

Homework 2

CIS-623 STRUCTURED PROGRAMMING & FORMAL METHODS

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For each of the following set of formulas, show if there is an entailment relation from formulas in a to the formulas in b. Give a formal proof if the entailment relation holds from the formulas in a to b.

Question 1:

a. $(p \wedge q) \vee (p \wedge r)$

b. $p \wedge (q \vee r)$

Yes, there exists an entailment relation from formula a to formula b. The proof is in the picture below.

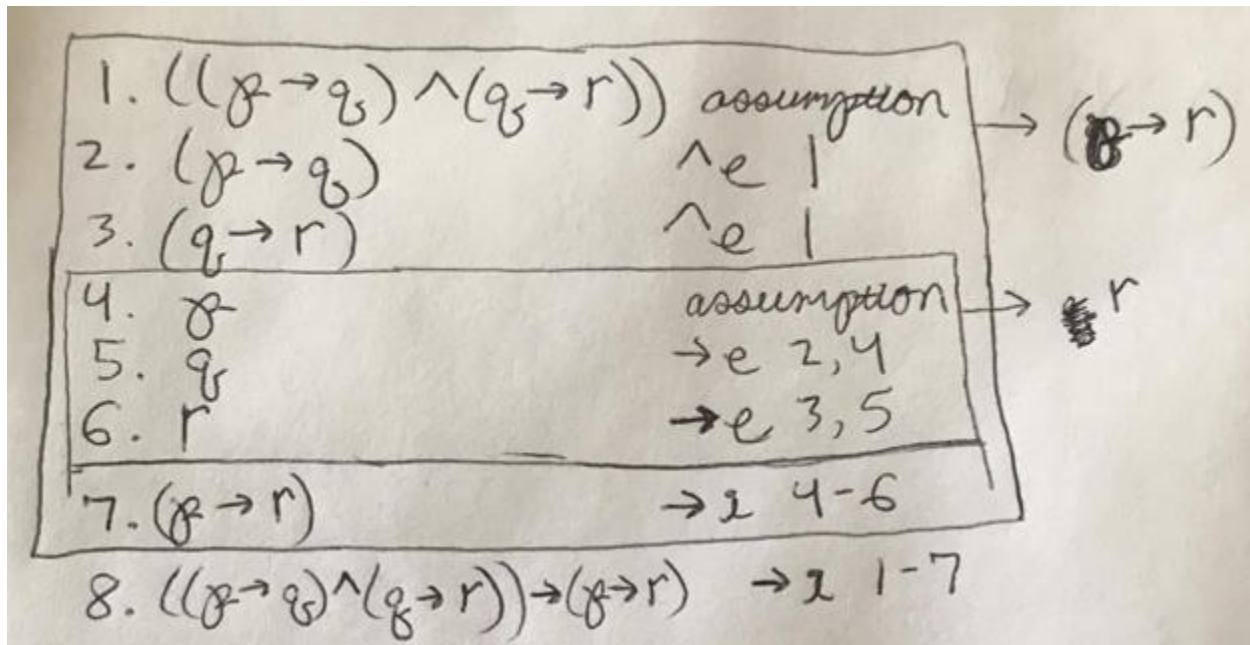
1.	$(p \wedge q) \vee (p \wedge r)$	premise	
2.	$(p \wedge q)$	assumption	$\rightarrow p \wedge (q \vee r)$
3.	p	$\wedge e$ 2	
4.	q	$\wedge e$ 2	
5.	$q \vee r$	$\vee i$ 4	
6.	$p \wedge (q \vee r)$	$\wedge i$ 3, 5	
7.	$(p \wedge r)$	assumption	$\rightarrow p \wedge (q \vee r)$
8.	p	$\wedge e$ 7	
9.	r	$\wedge e$ 7	
10.	$q \vee r$	$\vee i$ 9	
11.	$p \wedge (q \vee r)$	$\wedge i$ 8, 10	
12.	$p \wedge (q \vee r)$	$\vee e$ 1, 2-6, 7-11	

Question 2:

a. Nothing

b. $((p \rightarrow q) \wedge (q \rightarrow r)) \rightarrow (p \rightarrow r)$

Because formula a is "Nothing" we will check the validity of formula b.
 Yes, formula b is valid. The proof is in the picture below.

