Lab 1

CS 135

Logic - Solve the following.

1. Show that $p \rightarrow q$ is equivalent to $\neg q \rightarrow \neg p$

2. Use De Morgan's law to find the negation of each of these statement.
   a. Elon is rich and happy.
   b. Attila runs or walks around campus.
   c. You will not eat that cookie and walk away.

Answer Key

Show that $p \rightarrow q$ is equivalent to $\neg q \rightarrow \neg p$

1.	$p \rightarrow q$	
2.	$\neg p \vee q$	conditional identity law
3.	$q \vee \neg p$	commutative law
4.	$\neg \neg q \vee \neg p$	double negation
5.	$\neg q \rightarrow \neg p$	conditional identity

Answer Key

Use De Morgan's law to find the negation of each of these statements.

a. Elon is rich and happy.
   i. **Key:** is rich = R is happy = H
   ii. **Original:** $R \wedge H$
   iii. **De Morganified:** $\neg(R \wedge H) \equiv \neg R \vee \neg H \equiv$ elon is not rich or not happy

b. Attila runs or walks around campus.
   i. **Key:** runs = R walks = W
   ii. **Original:** $R \vee W$
   iii. **De Morganified:** $\neg(R \vee W) \equiv \neg R \wedge \neg W \equiv$ Attila doesn't run and doesn't walk around campus

c. You will not eat that cookie and walk away.
   i. **Key:** eat cookie = C walk away = W
   ii. **Original:** $\neg C \wedge W$
   iii. **De Morganified:** $\neg(\neg C \wedge W) \equiv \neg\neg C \vee \neg W \equiv C \vee \neg W \equiv$ You will eat that cookie or you won't walk away

Inference

Solve whether the following argument is valid using only laws of inference

If Peter does not have eight legs, then he is not a spider.
Peter is a spider.

∴ Peter has eight legs.

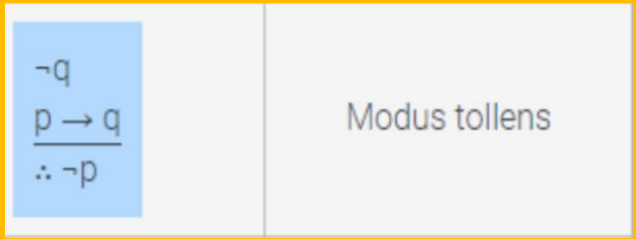
Answer Key

If Peter does not have eight legs, then he is not a spider.
Peter is a spider.

∴ Peter has eight legs.

Key:
L = Peter has 8 legs
S = Peter is a spider

¬ L→¬ S
S
∴ L



1.	S	Given
2.	¬ L→¬ S	Given
3.	L	Modus tollens, 1, 2

Inference

Show that the propositions p1 , p2 , p3 , p4 , and p5 can be shown to be equivalent by proving that the conditional statements p1 → p4, p3 → p1, p4 → p2, p2 → p5, and p5 → p3 are true.

Answer Key

Suppose that p1 → p4 → p2 → p5 → p3 → p1. To prove that one of these propositions implies any of the others, just use hypothetical syllogism repeatedly.

Trees - Is this argument valid?

a. If the government is lying, then the Mars Rover has a bug.
b. If Rover does not find life on Mars, then Rover has a bug or there is no life on Mars.
c. If Rover does not have a bug, then if there is life on Mars, Rover will find life on Mars.
d. If Rover finds life on Mars and Rover has a bug, then the government is lying.

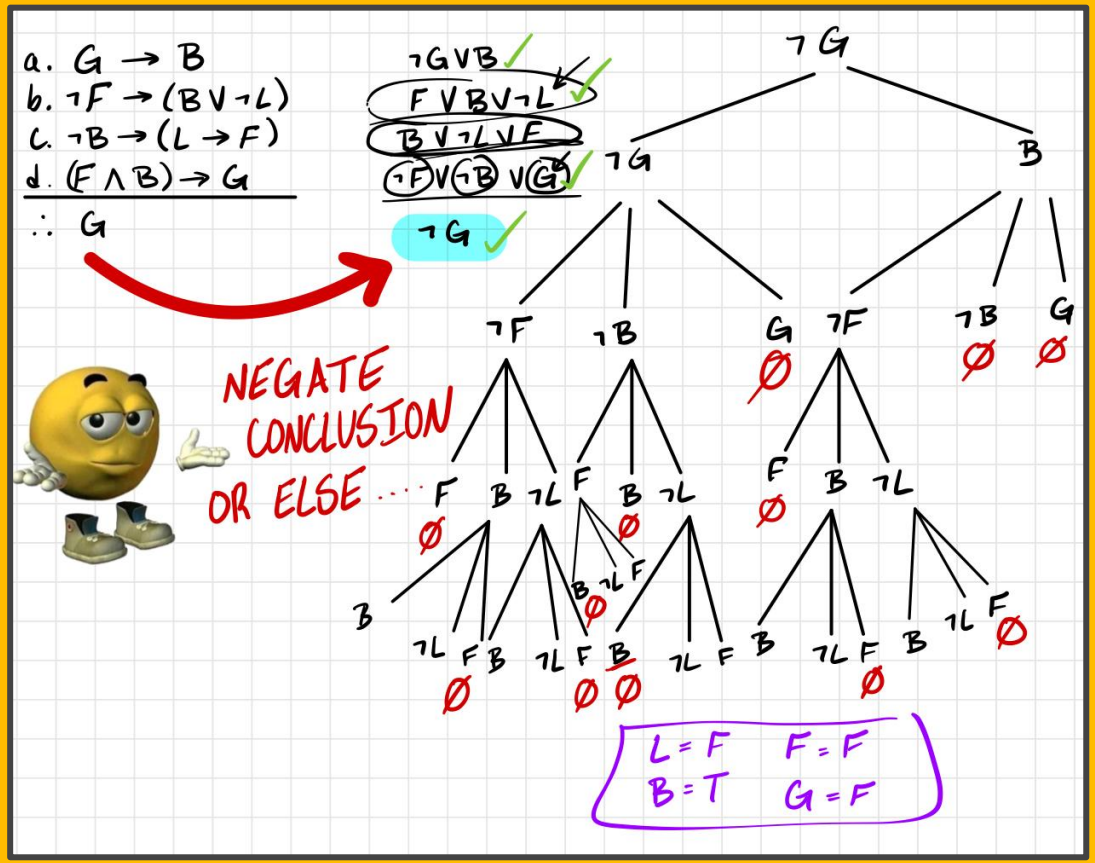
Therefore, the government is lying.

Answer Key

Invalid argument, contradictions found because path from root to leaves exist.

Key: G=govt. Lying, B=Rover has bug, L=life on Mars, F=Rover finds life on Mars

Possible contradiction:
L = False
B = True
F = False
G = False



Racket time!