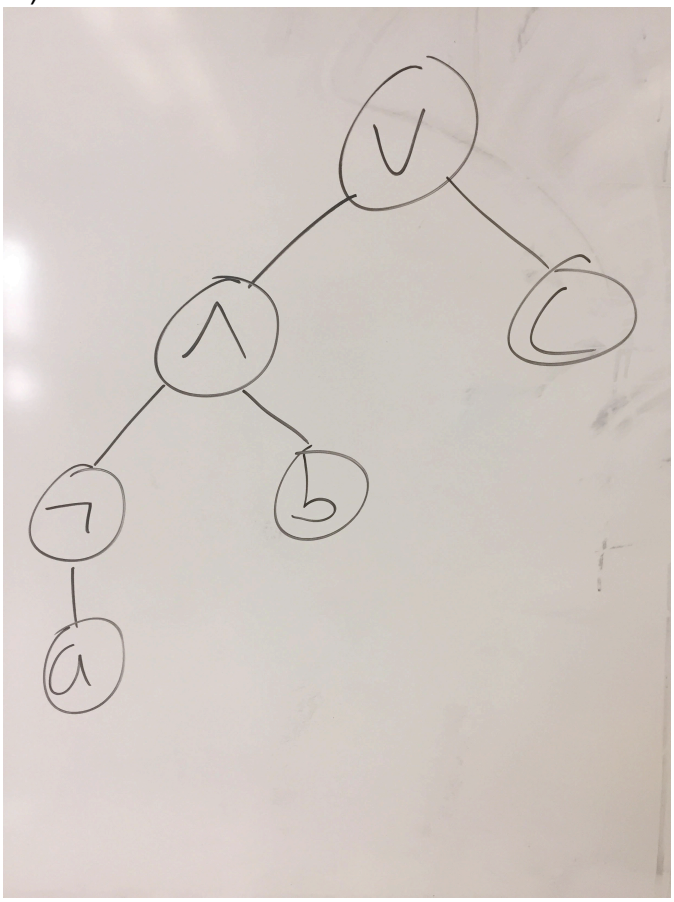
COMP 410
Fall 2021
Midterm Practice Exam #1

