CS 3100 – Models of Computation – Fall 2011
This assignment is worth 8% of the total points for assignments
100 points total

October 3, 2011

Assignment 4, Posted on: 9/15 Due: 9/22 Thursday 11:59pm

This assignment involves the use of JFLAP which will be illustrated in class on 9/15. JFLAP is available for your use by typing on CADE machines `/home/cs3100/jflap/bin/jflap`. JFLAP is extremely easy to install on your own own machines, from `http://www.cs.duke.edu/csed/jflap/`

I'll use these conventions:

1. `IF` is an initial-plus-final state
2. `F` is a final state that's not initial
3. `X` where `X` does not start with an `I` or an `F` is neither initial nor final
4. While using NFA conventions, I'll often write states as `{S}` or `{S1, S2}`

1. **15%** Draw the NFA for L_{div3} in JFLAP.

   This is the language of all strongs that are evenly divisible by 3 when fed MSB-first.

   I'm showing next states as sets of states.

   ```
   IF - 0 -> {IF}
   IF - 1 -> {S1}

   S1 - 1 -> {IF}
   S1 - 0 -> {S2}

   S2 - 0 -> {S1}
   S2 - 1 -> {S2}
   ```

2. **15%** Draw the NFA for $L_{ends1011}$ in JFLAP.

   Strings ending in 1011. These are strings of length ≥ 4.

   ```
   I - 0 -> {I}
   I - 1 -> {I, T1}
   T1 - 0 -> T2
   T2 - 1 -> T3
   T3 - 1 -> F
   ```

3. **20%** Draw the NFA for L_{cat1} which is defined as $L_{cat1} = L_{div3}\ L_{ends1011}$

```
I - 0 -> {I}
I - 1 -> {S1}

S1 - 1 -> {I}
S1 - 0 -> {S2}

S2 - 0 -> {S1}
S2 - 1 -> {S2}

I - epsilon -> A1

A1 - 0 -> {A1}
A1 - 1 -> {A1, T1}
T1 - 0 -> T2
T2 - 1 -> T3
T3 - 1 -> F
```

4. **20%** Draw the NFA for L_{union1} which is defined as $L_{union1} = L_{div3} \cup L_{ends1011}$

```
I - epsilon -> IF
I - epsilon -> I1

IF - 0 -> {IF}
IF - 1 -> {S1}

S1 - 1 -> {IF}
S1 - 0 -> {S2}

S2 - 0 -> {S1}
S2 - 1 -> {S2}

I1 - 0 -> {I1}
I1 - 1 -> {I1, T1}
T1 - 0 -> T2
T2 - 1 -> T3
T3 - 1 -> F
```

5. **15%** Draw the NFA for the language "second-to-last symbol is a 1" as discussed in class (the set of strings over $\{0,1\}^*$ such that the second-to-last symbol is a 1).

   I'm calling the language `L1xx` to suggest that the last two positions are don't-cares.

   Formally,

$$L1xx = \{w1xy \mid w \in \{0,1\}^* \text{ and } x, y \in \{0,1\}\}$$

```
I - 0 -> {I}
I - 1 -> {I, A}

A - 0,1 -> {B}

B - 0,1 -> {F}
```

6. **15%** Draw the DFA for the language "second-to-last symbol is a 1" as discussed in class (the set of strings over $\{0,1\}^*$ such that the second-to-last symbol is a 1; it is formally captured by the language $L1xx$ defined above).

```
S - 0 -> S0
S - 1 -> S1

S0 - 0 -> S00
S0 - 1 -> S01

S1 - 0 -> S10
S1 - 1 -> S11

S00 - 0 -> S000
S00 - 1 -> S001

S01 - 0 -> S010
S01 - 1 -> S011

S10 - 0 -> F100
S10 - 1 -> F101

S11 - 0 -> F110
S11 - 1 -> F111


S000 - 0 -> S000
S000 - 1 -> S001

S001 - 0 -> S010
S001 - 1 -> S011

S010 - 0 -> F100
S010 - 1 -> F101

S011 - 0 -> F110
S011 - 1 -> F111
```

```
F100 - 0 -> S000
F100 - 1 -> S001

F101 - 0 -> S010
F101 - 1 -> S011

F110 - 0 -> F100
F110 - 1 -> F101

F111 - 0 -> F110
F111 - 1 -> F111
```