PROLOG as Language

Syntax

Operators

Equality

Arithmetic

Satisfying Goals

Syntax

Terms

constant
variable
structure

Constants

Naming

Specific Objects

Specific Relationships

likes mary john book wine owns jewels can_steal a

void

=

'george-smith'

—>

george_smith

ieh2304

Integers

(size is implementation dependent)

Non-Valid Symbols

`2340ieh` — **Begins with number**

`george-smith` — **Dash**

`Void` — **Begins with Capital**

`_alpha` — **Begins with underscore**

Variables

Begin with Capital

or

with underscore

Answer

Input

_3_blind_mice

Anonymous

A single underscore

`likes(john,_).`

Need not be assigned to the same variable

`likes(_,_).`

Structures

Collection of Objects,

Components,

grouped together in one object

Help Organize

Make code more readable

Structures

Example

Index Card for Library

Author's Name

Title

Date

Publisher

Name could be split also

first, last, etc.

Examples

owns(john,book).

One Level

```
owns(john,wuthering_heights).
owns(mary,moby_dick).
```

Deeper

```
owns(john,book(wuthering_heights,bronte)).

owns(john,book(wuthering_heights, author(emily,bronte))).
```

Questions

Does John own a book by the Bronte sisters?

```
owns(john,book(X,author(Y,bronte))).
```

For the yes/no question

owns(john,book(_,author(_,bronte))).

(note that each _ could be different)

Equality

An infix operator

`=`

Example

`X = Y`

A match is attempted between

expression `X`

and

expression `Y`

PROLOG does what it can to match

`X` and `Y`

Example: Instantiated

`X` is uninstantiated

`Y` is an object

`X = Y`

`X` and `Y` will be matched

Thus X will be instantiated by the object Y

```
?- rides(clergyman,bicycle) = X.

X = rides(clergyman,bicycle) ;

No
```

Example: Symbols

```
?- policeman = policeman.

Yes
?- paper = pencil.

No
?- 1066 = 1066.

Yes
?- 1206 = 1583.

No
```

Arguments Instantiated

If the structures are equal

Then their arguments are matched

```
?- rides(clergyman,bicycle) = rides(clergyman,X).

X = bicycle ;

No
```

Arguments Instantiated

```
?- a(b,C,d(e,F,g(h,i,J))) = a(B,c,d(E,f,g(H,i,j))).

B = b
C = c
E = e
F = f
H = h
J = j ;

No
```

Equality

```
?- X=X.

X = _G147 ;

No
?- Y=X.

Y = _G147
X = _G147 ;

No
```

Equality

```
?- X=Y, X=1200.

X = 1200
Y = 1200 ;

No
?-
```

Arithmetic Comparisons

```
X = Y
X \= Y
X < Y
X > Y
X =< Y
X >= Y
```

Arithmetic

```
?- 123 > 14.

Yes
?- 14 > 123.

No
?- 123 > X.
ERROR: Arguments are not sufficiently instantiated
?-
```

Example

Prince *was a prince during year,* **Year** *if*
Prince *reigned between years,* **Begin** *and* **End**
Year *is between* **Begin** *and* **End**.

```
prince(Prince,Year) :-
     reigns(Prince,Begin,End),
     Year >= Begin,
     Year =< End.

reigns(rhodri,844,878).
reigns(anarawd,878,916).
reigns(hywel_dda,916,950).
reigns(lago_ad_idwal,950,979).
reigns(hywel_ab_ieuaf,979,985).
```

```
reigns(cadwallon,985,986).
reigns(maredudd,986,999).
```

Runs

Was Cadwallon a prince in 986?

Is Rhodri a prince in 1995?

```
?- prince(cadwallon,986).

Yes
?- prince(rhodri,1995).

No
?-
```

Who was a Prince When

Who was the prince in 900?
Who was the prince in 979?

```
?- prince(Prince,900).
Prince = anarawd ;

No
?- prince(Prince,979).

Prince = lago_ad_idwal ;

Prince = hywel_ab_ieuaf ;

No
?-
```

Invalid Question

When was Cadwallon a prince?

```
?- prince(cadwallon,Year).
ERROR: Arguments are not sufficiently instantiated
```

Calculating

Calculating the Population Density of a Country:
Population over the Area

```
density(Country,Density) :-
   pop(Country,Pop),
   area(Country,Area),
   Density is Pop/Area.

pop(usa,203).
pop(india,548).
pop(china,800).
pop(brazil,108).

area(usa,3).
```

```
area(india,1).
area(china,4).
area(brazil,3).
```

Questions

What is the population density of USA?
What Country has which density?

