Preparation for Second Midterm

Material

The material covered in this midterm consists of the following chapters and sections in the textbook:

Second edition:

- Chapter 7, sections 7.1, 7.2, 7.3, 7.4, 7.5
- Chapter 8, sections 8.1, 8.2, 8.3
- Chapter 9:
  - section 9.1
  - section 9.2, up to and NOT INCLUDING the "Storage and retrieval" subsection, which starts on page 278
  - section 9.3 up to and NOT INCLUDING the "Efficient forward chaining" subsection, which starts on page 283
- Chapter 11, sections 11.1, 11.2, 11.3.
- Chapter 12, sections 12.3, 12.4, 12.5.

Third edition:

- Chapter 7, sections 7.1, 7.2, 7.3, 7.4, 7.5
- Chapter 8, sections 8.1, 8.2, 8.3.
- Chapter 9, sections 9.1, 9.2.1, 9.2.2, 9.3.1, 9.3.2.
- Chapter 10, sections 10.1, 10.2, 10.4.4.
- Chapter 11, section 11.3.

Practice Questions

1. Convert the following knowledge base to conjunctive normal form:

   ```
   A AND B
   B => (A OR C)
   ```

2. Consider the following knowledge base:

   ```
   A
   B
   NOT A
   ```

   Does this knowledge base entail the following sentence:

   ```
   B OR C
   ```

   Justify your answer.

3. Given a propositional-logic vocabulary with only four symbols, A, B, C, D, how many models are there for the following sentences? In other words, for each of those statements, determine how many models that statement is true in. Note that each model is defined by assigning boolean values to all four symbols A, B, C, D.

   (a) `(A and B) or (B and C)`
   (b) `A or B`
   (c) `A <=> B <=>C`

4. Textbook exercise 7.6 (second edition), exercise 7.8 (third edition)

5. Textbook exercise 7.8 (second edition), exercise 7.10 (third edition)

6. For some sentence S involving literals A, B, C, here is the truth table:

A	B	C	Sentence
false	false	false	true
false	false	true	false
false	true	false	false
false	true	true	true
true	false	false	false
true	false	true	false
true	true	false	false
true	true	true	true

   Give a conjunctive normal form for sentence S.

7. What is the negation of each of the following sentences?

```
1. for-every x, exists y: son(x) = y
2. for-every x, for-every y: son(x) = y <=> father(y) = x
```

   In your answers, any "not" may only appear after the last appearance of a universal or existential quantifier.

8. Textbook exercise 8.8 (in both second and third edition).

9. Consider the technique of propositionalization. For each of the following two knowledge bases, decide if propositionalization can be applied successfully. If not, why not?

```
KB 1:

for-every x: king(x) and greedy(x) => evil(x)
king(John)
greedy(John)
brother(Richard, John)


KB 2:
for-every x: king(x) and greedy(x) => evil(x)
king(John)
greedy(John)
brother(Richard, John)
king(father(John))
```

10. What is the most general unifier for each of the following pairs of expressions:

```
1. major(John, x), major(y, mathematics)
2. major(John, x), major(y, z)
3. major(John, x), major(y, x)
4. major(John, x), major(x, y)
```

11. Textbook exercise 9.3 (in both second and third edition).

12. Textbook exercise 9.4 (in both second and third edition).

13. Textbook exercise 9.19, parts (a), (b), (c) (second edition), exercise 9.24, parts (a), (b), (c) (third edition).

14. Textbook exercise 11.2 (second edition), exercise 10.2 (third edition).

15. Textbook figure 10.3 in 3nd edition (figure 11.4 in 2nd edition) provides a description for a deterministic version of the blocks world. We want to make a modification to that description, so as to model a nondeterministic version, in which the effect of action move(b, x, y) is sometimes on(b, y) and sometimes on(b, table). How would you modify the description of the move action to make it reflect the above two possible outcomes of move(b, x, y)?

16. In the nondeterministic blocks world described in the previous exercise, suppose that the initial state and the goal are as as follows:

```
Initial state:
On(A, Table) and On(B, Table) and On(C, Table) and Block(A)
and Block(B) and Block(C) and Clear(A) and Clear(B) and Clear(C)

Goal:
On(A, B) and On(B, C)
```

    Is there a conditional plan that achieves this goal with guaranteed success? If yes, list the sequence of actions in that plan. If no, explain why not.