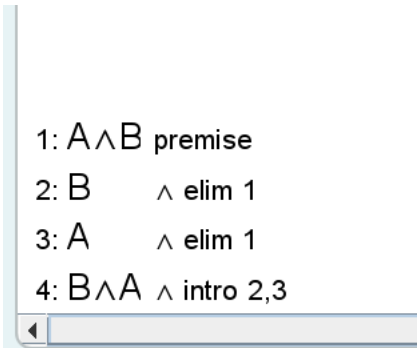
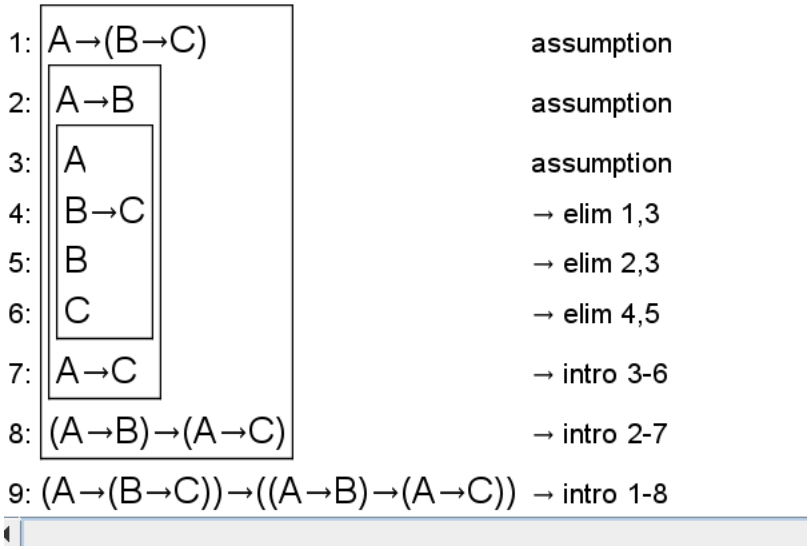
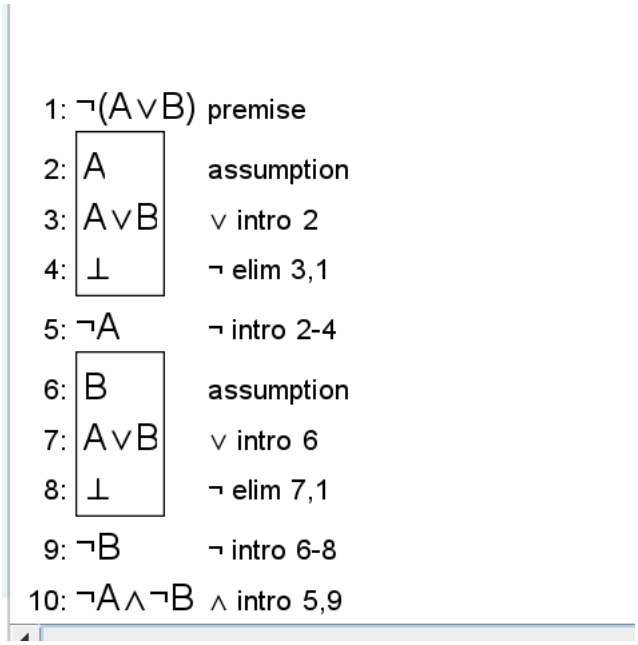
2)


1: A∧B premise
2: B ∧ elim 1
3: A ∧ elim 1
4: B∧A ∧ intro 2,3

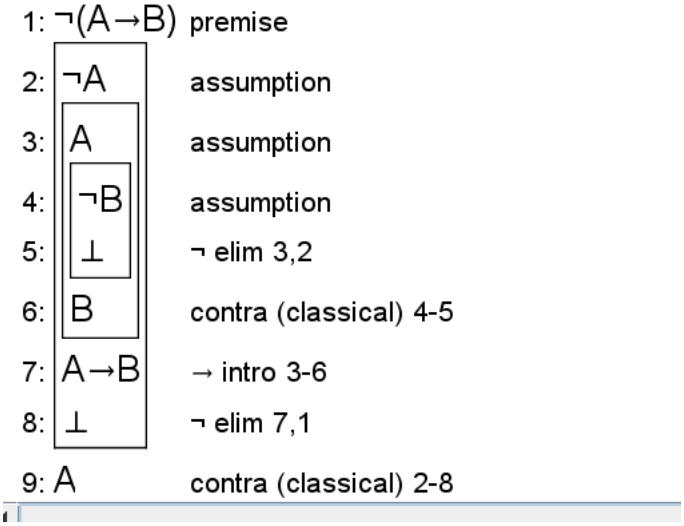
3)


