Assignment 1 - COMP 3400

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1. Produce a knowledge base in PROPOSITIONAL LOGIC capturing the following information as closely as possible as stated here: *If Tweety is a bird and it is not an abnormal bird, then it flies. A bird is abnormal exactly when it is an ostrich, a penguin, or not an abnormal wooden bird. A wooden bird is abnormal exactly when operated under remote control. Tweety is a bird, it is not an ostrich nor a penguin nor a remote controlled wooden bird.* Prove using Prover9 that *Tweety flies*. Notice that the two forms of abnormality mentioned here may be different, one is if birds, the other is for wooden birds.

Solution: We will use the propositional variables as listed below:

- a: *Tweety is a bird*
- b: *Tweety flies*
- c: *Tweety is an abnormal bird*
- d: *A bird is abnormal*
- e: *A bird is an ostrich*
- f: *A bird is a penguin*
- g: *A bird is an abnormal wooden bird*
- h: *A bird is operated by remote control*
- i: *A bird is wooden*

From this we are able to deduce a the following propositional formulas:

φ_0: $(a \wedge \neg c) \rightarrow b$.

Meaning: "If Tweety is a bird and it is not an abnormal bird, then Tweety flies."

φ_1: $(e \vee f \vee \neg g) \rightarrow d$

Meaning: "If a bird is an ostrich, a penguin or not an abnormal wooden bird, it is abnormal."

φ_2: $(i \wedge h) \rightarrow g$

Meaning: "If a bird is wooden and remote controlled, it is an abnormal wooden bird."

φ_3: a

Meaning: "Tweety is a bird"

φ_3: a

Meaning: "Tweety is a bird"

(b) We have to prove that $\neg e$ is a consequence of $\varphi_0, \ldots, \varphi_3$.

(c) We do this by contradiction, establishing by means of Otter that the set of formulas: $\{\varphi_0, \ldots, \varphi_3, \neg\neg e\}$ is contradictory.

For this, $\varphi_0, \ldots, \varphi_3$ go into the "usable" list, and e goes into the "sos" list.

REMARK (delete for submission): Notice from above that before you do anything with the automated reasoner, you have to explain what you will do and why. **END.**

REMARK (delete for submission): Below you have to include the main parts of your input/output files. The complete files have to be provided as appendices, not here. **END.**

The main part of the input file, "sup.in" (attached) is as follows:

```
set(binary_res).

formula_list(usable).
(a & w) -> p.
(-a -> i) & (-w -> m).
-p.
e -> (-i & -m).
end_of_list.

formula_list(sos).
e.
end_of_list.
```

The main part of the output file "sup.out" (attached) is:

```
formula_list(usable).
a&w->p.    (-a->i)& (-w->m).     -p.    e-> -i& -m.
end_of_list.

-------> usable clausifies to:

list(usable).
1 [] -a|-w|p.
2 [] a|i.
3 [] w|m.
4 [] -p.
```

```
 5 [] -e| -i.
 6 [] -e| -m.
 end_of_list.

 formula_list(sos).
 e.
 end_of_list.

-------> sos clausifies to:

 list(sos).
 7 [] e.
 end_of_list.

======= end of input processing =======

=========== start of search ===========

given clause #1: (wt=1) 7 [] e. ** KEPT (pick-wt=1): 8
[binary,7.1,6.1] -m. ** KEPT (pick-wt=1): 9 [binary,7.1,5.1]
-i. 8 back subsumes 6. 9 back subsumes 5.

given clause #2: (wt=1) 8 [binary,7.1,6.1] -m. ** KEPT
(pick-wt=1): 10 [binary,8.1,3.2] w. 10 back subsumes 3.

given clause #3: (wt=1) 9 [binary,7.1,5.1] -i. ** KEPT
(pick-wt=1): 11 [binary,9.1,2.2] a. 11 back subsumes 2.

given clause #4: (wt=1) 10 [binary,8.1,3.2] t. ** KEPT
(pick-wt=0): 12 [binary,10.1,1.2,unit_del,11,4] $F.

-----> EMPTY CLAUSE at   0.00 sec ---->
                       12 [binary,10.1,1.2,unit_del,11,4] $F.

Length of proof is 4.  Level of proof is 2.

---------------- PROOF ----------------

 1 [] -a| -w|p.
 2 [] a|i.
 3 [] w|m.
 4 [] -p.
 5 [] -e| -i.
 6 [] -e| -m.
 7 [] e.
 8 [binary,7.1,6.1] -m.
 9 [binary,7.1,5.1] -i.
 10 [binary,8.1,3.2] w.
 11 [binary,9.1,2.2] a.
 12 [binary,10.1,1.2,unit_del,11,4] $F.

------------ end of proof -------------
```

This run (output file) shows that Etc. Etc. Etc.

REMARK (delete for submission): Unless it is really clear, you have to

explain your output right after showing it! It is not the role of the marker to interpret your output! The onus is on you ... **END.**

Appendix: Input/Output Files

REMARK (delete for submission): Here you can use the verbatim environment, or attach the pdf versions of your files. **Everything has to to form a single PDF submission file. No (compressed) folders accepted. END.**