Digital Tools for Teaching Logic
Informatics Teaching Festival
07.06.2021

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School of Philosophy, Psychology and Language Sciences
LOGIC 1
Introduction to symbolic logic

Required course for all first-year philosophy students

Many outside students also take it

Approximately 500 students

3 lectures per week

About 30 tutorial groups

Plus logic lab
1. translations from natural language into the formal language
2. construction of derivations in the proof system
3. providing countermodels for invalid arguments
If the Oracle spoke truthfully, then Socrates is wise. Only that which is virtuous is wise, and only that which has knowledge is virtuous. Thus, if Socrates does not have knowledge, then either nothing spoke truthfully or nothing is wise.

a: the Oracle
b: Socrates
F: [1] spoke truthfully
G: [1] is wise
H: [1] is virtuous
K: [1] has knowledge

\((Fa \rightarrow Gb)\)
\((\forall x (Gx \rightarrow Hx) \land \forall x (Hx \rightarrow Kx))\)
\(\vdash (\neg Kb \rightarrow (\neg \exists xFx \lor \neg \exists xGx))\)
\[(Fa \rightarrow Gb)\]
\[(\forall x(Gx \rightarrow Hx) \land \forall x(Hx \rightarrow Kx))\]
\[\models (\neg Kb \rightarrow (\neg \exists xFx \lor \neg \exists xGx))\]

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For each of the following arguments either construct a derivation of the conclusion from the premises or show that it is invalid by specifying a countermodel. (2 points each)

39. $\forall x (Fx \rightarrow \exists y (Gy \land Rxy)) \therefore \forall x (Gx \rightarrow \exists y (Fy \land Ryx))$

40. $\forall x \forall y (Fxy \rightarrow Fyx). \exists x Fax \therefore \exists x (Fax \land \exists y Fxy)$

41. $\forall x \forall y \exists z Rxyz \therefore \forall x \exists z \forall y Rxyz$

42. $\forall x \exists y Fxy. \neg \exists x Fxx \therefore \exists x \exists y \exists z ((\neg Fxz \land Fxy) \land Fyz)$

43. $\neg \exists x \forall y \forall z \exists w Hxyzw \leftrightarrow \neg \forall x \neg \exists y \exists z \forall w \neg Hxyzw$
What I did this year

1. Used recordings of last year’s lectures, but edited them.

2. Organized Learn and populated it with links and content.

3. Used a logic application I’ve developed for homework and as an interface for tutorials.

4. Used Gather for online logic lab
Lectures

“A deduction is speech in which, certain things having been supposed, something different from those supposed results of necessity because of their being so.” (Aristotle)

Aristotle (384-322 BCE)
The earliest formal study of logic: Aristotle’s *The Organon*
Logic application
1. Web-based for easy access on a wide range of devices.

2. Intuitive and non-intimidating interface with a flat leaning curve.

3. Provide detailed feedback and guidance, so students never feel “stuck”.
PROBLEM STATEMENT

S4:21
Provide a symbolisation in L4 for the sentence:
"Ruth is an admirer of those who have no admirers."

WORKSHEET

Well done!
You have completed the problem.

Sentence
∀x(¬∃yMxy → Mbx)

Schema of abbreviation

<p>| | |</p>
<table>
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<tr>
<td>b</td>
<td>Ruth</td>
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D274 T65

Construct a derivation for the following argument:

\[ \neg((P \land Q) \leftrightarrow (\neg P \lor \neg Q)) \]

[Note: complete without using dm]

**Worksheet**

Well done!
You have completed the problem.

1. \textbf{Show} \((P \land Q) \leftrightarrow (\neg P \lor \neg Q)\)

2. \textbf{Show} \((P \land Q) \rightarrow (\neg P \lor \neg Q)\)

3. \((P \land Q)\) \; \text{ass cd}

4. \textbf{Show} \(\neg P \lor \neg Q\)

5. \((\neg P \lor \neg Q)\) \; \text{ass id}

6. \textbf{Show} \(P\)

7. \((\neg P \lor \neg Q)\) \; \text{id}

8. \textbf{Show} \(Q\)

9. \((\neg P \lor \neg Q)\) \; \text{id}

10. \((\neg P \lor \neg Q)\) \; \text{id}

11. \((\neg P \lor \neg Q)\) \; \text{id}

12. \((\neg P \lor \neg Q)\) \; \text{id}

13. \((\neg P \lor \neg Q)\) \; \text{id}

14. \((\neg P \lor \neg Q)\) \; \text{id}

15. \((\neg P \lor \neg Q)\) \; \text{id}

16. \((\neg P \lor \neg Q)\) \; \text{id}

17. \((\neg P \lor \neg Q)\) \; \text{id}

18. \((\neg P \lor \neg Q)\) \; \text{id}

19. \((\neg P \lor \neg Q)\) \; \text{id}

20. \textbf{Show} \((\neg P \lor \neg Q) \rightarrow (P \land Q)\)

21. \((\neg P \lor \neg Q)\) \; \text{ass cd}

22. \textbf{Show} \((P \land Q)\)

23. \((P \land Q)\) \; \text{ass id}

24. \((P \land Q)\) \; \text{id}

25. \((P \land Q)\) \; \text{id}

26. \((P \land Q)\) \; \text{id}

27. \((P \land Q)\) \; \text{id}

28. \((P \land Q)\) \; \text{id}

29. \((P \land Q)\) \; \text{id}

30. \((P \land Q)\) \; \text{id}

31. \((P \land Q)\) \; \text{id}
**PROBLEM STATEMENT**

M2:4
Construct a truth table for the following sentence:

\[ \neg R \land P \rightarrow Q \]

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**WORKSHEET**

Well done!
You have completed the problem.

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<th>Q</th>
<th>R</th>
<th>((\neg R \land P) \rightarrow Q)</th>
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MIU

Goal

Rule 1
xI → xIU

Rule 2
Mx → Mxx

Rule 3
xIIIy → xUy

Rule 4
xUUy → xy

MI

Axiom

https://mu-playground.brianraber.n.net/
thanks.