1: A→(B→C) assumption
2: A→B assumption
3: A assumption
4: B→C → elim 1,3
5: B → elim 2,3
6: C → elim 4,5
7: A→C → intro 3-6
8: (A→B)→(A→C) → intro 2-7
9: (A→(B→C))→((A→B)→(A→C)) → intro 1-8

4)


1: ¬(A∨B) premise
2: A assumption
3: A∨B ∨ intro 2
4: ⊥ ¬ elim 3,1
5: ¬A ¬ intro 2-4
6: B assumption
7: A∨B ∨ intro 6
8: ⊥ ¬ elim 7,1
9: ¬B ¬ intro 6-8
10: ¬A∧¬B ∧ intro 5,9

5)


1: ¬(A→B) premise
2: ¬A assumption
3: A assumption
4: ¬B assumption
5: ⊥ ¬ elim 3,2
6: B contra (classical) 4-5
7: A→B → intro 3-6
8: ⊥ ¬ elim 7,1
9: A contra (classical) 2-8

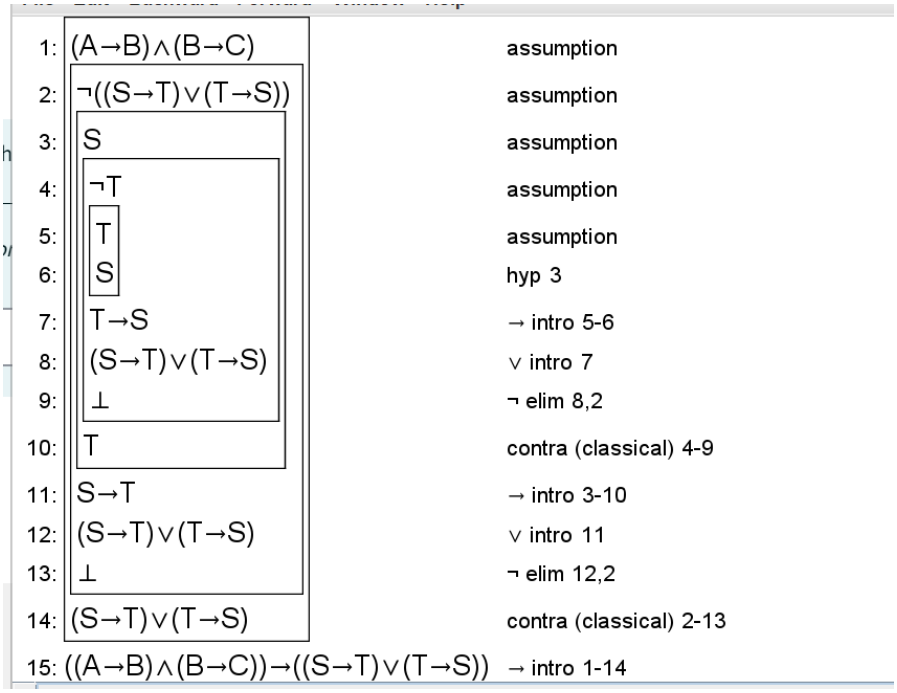
6)

1:	$(A \to B) \to A$	premise
2:	$\neg A$	assumption
3:	A	assumption
4:	$\neg B$	assumption
5:	$\bot$	¬ elim 3,2
6:	B	contra (classical) 4-5
7:	$A \to B$	→ intro 3-6
8:	A	→ elim 1,7
9:	$\bot$	¬ elim 8,2
10:	A	contra (classical) 2-9

