CS3331 - Assignment 1 - 2018

Regular Languages

Due: Tuesday, Oct 16, 2018 (Latest to submit: Friday, Oct 19)

1. (60pt) For each of the following languages, either prove it is not regular or do the following:
   - construct a NDFSM for it
   - convert the NDFSM into a regular expression (horrible regular expressions from JFLAP are accepted only when no obvious ones can be found)
   - convert the NDFSM into a DFSM (Note that you do not have to include trap/dead states)
   - minimize the DFSM

   (a) $\{w \in \{\texttt{a}, \texttt{b}\}^* : w$ has `abba` as a substring$\}$.

   (b) $\{w \in \{\texttt{a}, \texttt{b}\}^* : w$ does not have `abba` as a substring$\}$.

   (c) $\{w \in \{\texttt{0}, \texttt{1}\}^* :$ if w contains the substring `01` then $|w|$ is even$\}$.

   (d) $\{w \in \{\texttt{0}, \texttt{1}\}^* : w = w^{\mathrm{R}}\}$.

   (e) $\{w \in \{\texttt{a}, \texttt{b}\}^* : w$ does not end in `aa`$\}$.

   (f) $\{w \in \{\texttt{a}, \texttt{b}\}^* : w$ contains exactly three more `a`'s than `b`'s$\}$.

   (g) $\{w = yxyz : x, y, z \in \{\texttt{0}, \texttt{1}\}^+\}$.

   (h) $\{w \in \Sigma^* : w$ is a Java comment$\}$, where Σ is the ASCII alphabet and Java comments are of two types: `/* ... comment ... */`; `// ... comment ... \n`.

2. (20pt) The Pattern Searching problem is: Given two strings $p, T \in \Sigma^*$ (the pattern and the text), find all occurrences of p in T. It can be solved in time $\mathcal{O}(|T|)$ by constructing a DFSM for the language $\Sigma^* p$ and then run the text T through it; every time the machine is in an accepting state, we report the end of an occurrence of the pattern. Construct the minimal DFSM for the pattern $p =$ `ananea`. (Show also your NDFSM.)

3. (20pt) Show that the following problem is decidable: Given a FSM M and a regular expression α, it is true that both $L(M)$ and $L(\alpha)$ are finite and α generates at least one string that M does not accept?

Note well: You may submit your assignment in one of two ways:

- Ideally, submit your solution as a pdf file on OWL (scanned written assignments are fine). Submitted this way, assignments submitted by 11:59 pm Oct 19 will be accepted.
- Otherwise **staple your assignment** and hand in solutions in class or to the 3331 dropbox (locker #306, across from the elevator on the 3rd floor of Middlesex College). Submitted this way, assignments **will not be accepted after 5:00 pm Oct 19**.

Note well: You are allowed to use JFLAP to solve the assignment. But remember that JFLAP will not be allowed during the midterm exam.