CS3012 Formal Languages

Exercises 3: Regular Expressions and Finite State Automata

1. Give regular expressions which exactly define the following languages. The alphabet in each case is given at the end.
   (i). contains exactly one a, besides bs. $\{a, b\}$
   (ii). no a appears without another a beside it. $\{a, b\}$
   (iii). has 00 or 11 as a substring. $\{0, 1\}$
   (iv). has no b occurring anywhere after any a. $\{a, b, c\}$
   (v). contains exactly two as or exactly two bs. $\{a, b\}$
   (vi). has a substring abc or bc. $\{a, b, c\}$
   (vii). $\{a, b\}^*$ - $\{a\}$ $\{a,b\}$ [i.e. any string of as and bs, but not the string "a"]
   (viii). contains an even number of as and an even number of bs. $\{a, b\}$
   (ix). represents a number divisible by 3. $\{0, 1\}$

Answer:

2. Describe in plain English the languages defined by the following regular expressions
   (i) $(a + b)^*$
   (ii) $(a + b)^*ab(a + b)^*$
   (iii) $a^2 + b^2$
   (iv) $((a + b)^2)^*$
   (v) a^*b
   (vi) $1(0 + 1)^*$
   (vii) $(0 + 1)^*011$
   (viii) $011^* + 100^*$
   (ix) $(00 + 1)^*$
   (x) $0\ (1+0)^*0$

Answer:

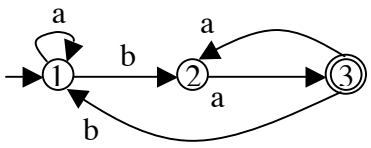
3. A certain programming language allows real constants to be written in exponent form - e.g. 3.25E6 (for 3.25x106) or 2.16E-5 (for 2.16x10-5). There must be exactly one digit before the decimal point (preceded by an optional sign), at least one digit after the decimal point, and the exponent can be a positive or negative integer. Write a regular expression specifying the language of such numbers. Define any abbreviations you use.

Answer:

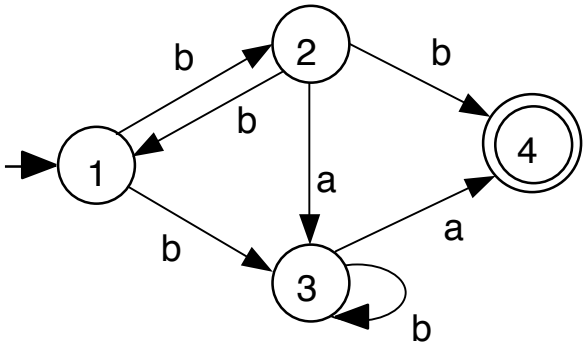
4. Give a regular expression for all character strings which contain the word "cat". Assume only letters and spaces occur in the strings, and that words are separated by single spaces.

Answer:

5. Convert the FSAs below to regular expressions, using the FSA -> RegExp algorithm (or by inspection).



Answer:



Answer: