

Ragionamento Automatico Automated Reasoning

Wolfgang Faber

University of Calabria, Italy

2007

Who am I?

- Wolfgang Faber
- <http://www.wfaber.com/>
- Ricevimento: Martedì 17:00 - 18:00
- And by appointment via email.

Who are you?

- Send an email to wf@wfaber.com
- Subject: Ragionamento Automatico
- Indicating who you are.

Course Webpage

- `http://www.mat.unical.it/informatica/Ragionamento_Automatico`
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- **Registratevi e sottoscrivete per ricevere notificazioni quando la pagina cambia.**

Orario

Lezioni ed Esercizi:

- Martedì 15:00 – 17:00
- Mercoledì 15:00 – 17:00
- Giovedì 11:30 – 13:30
- Laboratorio cubo 31A, I piano

Esami

- Esami (scritti):
 - Dati ancora non stabiliti, ma probabilmente Gennaio, Luglio, Settembre.
- Aula per gli esami: normalmente MT6

Materiale Didattico

- Lucidi (inglese)
- Materiale su
`http://www.mat.unical.it/informatica/Ragionamento_Automatico`
 - Articoli
 - Bibliografia
 - Links
- A. Asperti, A. Ciabattoni: *“Logica a Informatica”*

Outline: Today

- 1 Organization
- 2 Introduction
 - Definitions
- 3 Fundamental Questions
 - Semiotics
 - Languages
- 4 Logic
- 5 How to Reason?

Outline

- 1 Organization
- 2 Introduction**
 - **Definitions**
- 3 Fundamental Questions
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Automated Reasoning?

- What is YOUR definition?

Automated Reasoning – Zingarelli

- **Ragionamento:**

- Riflessione volta ad arrivare a una conclusione seguendo un procedimento logico.
- Operazione mentale mediante la quale si inferisce una conclusione o più di proposizioni precedentemente date.

- **Automatico:**

- Detto di operazione che si compie da sé, senza intervento di un manovratore.
- Detto di macchina o meccanismo che, regolato opportunamente, è in grado di compiere date operazioni senza il diretto intervento dell'uomo.
- Detto di movimento eseguito senza la diretta partecipazione della coscienza e della volontà.

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Automated Reasoning – English

- **reasoning**: the process by which one judgement is deduced from another or others which are given (Oxford English Dictionary)
- **reasoning**: the drawing of inferences or conclusions through the use of reason
reason: the power of comprehending, inferring, or thinking, esp. in orderly rational ways (cf. intelligence) (Merriam-Webster)

The scientific discipline of *Automated Reasoning* is concerned with the study of *reasoning processes as computational processes*.

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Automated Reasoning

- Drawing conclusions from given data.
- **How** is the data given?
- **How** do we draw conclusions?

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Semiotics

Semiotics?

Semiotics



Semiotics



Umberto Eco (*1932), Professor of Semiotics

Semiotics – Peirce



Charles Sanders Peirce (1839-1914), Philosopher, Logician

Semiotics – Peirce

semeion (greek) – “sign”

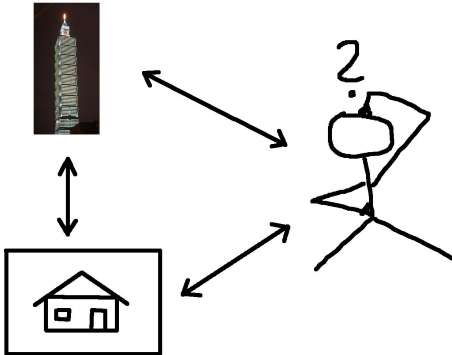
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Semiotics

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- Syntax

Relation between signs.

- Semantics

Relation between signs and objects they represent.

- Pragmatics

Relation between signs and user.

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Languages for Automated Reasoning

Which languages are suitable for Automated Reasoning?

- Natural languages?
- Formal languages?

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Natural Languages

- It is raining.
- If it is raining, the street is wet.

We could conclude that the street is wet.

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Natural Languages

- He hits the man with a hammer.
- He hits with a hammer.
- the man with a hammer.

All sorts of difficulties for automation.

⇒ Let's not use natural languages for Automated Reasoning.

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Formal Languages

- Formal languages
- with reasoning capabilities:
- (Mathematical) Logic!

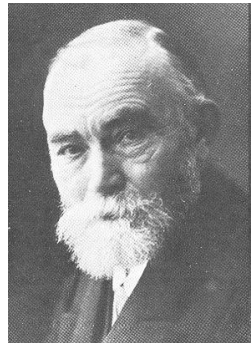
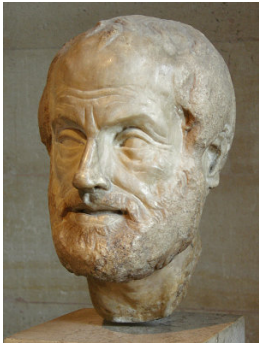
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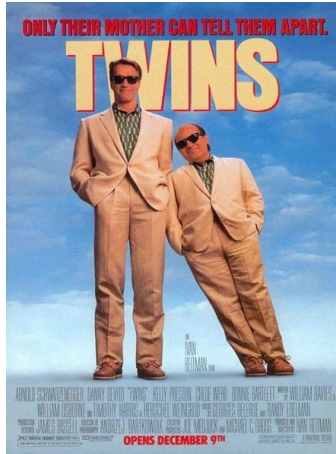
Formal Languages

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Mathematical Logic



Mathematical Logic



Mathematical Logic

Julius Benedict (Arnold Schwarzenegger) [to the bad guy]:

*You have no respect for logic
And I have no respect for those
with no respect for logic.
You're a very stupid person.*

[The bad guy gets beaten badly.]

We conclude:

If you don't have respect for logic,
you may get beaten up by Arnold Schwarzenegger.

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Mathematical Logic

Formalisms in this course:

- Propositional Logic
- Quantified Boolean Formulae
- First Order Logic
- Datalog
- Answer Set Programming

Specialized Reasoning

Frequent Notions:

- Reasoning about Time
- Reasoning about Space
- Reasoning about Causes

Causal Reasoning

Formalisms in this course:

- Reasoning about Causes
 - Action Languages

Reasoning Modes

Automated Reasoning: Drawing conclusions from given data.

- How do we draw conclusions?
 - Deduction
 - Abduction
 - Induction

General Outline

- Overview
- Propositional Logic
- Quantified Boolean Formulae
- First-Order Logic
- Logic for Databases
- Answer Set Programming
- Action Languages