Theories of Computation: Summative Assignment 1

To be handed in on Canvas before **Thursday 3rd March, 5pm GMT**

Exercise 1 *We consider the alphabet* $\Sigma = \{0, 1\}$. *We want to study the following grammar* G*:*

$$\begin{array}{rcccc} \Rightarrow & S & ::= & ZY & \mid & XZ \\ & X & ::= & 0X1 & \mid & \epsilon \\ & Y & ::= & 1Y0 & \mid & \epsilon \\ & Z & ::= & 0Z & \mid & \epsilon \end{array}$$

1. *Give a derivation tree in* G *for the word* 001100 *and the corresponding left-most derivation.* **[2 marks]**
2. *Is the above grammar* G *ambiguous? Justify your answer.* **[2 marks]**
3. *Are the following words in* $L(G)$*? Simply answer yes or no.* **[2 marks]**
   (a) 01000
   (b) 1
   (c) 01100
   (d) ϵ
4. *What is the language* $L(G)$ *generated by this grammar?* **[2 marks]**

Exercise 2 *Here again* $\Sigma = \{0, 1\}$. *Design a context-free grammar for the following language:* **[2 marks]**

$$L = \{0^a 1^b 0^c \mid a + b = c \text{ where } a, b, c \in \mathbb{N}\}$$