CS 3SD3

Assignment #1. Due October 4 (Monday), 2021, 23:59 via Avenue. Do not hesitate to discuss with TA or instructor all the problems as soon as you discover them. This assignment is labour consuming. Start early!

Total: 166pts

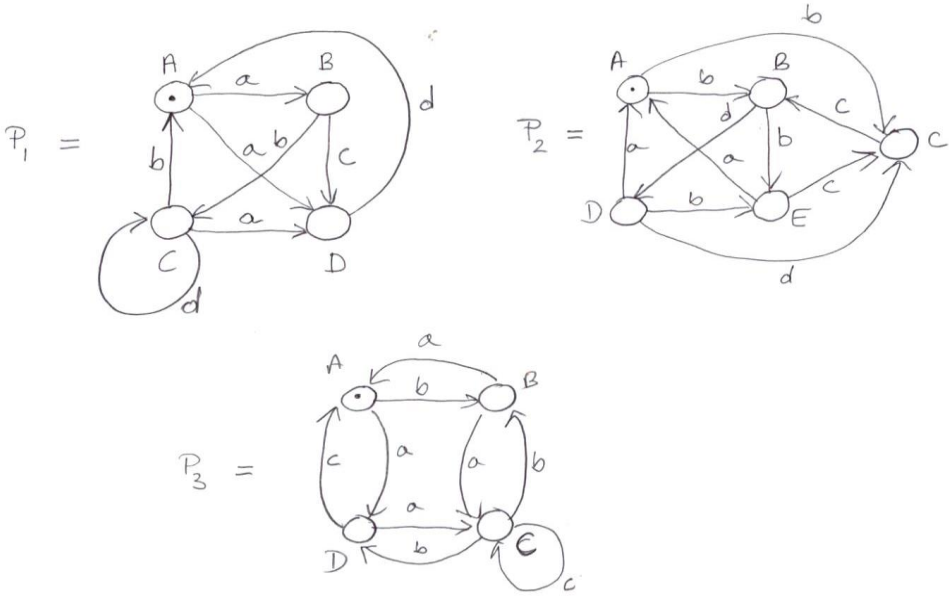
Instructions: For the solutions that involve FSPs you should provide a plain text file with the corresponding LTSA source code (properly commented). The LTSA solution for each one of the questions must be in a separate file. For questions that do not involve using LTSA or producing FSPs hand drawn pictures are allowed, but a solution should be in PDF format (you may do a scan or photo). You must upload your solutions using Avenue. *Any problem with Avenue please discuss with Mahdee Jodayree* <mahdijaf@yahoo.com>*, a TA for this course.*

For the implementation questions you should provide a Java program together with the corresponding instructions on how to compile it and run some test cases; good programming style will also be marked.

Furthermore, for each one of the questions involving Java, you must also submit either a plain text file or PDF file explaining in what way your Java program implements your model. Use properly structure diagrams for your FSP processes and class diagrams for your Java programs in your explanation.

1.[15] a.[9] For each one of the following three processes, give the Finite State Processes (FSP) description of the labelled transition graph. Dots indicate initial states.

b.[6] Use LTSA to transform the solutions to 1.a back into labelled transition systems. Compare the results and discuss differences (if any).



2.[10] Consider the following simple hotel reservation system. A customer makes a room request. If room is available, a confirmation is sent to the customer, otherwise the customer is put on a reservation list. If a room is confirmed, the customer may either use it, pay for the room, leave and the whole transaction is archived. However the customer may also cancel his/her reservation. When the customer is on waiting list, a room may become available, and then a confirmation is sent to a customer. The customer may also give up waiting and cancel his/her request.

Model this reservation system as a FSP process reservation. Note that this process always stops, so you have to use the process STOP. Also provide appropriate labelled transition system (use LTSA).

3.[3] 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 operate 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}.

4.[15] Program the radio of Question 3 in Java, complete with graphic display (if you can).