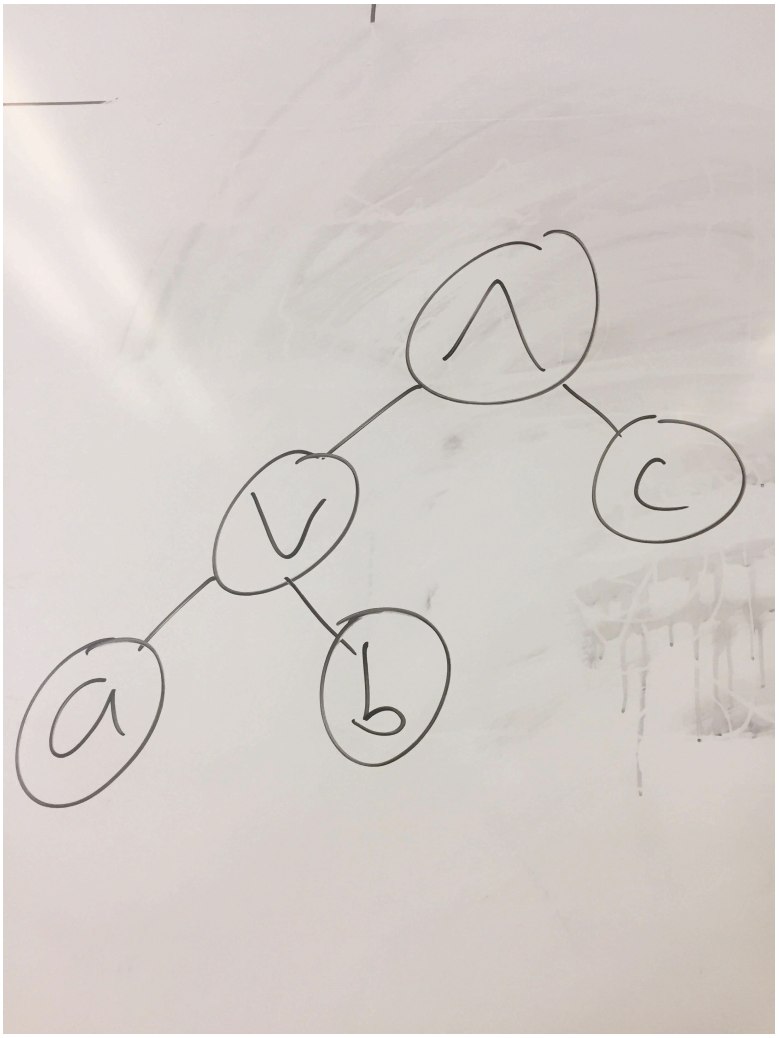
Abstract Syntax Trees

In Boolean expressions, ¬ has the highest precedence, followed by ∧ and ∨. With this in mind, write out the ASTs corresponding to each of the following Boolean expressions:

