# Reasoning and Formal Modelling for Forensic Science
# Lecture 2

Prof. Dr. Benedikt Löwe

2nd Semester 2010/11

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- Grading on a curve. The ECTS regulations give average percentages for the individual grades. This is a general European regulation, in principle followed by the UvA, but not fully implemented. Since the students disliked it so much, we shall assign individual grades for each homework set that will be averaged to give the grade of the homework component.

# Assessment and grade (2).

**Homework.**

- There will be four homework sheets, due on 15 February, 22 February, 8 March, and 18 March. Each of these will be worth 25 points.
- You are allowed to either work alone or in a group of at most two people for the homework. It is not necessary to stay in the same group for every homework set.
- Homework is handed in either in class or by e-mail to `carl@math.uni-bonn.de`.
- Late homework is not accepted. Whether extenuating circumstances constitute a reason for exceptions to this rule is decided by Merlin Carl.
- Each homework set will receive a grade. The grade for the homework component will be the average of the four homework grades.

# Assessment and grade (3).

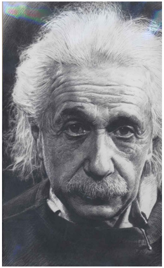


**Exam.**

The exam will be on 24 March 2011, 13–16, **REC-A AB.44 (Zaal D)**. It will have 100 points and 50 points are needed to get a passing grade (6.0).

**Final grade.**

The final grade is the average of the grade of the Homework component and the Exam component calculated according to the OER regulations (Part A, Article 23).



*Insofern sich die Sätze der Mathematik auf die Wirklichkeit beziehen, sind sie nicht sicher, und insofern sie sicher sind, beziehen sie sich nicht auf die Wirklichkeit.*

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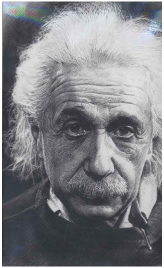

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- Formal logic, mathematics, *logica vetus*, objectivity, truth...
- Informal logic, rhetoric, *logica nova*, context-dependency, convincing other people...

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**Examples:**

- I am a human being.
- John is a human being.
- Every cat is black.
- Every swan is white.
- Sue and Bill are in love with each other.
- Tomorrow is Saturday.

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These statements ("propositions") are either true or false, and you can combine them:

- Apples are green and bananas are yellow.
- Everyone called John is a human being.
- $p$ and $q$ (for some propositions $p$ and $q$)

Consider

- $p$: "apples are green"
- $q$: "bananas are yellow"

and

"apples are green and bananas are yellow".

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Truth table

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- Legal text 1: “You are entitled to the mobility allowance if your place of last residence is more than 500 km away from your place of employment or if you are not a citizen of the country of the contract.”
- Legal text 2: “You are allowed to appeal to this decision by sending a written appeal to our office or filling in the appeal form on our website.”
- Conversational text: “There is a bowl of fruit on the table. You may take an apple or an orange.”

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Symbolically, we write $p \vee q$ for "$p$ or $q$" in the **inclusive** sense.

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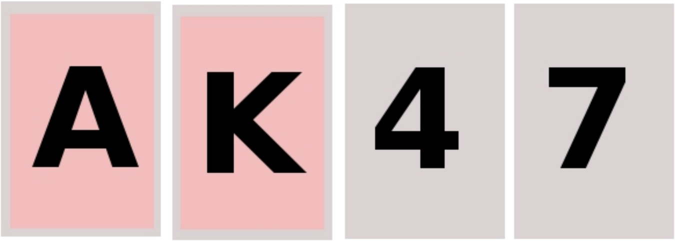

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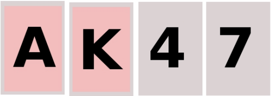

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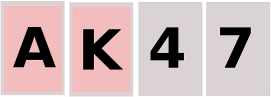


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- **A4**: 46%
- **A**: 33%
- **A47**: 7%
- **A7**: 4%
- others: 10%

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What could be the motivation to turn the card showing **4** (53%)?

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We often read "if ... then ..." clauses as equivalences.

# The material conditional and the equivalence.



If $p$ and $q$ are some propositions, then "if $p$ then $q$" and "$p$ and $q$ are equivalent" are propositions. (Symbolic notation: $p \rightarrow q$ and $p \leftrightarrow q$.)

"if $p$ then $q$" is false exactly when $p$ is true and $q$ is false.

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The definition of "murder" lists four conditions ("intentional", "malicious", "killing", "human being") and if all four are met, then an act is called "murder". Conditions like this are called sufficient conditions.

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So, actually, more is true. The four conditions **have to be** met in order for something to be called "murder". Conditions like this are called necessary conditions.

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When we aim to be precise and point out that we use the equivalence reading, we use "if and only if".

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"If the fingerprints belong to the suspect, he committed the crime."

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| $p$ causally implies $q$ | ??? | false | ??? | ??? |

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Remember the train conductor in front of the station, telling us where the station is and afterwards asking "What is the way to the station?"
It is our understanding of pragmatics that forces us to believe that he is asking a test question, not a genuine question.

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There are also unary connectives modifying just one proposition.

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Other examples: "yesterday", "tomorrow", "necessarily", "it is the law that".

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A binary connective whose definition is given by a truth table is called truth-functional. We have seen examples of binary connectives that are not truth-functional ("causally implies").

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| Option 3: $\triangle p$ | `false` | `true` |

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- the material conditional defined by the truth table

$$\begin{array}{c|cc} \rightarrow & T & F \\ \hline T & T & F \\ F & T & T \end{array},$$

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In what circumstances do we use which semantics of “if ... then ...”? Similarly, in which situation do we mean inclusive “or” and in which situations do we mean exclusive “or”?

This is governed by pragmatics.

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*A: "John was at the party."*
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This is because in communication situations, we follow the Gricean maxims of pragmatics:

- Be truthful.
- Make your contribution as informative as required and not more informative than required.
- Be relevant.
- Avoid ambiguity.

# Notions covered today.

- Propositions, truth values ("true" and "false"), truth tables.
- Exclusive or, inclusive or ($\vee$).
- Wason task, material conditional ($\rightarrow$), equivalence ($\leftrightarrow$), causal conditional.
- Definitions, *definiens*, *definiendum*, sufficient conditions, necessary conditions.
- Syntax, binary connectives, unary connectives.
- Semantics, truth functionality.
- Pragmatics, Gricean maxims.