Logical reasoning and programming, lab session 12

(December 14, 2020)

12.1 Produce all the possible paramodulants, but do not perform paramodulations into variables, of

$$\{\{p(X), \neg q(X,Y), f(c,Y) = g(X)\}, \{p(Z), q(g(a), f(Z,b)), c = f(c,c)\}\}.$$

For simplicity, we use $=$ instead of $\approx$ here.

12.2 Formulate the following problems in the TPTP language and (dis)prove them using the E prover. Assuming the following group axioms

$$e \cdot X = X,$$
$$X^{-1} \cdot X = e,$$
$$(X \cdot Y) \cdot Z = X \cdot (Y \cdot Z)$$

your task is to (dis)prove

(a) $X \cdot e = X$,

(b) $X \cdot X^{-1} = e$,

(c) $X \cdot Y = Y \cdot X$,

(d) $X \cdot Y = Y^{-1} \cdot X^{-1}$.

12.3 Use the model finder Paradox to produce counterexamples for unprovable claims in the previous exercise **12.2**.

12.4 Formalize in the TPTP format a simple example with the following axioms

$$\forall X \neg r(X,X),$$
$$\forall X \forall Y \forall Z(r(X,Y) \wedge r(Y,Z) \to r(X,Z)),$$
$$\forall X \exists Y r(X,Y)$$

and check how fast can Paradox generate possible finite models for this simple problem. Clearly, it will never find a model, because the problem has only infinite models.

12.5 Try the Vampire prover on the problem GRP140-1 from the TPTP library. We demonstrate the effect of the limited resource strategy (LRS), which discards unprocessed clauses that will be unlikely processed in a given time limit, by this example. For the intended behavior you need a special setting—age:weight ratio is 5:1 and the forward subsumption is turned off:

```
vampire -awr 5:1 -fsr off -t 30 GRP140-1.p
```

First, try the timelimit 30s, then try 15s, 7s, ... You can try even shorter times than 1s, e.g., `-t 5d` means 5 deciseconds.

For comparison you can try the competition mode on the same problem

```
vampire --mode casc GRP140-1.p
```

12.6 Try the E prover on the problem GRP001-1 from the TPTP library. Compare how can the use of a literal selection strategy influence the behavior of the prover:

```
eprover --literal-selection-strategy=NoSelection GRP001-1.p
eprover --literal-selection-strategy=SelectLargestNegLit \
        GRP001-1.p
```