Prac4

Theory Questions

1.Symbolize the following proposition and discuss the truth.

1. Everyone has black hair.
2. Some people boarded the moon.
3. No one has boarded Jupiter
4. Students studying in the US are not necessarily Asians.

1. assume $P(x)$: x is a person assume $Q(x)$: x has hair $\forall x(P(x) \Rightarrow Q(x))$ Actually, the hair color of the white people is quite colorful and not necessarily black. Thus, the statement is false.
2. assume $P(x)$:x is a person assume $Q(x)$:x boarded the moon $\exists x(P(x) \wedge Q(x))$ Some of Americans has boarded the moon during 20 century. Therefore, the statement is true.
3. assume $P(x)$:x is a person assume $Q(x)$:x has boarded Jupiter $\neg(\exists x(P(x) \wedge Q(x)))$ Since no one has been sent to Jupiter, the statement is true.
4. assume $P(x)$: x is a student studying in the US assume $Q(x)$:x is an Asians $\exists x(P(x) \wedge \neg(Q(x)))$ Since the students who is studying in the US come from all over the world besides Asia countries, the statement is true.

2.Judge the following formula, which is tautology? What is the contradiction?

1. $\forall xF(x) \Rightarrow (\exists x \exists y G(x,y)) \Rightarrow \forall xF(x))$
2. $\neg(\forall xF(x) \Rightarrow \exists yG(y)) \wedge \exists yG(y)$
3. $\forall x(F(x) \Rightarrow G(y))$

1. This is not tautology. From the truth table, we can find out not all results are truth under different situation. When $F(x)$ is false, no matter $G(x)$ is true or false, $F(x) \Rightarrow (\exists x \exists yG(x,y))$ will be true, but $\forall xF(x) \Rightarrow (\exists x \exists yG(x,y)) \Rightarrow \forall xF(x))$ will be false.
2. This is not tautology. From the truth table, we can find out not all results are truth under different situation. When $F(x)$ is true and $G(x)$ is false, then $\forall xF(x) \Rightarrow \exists yG(y)$ is false and $\neg(\forall xF(x) \Rightarrow \exists yG(y))$ is true. Then, $\neg(\forall xF(x) \Rightarrow \exists yG(y)) \wedge \exists yG(y)$ is false.
3. This is not tautology. From the truth table, we can find out not all results are truth under different situation. When $F(x)$ is true and $G(x)$ is false, then $\forall x(F(x) \Rightarrow G(y))$ is false.

3.Which of the following are correct?

1. False $\models$True.
2. $(A \wedge B) \models (A \Leftrightarrow B)$.
3. $(A \wedge B) \Rightarrow C \models (A \Rightarrow C) \vee (B \Rightarrow C)$.
4. $(A \vee B) \wedge (\neg C \vee \neg D \vee E) \models (A \vee B)$.

5. $(A \lor B) \land (\neg C \lor \neg D \lor E) \models (A \lor B) \land (\neg D \lor E)$.

1. Incorrect. Those models in false cannot be true at the same time.
2. Correct. Only when A is true and B is true, $(A \land B)$ is true. When A and B are both true, $A \Rightarrow B$ is true and $B \Rightarrow A$ is true, then $A \Leftrightarrow B$ is true.
3. Correct. The only situation that $(A \land B) \Rightarrow C$ is false is that A and B are true but C is false. While the only situation that $(A \Rightarrow C) \lor (B \Rightarrow C)$ is false is also that A and B are true but C is false. Thus, when model in $(A \land B) \Rightarrow C$ is true, it will be also true in $(A \Rightarrow C) \lor (B \Rightarrow C)$.
4. Correct. When model in $(A \lor B) \land (\neg C \lor \neg D \lor E)$ is true, then it also will be true in $(A \lor B)$ and $(\neg C \lor \neg D \lor E)$.
5. Incorrect. When model in$(A \lor B) \land (\neg C \lor \neg D \lor E)$ is true, it also will be true in $(A \lor B)$ and $(\neg C \lor \neg D \lor E)$. However, $(\neg C \lor \neg D \lor E)$ is true doesn't mean that $(\neg D \lor E)$ will also be true.

4.Conjunctive normal form.link:https://baike.baidu.com/item/%E5%90%88%E5%8F%96%E8%8C%83%E5%BC%8F/2459360

1. Obtaining conjunctive paradigm: $P \land (Q \Rightarrow R) \Rightarrow S$

   Basic steps to find a conjunctive normal form.¶

2. Cut redundant connectives，Reserved $\{\lor, \land, \neg\}$
3. Move or remove the negation ~
4. distribution rates

$P \land (Q \Rightarrow R) \Rightarrow S \equiv P \land (\neg Q \lor R) \Rightarrow S \equiv \neg(P \land (\neg Q \lor R)) \lor S \equiv \neg P \lor (Q \land \neg R) \lor S$

5.Arithmetic assertions can be written in first-order logic with the predicate symbol <,the function symbols + and ×, and the constant symbols 0 and 1. Additional predicates can also be defined with biconditionals.(Chapter 8.20)

1. Represent the property “x is an even number.”
2. Represent the property “x is prime.”
3. Goldbach’s conjecture is the conjecture (unproven as yet) that every even number is equal to the sum of two primes. Represent this conjecture as a logical sentence.

1. Even Number(x):x is an even number
2. Prime(x): x is prime
3. Assume Sum(x,y) means x+y Assume Equal(x,y) means x=y Then Goldbach’s conjecture can be represented as : $\forall z$Even Number(z)$\Rightarrow \exists x \exists y$ Equal(z,Sum(Prime(x),Prime(y)))

Programming Exercises

	Random ghost	Minmax ghost
Minmax pacman	Won 4/5 Average: 783	Won 1/5 Average: 38.6
Expectimax pacman	Won 3/5 Average:444	Won 0/5 Average:202

Result table

3. Describe the performance (in terms of the distribution) of Pacman in each case.

In which cases is the Pacman agent implementing the correct assumption of the ghosts behaviour?

From the table above, we can find out that pacman does better when meets random ghost and almost lost when it meet ghost with min-max method. Actually, I test expectimax pacman with minmax ghost 10 times, the first 5 pacman won 4 but later 5 it lose all. I also test expectimax pacman with random ghost, and I think a evaluation function is needed if we want to improve the performance of pacman.

I think cases under adversarial ghost (minmax ghost) and minmax pacman are implementing the correct assumption of the ghosts behavior, for they decide their next action depends on the former one agent's action.

4. Describe why the ghosts seem as if they are cooperating when using minimax even though they are not sharing information with each other.

That's because when one ghost (suppose agent number1) chooses an action which are minimize pacman's utility, the min-max tree change, and the next ghost (suppose agent number2) will chooses the one minimize pacman's utility and maximize ghosts' utility. This two actions will enlarge the utility of ghost. That will shows like two ghosts are cooperating with each other and new possible actions tree actually deliver some information.