Digital Tools for Teaching Logic

Informatics Teaching Festival

07.06.2021

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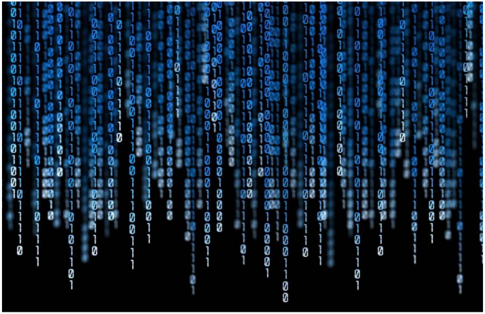
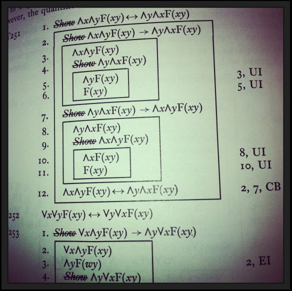


LOGIC 1



T251
1. ~~Show~~ $\bigwedge x \bigwedge y F(xy) \leftrightarrow \bigwedge y \bigwedge x F(xy)$
2. ~~Show~~ $\bigwedge x \bigwedge y F(xy) \rightarrow \bigwedge y \bigwedge x F(xy)$
3. $\bigwedge x \bigwedge y F(xy)$
4. ~~Show~~ $\bigwedge y \bigwedge x F(xy)$
5. $\bigwedge y F(xy)$ — 3, UI
6. $F(xy)$ — 5, UI
7. ~~Show~~ $\bigwedge y \bigwedge x F(xy) \rightarrow \bigwedge x \bigwedge y F(xy)$
8. $\bigwedge y \bigwedge x F(xy)$
9. ~~Show~~ $\bigwedge x \bigwedge y F(xy)$
10. $\bigwedge x F(xy)$ — 8, UI
11. $F(xy)$ — 10, UI
12. $\bigwedge x \bigwedge y F(xy) \leftrightarrow \bigwedge y \bigwedge x F(xy)$ — 2, 7, CB

T252 $\bigvee x \bigvee y F(xy) \leftrightarrow \bigvee y \bigvee x F(xy)$

T253
1. ~~Show~~ $\bigvee x \bigwedge y F(xy) \rightarrow \bigwedge y \bigvee x F(xy)$
2. $\bigvee x \bigwedge y F(xy)$
3. $\bigwedge y F(wy)$ — 2, EI
4. ~~Show~~ $\bigwedge y \bigvee x F(xy)$

PHIL08004

- 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

$(Fa \to Gb)$
$(\forall x(Gx \to Hx) \land \forall x(Hx \to Kx))$
$\vDash (\neg Kb \to (\neg \exists x Fx \lor \neg \exists x Gx))$

$$(Fa \to Gb)$$
$$(\forall x(Gx \to Hx) \land \forall x(Hx \to Kx))$$
$$\models (\neg Kb \to (\neg \exists x Fx \lor \neg \exists x Gx))$$

U:	{0,1}
a:	1
b:	0
F:	{0}
G:	{1}
H:	{1}
K:	{1}

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

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

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

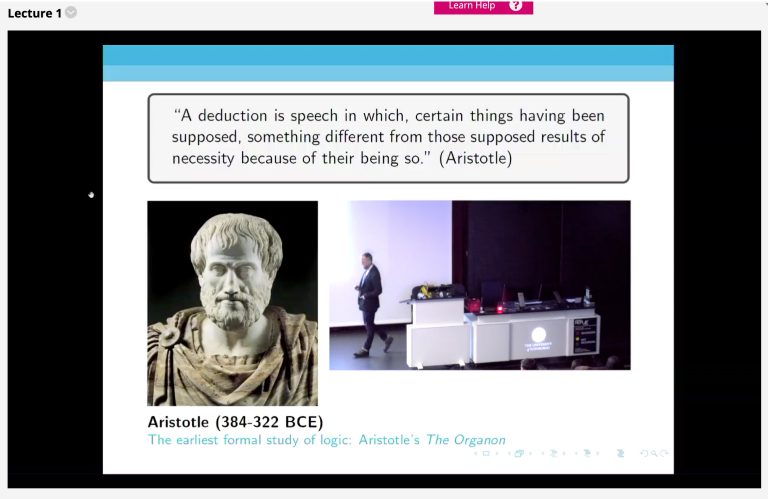
42. $\forall x \exists y Fxy.\; \neg \exists x Fxx \;\;\therefore \exists x \exists y \exists z((\neg Fxz \land Fxy) \land Fyz)$

