Optional homework – reasoning modelling

- share in the final grade: 10%
- deadline for homework submission: the first school week of January 2016.

Reasoning modelling using propositional logic and predicate logic: 10 points

Option 1: 10 points
5p – solve 6 exercises chosen from the list below using predicate logic
5p – compose and solve 6 exercises of reasoning modelling using propositional logic

Option 2: 10 points
5p – compose and solve 4 exercises of reasoning modelling using predicate logic
5p – compose and solve 6 exercises of reasoning modelling using propositional logic

Proof methods used in **propositional logic**: truth table, definition of deduction, semantic tableaux, resolution (general, lock, linear, set-of-support strategy, level-saturation strategy)

Proof methods used in **predicate logic**: semantic tableaux, resolution (general, lock, linear, set-of-support strategy, level-saturation strategy)

Remarks:
1. Each proof method must be used at least once.
2. Each knowledge base from exercises must have at least 4 hypotheses.

Notice: if two homeworks are at least 70% identical (the chosen/composed exercises are identical, and they have the same solutions), the persons involved will receive the default mark.

Reasoning modelling using predicate logic: proposed exercises.

1. Consider the following hypotheses and check the validity of the conclusion:

1. All hounds howl at night.
2. Anyone who has any cats will not have any mice.
3. Light sleepers do not have anything which howls at night.
4. John has either a cat or a hound.
5. (Conclusion) If John is a light sleeper, then John does not have any mice.

2 . Consider the following hypotheses and check the validity of the conclusion:

1. Anyone who buys carrots by the bushel owns either a rabbit or a grocery store.
2. Every dog chases some rabbit.

3. Mary buys carrots by the bushel.
4. Anyone who owns a rabbit hates anything that chases any rabbit.
5. John owns a dog.
6. Someone who hates something owned by another person will not date that person.
7. (Conclusion) If Mary does not own a grocery store, she will not date John.

4. Consider the following hypotheses and check the validity of the conclusion:

1. Every Austinite who is not conservative loves some armadillo.
2. Anyone who wears maroon-and-white shirts is an Aggie.
3. Every Aggie loves every dog.
4. Nobody who loves every dog loves any armadillo.
5. Clem is an Austinite, and Clem wears maroon-and-white shirts.
6. (Conclusion) Is there a conservative Austinite?

5. Consider the following hypotheses and check the validity of the conclusion:

1. Anyone whom Mary loves is a football star.
2. Any student who does not pass does not play.
3. John is a student.
4. Any student who does not study does not pass.
5. Anyone who does not play is not a football star.
6. (Conclusion) If John does not study, then Mary does not love John.

6. Consider the following hypotheses and check the validity of the conclusion:

1. Every coyote chases some roadrunner.
2. Every roadrunner who says ``beep-beep'' is smart.
3. No coyote catches any smart roadrunner.
4. Any coyote who chases some roadrunner but does not catch it is frustrated.
5. (Conclusion) If all roadrunners say ``beep-beep'', then all coyotes are frustrated.

7. Consider the following hypotheses and check the validity of the conclusion:

1. Anyone who rides any Harley is a rough character.
2. Every biker rides [something that is] either a Harley or a BMW.
3. Anyone who rides any BMW is a yuppie.
4. Every yuppie is a lawyer.
5. Any nice girl does not date anyone who is a rough character.
6. Mary is a nice girl, and John is a biker.
7. (Conclusion) If John is not a lawyer, then Mary does not date John.

8. Consider the following hypotheses and check the validity of the conclusion:

1. Every child loves anyone who gives the child any present.
2. Every child will be given some present by Santa if Santa can travel on Christmas eve.
3. It is foggy on Christmas eve.
4. Anytime it is foggy, anyone can travel if he has some source of light.
5. Any reindeer with a red nose is a source of light.
6. (Conclusion) If Santa has some reindeer with a red nose, then every child loves Santa.

9. Consider the following hypotheses and check the validity of the conclusion:

1. Every investor bought [something that is] stocks or bonds.
2. If the Dow-Jones Average crashes, then all stocks that are not gold stocks fall.
3. If the T-Bill interest rate rises, then all bonds fall.
4. Every investor who bought something that falls is not happy.
5. (Conclusion) If the Dow-Jones Average crashes and the T-Bill interest rate rises, then any investor who is happy bought some gold stock.

10. Consider the following hypotheses and check the validity of the conclusion:

1. Every child loves every candy.
2. Anyone who loves some candy is not a nutrition fanatic.
3. Anyone who eats any pumpkin is a nutrition fanatic.
4. Anyone who buys any pumpkin either carves it or eats it.
5. John buys a pumpkin.
6. Lifesavers is a candy.
7. (Conclusion) If John is a child, then John carves some pumpkin.

11. Consider the following hypotheses and check the validity of the conclusion:

1. Every tree that is an oak contains some grackle.
2. If anyone walks under any tree that contains any grackle, then he hates every grackle.
3. For every building, there is some tree that is beside it.
4. Taylor Hall is a building.
5. Every CS student visits Taylor Hall.
6. If anyone visits any building, then he walks under every tree that is beside that building.
7. (Conclusion) If some CS student does not hate some grackle, then there is some tree beside Taylor Hall that is not an oak.

