CSC442 Project 2

Chunlei Zhou, Hanjia Lyu

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1 Key Data Structures

We represented formulas, models, and clauses using *tree*. We used *set* to do resolution. We also implemented CNF conversions for WFFs.

2 Performance

The results are as followed. The execution duration of problem 4 may be a little bit longer.
Problem 1:

```
Modus Ponens test.
Knowledge base:
P
P ==> Q
Query:
Q
Ans with model checking: True
Ans with resolution: True
Ans with dpll satisfiable: True
```

Problem 2:

```
Wumpus World test.
Knowledge base:
~P11
B11 <=> (P12 | P21)
B21 <=> (P11 | P22 | P31)
~B11
B21
Query:
P12
Ans with model checking: False
Ans with resolution: False
Ans with dpll satisfiable: True
```

$P_{1,2}$ is false. There isn't a pit at location $[1, 2]$.
Problem 3:

```
Horned Clauses test.
Knowledge base:
Mythical ==> Immortal
~Mythical ==> Mammal
(Immortal | Mammal) ==> Horned
Magical <== Horned
Query:
Mythical
Ans with model checking: Maybe
Ans with resolution: Maybe
Ans with dpll satisfiable: True
Magical
Ans with model checking: True
Ans with resolution: True
Ans with dpll satisfiable: True
Horned
Ans with model checking: True
Ans with resolution: True
Ans with dpll satisfiable: True
```

We can prove that the unicorn may be mythical, and is magical, and is also horned.
Problem 4:

```
The Door of Enlightenment test. Smullyan's problem:
Knowledge base:
A <=> X
B <=> (Y | Z)
C <=> (A & B)
D <=> (X & Y)
E <=> (X & Z)
F <=> (D | E)
G <=> (C ==> F)
H <=> ((G & H) ==> A)
X | Y | Z | W
Query:
X
Ans with model checking: True
Ans with resolution: True
Ans with dpll satisfiable: True
Y
Ans with model checking: Maybe
Ans with resolution: Maybe
Ans with dpll satisfiable: True
Z
Ans with model checking: Maybe
Ans with resolution: Maybe
Ans with dpll satisfiable: True
W
Ans with model checking: Maybe
Ans with resolution: Maybe
Ans with dpll satisfiable: True

The Door of Enlightenment test. Liu's problem:
Knowledge base:
A <=> X
C <=> A
G <=> (C ==> (A | ~A))
H <=> ((G & H) ==> A)
X | Y | Z | W
Query:
X
Ans with model checking: True
Ans with resolution: True
Ans with dpll satisfiable: True
Y
Ans with model checking: Maybe
Ans with resolution: Maybe
Ans with dpll satisfiable: True
Z
Ans with model checking: Maybe
Ans with resolution: Maybe
Ans with dpll satisfiable: True
W
Ans with model checking: Maybe
Ans with resolution: Maybe
Ans with dpll satisfiable: True
```

Smullyan's problem: The philosopher should choose door X. Because X is true in all conditions, however, the other are not provided there is at least one door leads to inner Sanctum.

Liu's problem: We modified the proposition of C and G. To modify G, we add "C imples True". We still have that X always be the right door. Therefore, we still have enough evidence to prove.

3 Member Contributions

Member	**Contributions**
Chunlei Zhou	Coding and CNF Conversions
Hanjia Lyu	Writeup writing