1-Modeling

1.5-Formal reasoning

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1.5-Formal Reasoning

1. Logic(s)
2. Reasoning Problems
3. Choosing a logic

1.5.3-Choosing a logic

Lecture index

What is the right choice for me? (remark)

Facing a problem:

1. Formalize the problem, in terms of questions and answers;
2. Develop your own most appropriate logic or (most often)
3. Choose the right logic for the problem;
4. Write the theory T modeling the problem (make sure it complies to intended mental model);
5. Exploit it solve the problem (logical reasoning)

Steps 1,4,5: theory modeling;
Steps 2,3: logical modeling.

A crucial trade-off (remark)

Every logic is characterized by different levels of expressivity and computational efficiency

Expressivity: Which decision problems can i express

Computational efficiency: How much does it cost to solve a decision problem

The more expressive is a logic, the less computationally tractable it will be

The modeler must find the right trade-off between expressiveness and tractable forms of reasoning, i.e., the logic that best suits his particular problem.

Main issues: Propositional expressiveness (e.g., $\wedge$ versus $\vee$), and domain size (including choice of using a finite of finite domain of interpretation).

Decidability (notion)

Notion 1 (Decidability) A logic is decidable if there is an effective method for determining whether a formula is included in a theory

- The effective method is an algorithm(decision procedure) that given a decision problem returns an answer yes/no
- All logics in this course are decidable but First Order Logic

Complexity (notion)

Notion 2

- Given a decidable logic, the computational complexity quantifies the difficulty to compute a reasoning task in a given logic
- Logical languages are classified according to varying degrees of complexity
  - P
  - NP
  - PSpace
  - ...

Expressiveness (example)

Language	NL Sentence	Formula
Propositional logic	Fausto likes skiing I like skiing	Fausto-likes-skiing I-like-skiing
First-order logic	Every person likes skiing I like skiing Fausto likes skiing	$\forall$ person.like-skiing(person) like-skiing(I) like-skiing(Fausto)
Modal logic	I believe I like skiing	B(I-like-skiing)
Description Logic	Every person likes cars	person $\sqsubseteq \exists$ likes.Car
...		

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