

Exercises for FFL, Fall 2017, sheet 6 - solutions

Return Thursday Nov 9, in class.

Exercise 1. Is *baaab* in the language of the grammar

$S \rightarrow AB \mid BC, A \rightarrow BA \mid a, B \rightarrow CC \mid b, C \rightarrow AB \mid a$? Provide the CYK table and the answer.

Solution: the CYK table is

	$\{S,C\}$				
	$\{S, A, C\}$	$\{S,C\}$			
	$\{\}$	$\{S,C,A\}$	$\{B\}$		
$\{S,A\}$	$\{B\}$	$\{B\}$	$\{S,C\}$		
$\{B\}$	$\{A,C\}$	$\{A,C\}$	$\{A,C\}$	$\{B\}$	
b	a	a	a	a	b

and the answer is yes.

Exercise 2. Describe a decision procedure that decides whether $\varepsilon \in L(G)$, where G is some CFG.

Solution. Determine all nullable variables in G , using the procedure given in the lecture notes. Then $\varepsilon \in L(G)$ iff the starting variable S is nullable.

Exercise 3. Formalize in FOL the following English statements. In each case, declare the type of each signature symbol that you use. Use the strict syntax declared by the definitions in the lecture notes – not using more or less brackets than demanded by those strict syntax rules.

1. My father is an airline pilot.
2. Nobody is perfect.
3. Men and women have the same rights.
4. New York is further away from Bremen than Hannover.

Solution. Note: the following are suggestions only; formalizing natural language statements can always be done in many different ways.

1. Airline-Pilot Father-of I *where* Airline-Pilot is unary pred. symbol, Father-of unary function symbol, I constant symbol
2. $\forall x (\text{human } x \rightarrow \neg \text{perfect } x)$ *where* human and perfect are unary pred. symbols
3. $\forall x_1 \forall x_2 \forall x_3 (((\text{man } x_1 \wedge \text{woman } x_2) \wedge \text{right } x_3) \rightarrow (\text{has } x_1 x_3 \leftrightarrow \text{has } x_2 x_3))$ *where* man, woman, right are unary predicate symbols, has is a binary relation symbol.
4. Greater-than dist NY Bremen dist Hannover Bremen *where* Greater-than is binary relation symbol, dist is binary function symbol, NY, Bremen, Hannover are constant symbols.