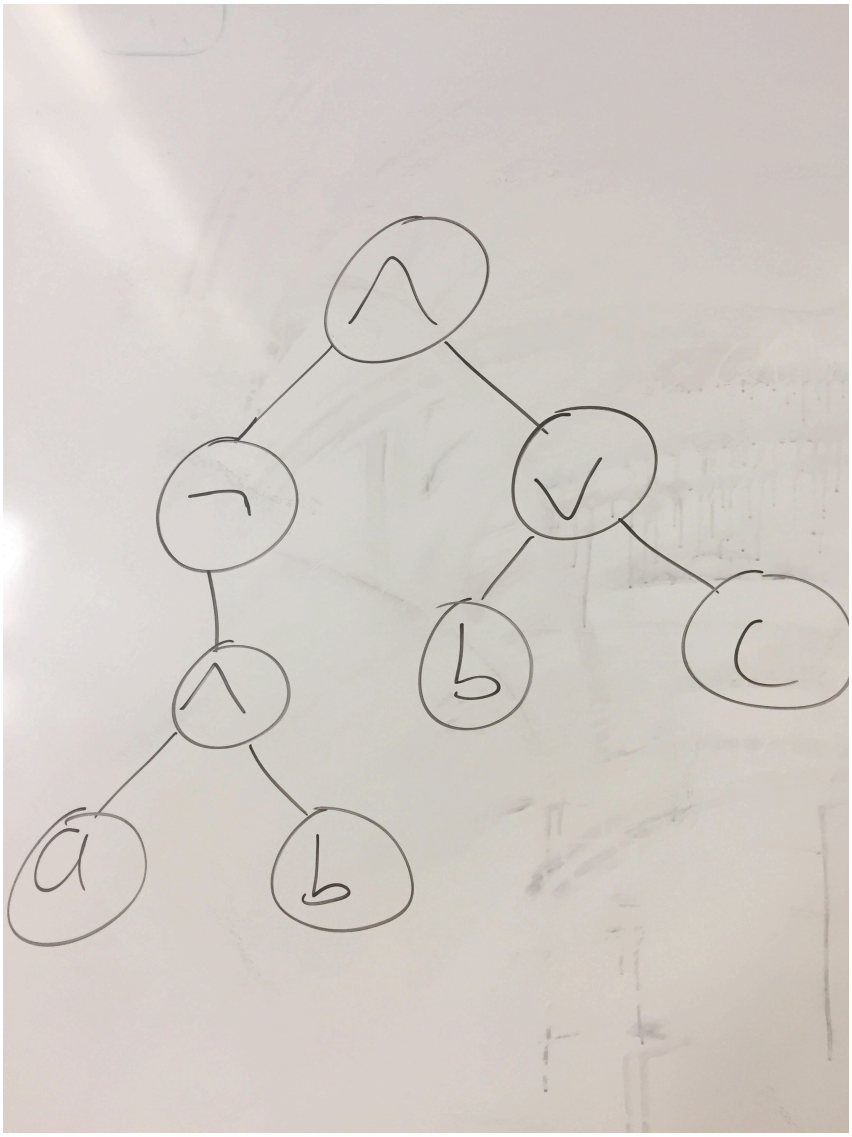
1.) `¬a ∧ b ∨ c`



2.) `(a ∨ b) ∧ c`



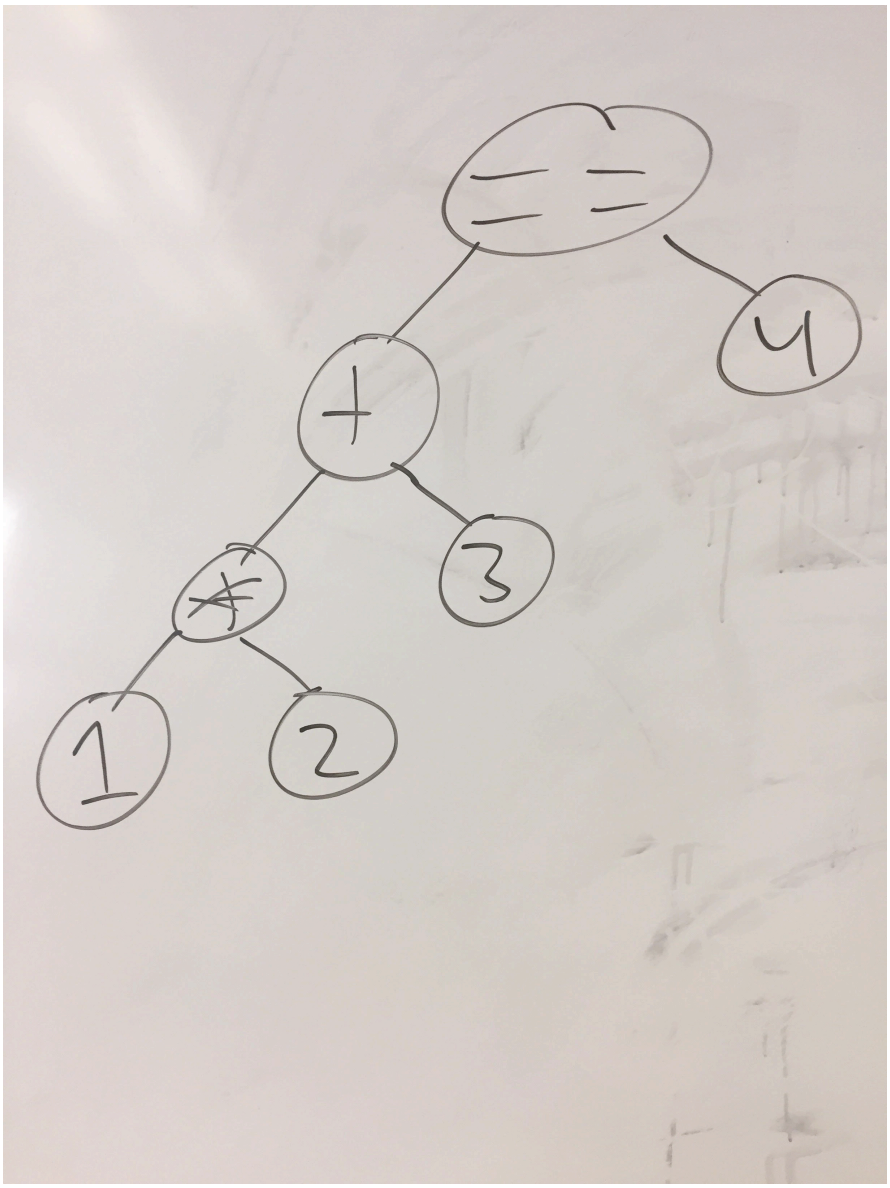
3.) ¬(a ∧ b) ∧ (b ∨ c)



