you can all create better grammars.

- Improve your grammar and push for best perplexity on new dev set & try to generate even harder examples.

Suggestions

- Historically, it takes a while to get an idea of what you're supposed to do.

- Get started by adding POS (Parts of Speech)
  - Look at examples in the Dev set
  - Write out general rules to cover these constructions
  - Extend out into other English constructions

Let's get started!

See handout!

1) Form teams of 2–3.
2) Get code
3) Make sure you can parse, generate, and validate
4) Start lowering your grammar's cross-entropy on the provided dev set
   - You can divide grammar into more files if it's more convenient
5) 10 minutes before the end, submit your grammar with the submit script!
6) Profit.

Feel free to ask us for help!

Suggestions

- Fine grained POS: Coordinating conjunctions, modal verbs, number words, adverbs
- Base, past and gerund verb forms
- Personal vs possessive pronouns
- Negation
- Questions
- Subcategorization frames, intransitive verbs
- Appositives
- +++++++++

Suggestions

1. CC Coordinating conjunction
2. CD Cardinal number
3. DT Determiner
4. EX Existential there
5. FW Foreign word
6. IN Preposition
7. JJ Adjective
8. JJR Adjective, comparative
9. JJS Adjective, superlative
10. LS List item marker
11. MD Modal
12. NN Noun, singular or mass
13. NNS Noun, plural
14. NP Proper noun, singular
15. NPS Proper noun, plural
16. PDT Predeterminer
17. POS Possessive ending
18. PP Personal pronoun
19. PP$ Possessive pronoun
20. RB Adverb
21. RBR Adverb, comparative
22. RBS Adverb, superlative
23. RP Particle
24. SYM Symbol
25. TO to
26. UH Interjection
27. VB Verb, base form
28. VBD Verb, past tense
29. VBG Verb, gerund or present participle
30. VBN Verb, past participle
31. VBP Verb, non-3rd person singular present
32. VBZ Verb, 3rd person singular present
33. WDT Wh-determiner
34. WP Wh-pronoun
35. WP$ Possessive wh-pronoun
36. WRB Wh-adverb