Logic in Computer Science Assignment 1

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1 证明

1.1 $\neg(p \wedge q) \dashv\vdash \neg q \vee p)$

正向:

1	$\neg(p \wedge q)$	premise
2	$p \vee \neg p$	LEM
3	p	assumption
4	q	assumption
5	$p \wedge q$	$\wedge$i 3, 4
6	$\bot$	$\neg$e 1, 5
7	$\neg q$	$\neg$i 4 – 6
8	$\neg q \vee \neg p$	$\vee \mathrm{i}_1$ 7
9	$\neg p$	assumption
10	$\neg q \vee \neg p$	$\vee \mathrm{i}_2$ 9
11	$\neg q \vee \neg p$	$\vee$e 2, 3 – 8, 9 – 10

逆向:

1	$\neg q \vee \neg p$	premise
2	$\neg q$	assumption
3	$p \wedge q$	assumption
4	q	$\wedge \mathrm{e}_2$ 3
5	$\bot$	$\neg$e 2, 4
6	$\neg(p \wedge q)$	$\neg$i 3 – 5
7	$\neg p$	assumption
8	$p \wedge q$	assumption
9	p	$\wedge \mathrm{e}_1$ 8
10	$\bot$	$\neg$e 7, 9
11	$\neg(p \wedge q)$	$\neg$i 8 – 10
12	$\neg(p \wedge q)$	$\vee$e 1, 2 – 6, 7 – 11

1.2 $p \to q \dashv\vdash \neg q \to \neg p$

正向：

1	$p \to q$	premise
2	$\neg q$	assumption
3	$\neg p$	MT 1, 2
4	$\neg q \to \neg p$	$\to$ i 2 – 3

逆向：

1	$\neg q \to \neg p$	premise
2	p	assumption
3	$\neg\neg p$	$\neg\neg$i 2
4	$\neg\neg q$	MT 1, 3
5	q	$\neg\neg$e 4
6	$p \to q$	$\to$ i 2 – 5

1.3 $p \wedge q \to p \dashv\vdash r \vee \neg r$

正向：

1	$r \vee \neg r$	LEM

逆向：

1	$p \wedge q$	assumption
2	p	$\wedge e_1$ 1
3	$p \wedge q \to p$	$\to$ i 1 – 2