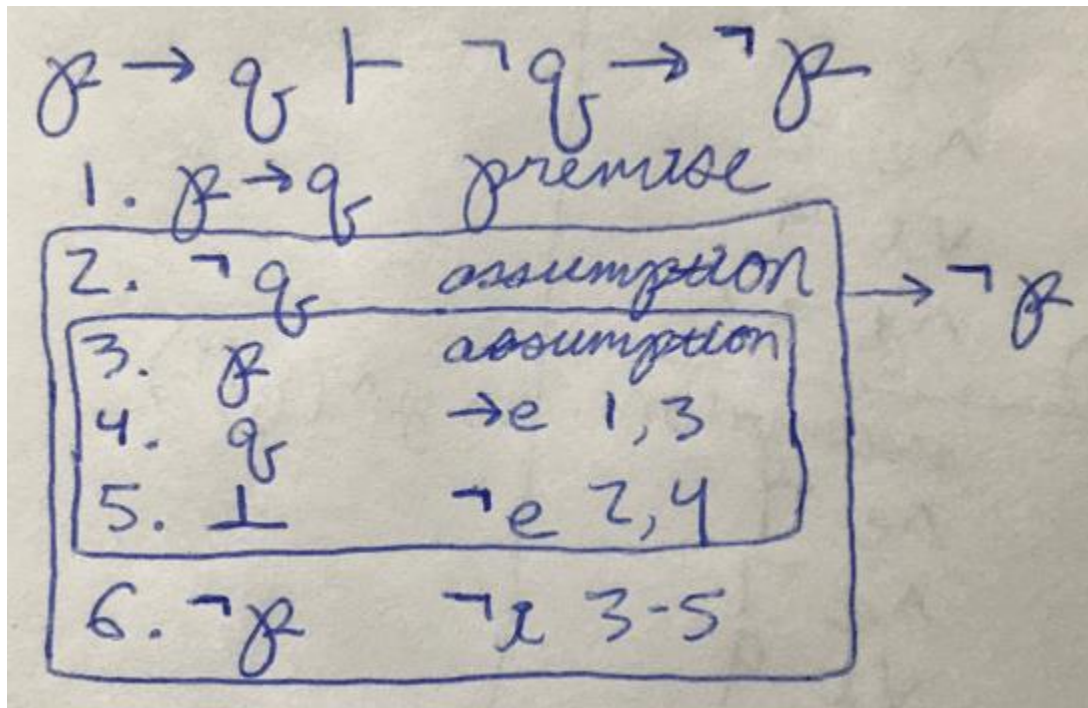


Question 3:

a. $p \rightarrow q$

b. $\neg q \rightarrow \neg p$

Yes, there exists an entailment relation from formula a to formula b. The proof is in the picture below.

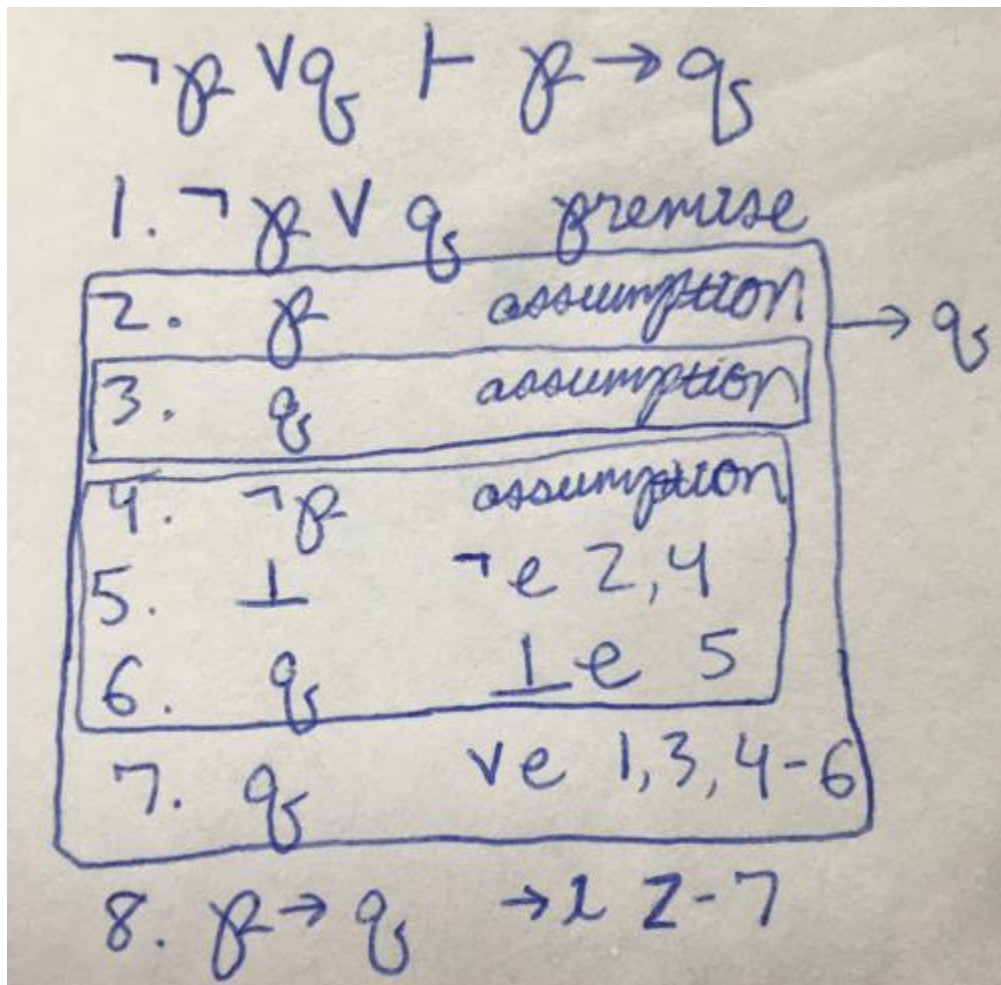


Question 4:

a. $\neg p \vee q$

b. $p \rightarrow q$

Yes, there exists an entailment relation from formula a to formula b. The proof is in the picture below.

