Kap. 2 Prädikatenlogik

$\downarrow$

Kap. 3 Suchen in Entscheidungbäumen

Aussagenlogik

Konstante Atomare Aussagen

1	true	true
0	false	fail

Operatoren $\wedge, \vee, \neg$

AND OR NEGATION

Prolog

and(1, 0) $\quad 1 \wedge 0$

Stuktur

and (and (1, 0), 1) $(1 \wedge 0) \wedge 1$

$\uparrow$ S_1 $\uparrow$ S_2

and (or (1, 0), or (and (1, 1), 1))

$(1 \vee 0) \vee ((1 \wedge 1) \vee 1)$

?- eval (and (1, 1)).

yes

```
eval ( 1 ) :- true.
eval ( and ( A, B ) ) :- eval(A), eval(B).
eval ( or ( A, B ) ) :- eval(A); eval(B).
eval ( not (A) ) :- not (eval(A)).
```

$\underbrace{\text{not (A)}}_{\text{Stuktur}}$ $\underbrace{\text{not}}_{\text{Prädikat}}$

$$? \ \text{eval}(\overbrace{\text{and}(\text{not}(1), 1)}^{\text{Strukturen}}).$$

$$f(g(h(x)))$$

? eval(0).
fail.

Negation als Failure

```
not(A) :- call(A), !, fail.
not(A) :- true.
```

call: meta prädikat

! : cut

! ← entfernt der choice point

? not(true).
yes

```
not(A) :- call(A), fail.
not(A) :- true.
```

CP

? not(fail).
yes

```
not(fail) :- call(fail), fail.
not(fail).
```

? not(true).

fail

not(true) :- call(true), !, fail.

~~CP~~ → ~~not(true) :- true.~~

__________ . __________

```
eval(1) :- true.
eval(and(A,B)) :- !, eval(A), eval(B).
eval(not(A)) :- !, not(eval(A))
eval(or(A,B)) :- !, eval(A); eval(B).
```

CP fail

? . p1 , p2 , ... p3 . ... p4

4. Zeile

```
eval(or(A,B)) :- eval(A).
eval(or(A,B)) :- eval(B).
```

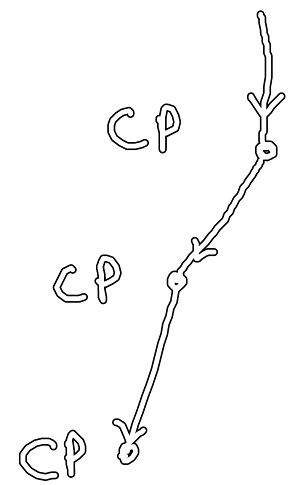
p1(   ) :- !,

p1(   ) :- (a, b);(c, d)

p1(   ) :-

p1(   ) :-

a, (b;c), d



eval ← Metainterpreter

<u>Prädikatenlogik</u> = Aussagenlogik

+

Quantoren $\forall, \exists$

+

Variablen
+
Funktionen

Bsp:

$$\underbrace{\forall x \quad A(x) \wedge B(x)}$$

Metainterpreter für PL

forall (X, P)

Var Aussage

exists (X, P)

Variablen: x(1)
x(2)
x(3)
⋮

father (x(1))
mother (x(2))
⋮

$\exists y$ friend (y, peter)

friend(thomas, peter).

⋮

KI-VL

Prolog

?- verify(......). ← überprüft Syntax

yes

verify(1) :- !, true.

```
verify(0) :- !, true.
verify(exists(x(N), P)) :- !, verify(P).
verify(forall(x(N), P)) :- !, verify(P).
verify(and(A, B)) :- !, verify(A),
                        verify(B).
verify(or(A, B)) :- !, verify(A),
                       verify(B).
verify(not(A)) :- !, verify(A).
```

(Funktionen kommen noch)

```
? verify(and(1, forall(x(1), 1))).
```

KNF $\equiv$ Konjuntive Normalform

$$S \equiv S_1 \wedge S_2 \wedge \ldots \wedge S_n$$

$$S_i \equiv S_i' \vee S_i'' \vee \ldots$$

$$S_i' \equiv S \mid \neg S$$

KNF

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

```
knf(A, B) :- negation(A, C),
             reorder(C, B).
```

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

$$a \vee (b \wedge c) \equiv (a \vee b) \wedge (a \vee c)$$

```
reorder(or(and(A,B),C), and(or(A,C),
                            or(B,C))).

reorder(or(and(A,B),C), reorder(A,A2),
                        reorder(B,B2),
                        reorder(C,C2),
                        ⋮
                        ).

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

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

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

reorder(and(A,B), and(X,Y)):-!,
    reorder(A,X),
    reorder(B,Y),

( reorder(or(A,B),or(X,Y)):.... ? )
reorder(A,A).
```

Unifikation

```
? unify(x(1), 1).
  yes
  ⋮
```

Metaprädikate

```
? var(X).
  yes
? var(2).
  fail
```

Wahr wenn Argument eine Variable

```
? s(1,2,3) =.. L.
```

L = [s, 1, 2, 3]

?

(Syntax von Prolog)

Unifikation (Versuch 1)

```
1)    unify(X,Y) :- var(X), !, true.

      ? unify(T,1).
        yes

2)    unify(X,Y) :- var(Y), !, true.

3)    unify(X,Y) :- X==Y, !.

4)    unify(X,Y) :-

      ? unify(s(X), s(1)).

      unify(X,Y) :- X =.. L1,
                    Y =.. L2,
                    uniflist(L1,L2).

      ? 1 =.. L.
        L = [1].
```