

# **Theoretical Computerscience – Summary**

WS 24/25

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## 1 Words

A word  $w$  (also called String) has length  $l$  and consists of symbols  $\sigma \in \Sigma$ .

The empty word  $\varepsilon$  has length 0.

## 2 Regular Languages

### 3 Regular Expressions

A regular expression always describes a regular language. If we can build a regular expression  $E$ , then  $L(E) \in \text{REG}$ .

## **4 Common Proof Techniques**

### **4.1 Pumping Lemma**

#### **4.1.1 Example**

### **4.2 Myhill Nerode**

#### **4.2.1 Example**

## 5 Useful Proofs

### 5.1 Regular Languages

#### 5.1.1 Finite Set

**Exercise:**

Show that the following language is regular over the alphabet  $\{0,1\}$ .

$$L = \{x \mid x \text{ is prime and } x < 1'000'000'000\}$$

**Solution:**

Since there are only finitely many prime numbers between 0 and  $1'000'000'000$ , the set of the words that are accepted by  $L$  is finite and thus the language is regular.

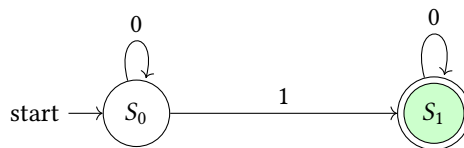
#### 5.1.2 Finite Automaton

**Exercise:**

Show that the following language is regular over the alphabet  $\{0,1\}$ .

$$L = \{0^n 10^m \mid n, m \in \mathbb{N}\}$$

**Solution:**



Since we can describe the language  $L$  by the finite automaton given above, the language is regular.

#### 5.1.3 Regular Expression

## 5.2 Non-Regular Languages



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