1 Organization

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`
- `https://www.mat.unical.it/informatica/Ragionamento_Automatico`
- 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

Contents

2 Introduction

2.1 Definitions

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.

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*.

3 Fundamental Questions

Automated Reasoning

- Drawing conclusions from given data.

- **How** is the data given?

- **How** do we draw conclusions?

3.1 Semiotics

Semiotics
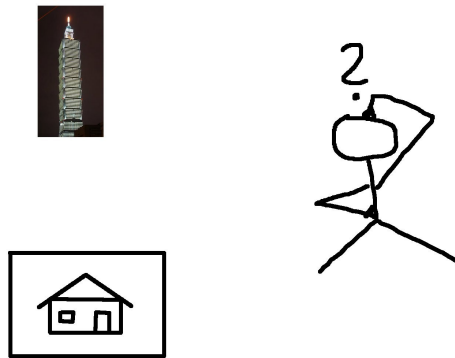
Semiotics?

Umberto Eco (*1932), Professor of Semiotics

Semiotics – Peirce

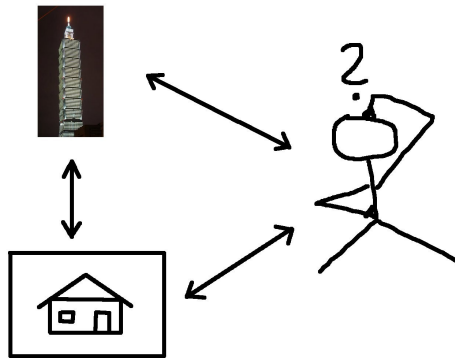

Charles Sanders Peirce (1839-1914), Philosopher, Logician

Semiotics – Peirce

semeion (greek) – "sign"

Semiotics – Peirce

semeion (greek) – "sign"

Semiotics

semeion (greek) – "sign"

- Syntax Relation between signs.

- Semantics Relation between signs and objects they represent.

- Pragmatics Relation between signs and user.

Automated Reasoning

- Drawing conclusions from given data.

- **How** is the data given?

- **How** do we draw conclusions?

3.2 Languages

Languages for Automated Reasoning

Which languages are suitable for Automated Reasoning?

- Natural languages?

- Formal languages?

Natural Languages

- It is raining.

- If it is raining, the street is wet.

We could conclude that the street is wet.

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.

Formal Languages

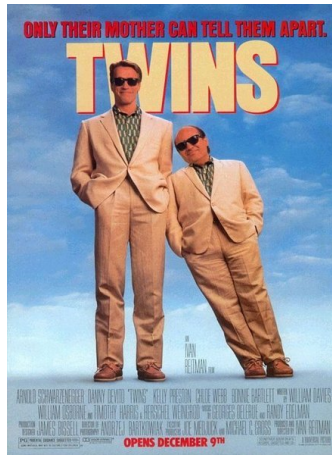- Formal languages

- with reasoning capabilities:

- (Mathematical) Logic!

4 Logic

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.

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

5   How to Reason?

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