Middle East Technical University | Department of Computer Engineering

CENG 424

Logic For Computer Science

Fall 2024-2025

Assignment 4

Regulations

1. The homework is due by **23:55 on December 15th, 2024**. Late submission is not allowed.
2. Submissions will be via ODTUClass, do not send your homework via e-mail.
3. You typeset your homework in any typesetting tool (LaTex, Word, etc.) or submit handwritten answers. However, you must upload the homework as a single **pdf file**. Other formats will not be considered for grading. In case you submit handwritten solutions, **make sure that the page layouts are properly organized and your answers are clear and readable.**
4. Write your names and surnames to each of your pages.
5. Name your submission files as $< yourName\_yourSurname\_424HW4 >$.pdf.
6. Send an e-mail to **garipler@metu.edu.tr** if you need to get in contact.
7. **This is an individual homework, which means you have to answer the questions on your own. Any contrary case including but not limited to getting help from automated tools, sharing your answers with each other, extensive collaboration etc. will be considered as cheating and university regulations about cheating will be applied.**

Question 1

Given the premises below;

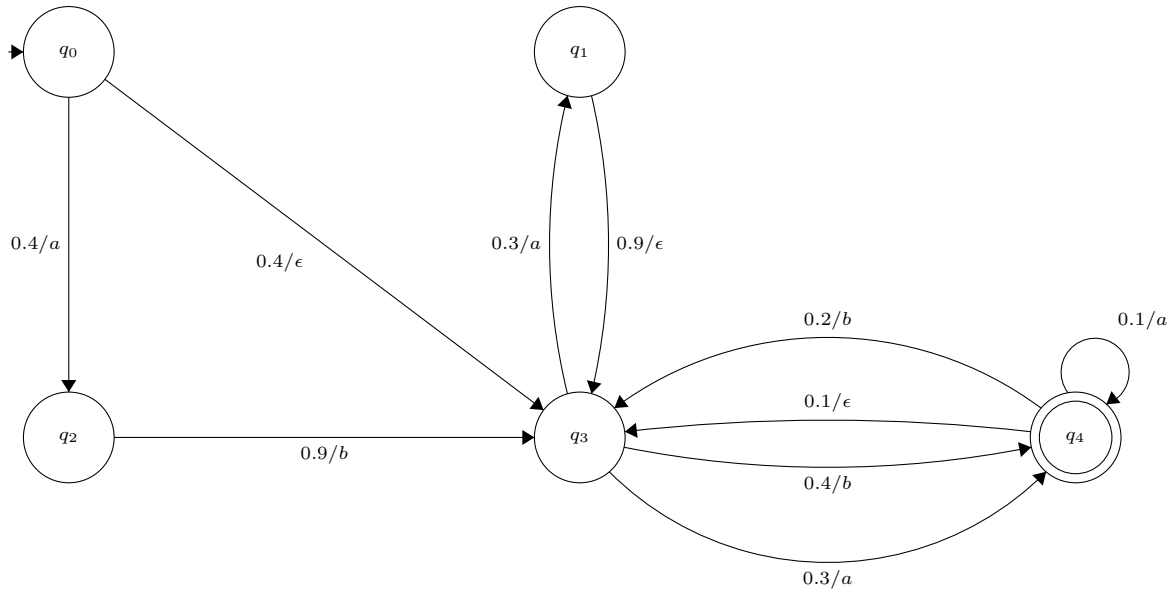
- Everyone whom Jane loves is a traveler.
- Any person who does not earn money, does not travel.
- Jim is a doctor.
- Every doctor is a person.
- Any doctor who does not work, does not earn money.
- Anyone who does not travel, is not a traveler.

Use relational resolution to conclude that;
"If Jim does not work, then Jane does not love Jim."

Use the following relation symbols while formulation your relational logic sentences:

LOVES(x,y) (for x loves y),
DOCTOR(x),
EARN(x),
TRAVEL(x),
WORK(x),
PERSON(x),
TRAVELER(x)

Question 2



The figure given above depicts the probabilistic transition system PTS_1. Its principles of operation are given below:

1. The system always starts its operation from the starting state q_0.
2. The system may take any number of transitions once it has started operating and may stop at any of the states. However, for an operation to be a correct operation, it must stop at the final state q_4.
3. A transition from a state q to a state q' is shown with an arrow from q to q' and labeled with *probability/output* pairs. *probability* represents the system taking that transition while it is in that state and *output* represents the symbol outputted by that transition. To illustrate, while it is at the state q_2, PTS_1 transitions to q_3 with the probability 0.9 and outputs b as the result of that transition.
4. While it is at a state q, the system may either take any one of the transitions outgoing from that state (q), with the probability associated with that transition, or it can stop operationg (i.e. may remain at that state).

5. For each state, the probabilities of stopping at that state are implicitly given. That is, for any state q, sum of the probabilities of the transitions outgoing from that state (q) summed with the probability of remaining at that state (q) equals to 1.

In this question, you are asked to calculate the probability of PTS_1 making a correct operation outputting *aba*. Please answer each of the following 4 sub-questions to reach the desired answer.

a.

Formulate the relation representing the a transition form a state q to a state q' with the probability p.

b.

Draw the partial probabilistic computation tree corresponding to the related part of the PTS_1. Only draw the parts that are necessary and sufficient for the question.

c.

Using the relation you defined at the part a and the computation tree you drew at part b, write each of the premise(s) representing the transitions that are related to the question (i.e. required to solve the question).

d.

You need an extra premise (may be more than one, according to your solution strategy) to relate the consecutive transitions and calculate the related probability. Write that(/those) premises as relations and define with a few words what they mean.

e.

Using answer extraction method (with relational resolution), compute the probability of PTS_1 making a correct operation outputting *aba*. So as to get the full credit from this question, you have to solve it by a single resolution instance.
However, that may be lengthy and hard. Therefore, solutions using multiple resolution instances for each path and summing the results at the end will also accepted with a mild grade deduction.