

CENG 424

Logic For Computer Science

Fall '2019-2020

Assignment 4

Regulations

1. Due date is 09 December 2019. 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.
4. Send e-mail to cseylan@ceng.metu.edu.tr if you need to get in contact.
5. 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

Make a formal proof of *there exists a 90's kid* by the given axiom schemata and given premises. First, represent the sentences in relational logic. Clearly pair each sentence and its relational logic expression. Then give the formal proof step-by-step writing each axiom used in that line and which premises are used.

In the proof, you can use the following rules to make proof, do not forget to state which lines are used for that rule:

- Modus Ponens (MP), Modus Tolens (MT), And Introduction (AI), And Elimination (AE).
- Universal Generalization (UG)
- Existential Generalization (EG)
- Universal Instantiation (UI)
- Existential Instantiation (EI)

The premise set is as follows:

1. Everybody played *taso* with everyone and played (same everybody) *yakan top* with everyone (same everyone) implies that *everybody is a 90's kid*.

2. Everybody played *seksek*.
3. There exists a kid that played *seksek* and played *saklambac* implies that, that kid also played *yerden yuksek*.
4. Everybody who played *yerden yuksek* implies that there exists a kid who they (everybody who played *yerden yuksek*) played *taso* with and played *yakan top* with.
5. Everybody played *saklambac*.

Use the following symbols for the rules for converting sentences above:

- $A(i, j)$ for i played *taso* with j .
- $B(i, j)$ for i played *yakan top* with j .
- $c(i)$ for i played *seksek*.
- $d(i)$ for i played *saklambac*.
- $f(i)$ for i played *yerden yuksek*.
- $e(i)$ for i is a 90's kid.

2 Question 2

Following axioms are given:

1. Everyone who Jane *loves* is a *traveller*.
2. Any doctor who does not *earn* money, does not *travel*.
3. Jim is a *doctor*.
4. Any *doctor* who does not *work*, does not *earn* money.
5. Anyone who does not *travel*, is not a *traveller*.

According to the axioms above, conclude that:

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

While reaching the conclusion, do the following:

1. Write down the sentences as relational logic sentences.
2. Convert them into clausal form using *inseado*.
3. Reach to the conclusion by using resolution and show each step clearly.
4. Use the following formalism:
 - $LOVES(x, y)$ for x loves y .
 - $DOCTOR(x)$ for x is a *doctor*.
 - $EARN(x)$ for x earns money.
 - $TRAVEL(x)$ for x travels.
 - $WORK(x)$ for x works.
 - $TRAVELLER(x)$ for x is a *traveller*.