# Parsing

**Hausaufgabe 1, Abgabe 12.04.2022 vor der Vorlesung, also vor 10.30 Uhr**

Laura Kallmeyer

SS 2022, Heinrich-Heine-Universität Düsseldorf

**Question 1 (Grammars)**

*Consider the following three languages:*

- $L_1 = \{a^n cd^m e^{n+3} \mid n, m > 0\}$
- $L_2 = \{a^k bc^n (cd)^m \mid k, n, m \geq 0\}$
- $L_3 = \{a^n (bcd)^{n-1} e^{n+1} \mid n \geq 2\}$

*One of the languages is regular, one context-free and not regular and one not context-free. Which are the regular and the non-regular context-free languages? Justify your answer by giving the corresponding grammars.*

Solution:

$L_1$ is context-free: $S \to aSe \mid aTeee, T \to cD, D \to dD \mid d$.

$L_2$ is regular: $S \to aS \mid bT, T \to cT \mid U, U \to cdU \mid \varepsilon$.

**Question 2 (CFG)** *What are the CFLs generated by the following grammars?*

1. *$G$ with non-terminals $N = \{S, T\}$, terminals $T = \{a, b, c\}$, start symbol $S$ and productions*

$$S \to aTba \mid aT, T \to S \mid c$$

2. *$G$ with non-terminals $N = \{S\}$, terminals $T = \{a, b, c\}$, start symbol $S$ and productions*

$$S \to aSa \mid bSc \mid \varepsilon$$

Solution:

1. $\{a^n c(ba)^m \mid n \geq m \geq 0, n > 0\}$
2. $\{w_1 w_2 \mid w_1 \in \{a, b\}^*, w_2 = h(w_1^R)$ with $h(a) = a, h(b) = c\}$