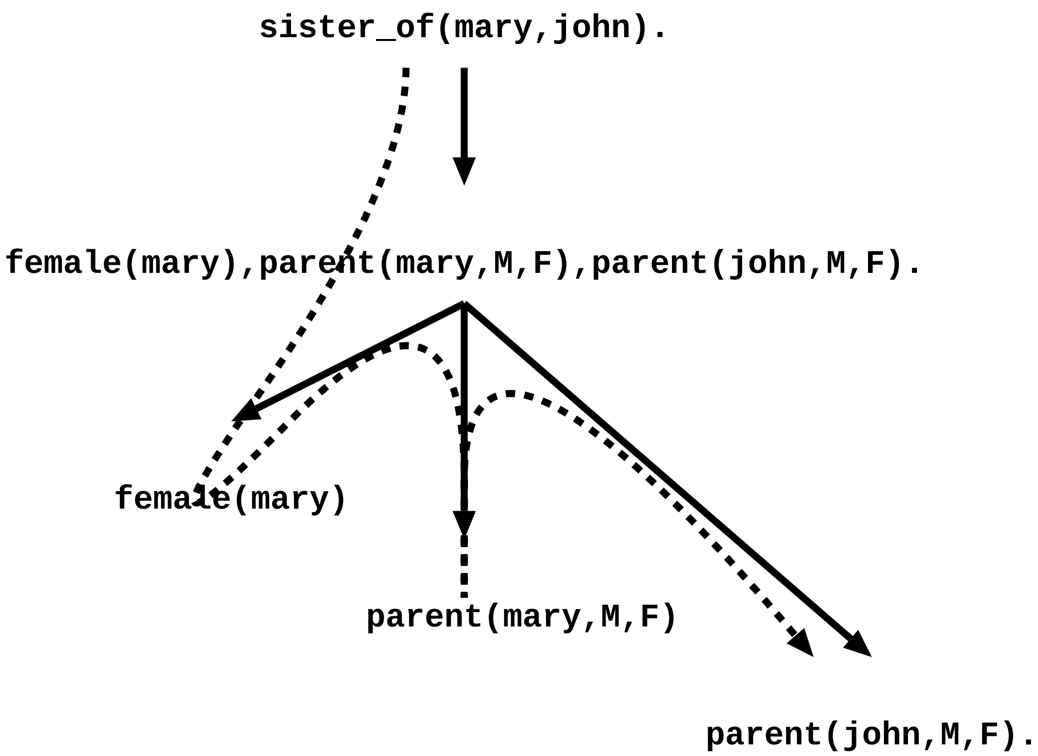
```
?- density(usa,X).

X = 67.6667 ;

No
?- density(X,Y).

X = usa
Y = 67.6667 ;

X = india
Y = 548 ;
```

```
X = china
Y = 200 ;

X = brazil
Y = 36 ;

No
?-
```

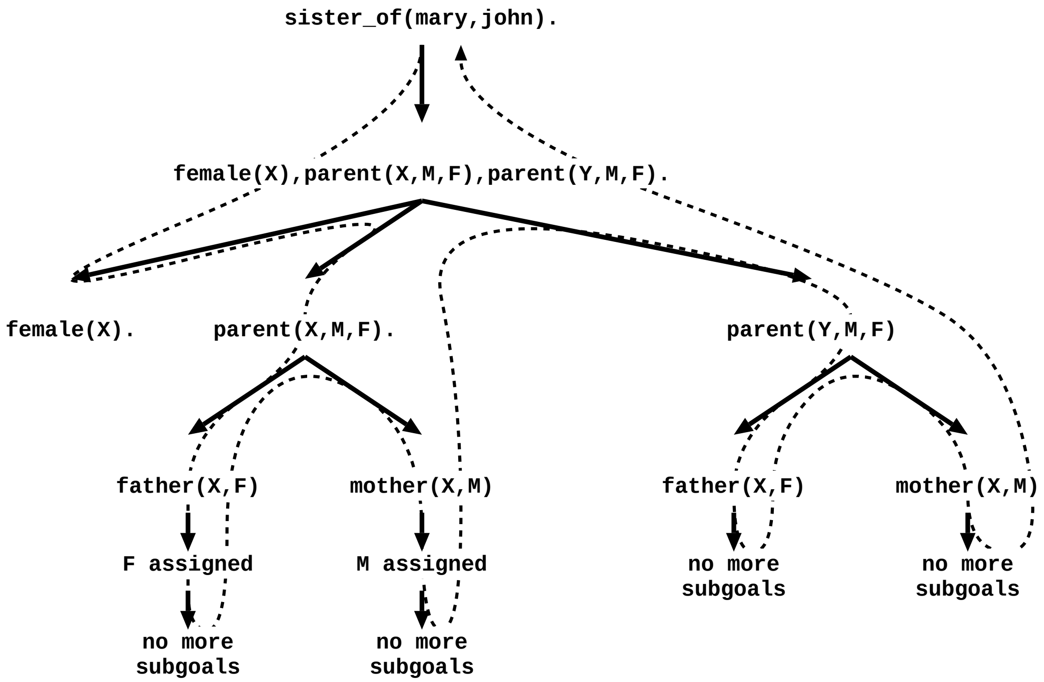
Arithmetic Operations

```
X + Y
X - Y
X * Y
X / Y
X mod Y
```

