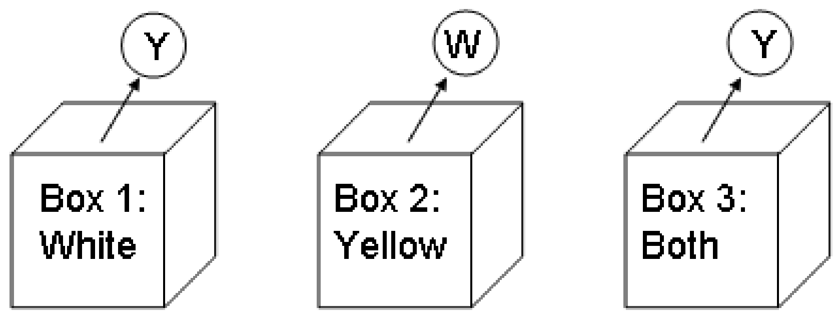
# CSCE 420, HW #2

**due: Tues, Oct 30, 2018, 9:35am - turn-in on eCampus**

You are the proprietor of *Sammy's Sport Shop*. You have just received a shipment of three boxes filled with tennis balls. One box contains only yellow tennis balls, one box contains only white tennis balls, and one contains both yellow and white tennis balls. You would like to stock the tennis balls in appropriate places on your shelves. Unfortunately, the boxes have been labeled incorrectly; the manufacturer tells you that you have exactly one box of each, but that each box is definitely labeled wrong. One ball is drawn from each box and its color observed. Given the initial (incorrect) labeling of the boxes above, and the three observations, use Propositional Logic to derive the correct labeling of the middle box.




Use propositional symbols in the following form: O1Y means a yellow ball was drawn (observed) from box 1, L1W means box 1 was initially labeled white, C1W means box 1 contains (only) white balls, and C1B means box 1 actually contains both types of tennis balls.

The initial facts describing this particular situation are: {O1Y, L1W, O2W, L2Y, O3Y, L3B}

1. Using these symbols, write a propositional knowledge base that captures the knowledge in this domain (i.e. implications of what different observations or labels mean, as well as constraints inherent in this problem, such as that all boxes have different contents). Do it in a complete and general way, writing down *all* the rules and constraints, not just the ones needed to make the specific inference about the middle box. *Do not include derived knowledge* that depends on the particular labeling of this instance shown above.

2. Prove that box 2 must contain white balls (C2W) using Natural Deduction.

3. Convert the KB to CNF (if you do not want to manually type out all the rules, you might want to write a small script to generate them).

4. Prove C2W using Resolution Refutation.

5. Consider the following set of conjunctive rules about ways to get to work:

KB = { a. CanBikeToWork → CanGetToWork
b. CanDriveToWork → CanGetToWork
c. CanWalkToWork → CanGetToWork
d. HaveBike ∧ WorkCloseToHome ^ Sunny → CanBikeToWork
e. HaveMountainBike → HaveBike
f. HaveTenSpeed → HaveBike
g. OwnCar → CanDriveToWork
h. OwnCar → MustGetAnnualInspection
i. OwnCar → MustHaveValidLicense
j. CanRentCar → CanDriveToWork
k. HaveMoney ∧ CarRentalOpen → CanRentCar
l. HertzOpen→ CarRentalOpen
m. AvisOpen→ CarRentalOpen
n. EnterpriseOpen→ CarRentalOpen
o. CarRentalOpen → IsNotAHoliday
p. HaveMoney ∧ TaxiAvailable → CanDriveToWork
q. Sunny ^ WorkCloseToHome → CanWalkToWork
r. HaveUmbrella ^ WorkCloseToHome → CanWalkToWork
s. Sunny → StreetsDry }

Facts: { Rainy, HaveMoutainBike, EnjoyPlayingSoccer, WorkForUniversity, WorkCloseToHome, HaveMoney, HertzClosed, AvisOpen, McDonaldsOpen }

For brevity, you can use the following symbols: R, HMB, EPS, WFU, WCTH, HM, HC, AO, MDO, etc.

a. Show all the inferences that can be derived by Forward-Chaining.
Show the agenda at each step, which rules are triggered, and indicate when new inferences are made.

b. Prove that 'CanGetToWork' is entailed by Backward-Chaining. Trace all steps, showing the goal stack, which rules are applied, and indicate if and when back-tracking occurs.