43. $\neg \exists x \forall y \forall z \exists w Hxyzw \leftrightarrow \neg \forall x \neg \exists y \exists z \forall w \neg Hxyzw$

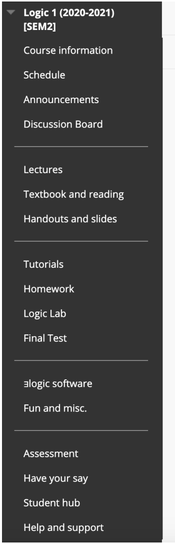
What I did this year

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


Lecture 1
Learn Help
"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

Learn organisation



Logic application

3LOGIC

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

Edit

Well done!

You have completed the problem.

Sentence

$\forall x(\neg \exists y Myx \to Mbx)$

Schema of abbreviation

b	Ruth
M	[1] admires [2]

PROBLEM STATEMENT

D2:74 T65

Construct a derivation for the following argument:

$\therefore \quad \neg(P \land Q) \leftrightarrow (\neg P \lor \neg Q)$

[note: complete without using dm]

WORKSHEET

Edit

Well done!
You have completed the problem.

1.	~~Show~~ $\neg(P \land Q) \leftrightarrow (\neg P \lor \neg Q)$	
2.	~~Show~~ $\neg(P \land Q) \rightarrow (\neg P \lor \neg Q)$	
3.	$\neg(P \land Q)$	ass cd
4.	~~Show~~ $\neg P \lor \neg Q$	
5.	$\neg(\neg P \lor \neg Q)$	ass id
6.	~~Show~~ P	
7.	$\neg P$	ass id
8.	$\neg P \lor \neg Q$	7 add
9.	$\neg(\neg P \lor \neg Q)$	5 r
10.		8 9 id
11.	~~Show~~ Q	
12.	$\neg Q$	ass id
13.	$\neg P \lor \neg Q$	12 add
14.	$\neg(\neg P \lor \neg Q)$	5 r
15.		13 14 id
16.	$P \land Q$	6 11 adj
17.	$\neg(P \land Q)$	3 r
18.		16 17 id
19.		4 cd
20.	~~Show~~ $(\neg P \lor \neg Q) \rightarrow \neg(P \land Q)$	
21.	$\neg P \lor \neg Q$	ass cd
22.	~~Show~~ $\neg(P \land Q)$	
23.	$P \land Q$	ass id
24.	P	23 s
25.	$\neg\neg P$	24 dn
26.	$\neg Q$	25 21 mtp
27.	Q	23 s
28.		26 27 id
29.		22 cd
30.	$\neg(P \land Q) \leftrightarrow (\neg P \lor \neg Q)$	2 20 cb
31.		30 dd

PROBLEM STATEMENT

M2:4

Construct a truth table for the following sentence:

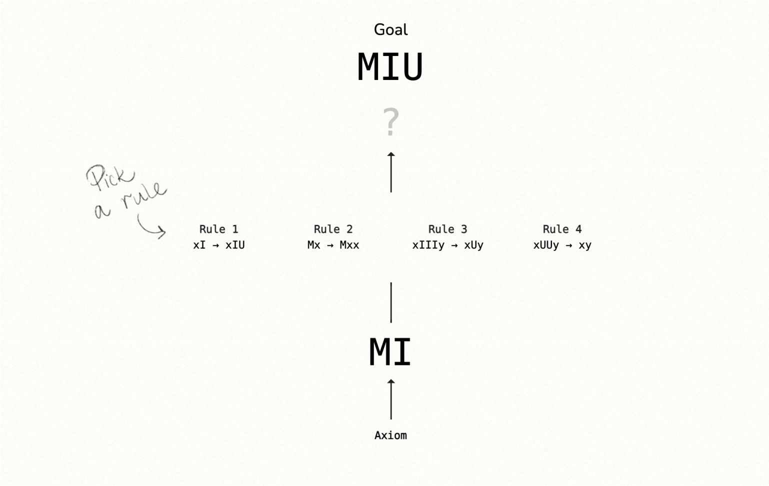
(¬R ∧ P) → Q

WORKSHEET

Edit

Well done!
You have completed the problem.

P	Q	R	(¬R ∧ P) → Q
T	T	T	T
T	T	F	T
T	F	T	T
T	F	F	F
F	T	T	T
F	T	F	T
F	F	T	T
F	F	F	T



https://mu-playground.brianrabern.net/

gather.town/logic-lab

logic lab

thanks.