

# Theoretische Grundlagen der Informatik 3: Hausaufgabenabgabe 9

## Tutorium: Sebastian , Mi 14.00 - 16.00 Uhr

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### Aufgabe 1

(i)

$$\begin{aligned}\varphi_1 &:= \neg(\exists x \exists y E(x, y) \wedge \neg \exists x \forall y \exists z (\neg E(x, z) \vee f(x, y) = z)) \rightarrow \exists x E(x, f(y, x)) \\ &\equiv (\exists x \exists y E(x, y) \wedge \neg \exists x \forall y \exists z (\neg E(x, z) \vee f(x, y) = z)) \vee \exists x E(x, f(y, x)) \\ &\equiv (\exists x \exists y E(x, y) \wedge \forall x \exists y \forall z \neg (\neg E(x, z) \vee f(x, y) = z)) \vee \exists x E(x, f(y, x)) \\ &\equiv (\exists x \exists y E(x, y) \wedge \forall x \exists y \forall z (E(x, z) \wedge \neg (f(x, y) = z))) \vee \exists x E(x, f(y, x)) \text{ in NNF} \\ &\equiv (\exists x_1 \exists y_2 E(x_1, y_2) \wedge \forall x_2 \exists y_2 \forall z_1 (E(x_2, z_1) \wedge \neg (f(x_2, y_2) = z_1))) \vee \exists x_3 E(x_3, f(y, x_3)) \\ &\equiv \exists x_1 \exists y_2 \forall x_2 \exists y_2 \forall z_1 \exists x_3 ((E(x_1, y_2) \wedge (E(x_2, z_1) \wedge \neg (f(x_2, y_2) = z_1))) \vee E(x_3, f(y, x_3))) \text{ in PN}\end{aligned}$$

(ii)

### Aufgabe 2

$$\begin{aligned}\phi_1(\mathcal{N}) &:= \exists x (y = x + x) \\ \phi_2(\mathcal{N}) &:= \exists x (y = x \cdot x) \\ \phi_3(\mathcal{R}) &:= x = y \cdot y \\ \phi_4(\mathcal{R}) &:= \exists m \forall n (m \cdot n = m \wedge m = x + y) \\ \phi_5(\mathcal{R}) &:= \exists m \exists n (n \cdot n = m \wedge y = x + m) \\ \phi_6(\mathcal{R}) &:= (u'' = u \cdot u' - v \cdot v') \wedge (v'' = u' \cdot v + u \cdot v')\end{aligned}$$