

## seq.1 Derivability and the Propositional Connectives

fol:seq:ppr:  
sec

### Proposition seq.1.

fol:seq:ppr:

prop:provability-land

fol:seq:ppr:

prop:provability-land-left

fol:seq:ppr:

prop:provability-land-right

1. Both  $\varphi \wedge \psi \vdash \varphi$  and  $\varphi \wedge \psi \vdash \psi$ .

2.  $\varphi, \psi \vdash \varphi \wedge \psi$ .

*Proof.* 1. Both sequents  $\varphi \wedge \psi \Rightarrow \varphi$  and  $\varphi \wedge \psi \Rightarrow \psi$  are **derivable**:

$$\frac{\varphi \Rightarrow \varphi}{\varphi \wedge \psi \Rightarrow \varphi} \wedge L \quad \frac{\psi \Rightarrow \psi}{\varphi \wedge \psi \Rightarrow \psi} \wedge L$$

2. Here is a **derivation** of the sequent  $\varphi, \psi \Rightarrow \varphi \wedge \psi$ :

$$\frac{\varphi \Rightarrow \varphi \quad \psi \Rightarrow \psi}{\varphi, \psi \Rightarrow \varphi \wedge \psi} \wedge R$$

□

fol:seq:ppr:

prop:provability-lor

### Proposition seq.2.

1.  $\varphi \vee \psi, \neg\varphi, \neg\psi$  is inconsistent.

2. Both  $\varphi \vdash \varphi \vee \psi$  and  $\psi \vdash \varphi \vee \psi$ .

*Proof.* 1. We give a **derivation** of the sequent  $\varphi \vee \psi, \neg\varphi, \neg\psi \Rightarrow$ :

$$\frac{\frac{\frac{\varphi \Rightarrow \varphi}{\neg\varphi, \varphi \Rightarrow} \neg L}{\varphi, \neg\varphi, \neg\psi \Rightarrow} \quad \frac{\frac{\psi \Rightarrow \psi}{\neg\psi, \psi \Rightarrow} \neg L}{\psi, \neg\varphi, \neg\psi \Rightarrow} \quad \frac{}{\varphi \vee \psi, \neg\varphi, \neg\psi \Rightarrow} \vee L$$

(Recall that double inference lines indicate several weakening, contraction, and exchange inferences.)

2. Both sequents  $\varphi \Rightarrow \varphi \vee \psi$  and  $\psi \Rightarrow \varphi \vee \psi$  have **derivations**:

$$\frac{\varphi \Rightarrow \varphi}{\varphi \Rightarrow \varphi \vee \psi} \vee R \quad \frac{\psi \Rightarrow \psi}{\psi \Rightarrow \varphi \vee \psi} \vee R$$

□

fol:seq:ppr:

prop:provability-lif

### Proposition seq.3.

fol:seq:ppr:

prop:provability-lif-left

fol:seq:ppr:

prop:provability-lif-right

1.  $\varphi, \varphi \rightarrow \psi \vdash \psi$ .

2. Both  $\neg\varphi \vdash \varphi \rightarrow \psi$  and  $\psi \vdash \varphi \rightarrow \psi$ .

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1

*Proof.* 1. The sequent  $\varphi \rightarrow \psi, \varphi \Rightarrow \psi$  is **derivable**:

$$\frac{\varphi \Rightarrow \varphi \quad \psi \Rightarrow \psi}{\varphi \rightarrow \psi, \varphi \Rightarrow \psi} \rightarrow L$$

2. Both sequents  $\neg\varphi \Rightarrow \varphi \rightarrow \psi$  and  $\psi \Rightarrow \varphi \rightarrow \psi$  are **derivable**:

$$\frac{\frac{\frac{\varphi \Rightarrow \varphi}{\neg\varphi, \varphi \Rightarrow} \neg L}{\varphi, \neg\varphi \Rightarrow} XL}{\varphi, \neg\varphi \Rightarrow \psi} WR \quad \frac{\frac{\psi \Rightarrow \psi}{\varphi, \psi \Rightarrow \psi} WL}{\psi \Rightarrow \varphi \rightarrow \psi} \rightarrow R$$

□

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## Bibliography