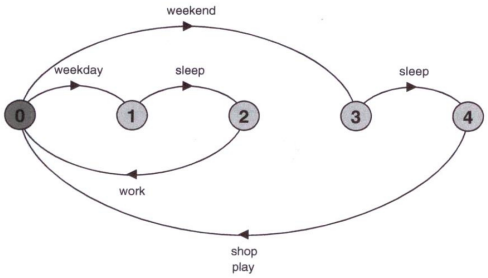
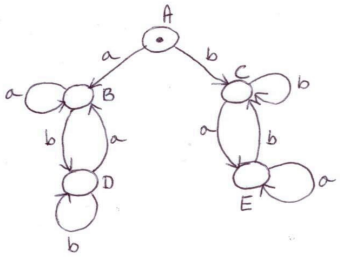
CS 3SD3

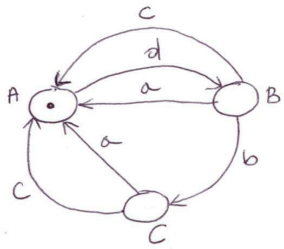
Assignment #1. Due October 5 (Friday), 2018, 23:59 via the course' SVN depository. Do not hesitate to discuss with TA or instructor all the problems as soon as you discover them.

Instructions: For the solutions that involve FSPs you should provide a plain text file with the corresponding LTSA source code (properly commented). The LTSA solution for each one of the questions must be in a separate file. For questions that do not involve using LTSA or producing FSPs, hand drawn pictures are allowed, but a solution should be in PDF format (you may do a scan or photo). You must upload your solutions in the course' svn repository. The SVN has been created and is at the link https://websvn.cas.mcmaster.ca/cs3sd3. *Any problem with svn repository please discuss with Duy Vu <vud1@mcmaster.ca>, a TA for this course.*

1. For each one of the following three processes, give the Finite State Processes (FSP) description of the labelled transition graph.







2. A miniature portable FM radio has three controls. An on/off switch turns the device on and off. Tuning is controlled by two buttons scan and reset which operates as follows. When the radio is turned on or reset is pressed, the radio is tuned to the top frequency of the FM band (108 MHz). When scan is pressed, the radio scans towards the bottom of the band (88 MHz). It stop scanning when it locks onto a station or it reaches the bottom (end). If the radio is currently tuned to a station and scan is pressed then it start to scan from the frequency of that station towards the bottom. Similarly, when reset is pressed the receiver tunes to the top. Model the radio as a FSP process RADIO. Also provide an appropriate labelled transition system.
Hint: The alphabet of RADIO is {on, off, scan, reset, lock, end}.

3. Program the radio of Question 2 in Java, complete with graphic display (if you can).

4. Model the following Road Deicing protocol as FSP. The road could be in one of the following states: Predicted Safe For Use, Predicted Unsafe For Traffic But Open, Closed. If road is 'Predicted Safe For Use', coming 'Predicted Ice Formation' changes its status to 'Predicted Unsafe For Traffic But Open'. If road is 'Predicted Unsafe For Traffic But Open', ice may melt (i.e. action 'Ice melts' occurs) and the road is again 'Predicted Safe For Use', or it becomes unsafe for use (action 'Unsafe for Use') and it is in the state 'Closed', or it is treated (action 'Road treated') and it is in the state 'Predicted Safe For Use' again. If the road is 'Closed', either 'Ice melts' or it is treated (action 'Road treated'), in both cases it becomes 'Predicted Safe For Use'.
Hint: The processes: ROAD-DEICING, PREDICTED-SAFE, PREDICTED-UNSAFE, CLOSED.

5. Consider the following set of FSPs:

   A = (a → (b → B)) | (c → (a → A | c → B)) | c → C)
   B = (b → (a → A | c → (a → A | b → C)))
   C = (a → (b → (c → B)))

   a. Construct an equivalent Labelled Transition System using the rules from page 16 of Lecture Notes 2.
   b. Use LTSA to derive appropriate LTS, and, if different then yours, analyse and explain differences.

6. ELEMENT = (up → down → ELEMENT) accepts an up action and then a down action. Using parallel composition '||' and the ELEMENT process describe a model that can accept up to four up actions before a down action.

7. Model the system from page 10 of Lecture Notes 3 as a composition of *FSP* processes. In this case, the entities that are represented by places in the Petri Nets model, must be represented by actions/transitions in *FSP* model.

8. Model the system from page 13 of Lecture Notes 3 as a composition of *FSP* processes.

9. Consider the following simplified 'ancient' library system. Users can access the library by three desks; the request desk, the collection desk and return desk. In the library all books are kept in the stack and each book has an index card. A potential borrower enters the library system at the request desk where a particular book may be requested. If the book is in the library it is taken from the stack and the borrowed index is updated. The user gets the book at the collection desk. When a user returns a book, he does it so via the return desk; the book is put back in the stack and the index is appropriately updated.
   a. Model the system using Elementary Petri Nets.
   b. Model the system as a composition of *FSP* processes.
   c. Compare these two models, discuss similarities and differences.

10. Construct *reachability graphs* (defined on page 18 of Lecture Notes 3) for both Petri nets from page 12 of Lecture Notes 4.

11. Consider four Labelled Transition Systems (Finite State Machines, Finite Automata) given below: P_1, Q_1, P_2 and Q_2. Tokens represent initial states. Show that:
   a. $P_1 \approx Q_1$, i.e. P_1 and Q_1 are *bisimilar*,
   b. $P_2 \not\approx Q_2$, i.e. P_2 and Q_2 are *not bisimilar*,
   c. Traces(P_1) = Traces(Q_1) = Pref(*give a proper regular expression*).
   d. Traces(P_2) = Traces(Q_2) = Pref(*give a proper regular expression*).
   e. Provide Finite State Processes (FSPs) equivalent to automata P_1, Q_1, P_2 and Q_2.