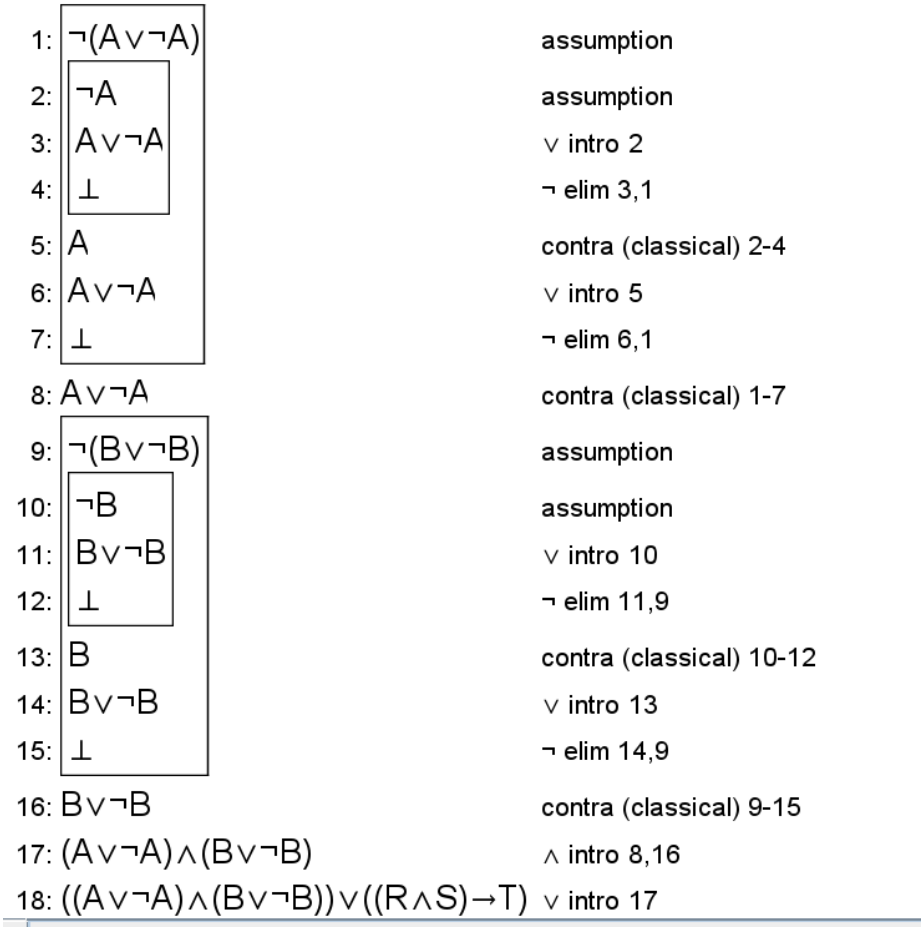
7)

1:	$A \wedge (B \vee C)$	assumption
2:	$B \vee C$	∧ elim 1
3:	B	assumption
4:	A	∧ elim 1
5:	$A \wedge B$	∧ intro 4,3
6:	$(A \wedge B) \vee (A \wedge C)$	∨ intro 5
7:	C	assumption
8:	A	∧ elim 1
9:	$A \wedge C$	∧ intro 8,7
10:	$(A \wedge B) \vee (A \wedge C)$	∨ intro 9
11:	$(A \wedge B) \vee (A \wedge C)$	∨ elim 2,3-6,7-10
12:	$(A \wedge (B \vee C)) \to ((A \wedge B) \vee (A \wedge C))$	→ intro 1-11

8)


1: (A→B)∧(B→C) assumption
2: ¬((S→T)∨(T→S)) assumption
3: S assumption
4: ¬T assumption
5: T assumption
6: S hyp 3
7: T→S → intro 5-6
8: (S→T)∨(T→S) ∨ intro 7
9: ⊥ ¬ elim 8,2
10: T contra (classical) 4-9
11: S→T → intro 3-10
12: (S→T)∨(T→S) ∨ intro 11
13: ⊥ ¬ elim 12,2
14: (S→T)∨(T→S) contra (classical) 2-13
15: ((A→B)∧(B→C))→((S→T)∨(T→S)) → intro 1-14

9)