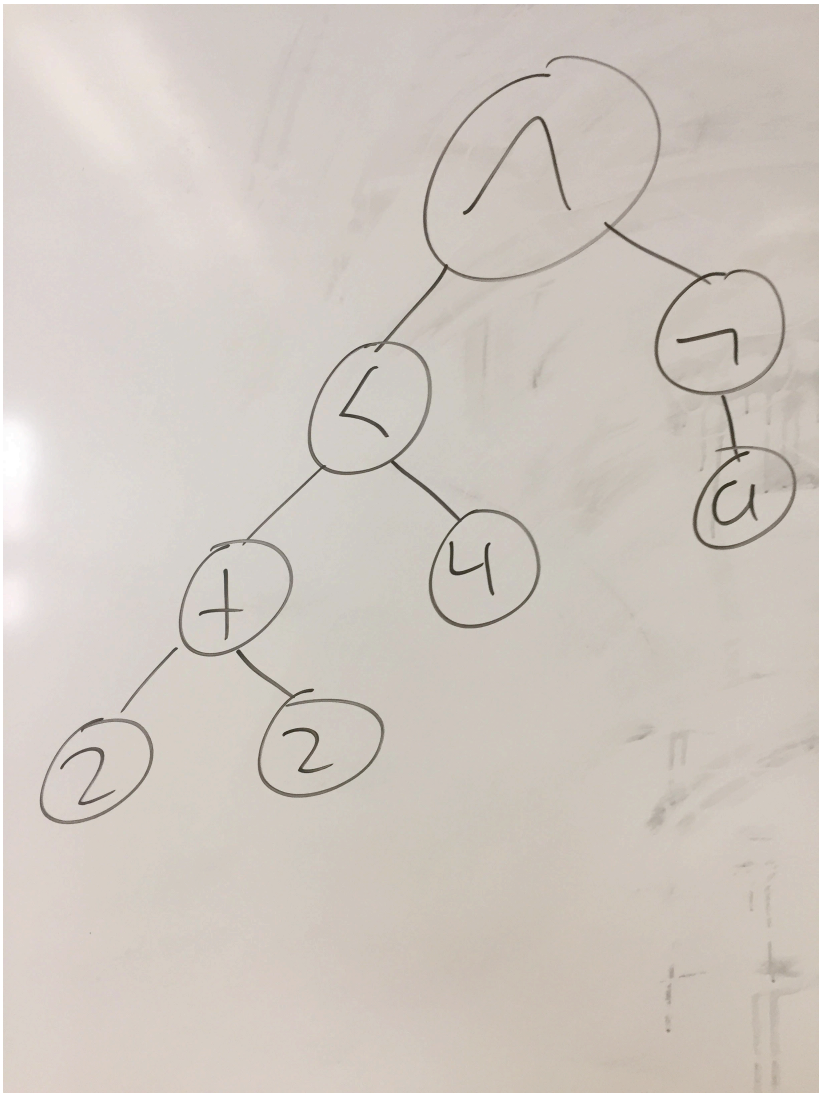
Arithmetic expressions can be used to form Boolean expressions with the help of arithmetic comparisons (e.g., <, <=, >, >=, ==). These comparisons have the lowest

possible precedence. With this in mind, write out the ASTs corresponding to each of the following expressions:

