

CENG 424

Logic For Computer Science

Fall 2020-2021

Assignment 5

Regulations

1. The homework is due by **15 January 2021,23:55**. Late submission is not allowed.
2. Submissions will be via OdtuClass, do not send your homework via e-mail, or do not bring any hardcopy.
3. You can use any typesetting tool (LaTeX, Word, etc.) or handwriting while writing the homework. However, you must upload the homework as a pdf file. Other formats will not be considered for grading. A template tex file will be provided to you if you prefer to use LaTeX to write your solutions.
4. Name pdf files you will submit as **studentid_hw4** . In case you violate the naming convention, you will receive 5 points penalty (over 100).
5. Send an e-mail to **atakan.garipler@metu.edu.tr** if you need to get in contact.
6. This is an individual homework, which means you have to answer the questions on your own. Any contrary case will be considered as cheating and university regulations about cheating will be applied.

1 Question 1

Prove the validity of the following sequents in predicate logic, using rules of inference you have learned. (Do **not** use resolution.)

1. $\exists x \exists y (S(x, y) \vee S(y, x)) \vdash \exists x \exists y S(x, y)$
2. $\forall x (P(x) \vee Q(x)), \exists x \neg Q(x), \forall x (R(x) \Rightarrow \neg P(x)) \vdash \exists x \neg R(x)$
3. $\forall x \forall y (S(y) \Rightarrow F(x)) \vdash \exists y S(y) \Rightarrow \forall x F(x)$

2 Question 2

Given the axioms 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 resolution to conclude that;

- If Jim does not work, then Jane does not love Jim.

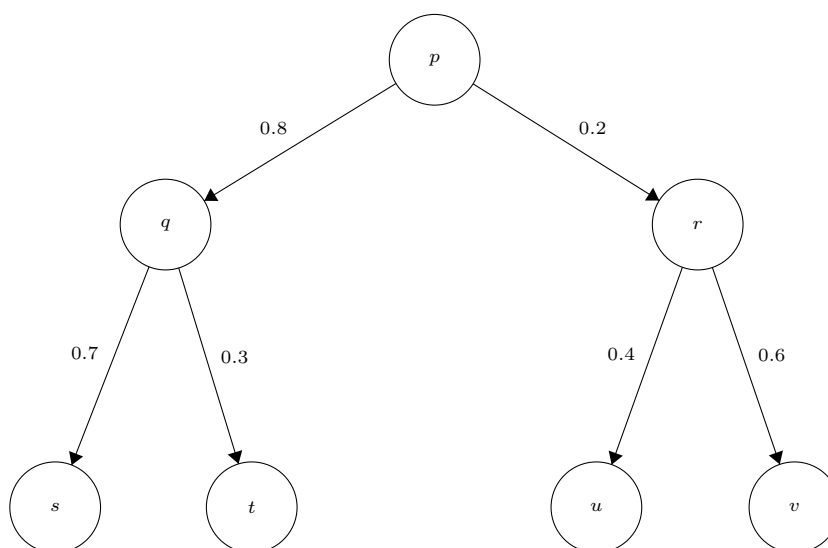
Use the following relation symbols while writing Relational Logic sentences:

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

Steps to follow:

1. Write down the sentences as Relational Logic sentences,
2. Convert them into clausal form using INSEADO,
3. **Using resolution**, conclude the final sentences from axioms.

3 Question 3



Given the probabilistic computation tree above, use **answer extraction method** to compute the probability of the computation (which is starting from the node p) ending at the node t . Show the steps of your solution.

(Hint 1: Use can represent a transition from x to y with probability p with the predicate $P(x, y, p)$.)

(Hint 2: If there is a transition from x to y with probability p_1 and a transition from y to z with probability p_2 , then probability of reaching z from x is $p_1 \times p_2$. Formalize and use this fact.)

4 Question 4

Why does universal generalization rule work? How can it generalize from an arbitrary instance to any? Give a brief explanation. (Comparing and explaining the cases in which it is applicable and in which it is inapplicable may be helpful.)