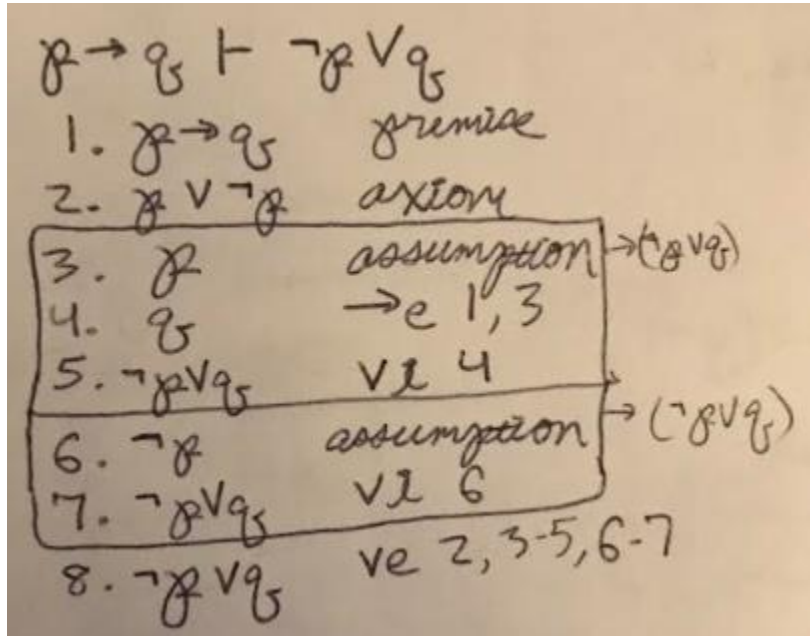


Question 5:

a. $p \rightarrow q$

b. $\neg p \vee q$

Yes, there exists an entailment relation from formula a to formula b. The proof is in the picture below.

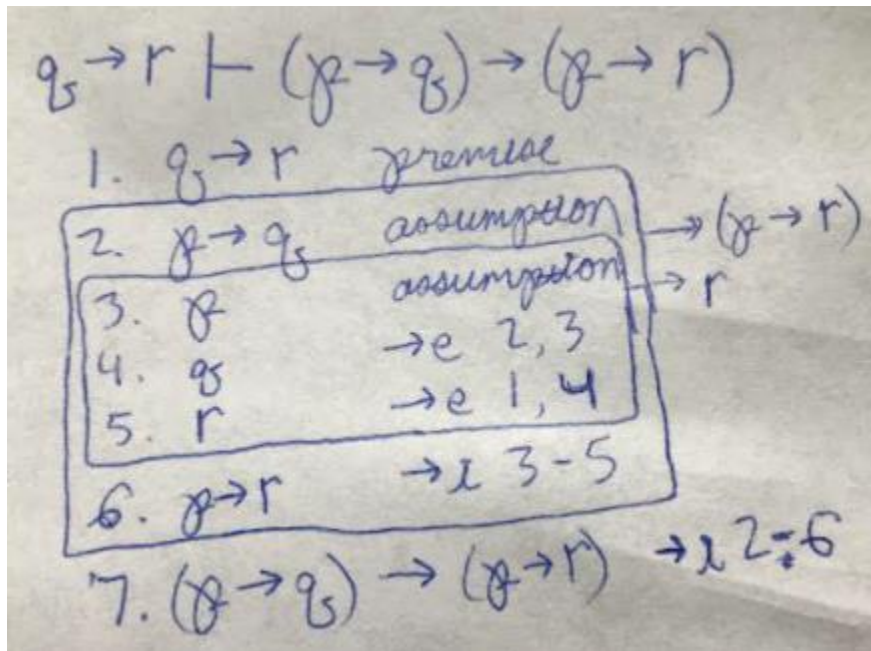


Question 6:

a. $q \rightarrow r$

b. $(p \rightarrow q) \rightarrow (p \rightarrow r)$

Yes, there exists an entailment relation from formula a to formula b. The proof is in the picture below.



Question 7:

a. Nothing

b. $(p \rightarrow q) \vee (q \rightarrow r)$

Because formula a is "Nothing" we will check the validity of formula b.
Yes, formula b is valid. The proof is in the picture below.