12. Consider the following hypotheses and check the validity of the conclusion:

1. Every child sees some witch.
2. No witch has both a black cat and a pointed hat.
3. Every witch is good or bad.
4. Every child who sees any good witch gets candy.
5. Every witch that is bad has a black cat.
6. (Conclusion) If every witch that is seen by any child has a pointed hat, then every child gets candy.

13. Consider the following hypotheses and check the validity of the conclusion:

1. Every boy or girl is a child.
2. Every child gets a doll or a train or a lump of coal.
3. No boy gets any doll.
4. No child who is good gets any lump of coal.
5. (Conclusion) If no child gets a train, then no boy is good.

14. Consider the following hypotheses and check the validity of the conclusion:

1. Every child who finds some [thing that is an] egg or chocolate bunny is happy.
2. Every child who is helped finds some egg.

3. Every child who is not young or who tries hard finds some chocolate bunny.
4. (Conclusion) If every young child tries hard or is helped, then every child is happy.

15. Consider the following hypotheses and check the validity of the conclusion:

1. Anything that is played by any student is tennis, soccer, or chess.
2. Anything that is chess is not vigorous.
3. Anyone who is healthy plays something that is vigorous.
4. Anyone who plays any chess does not play any soccer.
5. (Conclusion) If every student is healthy, then every student who plays any chess plays some tennis.

16. Consider the following hypotheses and check the validity of the conclusion:

1. Every student who makes good grades is brilliant or studies.
2. Every student who is a CS major has some roommate. [Make ``roommate'' a two-place predicate.]
3. Every student who has any roommate who likes to party goes to Sixth Street.
4. Anyone who goes to Sixth Street does not study.
5. (Conclusion) If every roommate of every CS major likes to party, then every student who is a CS major and makes good grades is brilliant.

17. Consider the following hypotheses and check the validity of the conclusion:

1. Everyone who is ace at any final exam studies or is brilliant or is lucky.
2. Everyone who makes an A is an ace at some final exam.
3. No CS major is lucky.
4. Anyone who drinks beer does not study.
5. (Conclusion) If every CS major makes an A, then every CS major who drinks beer is brilliant.

18. Consider the following hypotheses and check the validity of the conclusion:

1. Anyone who loves any lottery is a gambler.
2. Everyone who favours the lottery proposition loves some lottery.
3. Everyone favours the lottery proposition or opposes the lottery proposition.
4. If every Baptist votes and opposes the lottery proposition, then the lottery proposition does not win.
5. Every Baptist who is faithful is not a gambler.
6. (Conclusion) If every Baptist votes and the lottery proposition wins, then some Baptist is not faithful.

19. Consider the following hypotheses and check the validity of the conclusion. Hint: the predicates WHITE, SNOWY, HAPPY, and GETS should each have a ``time'' argument.

1. Anyone who owns any sled is happy when it is snowy.
2. When it is white, it is snowy.
3. If Santa is happy at Christmas, then every child who is good gets some toy at Christmas.
4. Any child who gets a toy at any time is happy at that time.
5. Santa owns a sled.
6. (Conclusion) If it is white at Christmas and every child who is not good owns some sled, then every child is happy at Christmas.

20. Consider the following hypotheses and check the validity of the conclusion.

1. Anyone who is on Sixth Street and is not a police officer has some costume.
2. No CS student is a police officer.
3. Every costume that is good is a robot costume.
4. For anyone, if they are on Sixth Street and are happy, then every costume they have is good or they are drunk.
5. (Conclusion) If no CS student is drunk and every CS student on Sixth Street is happy, then every CS student on Sixth Street has some costume that is a robot costume.

21. Consider the following hypotheses and check the validity of the conclusion.

1. For every mall, there is some Santa who is at the mall.
2. Every child who visits anywhere talks with every Santa who is at the place visited. [Don't make a predicate for ``the place visited''; it should just be a variable.]
3. Every child who is a city child visits some mall.
4. Every child who is good or who talks with some Santa gets some toy.
5. (Conclusion) If every child who is not a city child is good, then every child gets some toy.

22. Consider the following hypotheses and check the validity of the conclusion.

1. Everyone who feels warm either is drunk, or every costume they have is warm.
2. Every costume that is warm is furry.
3. Every AI student is a CS student.
4. Every AI student has some robot costume.
5. No robot costume is furry.
6. (Conclusion) If every CS student feels warm, then every AI student is drunk.

23. Consider the following hypotheses and check the validity of the conclusion.

1. Every bird sleeps in some tree.
2. Every loon is a bird, and every loon is aquatic.
3. Every tree in which any aquatic bird sleeps is beside some lake.
4. Anything that sleeps in anything that is beside any lake eats fish.
5. (Conclusion) Every loon eats fish.

24. Model the following reasoning:

Wolves, foxes, birds, caterpillars, and snails are animals, and there are some of each of them. Also there are some grains, and grains are plants. Every animal either likes to eat all plants or all animals much smaller than itself that like to eat some plants. Caterpillars and snails are much smaller than birds, which are much smaller than foxes, which in turn are much smaller than wolves. Wolves do not like to eat foxes or grains, while birds like to eat caterpillars but not snails. Caterpillars and snails like to eat some plants. Therefore there is an animal that likes to eat a grain-eating animal.