

# Transformation of natural language sentences into predicate Formulas

1.  $D_S = \text{the set of students}$

$$(\forall x)_{x \in D_S} (CS(x) \rightarrow sm(x))$$

$$2. (\exists x)_{x \in D_S} (stuUB(x) \wedge sm(x))$$

3.  $D = \mathbb{Z}$

$$(\forall x)(\forall y) (neg(x) \wedge neg(y) \wedge gt(x, y) \rightarrow gt(sq(x), sq(y)))$$

Example 1: Lecture 5

$$H_1: (\forall x) (hb(x) \rightarrow rc(x))$$

$$H_2: \neg(\exists x)(\neg sb(x) \wedge lh(x))$$

$$\equiv (\forall x)(sb(x) \vee \neg lh(x))$$

$$\equiv (\forall x)(\neg sb(x) \rightarrow \neg lh(x))$$

$$H_3: (\forall x)(\neg lh(x) \rightarrow \neg rc(x))$$

$$H_4: hb(p)$$

$$C_1: (\exists x) lh(x)$$

$$C_2: (\forall x)(hb(x) \rightarrow sb(x))$$

$$H_1 \frac{}{\text{univ. inst.}, x \leftarrow p} hb(p) \rightarrow rc(p) : J_5$$

$$H_2 \frac{}{\text{univ. inst.}, x \leftarrow p} \neg sb(p) \rightarrow lh(p) : J_6$$

$$H_3 \frac{}{\text{univ. inst.}, x \leftarrow p} \neg lh(p) \rightarrow \neg rc(p) : J_7$$

$$H_4, J_5 \frac{}{\text{m.p.}} rc(p) : J_8$$

$$J_8, J_7 \frac{}{\text{m.t.}} lh(p) : J_9$$

$$J_9 \frac{}{\text{exist-gen}} (\exists x) lh(x) : C_1$$

$$H_1 \frac{}{\text{univ. inst.}} hb(x) \rightarrow rc(x) : J_{10}$$

$$H_2 \frac{}{\text{univ. inst.}} \neg sb(x) \rightarrow \neg lh(x) : J_{11}$$

$$H_3 \frac{}{\text{univ. inst.}} \neg lh(x) \rightarrow \neg rc(x) : J_{12}$$

$$J_{11}, J_{12} \frac{}{\text{syllogism}} \neg sb(x) \rightarrow \neg rc(x) : J_{13}$$

$$J_{13} \frac{}{\text{m.t.}} rc(x) \rightarrow sb(x) : J_{14}$$

$$J_{10}, J_{14} \frac{}{\text{syllogism}} hb(x) \rightarrow sb(x) : J_{15}$$

15 univ. gen.  $(\forall x)(h(x) \rightarrow sb(x))$

Logical equivalences in predicate logic

$$(\forall x) A(x) \equiv A(a) \wedge A(b) \\ x \in \{a, b\}$$

$$(\exists x) A(x) \equiv A(a) \vee A(b) \\ x \in \{a, b\}$$