Concepts of programming languages

Prolog

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Terms

- ▶ building blocks of facts, rules, and queries.
- ▶ 4 kinds of terms:
- ▶ atoms
- ▶ numbers (both are called constants)
- ▶ variables
- ▶ complex terms

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Atom

Either:

- string of charachrers (upper-case, lower-case, digits, _), begins with lower-case ch. E.g.: big_kahuna_burger, listens2Music.
- arbitraty string of characters enclosed in '' (single). E.g: 'The Beatles', ' &ˆ%&#@$ &* '.
- string of special characters (e.g. ; or :-) E.g: in rule syntax term1 :- term2;

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Numbers

- ► Floats (e.g. 1657.3087 or π)
- ► Integers (23 , 1001 , 0 , -365)
- ► Straigtforward syntax

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Variable

- starts with upper-case letter or _ (E.g: X, Y_50, List1, _input)
- anonimous variable _

Complex term

- building block: functor (which is an atom) with arguments (terms) E.g: `playsAirGuitar(jody)`, `loves(vincent,mia)`.
- nested functors make up complex terms E.g: `and(big(burger),kahuna(burger)).`, `vertical(line(point(X,Y),point(X,Z))).`

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Clauses

- ▶ Rules (clauses) state information that is conditionally true of the situation of interest.
- ▶ term1 :- term2
- ▶ term1 is true if term2 is true.

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some examples again

```
father(Y,Z):-  man(Y),  son(Z,Y).
wizard(X):-  hasBroom(X),  hasWand(X).
```

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Unification (how it works)

Two terms unify if they are the same term or if they contain variables that can be uniformly instantiated with terms in such a way that the resulting terms are equal.

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what this means??

Some examples: * x = 1. * list(X, X) = list(1, 2) * X = father(X)

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more on unification..

- ► two terms either unify or not
- ► if they unify, we are interested to know how the variables have to be instantiated to make the terms unify.

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more precise rules:

Two terms (term1 and term2) unify:

►   1. If they are both constants, they unify iff they are the same atom (or number)

►   2. If term1 is a variable and term2 is any term, then they unify and term1 is instantiated to term2.

►   3. If both terms are variables, they're both instantiated to each other.

►   4. If both are complex terms and … (next silde)

►   5. Iff it follows from the rules above that they unify.

Some examples first

Terms that unify * (1) *burger_1* and *burger_1*

- ► 2. *X* and vincent (*X* is inst-ed to *vincent*)
- ► 3. *X* and *Y*

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For complex terms:

If term1 and term2 are complex terms, they unify iff:

- ▶ they have the same functor and arity (nr. of args)
- ▶ all their corresponding arguments unify
- ▶ the variable instantiations are compatible

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Example:

Knowledge base (KB):

vertical(line(point(X,Y),point(X,Z)))

Query:

vertical(line(point(1,1),point(2,3))).

Processing logic: * 1. Try unification of the complex term vertical(1 argument) in the query to that in the KB.

- ► 2. Try unification of the functor (complex term) *line* in query and KB.
- ► 3. Try unification of the arguments of the functor *line*.
- ► 4. … Unify point(1, 1) with point(X, Y), instantiate X to 1 and Y to 1.
- ► 5. Unify point(1, 3) with point(X, Z). Conflict: X has been inst.-ed to 1 and cannot unify with 2 now.
- ► 6. Hence, two complex terms do not unify.