5.[15] A drinks dispending machine charges 15c for can of Sugerola, 20c for a can of SugerolaDiet and 25c for a can of SugerolaSuperDiet. The machine accepts coins with denominations 5c, 10c and 25c and gives changes. Model the machine as an *FSP* process, DRINKS.

6.[15] Consider the following set of FSPs:

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

a.[12] Construct an equivalent Labelled Transition System using the rules from page 16 of Lecture Notes 2.

b.[3[Use LTSA to derive appropriate LTS, and, if different then yours, analyse and explain differences.

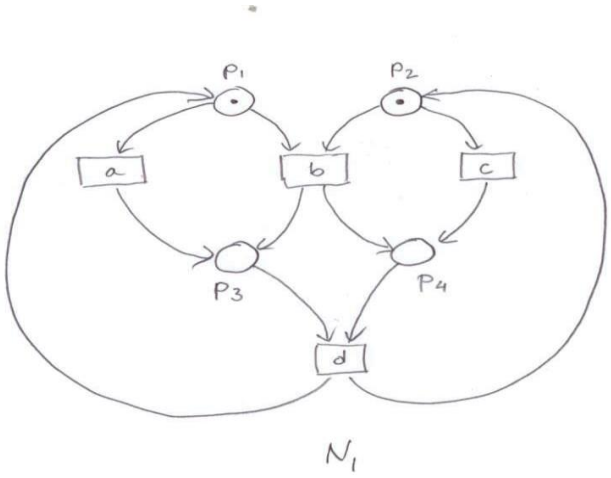
7.[18] a.[8] Show that processes ||*S*1 and *S*2 generate the same Labelled Transition Systems, i.e. LTS(||*S*1) = LTS(*S*2) (or equivalently, they generate the same behaviour)

P = (*a* -> *b* -> *d* -> *P*)
Q = (c -> *b* -> *e* -> *Q*)
|| *S*1 = (*P* || *Q*)

*S*2 = (*a* -> S2A | *c* -> S2B)
S2A = (*c* -> *b* -> *d* -> S2C | *c* -> *b* -> *e* -> S2D)
S2B = (*a* -> *b* -> *d* -> S2C | *a* -> *b* -> *e* -> S2D)
S2C = (*e* -> S2 | *a* -> *e* -> S2A)
S2D = (*d* -> S2 | *c* -> *d* -> S2B)

b.[10] Using a method presented on page 17 of Lecture Notes 3 and pages 10-11 of Lecture Notes 4, transform the processes ||*S*1 and *S*2 into appropriate Petri nets. Are these nets identical? Explain the difference. Which one allows *simultaneity*?

8.[10[Consider a Petri net below:



Model the net N_1 as a composition of *FSP* processes.

9.[10] 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.

10.[10] A roller-coaster control system only permits its car to depart when it is full. Passengers arriving at the departure platform are registered with the roller-coaster controller by a turnstile. The controller signals the car to depart when there are enough passengers on the platform to fill the car to its maximum capacity of *M* passengers. Ignore the synchronization detail of passengers embarking from the platform and car departure. The roller-coaster consists of three processes: *TURNSTILE*, *CONTROL* and *CAR*. *TURNSTILE* and *CONTRO*L interact by the shared action *passenger* indicating an arrival and *CONTROL* and *CAR* interact by the shared action *depart* signalling the car departure. Provide FSP description for each process and the overall composition.

11.[10] Construct *reachability graph* (defined on page 18 of Lecture Notes 3) for the Petri net from Question 8.

12.[18] Consider three Labelled Transition Systems (Finite State Machines, Finite Automata) given below: P_1, P_2 and P_3. Tokens represent initial states. Show that:

a.[8] $P_2 \approx P_3$, i.e. P_3 and P_3 are *bisimilar*,

b.[6] $P_1 \not\approx P_2$, i.e. P_1 and P_2 are *not bisimilar*,

c.[6] $P_1 \not\approx P_3$, i.e. P_1 and P_3 are *not bisimilar*,

d.[8] Traces(P_1) = Traces(P_2) = Traces(P_3) = Pref(*give a proper regular expression*).