CURTIN UNIVERSITY OF TECHNOLOGY (CRICOS number: 00301J)
Division of Engineering, Science and Computing
Department of Computing

Theoretical Foundations of Computer Science 300 (Index No. 12334)
Theoretical Foundations of Computer Science 552 (Index No. 302976)

Work Sheet 3

AIM:
- To explore regular languages.
- To practice the conversion between NFAs and regular strings.
- To formally prove that a language is regular.

I recommend that you undertake the work below as a group activity; however each student is individually responsible for their own learning. If you work in a group, make sure you understand how any answers were arrived at.

If you work by yourself, you may want to leave some of these questions for revision purposes later since doing them all may take too long. This makes it harder for you to ask meaningful questions in the tutorial, though.

The worksheet will not be submitted or marked, and no answers will be given directly. The questions in this sheet will be discussed in the lecture in week 3 of semester, and in the tutorial in week 4.

ACTIVITY 1: Regular Languages
For each language composed of the binary strings described below, give a formal definition using regular constructors.
   a) All strings containing the sub-string '01'.
   b) All strings starting with a '1' and ending in '00'.
   c) All strings consisting of one or more repetitions of the sub-string '011'.
   d) All strings that have no '1's before the first '0', and no '0's after the first '1'.
   e) All strings containing an even number of digits. (Note, consider zero as even.)

ACTIVITY 2: Converting between NFAs and Regular Strings
For each of the cases in Activity 2 of Worksheet 2, convert the NFA to a regular string.

Convert the following string into an NFA: $(0 \cup 1)*011*$

ACTIVITY 3: Proving the Regularity of a Language
Formally prove that each of the languages in Activity 1 above are regular by (i) creating a DFA or NFA and (ii) creating a formal mathematical proof using the Pumping Lemma.

ACTIVITY 4: Proving the Irregularity of a Language

Formally prove that each of the following languages are not regular, using the Pumping Lemma.

  a) The language that accepts binary strings of the form 0^i1^i for some $i>0$.
  b) The language $0^i\#1^j$ where $i<j$.
  c) The language that accepts any binary string that has the form $0^i1^j0^i1^j$ for $i,j>0$.

End of Work Sheet 3