4.) `1 * 2 + 3 == 4`



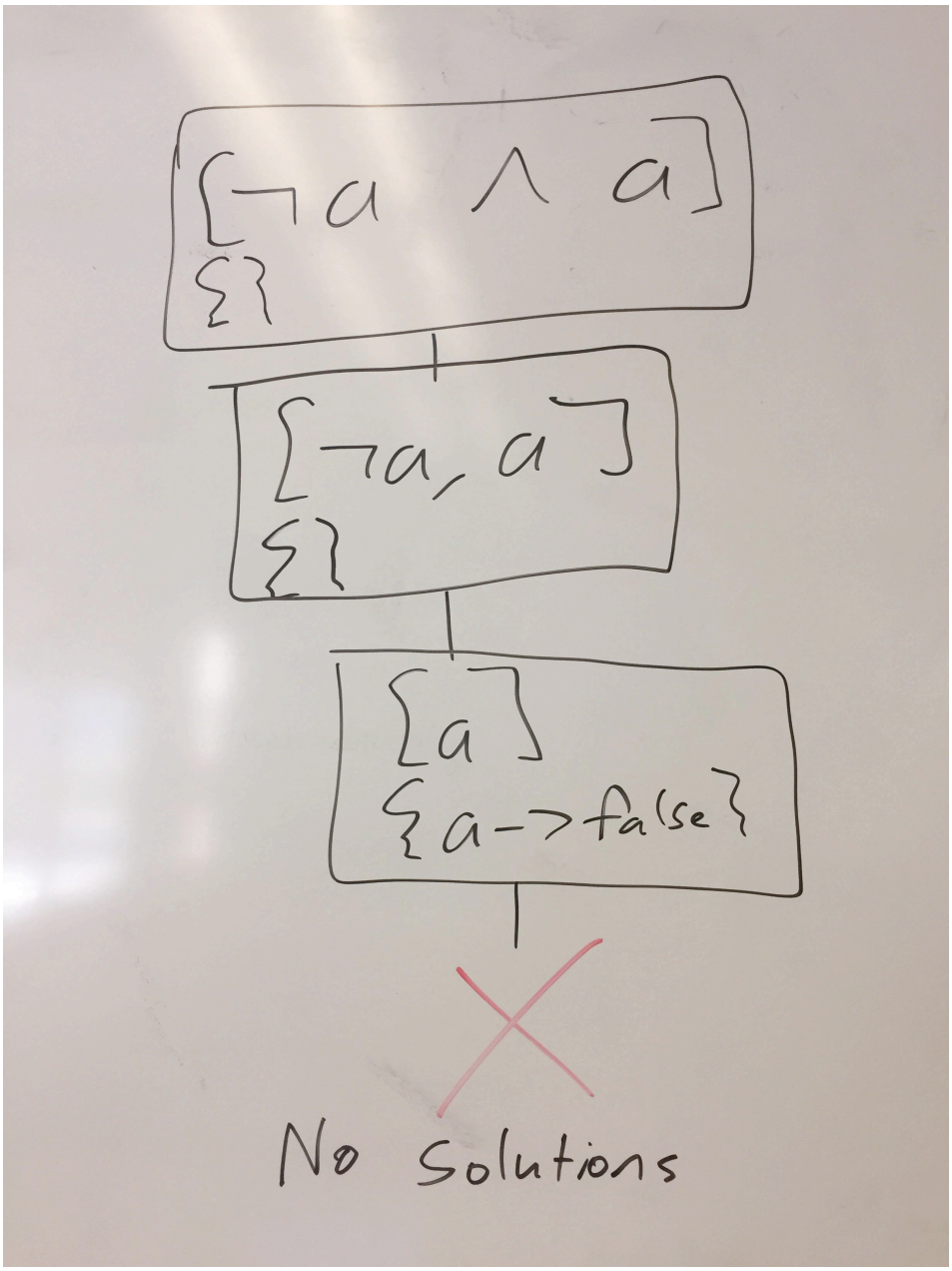
5.) (2 + 2 < 4) ∧ ¬a



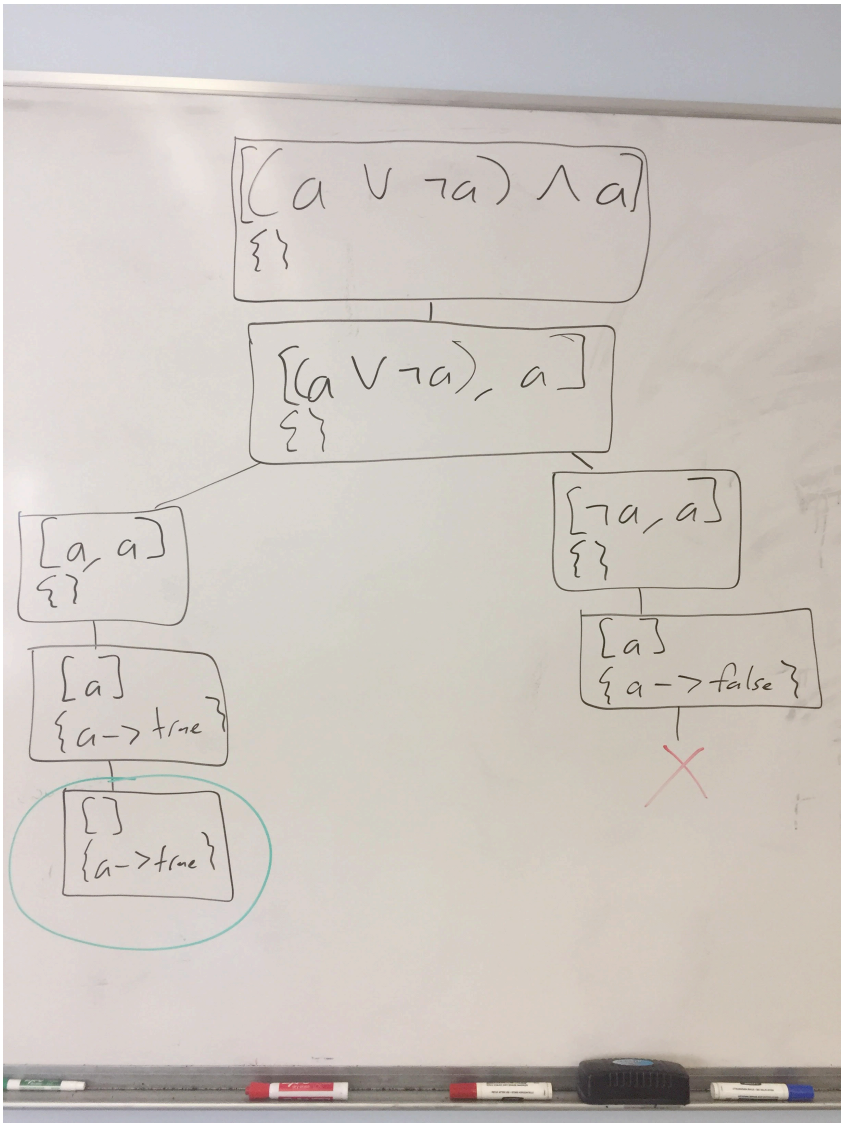
Semantic Tableau

For each of the following Boolean formulas, write out the complete semantic tableau tree. **Circle** the nodes in the tree representing solutions. If a tree has no solutions, say so. **Be sure to write all steps.**

