

**Automated Theorem Proving, SS 2014. Homework 3 (due April 15, 2014)**

1. Prove the following theorems:
  - (1.a)  $\varphi \equiv \psi$  iff  $\varphi \iff \psi$  is valid.
  - (1.b)  $\varphi \equiv \psi$  iff  $(\varphi \models \psi \text{ and } \psi \models \varphi)$ .
  - (1.c)  $\varphi_1, \dots, \varphi_n \models \psi$  iff  $\varphi_1 \wedge \dots \wedge \varphi_n \Rightarrow \psi$  is valid.
  - (1.d)  $\varphi_1, \dots, \varphi_n \models \psi$  iff  $\varphi_1 \wedge \dots \wedge \varphi_n \wedge \neg\psi$  is unsatisfiable.
2. Prove that  $Q$  is a logical consequence of  $P$  and  $P \Rightarrow Q$ . This is the so-called *modus ponens* rule.
3. Prove that  $Q$  is a logical consequence of  $P$  and  $\neg Q \Rightarrow \neg P$ .