Discussion #1: Regular Languages

1 Disassembling DFAs

Provide a concise english description for the language recognized by each of the following DFAs. Also provide the corresponding regular expression for the language. Let $\Sigma = \{0, 1\}$.

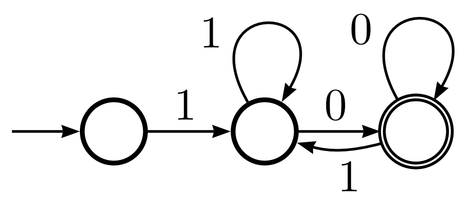

Figure 1: All binary strings that start with a 1 and end with a 0: $1(1|0)^*0$.

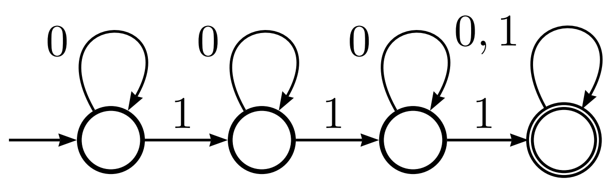

Figure 2: All binary strings that have at least three 1's: $(0|1)^*1(0|1)^*1(0|1)^*1(0|1)^*$

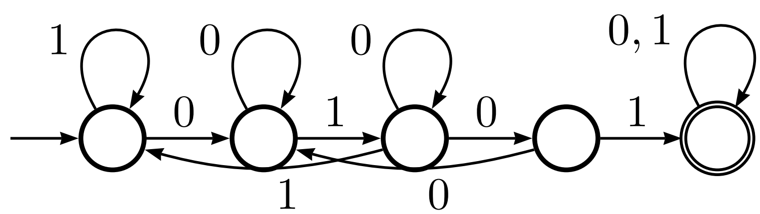

Figure 3: All binary strings containing the substring 0101: $(0|1)^*0101(0|1)^*$

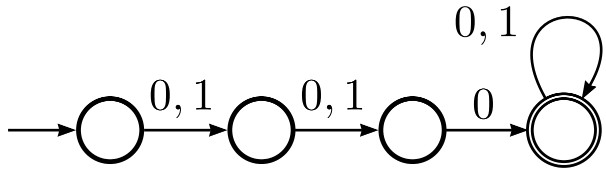

Figure 4: All binary strings that have length at least 3 and third symbol 0: $(0|1)(0|1)0(0|1)^*$

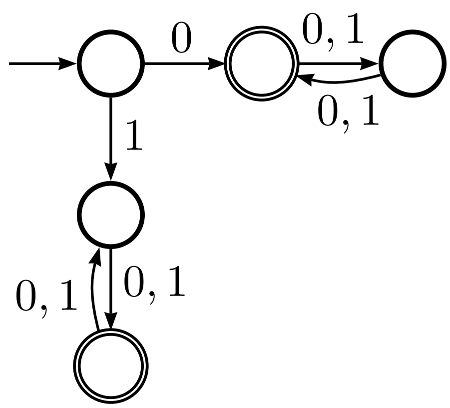

Figure 5: All binary strings that start with 0 and have odd length, or start with 1 and have even length: $0((0|1)(0|1))^*|1(0|1)((0|1)(0|1))^*$

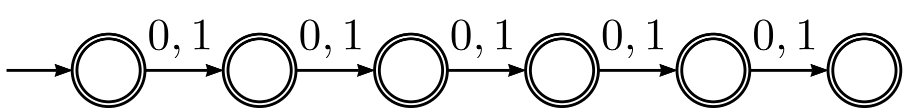

Figure 6: All binary strings that have length at most 5: $(0|1|\epsilon)(0|1|\epsilon)(0|1|\epsilon)(0|1|\epsilon)(0|1|\epsilon)$

2 Constructing DFAs

A language is regular if there exists a DFA that recognizes it. Alternatively, a language is regular if there exists a regular expression that generates it. Show that the following languages are regular using both constructions.

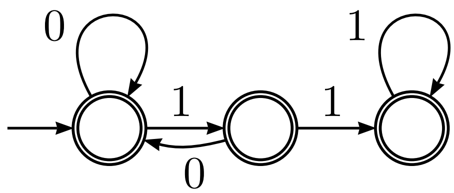

Figure 7: $\{w|w$ doesn't contain the substring 110$\}$: $0^*(10)^*0^*1^*$

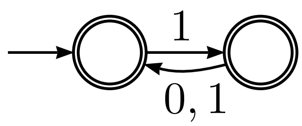

Figure 8: $\{w|$ every odd position of w is a 1$\}$: $1(01|11)^*|(10|11)^*$

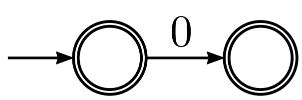

Figure 9: $\{\epsilon, 0\}$: $\epsilon|0$

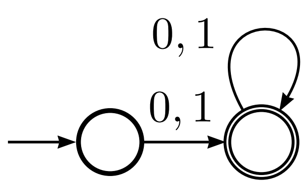

Figure 10: All binary strings except the empty string: $(1|0)(1|0)^*$