

COMP5211 2020 Fall Semester Assignment #3

Date assigned: Friday, Nov 20.

Due time: 23:59 on Friday, Dec 4.

How to submit it: Submit your `lady.py`, `ranking.py` in YourID.zip. Also, submit the written part in YourID.pdf.

Penalties on late papers: 20% off each day (anytime after the due time is considered late by one day)

Reasoning

The following two questions are exercises for you to use a mechanical theorem prover to solve problems by reasoning or finding models. The theorem prover you need to use is Z3. The official release can be found *here*.

You can install a Python 3 version using pip:

```
pip install z3-solver
```

Problem 1: The Lady or The Tiger Problem (50 pts)

There are three rooms. Each contains either a lady or a tiger but not both. Furthermore, one room contained a lady and the other two contained tigers. Each of the rooms has a sign, and at most one of the three signs was true. The three signs are:

- Room I: A TIGER IS IN THIS ROOM.
- Room II: A LADY IS IN THIS ROOM.
- Room III: A TIGER IS IN ROOM II.

Which room contains the lady?

Problem 2: The Ranking Problem (50 pts)

Given the following facts:

1. Lisa is not next to Bob in the ranking
2. Jim is ranked immediately ahead of a biology major
3. Bob is ranked immediately ahead of Jim
4. One of the women (Lisa and Mary) is a biology major
5. One of the women is ranked first

What are possible rankings for the four people?

Examples of Z3 usages

The following python code check if q follows from p and $p \supset q$:

```
-----  
from z3 import *  
  
p = Bool('p')  
q = Bool('q')  
s = Solver()  
s.add(Implies(p,q))  
s.add(p)  
# to prove q, add Not(q) to see if it causes a contradiction  
s.add(Not(q))  
print(s.check())  
-----
```

The following is a python code to compute a model of $p \vee q$ and $\neg(p \wedge q)$:

```
-----  
from z3 import *  
  
p = Bool('p')  
q = Bool('q')  
s = Solver()  
s.add(Or(p,q))  
s.add(Not(And(p,q)))  
print(s.check())  
print(s.model())  
-----
```

1 Submission

Please submit your solution on Canvas before the due date. You should submit a pdf file and a zip file containing the python codes:

- **StudentID.pdf**

The axiomatizations for problem 1 and problem 2.

- **lady.py**

the z3 query file for your problem 1. When being run, it should print one of the following 'I', 'II', 'III'.

- **ranking.py**

the z3 query file to find a model from which to read out a ranking for problem 2. When being run, it should print the ranking as a list. For example, ['Lisa', 'Bob', 'Mary', 'Jim'] if Lisa ranks the first and Jim ranks the last.