

Prädikatenlogik

$\wedge \vee \neg$ $a \ b \ c \dots$

$\exists x \ \forall y$ $s(a,b)$

— . —

Metainterpreter

1) KNF = konjunktive
Normalform

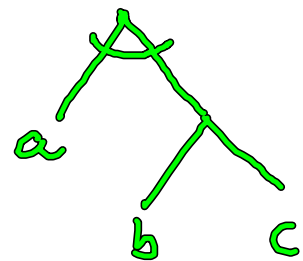
2) Resolution ← Beweismethode

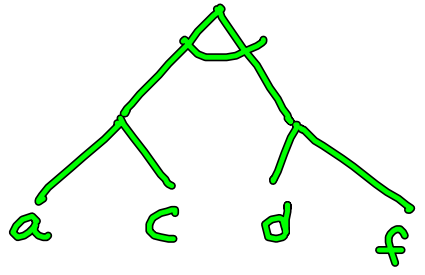
KNF

AND-OR-Bäume

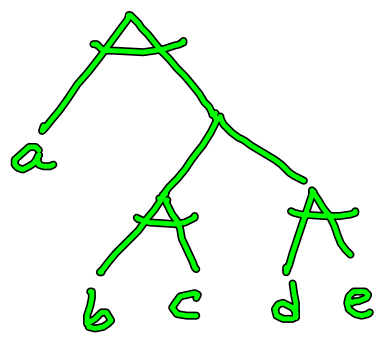
$a \wedge (b \vee c)$

$(a \vee c) \wedge (d \vee f)$





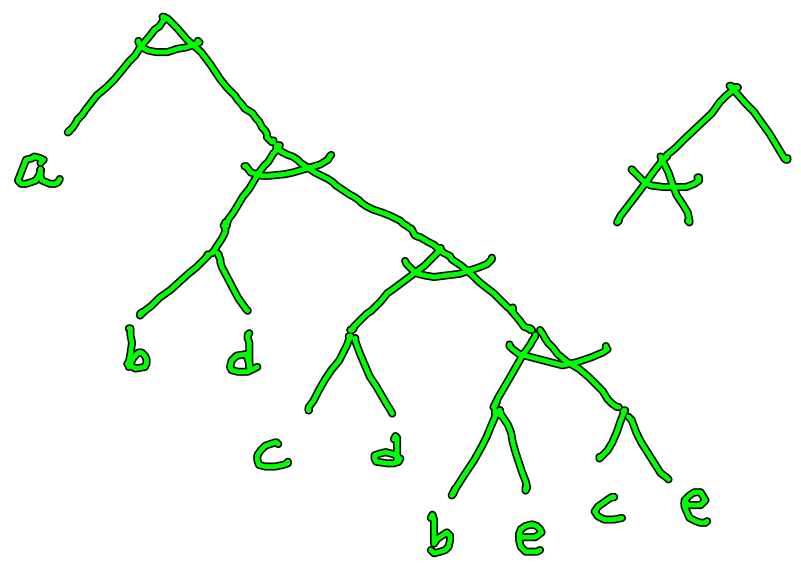
Nicht KNF



$$a \wedge ((b \wedge c) \vee (d \wedge e))$$

$$a \wedge (((b \wedge c) \vee d) \wedge ((b \wedge c) \vee e))$$

$$a \wedge ((b \vee d) \wedge (c \vee d) \wedge (b \vee e) \wedge (c \vee e))$$



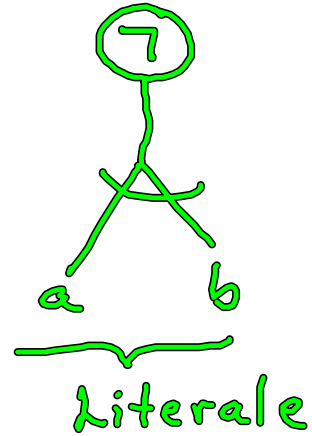
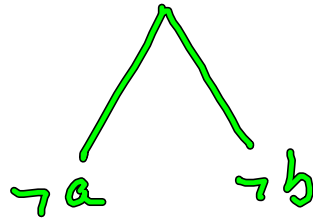
$$(a + b) * c$$

$$a * c + b * c$$

$$\neg(a \wedge b)$$

|||

$$\neg a \vee \neg b$$



$$\frac{\forall x \quad P(x)}{\dots \dots \dots} \Rightarrow P(x)$$
$$\exists x \quad P(x)$$

renaming

$$\forall x \left(P(x) \wedge \left(\forall x \quad Q(x) \right) \right)$$
$$\forall x \quad P(x) \wedge \left(\forall y \quad Q(y) \right)$$

