Propositional Logic – Lab 1

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General info

- Aim: Students will practice with the topics discussed during the lectures. Exercises will be done by hand and software and will be held in Via Sarnesi 1, Room D003, from 01.10.2007 to 26.01.2008 each Friday 10.30-11.30 (minus holidays; any changes can be found in the RIS calendar)
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  Labs: http://www.meteck.org/LogicCourse.html

Introduction

- Logic is everywhere...
  - Try Minesweeper at home
- Many books with exercises by hand (e.g., Hedman), but also e.g. the "blocks world" software by Barwise & Etchemendy, and online exercises with instant gratification multiple-choice & answers (e.g. http://people.hofstra.edu/Stefan_Waner/RealWorld/logic/logic1.html).

Quick references

- PL Syntax: Page 11 of course slides
- PL Semantics: Pages 12 & 13 of course slides
- PL Truth tables: Pages 20-24 of course slides
- PL Rules:
  - Recollect—or, *write them down without looking at the course slides*: commutativity, associativity, idempotence, absorption, distributivity, tautology, unsatisfiability, negation, neutrality, double negation, De Morgan, implication
  - (Page 26 & 27 of course slides)

Beginnings

- Are these atomic formulas?
  - A = “Aristotle is alive”
  - B = “Bolzano is in Italy”
  - C = “Praise Allah”
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Beginnings

- Are these atomic formulas?
  - A = "Aristotle is alive" Y
  - B = "Bolzano is in Italy" Y
  - C = "Praise Allah" N
- Truth values 1 or 0 (or something else with many-valued logics)
- Realise that propositional logic is not the study of truth, but of the relationship between the truth of one statement and that of another.

A few examples with text after all

- Let's take a few statements, then what is $\neg p$ if
  - p: "All football players of Inter Milan are handsome"
  - p: "There is a Russian observation station on the South pole"
- Let's combine this with conjunction and disjunction.
  1. p: "Columbus thought he discovered America"
     q: "No people lived in America back then"
     $p \wedge \neg q$?
  2. p: "$1 + 4 < 5$"
     q: "$1 + 4 = 5$"
     $\neg p \wedge \neg q$?
  3. p: "$2 = 5$"
     q: "$2 \geq 5$"
     $p \vee \neg q$?
  4. p: "a m^3 of feathers equals a m^3 of apples"
     q: "a m^3 of feathers is less than a m^3 of apples"
     $(p \vee q) \wedge \neg p$?

Truth tables

- Find the truth tables for each of the following formulas and state whether each is a tautology, a contradiction, or neither.
  1. $\neg\neg A \rightarrow A$
  2. $A \wedge (B \wedge \neg A)$
- Optional: Find the truth tables for each of the following formulas and state whether each is a tautology, a contradiction, or neither.
  1. $(\neg A \rightarrow B) \vee ((A \wedge \neg C) \leftrightarrow B)$
  2. $(A \rightarrow B) \wedge (A \rightarrow \neg B)$
  3. $(A \rightarrow (B \vee C)) \vee (C \rightarrow \neg A)$

More text and truth tables

- Is the following argument valid? Represent the argument formally and use truth tables to prove it.
  - If Tibbles roves the Lungo Talvera, he lives in Bolzano.
  - Tibbles lives in Bolzano.
  - Therefore Tibbles roves the Lungo Talvera.

Truth tables & use of braces

- The order of things: $\neg$ has priority over $\wedge$, $\vee$, $\rightarrow$, and $\leftrightarrow$. For the rest, use braces to group formulas. Compare, e.g., $A \wedge (B \rightarrow C)$ with $(A \wedge B) \rightarrow C$ and note the differences in satisfiable truth assignments in their respective truth table.

Table: Truth table for implication

A	**B**	$\mathbf{A \rightarrow B}$ $\mathbf{\neg A \vee B}$
0	0	1
0	1	1
1	0	0
1	1	1