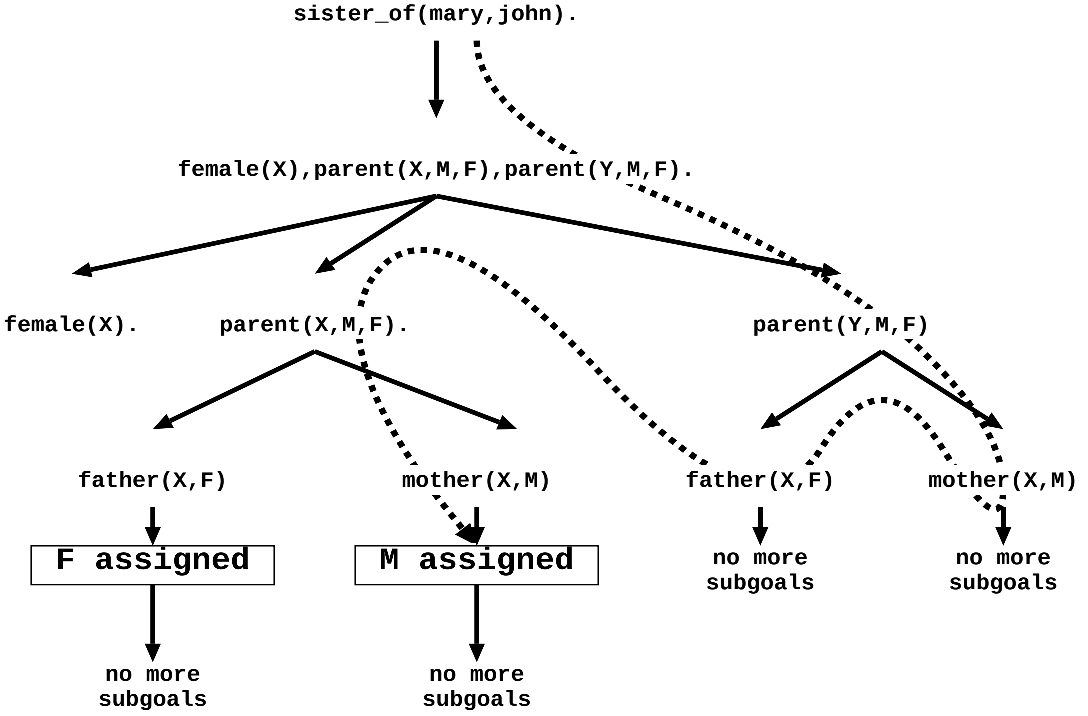
Simple Flow


sister_of(mary,john).
female(mary),parent(mary,M,F),parent(john,M,F).
female(mary)
parent(mary,M,F)
parent(john,M,F).

Satisfying Sub-Goals



Backtrack after Fail



Matching

An Uninstantiated Variable
will match any object
That object will be what the variable stands for

An integer or atom will only match itself

A structure will match another structure
with the same functor
and the same number of arguments
and all corresponding arguments must match

How is this matched

```
?- assert(sum(5)).
yes
?- assert(sum(3)).
yes
?- assert(sum(X+Y)).
true ? ;
no
?- sum(2+3).
yes
?- trace.
yes
{trace}
?- sum(2+3).
 + 1  1  Call: sum(2+3) ?
```

```
 + 1  1  Exit: sum(2+3) ?
yes
```