Theoretical-Computer-Science

This repository contains basic notes about Theoretical-Computer-Science course of Università Della Calabria. You can use this repo for review but not for study as proofs of the theorems are missing

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Languages

What is a language? It is simple. A set of strings. Now the question is obvious. What are strings? Strings are a sequence of simbol of an alphabet. Mathematically we denote with this simbol Σ an alphabet, and with Σ^* all the strings from the alphabet.

Now we can define formally a language given an alphabet Σ like the set $L= (w \mid w \in \Sigma ^*)$

Example: $\Sigma ={ 0,1 }, $L={11,01,1}

Grammars

Grammars generate languages. Formally a grammar is a quadruple $G = (V,T,P,S)$

- V is the set of non-terminal symbols
- T is the set of terminal symbols
- S is the initial non-terminal symbol
- P is a set of productions

What is a production? Simple a rule that allows you to replace the left side with the right. Formally a production is $\alpha A \beta => \alpha \gamma \beta$ e $A \in V$, e $`\alpha , \gamma , \beta \in (V \cup T )^*`$, With $(V \cup T)^*$ we identify strings of non-terminal and terminal symbols.

Chomsky hierarchy

We can divide grammars in 4 types base on the language they generate:

- Type 3 grammar: grammar production are of the type, $`A => a`$ $`A \in V,\ a \in T `$ $`A => Ba, A,B \in V, a \in T`$ $`A => aB, A,B \in V, a \in T`$
- Type 2 grammar: grammar production are of the type, $`A => \Gamma `$ $`A \in V, \Gamma \in (V \cup T)^*`$
- Type 0 grammar: grammar production are of the type, $`\alpha A \beta => \alpha \gamma \beta`$ $`A \in V`$, $`\alpha , \gamma , \beta \in (V \cup T )^*`$

Regular languages

Type 3 languages are generated by regular expression and recognized by Deterministic finite state automata DFA

Deterministic finite state automata

Deterministic finite state automata DFA formally is a $ `DFA= (Q,\Sigma, \delta, q_{0}, F)` $.

- Q is the set of states of the finite state automaton.
- $ `\Sigma` $ is the alphabeth.
- $ `q_{0}` $ is the initial state of the DFA.
- $ `F \subseteq Q` $ is the set of final states of automata.
- $ `\delta` $ is the set of transactions. In a DFA the transactions are of the type: $ `Q \times \Sigma \rightarrow Q` $

Non deterministic finite state automata

Regular expression

Proprieties of regular languages

Pumping lemma for regular languages