AI2 Module 2

Tutorial 3

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1. What is the least inclusive class of languages that includes all strings of the form $a^m b^n c^o$, where $m, n, o \geq 1$?

(a) Write a grammar that generates this language.

(b) Draw an automaton that recognizes this language.

(c) Now write another grammar that generates this same language.

2. Consider two grammars that produce the same set of strings, such as those you constructed for the last problem. Will such grammars necessarily have the same set of rules? When are such grammars **weakly** equivalent? When are they **strongly** equivalent?

3(a). Analyse the sentence

> She sees a man in the park with a telescope.

according to the grammar:

Grammar Rules	Lexicon
s → np, vp.	tv → [Word], tv(Word).
np → det, nom.	tv(see).
np → pro.	det → [Word], det(Word).
nom → n.	det(the).
nom → nom, pp.	det(a).
pp → prep, np.	n → [Word], n(Word).
vp → tv, np.	n(man).
vp → vp, pp.	n(park).
	n(telescope).
	prep → [Word], prep(Word).
	prep(in).
	prep(with).
	pro → [Word], pro(Word).
	pro(she).
	pro(i).

(b). Whatever analysis you produced, it is not the only possible one. So give another analysis of this sentence.

(c). These two are still not the only possible ways to analyse this sentence. How many ways are there? (Think in terms of the different ways you might characterise the man, the park and the seeing.) What are all the possible analyses?

N.B. When we say that this sentence is *N-ways ambiguous*, *N* is the number of different analyses that one can come up with.

(d). The set of grammar rules given above accepts all of the following sentences as belonging to the language:

1. I see the man.
2. She see the man.
3. The man see she.
4. The man see the park with she.

The latter three should **not** be accepted. Rather, the grammar should only accept:

2'. She **sees** the park.
3'. The man **sees her**.
4'. The man **sees** the park with **her**.

To accept only the correct version of these sentences requires that the words **sees** and **her** be added to the lexicon and that **features** be added to appropriate grammar rules and lexical entries. The features can be used to check agreement and to make sure that the appropriate form of pronoun be used in appropriate places.

What features should be added to what rules? We've already done subject-verb agreement in class – in `dcg8`. So you should add similar features to the current grammar in order to reject sentence 2 and only get 2'. Assuring the appropriate form of the pronoun in sentences 3' and 4' is a different matter. How would you ensure that "she" only appears as the *subject* of a sentence, and that "her" is used when the pronoun is the *object* of a transitive verb or in a prepositional phrase (pp)?