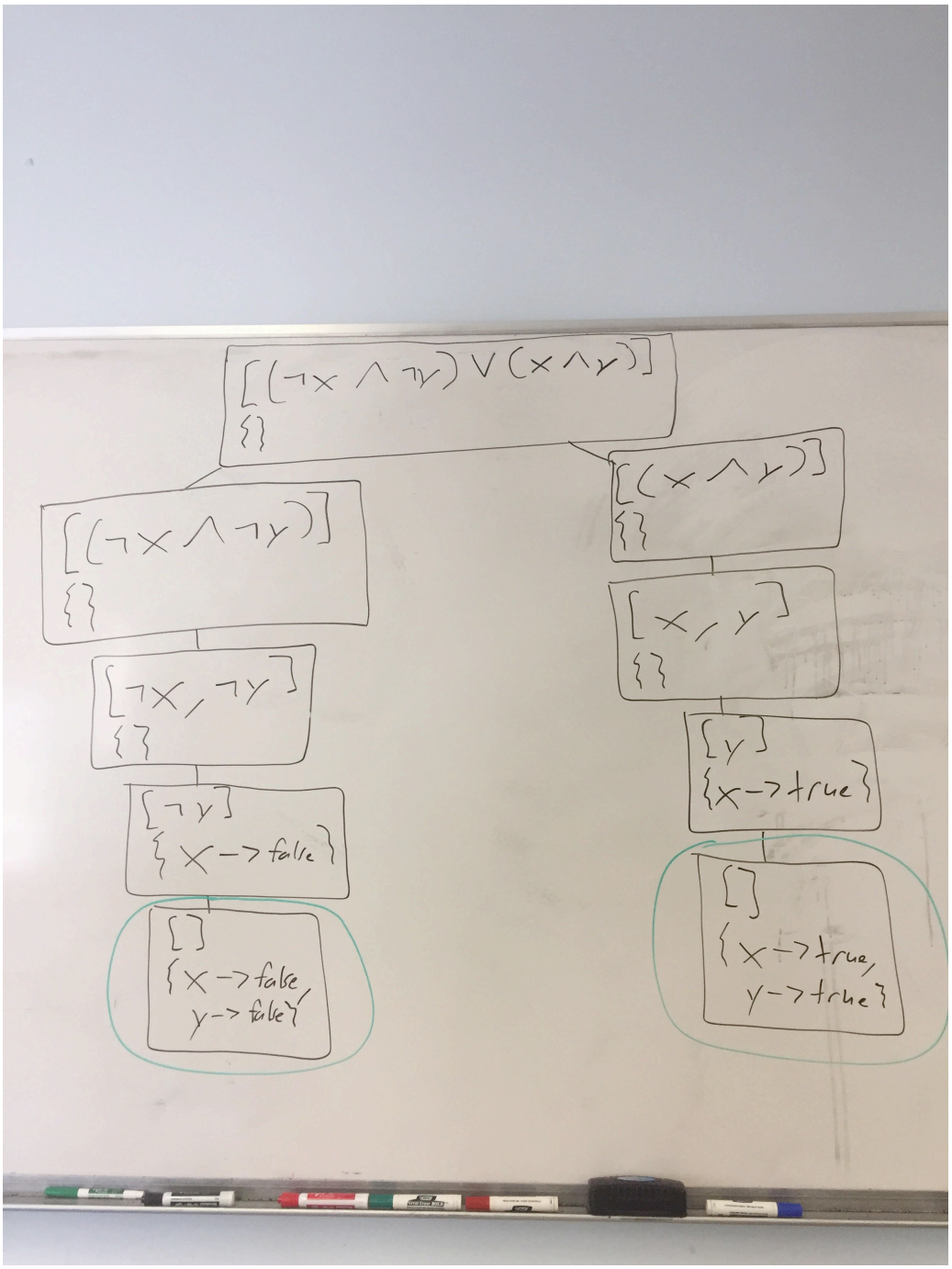
6.) ¬a ∧ a



7.) (a ∨ ¬a) ∧ a



8.) (¬x ∧ ¬y) ∨ (x ∧ y)



Prolog - Modeling the World

9.a)
For this problem, you need to write a clause database encapsulating pricing information for a convenience store. Write Prolog code accurately reflecting the following:

- Soda costs $2
- Chips cost $3
- Hot dogs cost twice as much as soda (do not hardcode $4)
- Soda chips, and hot dogs are food
- Pencils and pens are office supplies
- All office supplies cost $2
- Cold medicine costs $7

```
% all facts and rules with the same name should be placed
% together in the file
cost(soda, 2).
cost(chips, 3).
cost(hot_dog, Cost) :-
    cost(soda, SodaCost),
    Cost is SodaCost * 2.
cost(OS, 2) :-
    office_supplies(OS).
cost(cold_medicine, 7).

food(soda).
food(chips).
food(hot_dog).

office_supplies(pencil).
office_supplies(pen).
```

Using the clause database you previously wrote, write queries to determine the following:

9.b.) Which items cost exactly $2?

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?- cost(Item, 2).
```

9.c.) Which items cost more than $3?

```
?- cost(Item, Cost), Cost > 3.
```

9.d.) Which foods cost less than $3?

```
?- food(Food), cost(Food, Cost), Cost < 3.
```

9.e.) Which foods are also office supplies?

```
?- food(Item), office_supplies(Item).
```