1: ¬(A∨¬A) assumption
2: ¬A assumption
3: A∨¬A ∨ intro 2
4: ⊥ ¬ elim 3,1
5: A contra (classical) 2-4
6: A∨¬A ∨ intro 5
7: ⊥ ¬ elim 6,1
8: A∨¬A contra (classical) 1-7
9: ¬(B∨¬B) assumption
10: ¬B assumption
11: B∨¬B ∨ intro 10
12: ⊥ ¬ elim 11,9
13: B contra (classical) 10-12
14: B∨¬B ∨ intro 13
15: ⊥ ¬ elim 14,9
16: B∨¬B contra (classical) 9-15
17: (A∨¬A)∧(B∨¬B) ∧ intro 8,16
18: ((A∨¬A)∧(B∨¬B))∨((R∧S)→T) ∨ intro 17

10)

1:	$P \to Q$	assumption
2:	$\neg Q$	assumption
3:	P	assumption
4:	Q	→ elim 1,3
5:	$\bot$	¬ elim 4,2
6:	$\neg P$	¬ intro 3-5
7:	$\neg Q \to \neg P$	→ intro 2-6
8:	$(P \to Q) \to (\neg Q \to \neg P)$	→ intro 1-7
9:	$\neg Q \to \neg P$	assumption
10:	P	assumption
11:	$\neg Q$	assumption
12:	$\neg P$	→ elim 9,11
13:	$\bot$	¬ elim 10,12
14:	Q	contra (classical) 11-13
15:	$P \to Q$	→ intro 10-14
16:	$(\neg Q \to \neg P) \to (P \to Q)$	→ intro 9-15
17:	$((P \to Q) \to (\neg Q \to \neg P)) \wedge ((\neg Q \to \neg P) \to (P \to Q))$	∧ intro 8,16

11)

1:	$A \wedge B$	assumption
2:	A	∧ elim 1
3:	$A \to B$	assumption
4:	A	hyp 2
5:	$(A \to B) \to A$	→ intro 3-4
6:	$(A \wedge B) \to ((A \to B) \to A)$	→ intro 1-5

12)

1:	¬((A→B)∨(B→A))	assumption
2:	A	assumption
3:	¬B	assumption
4:	B	assumption
5:	A	hyp 2
6:	B→A	→ intro 4-5
7:	(A→B)∨(B→A)	∨ intro 6
8:	⊥	¬ elim 7,1
9:	B	contra (classical) 3-8
10:	A→B	→ intro 2-9
11:	(A→B)∨(B→A)	∨ intro 10
12:	⊥	¬ elim 11,1
13:	(A→B)∨(B→A)	contra (classical) 1-12

13)

1:	(P→Q)∧(Q→R)	premise
2:	P	assumption
3:	P→Q	∧ elim 1
4:	Q→R	∧ elim 1
5:	Q	→ elim 3,2
6:	R	→ elim 4,5
7:	(P→R)	→ intro 2-6

14)

1:	(E→(F→G)), E→F, E	premises
2:	F	→ elim 1.2,1.3
3:	F→G	→ elim 1.1,1.3
4:	G	→ elim 3,2

15)

1:	$\neg(P \vee Q)$	assumption
2:	$\neg P$	assumption
	. . .	
3:	P	
4:	$P \vee Q$	$\vee$ intro 3
5:	$\bot$	$\neg$ elim 4,1
6:	P	contra (classical) 2-5
7:	$P \vee Q$	$\vee$ intro 6
8:	$\bot$	$\neg$ elim 7,1
9:	$P \vee Q$	contra (classical) 1-8
10:	$\neg(R \vee S)$	assumption
11:	$\neg S$	assumption
	. . .	
12:	S	
13:	$R \vee S$	$\vee$ intro 12
14:	$\bot$	$\neg$ elim 13,10
15:	S	contra (classical) 11-14
16:	$R \vee S$	$\vee$ intro 15
17:	$\bot$	$\neg$ elim 16,10
18:	$R \vee S$	contra (classical) 10-17
19:	$(P \vee Q) \wedge (R \vee S)$	$\wedge$ intro 9,18
20:	$((P \vee Q) \wedge (R \vee S)) \vee \neg(P \wedge R)$	$\vee$ intro 19