Logic Tutorial 2

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Overview

- 16:00 What’s it all good for?
- 16:10 Recap
- 16:20 **Q&A**
- 16:50 Quiz
- 17:00 **Q&A**
- 18:00 Feierabend

What's it all good for? – Studies

Bachelor

- Reasoning techniques
- Logic for AI (elective)
- Prolog (elective)

Master

- Foundations of Agents
- Master projects

Logic master Amsterdam, Munich

What’s it all good for? – Studies

Programming paradigms

- **Imperative:** C, Java, Python, Javascript
- **Functional:** Elm, Scala, Haskell, Racket
- **Relational:** Prolog

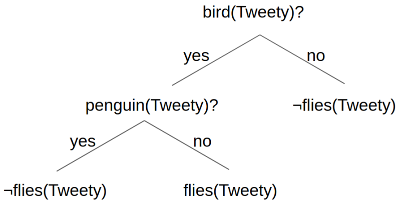
What’s it all good for? – Studies

bird(x)	~>	flies(x)
penguin(x)	~>	¬flies(x)
penguin(x)	-->	bird(x)

flies(Tweety)?

penguin(Tweety) **penguin(x) ~> ¬flies(x)**	⊢ ¬flies(Tweety)

penguin(Tweety) penguin(x) --> bird(x) **bird(x) ~> flies(x)**	⊢ flies(Tweety)



What’s it all good for? – Industry

- Expert systems, decision support systems
  - Law: *Neota Logic, Bryter, LegalOS, KnowledgeTools*
- …

What's it all good for? – Research

Symbolic AI [Explainable AI] *(vs neural AI)*

- Probabilistic logic programming
- Neural logic programming
- Relational machine learning
  - Inductive logic programming
- Neuro-symbolic learning
- Answer set programming
- ...

What’s it all good for? – Summer schools

~~Law and logic~~

Logic, language and information

~~Logic and formal epistemology~~

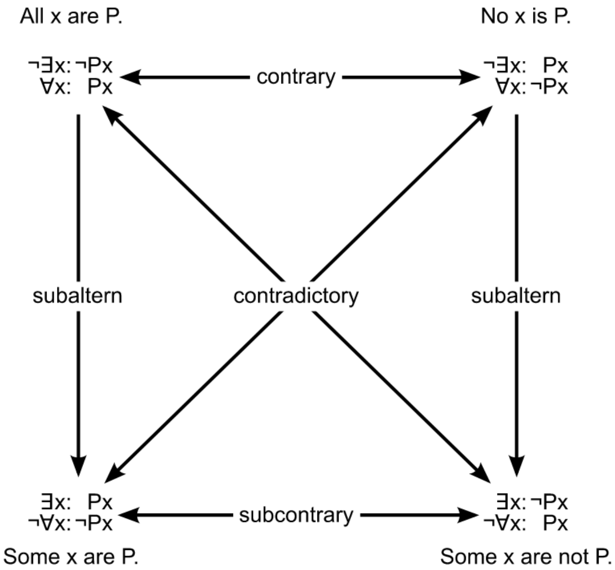
~~Contemporary logic, rationality and information~~

Probability and logic

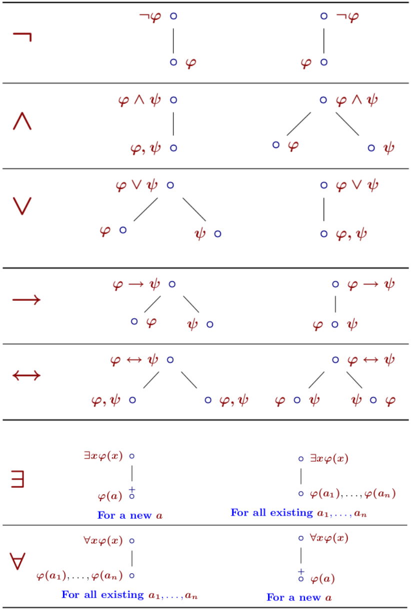
Mathematical philosophy for female students

- More extensive list by UvA

Square of opposition



Semantic Tableau



Natural deduction

$$\frac{\varphi\,,\ \varphi \to \psi}{\psi}\ \texttt{modus ponens}$$

$$\frac{\begin{array}{|l} \varphi \\ \hline \vdots \\ \psi \end{array}}{\varphi \to \psi}\ \texttt{deduction}$$

$\mathbf{E}_{\to}$ $\mathbf{I}_{\to}$

$$\frac{\varphi \wedge \psi}{\varphi} \qquad \frac{\varphi \wedge \psi}{\psi}$$

$$\frac{\varphi\,,\ \psi}{\varphi \wedge \psi}$$

$\mathbf{E}_{\wedge}$ $\mathbf{I}_{\wedge}$

$$\frac{\neg\varphi\,,\ \varphi}{\bot}$$

$$\frac{\begin{array}{|l} \neg\varphi \\ \hline \vdots \\ \bot \end{array}}{\varphi}\ \texttt{refutation}$$

$\mathbf{E}_{\neg}$ $\mathbf{I}_{\neg}$

$$\frac{\varphi \vee \psi\,,\quad \begin{array}{|l} \varphi \\ \hline \vdots \\ \chi \end{array}\quad ,\quad \begin{array}{|l} \psi \\ \hline \vdots \\ \chi \end{array}}{\chi}$$

$$\frac{\varphi}{\varphi \vee \psi} \qquad \frac{\psi}{\varphi \vee \psi}$$

$\mathbf{E}_{\vee}$ $\mathbf{I}_{\vee}$

Natural deduction

$$\frac{\forall x\, \varphi}{(\varphi)^x_t}$$

provided that no variable in t occurs bounded in φ

$\mathbf{E}_\forall$

$$\frac{\begin{array}{r|l} u & \\ \hline & \vdots \\ & (\varphi)^x_u \end{array}}{\forall x\, \varphi}$$

for u a special symbol not used anywhere else in the proof

$\mathbf{I}_\forall$

$$\frac{\exists x\, \varphi\ , \qquad \begin{array}{r|l} u & (\varphi)^x_u \\ \hline & \vdots \\ & \psi \end{array}}{\psi}$$

for u a special symbol not used anywhere in the proof

$\mathbf{E}_\exists$

$$\frac{(\varphi)^x_t}{\exists x\, \varphi}$$

provided that no variable in t occurs bounded in φ

$\mathbf{I}_\exists$

$$\frac{t_1 = t_2\ ,\ \varphi}{\varphi_{[t_1/t_2]}}$$

$$\frac{t_1 = t_2\ ,\ \varphi}{\varphi_{[t_2/t_1]}}$$

where $\varphi_{[t_1/t_2]}$ is the result of replacing, in φ, some ocurrences of t_2 by t_1, provided that

- t_2 contains only variables that occurr freely in φ, and
- t_1 contains only variables that do not get bounded after replacement.

$\mathbf{E}_=$

$$\frac{}{t = t}$$

for any term t.

$\mathbf{I}_=$

Q & A

excalidraw

Quiz

- Tahook

Feedback

Anonymous feedback form:

- linktr.ee/davidpomerenke