Example programs

Showing things to look for

Infinite loops

- Avoid circular definitions

```
parent ( A,  B )  :-  child ( B,  A ).
child ( C,  D )  :-  parent ( D,  C ).
```

- Easy to see here but as database grows you can forget what is in it and circularity can creep in

Infinite loops – Left Recursion – 1

- Left recursion can cause problems

```
person ( X )  :-  person ( Y ) , mother ( Y, X ).

person ( eve ).
```

  - **The query person (P) loops indefinitely as the first rule is found first on every recursive call.**
  - **Second rule is only tried if first rule fails**

- Reordering the rules will correct the problem if only the first answer is wanted.

Heuristic
Put facts before rules

Infinite loops – Left Recursion – 2

- Left recursion can cause problems – continued

```
person ( eve ).

person ( X )  :-  person ( Y ) , mother ( Y, X ).
```

  - **Assuming mother fails, the query person (P) loops indefinitely after P = eve**

- Left recursion is the problem

Do not assume Prolog will find the facts and rules.
Need to know how searching works

Multiple answers – isList, weakList

- The textbook gives the following predicate but loops forever on the query **isList (X)**.

```
isList ( [ A | B ] )  :-   isList ( B ).
isList ( [] ).
```

- It can be defined just as well by putting the fact first.

```
isList ( [] ).
isList ( [ A | B ] )  :-   isList ( B ).
```

- But gives more than one answer for the query **isList (X)** but does not loop forever.

- For the latter query, to have only one answer, can assert the following.

```
weak_isList ( [] ).
weak_isList ( [ _ | _ ] ).
```

Why is weak_isList weak?

- The strong definition says a list must have the correct structure and must end in nil.
- The weak definition simply says the list must have the correct structure for one level and says nothing about nil except for the empty list.
- For example – recall [...] is shorthand for the structure .(...)

```
isList ( .( a , [] ) ).                  ==> yes
isList ( .( a , .( b , [] ) ) ).         ==> yes
isList ( .( a , .(b, .( c , [] ) ) ) ).  ==> yes
isList ( .( a , b ) ).                   ==> no
isList ( .( a , .( b , c , [] ) ) ).     ==> no
```

- But all responses are yes for weak_isList

Mapping

- Consider the problem of translating a sentence from one form to another
  - **For example as in the following "dialogue" the second sentence is a translation of the preceding sentence**
    - **you are a computer**
      I am not a computer
    - **do you speak french**
      no I speak german
  - **Assume the following simplistic translations**
    - **you ==> I**
      are ==> am not
      do ==> no
      french ==> german

Mapping – 2

- Let us represent sentences as a list of words

  you are a computer ==> [you , are , a , computer]

- We represent the list of words to change as a set of change rules

```
change ( you , I ).
change ( are ,  [ am , not ] ).
change ( french , german ).
change ( do , no ).
change ( X , X ).      /* catch all to make no
                          changes */
```

Mapping – 3

- Then the translation rules can be the following.

```
alter([] , []).
alter ( [ H I T ] , [ X I Y ] )  :-  change (H, X ) , alter ( T, Y ).
```

- Then we can translate our example sentences

```
alter ( [ you, are, a, computer ] , Trans ).
```

> Trans = [I , am , not , a , computer]

» Try using ;<return> on the above. Explain why there are multiple answers. Try a trace to see what is happening.

> We need a method to prevent multiple answers

Mapping – 4

- Try the inverse – with **;<return>**

  alter (Org , [I , am , not , a , computer]).

- Try a variable – with ; <return>

  alter ([you , are , a , X] , Trans)

Warning – Caution – Danger

Logic and a finite database
can lead to strange
and unexpected results.
Use with extreme caution.