

HW 1: Logical Languages

Samala (Chumash) is a language where words cannot contain both sounds [s] and [ʃ] (Applegate, 1972). Thus words like [posokoso] and [pofokofo] are well-formed in Samala, but words like [pofokoso] and [posokofo] are not. The generalization in Samala is an example of a symmetric consonant harmony pattern (Hansson, 2010).

An asymmetric consonant harmony pattern can be found in the Athapaskan language Sarcee (Cook, 1984, 1978). In Sarcee [s] may follow [ʃ] but [ʃ] but may not occur anywhere after [s]. Thus, in this language words like [posokoso], [pofokofo] and [pofokoso] are well-formed, but words like [posokofo] are not.

See (Heinz, 2010; Lai, 2015; McMullin, 2016) for discussion of the computational and learnability issues surrounding such patterns.

1. Write a sentence of $\text{FO}(\mathcal{M}^{\triangleleft})$ which describes the symmetric constraint in Samala, where $\mathcal{M}^{\triangleleft}$ is the signature $\langle \mathcal{D}; \triangleleft, a, o, p, t, k, s, \text{ʃ} \rangle$.
2. Explain why models of the words [posokoso] and [pofokofo] satisfy this formula but the models of the words [pofokoso] and [posokofo] do not.
3. Prove that there is no sentence of $\text{FO}(\mathcal{M}^{\triangleleft})$ which describes the asymmetric constraint of Sarcee. (Hint: Use Theorem 1 in Chapter 2.)
4. Write a formula in $\text{FO}(\mathcal{M}^{\triangleleft})$ which describes the Sarcee constraint, where $\mathcal{M}^{\triangleleft}$ is the signature $\langle \mathcal{D}; \triangleleft, a, o, p, t, k, s, \text{ʃ} \rangle$.
5. Of course, Samala and Sarcee actually have more sounds than [a,o,p,t,k,s,ʃ]. The full consonant and vowel inventories of Samala are shown below. The superscripts [ʔ] [h] indicate glottalization and aspiration, respectively.

Consonants						
	labial	coronal	postalveolar	velar	uvular	glottal
stop	p pʔ p ^h	t tʔ t ^h		k kʔ k ^h	q qʔ q ^h	ʔ
affricates		tʃ tʃʔ tʃ ^h	tʃ̠ tʃ̠ʔ tʃ̠ ^h			
fricatives		s sʔ s ^h	ʃ ʃʔ ʃ ^h	x xʔ		h
nasal	m	n nʔ				
lateral		l lʔ				
approximants	w	y				

Vowels

i	i	u
e		o
	a	

The true generalization in Samala is that coronal affricates and fricatives are not allowed in the same words as the postalveolar affricates and fricatives and vice versa.

Your task: Define a logical language and state the true generalization of Samala within this logical language with a formula φ . Also, show how models for the words [posokoso] and

[pofokofo] satisfy φ but the models of words like [pofokoso] and [posokofo] do not. Please write your answer to this question in paragraph form, where you interleave mathematical expressions with prose to fully explain your answer.

Hint: To do #5, you will have to come up with a model signature which can represent words in Samala (and Sarcee). There are many ways to do this, and there is no ‘right’ answer, but some choices may make your job easier than others. Your signature can use features, letters, the successor relation, or the precedence relation, or any combination you want. Your job is to clearly present the representations you are employing, and explain how they relate to strings written with the symbols in the inventories above. Your logical language can be FO or MSO. You do NOT need to define FO or MSO logic. It is enough to say here is my model $\mathcal{M} = \langle D; \dots \rangle$ and that you are using the logical language $FO(\mathcal{M})$ (for instance).

6. Explain whether your logical language also contains a sentence describing the constraint in Sarcee. For the sake of this exercise, assume it has the same consonant inventory as Samala (but note this is not true in reality). A correct answer here depends on your answer to #5.

References

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