Künstliche Intelligenz – Übung 11

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Organizational

Homework 10

Homework 11

Misc: Questions, Anecdotes & etc

Organizational

Personal information

my email address: marius.frinken@fau.de
PGP encrypted mails are preferred!
my PGP fingerprint:
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EVALUATION

Get your **TAN** and use it here: https://eva.fau.de/
Please fill out the form until **26th January 2019, 12:00 (noon)**

My proper first name is Marius, don't be fooled by your TAN ;)

ONLY 6 people did it until now!

KALAH Tournament

see https://fsi.cs.fau.de/forum/thread/16932-Kalah-Tournament

Questionnaires

Max created/creates some questionnaires that should test your understanding of the current lecture topics.

They are avaliable at **studon**.

see https://fsi.cs.fau.de/forum/post/159191

Homework 10

Problem 10.1

- stick to the notation of the lecture!
- this is mostly training!

10.2: the "proof" we wanted (Sketch)

- assume SAT-Solver X:
  X solves *Input* by **transforming** it into a DNF and **checking** whether *DNF*(*Input*) is satisfiable
- you show that **checking** whether anything in a DNF is satisfiable can be done in polynomial time:
  Given a formula in DNF, a valid assignment only needs to satisfy any of the conjunctive clauses... (Here lies 99% of your work!)
- you can conclude that **transforming** into a DNF must be (at least) **NP-Hard**, since SAT is **NP-Hard** (Hint 2)

So you essentially built a polynomial time reduction from SAT to **transforming into a DNF**, i.e. if you solve (**transforming into a DNF**) with solution `X` then you can come in polynomial time from `X` to a solution `Y` for SAT.

WARNING

We are currently wondering if "So you essentially built a polynomial time reduction from SAT to **transforming into a DNF**." is actually true.
The parts we are unsure about are:

1. **polynomial time reduction** i.e if it has to be polynomial depending on the input (which is is not, is is only polynomial depending on the DNF-Formula)
2. **NP-Hardness** is only defined for formal languages
   $\Rightarrow$ the whole idea of this assignment seems to be somewhat broken

So expect some post on the forum in the next weeks about this!
Nevertheless we will simply grade in your favor.

Homework 11

Recap PL^1

(skip through slides 383 – 388)

Problem 11.1

(see assignment)
Hint: look at “Semantics of PL1 (Evaluation)” (slide 388)

Problem 11.2

(see assignment)

Hints:

- very similar to 8.3
- Prove A: show that $\mathcal{I}_\varphi(A)$ is evaluated to $\top$ for any φ **and** for any Model $(\mathcal{D}_\iota, \mathcal{I})$ by applying the definitions of $\mathcal{I}$ and $\mathcal{I}_\varphi$
- Disprove A: give one Model $(\mathcal{D}_\iota, \mathcal{I})$ where there can not be any φ so that $\mathcal{I}_\varphi(A)$ is evaluated to $\top$

Problem 11.2

(see assignment)

Hints:

- very similar to 8.3
- Prove A: show that $\mathcal{I}_\varphi(A)$ is evaluated to $\top$ for any φ **and** for any Model $(\mathcal{D}_\iota, \mathcal{I})$ by applying the definitions of $\mathcal{I}$ and $\mathcal{I}_\varphi$
- Disprove A: give one Model $(\mathcal{D}_\iota, \mathcal{I})$ where there can not be any φ so that $\mathcal{I}_\varphi(A)$ is evaluated to $\top$
- "We use the semantics of first-order logic without equality" $\Rightarrow$ + and = are arbitrary symbols for a function and a predicate (treat them like you do not know what they do in math)
- an empty Universe $\mathcal{D}_\iota$ is not helpful / allowed (see slide 387)

Recap: Natural Deduction in PL^1

- **Definition 3.10 (New Quantifier Rules).** The first-order natural deduction calculus $\mathcal{ND}^1$ extends $\mathcal{ND}^0$ by the following four rules

$$\frac{\mathbf{A}}{\forall X\,.\,\mathbf{A}}\forall I^* \qquad \frac{\forall X\,.\,\mathbf{A}}{[\mathbf{B}/X](\mathbf{A})}\forall E$$

$$\frac{[\mathbf{B}/X](\mathbf{A})}{\exists X\,.\,\mathbf{A}}\exists I \qquad \frac{\exists X\,.\,\mathbf{A} \qquad \begin{array}{c}[[c/X](\mathbf{A})]^1\\ \vdots\\ \mathbf{C}\end{array}}{\mathbf{C}}\exists E^1$$

  * means that **A** does not depend on any hypothesis in which X is free.

Examples: see blackboard

Problem 11.3

Use the hint!
(although not needed here, you should keep in mind that there are rules for ND with equality, see lecture)

Misc: Questions, Anecdotes & etc

Questions?