Skolemisierung

$$\exists x \quad P(x) \Rightarrow P(\text{gott})$$

$$\forall y (\exists x P(x,y)) \Rightarrow P(f(y), y)$$

$$\neg (\forall y P(y)) \equiv \exists x \neg P(x)$$

$$\downarrow$$

$\neg P(\text{jemand})$

$$\neg (\exists x g(x)) \equiv \forall x \neg g(x)$$

Syntax

and (-, -)

or (-, -)

not ()

forall (a, P(a)) $\forall a P(a)$

exists (b, forall (a, P(a,b)))

$\exists b \forall a P(a,b)$

$$\neg(\forall x \neg(\exists y (p(x) \vee (\forall z g(y,x,z))))))$$

KNF-Form

- 1) Negationen weiter reichen
- 2) Quantoren entfernen
- 3) Reordnen (AND, OR)

negation (Formel, Transformiert)

negation (not (not (A)), C) :- 1
 negation (A, C).

negation (not (and (A, B)), or (C, D)) :-
 !, negation (^{not(A)}~~A~~, C), negation (~~B~~, ^{not(B)}D).

negation (not (or (A, B)), and (C, D)) :-

!, negation (not(A), C),
negation (not(B), D).

negation (and (A, B), and (C, D)):-
!, negation (A, C), negation (B, D).

negation (or or):-
" " " " "

negation (not (forall (X, P)),
!, exists (X, Y)):-!,
negation (not(P), Y).

negation (not (exists
!, forall
negation (A, A). "catch all"

reorder (or (and (A, B), C), and (X, Y)):-

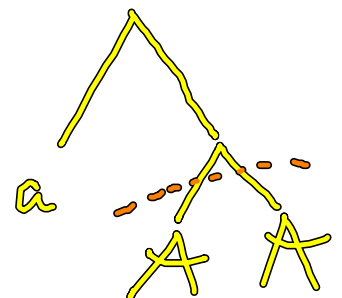
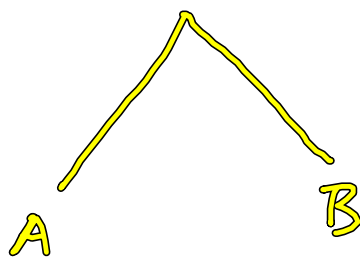
reorder (or (A, C), X),
 reorder (or (B, C), Y).

reorder (or (C, and (A, B))) :-
 C, A C, B

reorder (and (A, B), and (C, D)) :-
 !, reorder (A, C),
 reorder (B, D).

reorder (or (A, B), and (X, Y)) :-
 reorder (A, and (D, E)), !,
 reorder (or (D, B), X),
 reorder (or (E, B), Y).

$A \vee B$
 $(D \wedge E) \vee B$



reorder (.....) :-

reorder (B, and (D, E)), !,

reorder (or (A, D), X),

reorder (or (A, E), Y).

reorder (A, A).

~~reorder (P, Q) :-~~

~~reorder (or (A, B), P),~~

~~reorder (and (X, Y), Q).~~

~~reorder (A, and (D, E)), !,~~

forall (x, exists (b, g (x, b)))



entfent

exists (b, g (x, b))



$$g(x, b(x))$$



$$\underbrace{\forall x \forall y}_{\text{histe}} \exists z \quad g(x, y, z)$$

histe



$$g(x, y, z(x, y))$$

$$\forall x \left(\forall y \left(\exists x \ g(x, y) \right) \right)$$

$$\left(\forall x(1) \left(\forall y(2) \left(\exists x(3) \ g(x(3), y(2)) \right) \right) \right)$$

$$\text{Vars} = [\dots]$$

$$= [[,] , [,] , [,] , \dots]$$

$$= [[x, x(1)], [y, x(2)],$$

$$[x, x(3)]$$

member $(x, [x1-])$.

member $(x, [-|R]) :-$ member (x, R) .

? $x(1,2) = .. Y$.

$$Y = [x, 1, 2]$$

? $Z = .. [x, 1, 2]$

$$Z = x(1,2)$$

?

$$\forall x \forall y \exists z \dots z$$

↑
 $z(x,y)$

$$[[x, x(1)], [y, x(2)]]$$

$$z \rightarrow z(x^{(1)}, x^{(2)})$$

Standard (... Formel... Formel Ohne...)

↗ substitute (.....)

transf (x, y)
= =
↑ KNF