SNePS 3 USER'S MANUAL[1]

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Chapter 1

Syntax

1.1 Notation

The syntax is given in this chapter using Extended Backus-Naur Form (EBF). Terminal symbols are surrounded by the quotation marks "`" and "'". Sequences of items are separated by commas, ",". Parentheses "(" and ")" are used as grouping brackets. Alternatives are separated by "|". Optional symbols are surrounded by "[" and "]". Material that can be repeated zero or more times is followed by "*". Material that can be repeated one or more times is followed by "+". Each syntactic rule is terminated by ";". Material starting with "//" and extending to the end of the line is a comment. The symbol $\not b$ appearing instead of a comma indicates that the two surrounding items are to appear without whitespace separating them; otherwise consecutive items must be identifiable to the reader as separate tokens. Items in *italics* are expected to be understood without definition herein. The characters i, j, and k stand for any non-negative integers such that $i \leq j \leq k$. Material in red has not yet been implemented.

1.2 Syntax of Well-Formed Terms

The language in which SNePS 3 well-formed terms are expressed is a version of Common Logic Interchange Format (CLIF) (ISO/IEC, 2007).

```
wft               =  atomicwft
                     | 'wft' /b i
                     | '(' , function , argument+ , ')'
                     | '(' , binaryop , argument , argument , ')'
                     | '(' , naryop , wft* , ')'
                     | '(' , param2op , '(' , i , j , ')' wft+ , ')'
                     | '(' , 'thresh' , '(' , i , ')' wft+ , ')'
                     | '(', 'close' , (atomicname | ('(', atomicname+ , ')')) ,
                         wft , ')'
                     | '(', 'every' , atomicname , wft* , ')'
                     | '(', 'some' , atomicname , '(' , wft* , ')' , wft* , ')'
                     | '(', '?' /b atomicname , wft* , ')'
                     | Generalized quantifiers to replace nexists ;

binaryop          =  'if' | i /b '=>' | 'v=>' ;

naryop            =  'and' | 'or' | 'not' | 'nor' | 'thnot' | 'thnor' | 'nand'
                     | 'xor' | 'iff' ;

param2op          =  'andor' | 'thresh' ;

atomicwft         =  atomicname | Lisp string | Lisp number ;

atomicname        =  Lisp symbol other than wfti ;

function          =  wft // other than reservedWord ;

argument          =  wft | 'nil' | '(' , argumentFunction , wft* , ')' ;

argumentFunction  =  'setof' ;

reservedWord      =  'every' | 'some' | 'close' | '?' /b atomicname
                     | binaryop | naryop | param2op ;
```

Every non-atomic `wft` (that is, a `wft` other than an `atomicwft`) is given a wft-name when it is stored into the SNePS knowledge base. The wft-name of every stored term may be seen by evaluating the user command `(list-terms)`. The user expression `wfti` is a syntactic abbreviation of the `wft` that was assigned `wfti` as its wft-name. If no `wft` has yet been assigned that wft-name, `wfti` is syntactically illegal.

1.3 Syntax of Paths

In this section is presented the syntax of path expressions used in `definePath` and `defineSlot`.

```
path  =  slotname
         | slotname ♭ '-'
         | '!'
         | '(' , 'converse' , path , ')'
         | '(' , 'kplus' , path , ')'
         | '(' , 'kstar' , path , ')'
         | '(' , 'compose' , path* , ')'
         | '(' , 'or' , path* , ')'
         | '(' , 'and' , path* , ')'
         | '(' , 'irreflexive-restrict' , path , ')'
         | '(' , 'restrict' , path , (atomicwft | 'wft' ♭ i) , ')'
```

Chapter 2

User Commands

`.+.`, `.-.`, `.*.`, `./.` [*Function*]
Each function takes an arbitrary number of arguments, each of which can be a number or a term that looks like a number. The function `unbox`es each of its arguments, applies the corresponding Lisp arithmetic function, and returns the `box`ed version of the result.

`.<.`, `.<=.`, `.>.`, `.>=.`, `.=.`, `./=.` [*Function*]
Each function takes an arbitrary number of arguments, each of which can be a number or a term that looks like a number. The function `unbox`es each of its arguments, applies the corresponding Lisp relational function, and returns `t` or `nil`, appropriately.

`(allTerms &key (test #'(lambda (x) t)))` [*Function*]
Returns a set of all the terms in the knowledge base that satisfy the test, which defaults to the always True function.

`(ask` *`exprpat`*`)` [*Function*]
Returns a set of instances of the term pattern *`exprpat`* or its negation that are derivable in the current context; or the empty set if there are none.

`(askif` *`exprpat`*`)` [*Function*]
Returns a set of instances of the term pattern *`exprpat`* that are derivable in the current context; or the empty set if there are none.

`(askifnot` *`exprpat`*`)` [*Function*]
"Returns a set of instances of the negation of the term pattern *`exprpat`* that are derivable in the current context; or the empty set if there are none.

`(assert` *`expr`*`)` [*Function*]
Asserts the term expressed by *`expr`* in the current context.

`(assert!` *`expr`*`)` [*Function*]
Asserts the term expressed by *`expr`* in the current context, and triggers forward inference.

`(attachPrimaction` *`term primfun`*`)` [*Function*]
Puts the function named *`primfun`* in the `primaction` slot of the given *`term`*, which must be an `Act` or an `Action`. If *`term`* is an `Act`, it can then be `perform`ed; if it is an `Action`, an `Act` can then be

performed whose Action is *term*.

(box *n*) [*Function*]
Returns a term whose name looks like *n*, building it if necessary.

(clearkb &optional (*clearall* nil)) [*Function*]
Reinitializes the SNePS knowledge base. If *clearall* is non-nil also reinitializes all slots, and case-frames, but not the semantic types.

(currentContext) [*Function*]
Returns the current context.

(defineCaseframe *type frame* &key *docstring fsymbols*) [*Function*]
Defines a caseframe, where: *type* is the name of a SNePS semantic type; *frame* is either (*slot1 ... slotn*) or ('*function-symbol slot1 ... slotn*); *docstring* is a caseframe documentation string; *fsymbols* is a list of function symbols required if first of the *frame* is not quoted.

(defineContext *name* &key (*docstring* "") (*parents* '(BaseCT)) *hyps*) [*Function*]
Defines a new context with the given name, docstring, parent contexts, and initial hypotheses. If *dosctring* is omitted, it defaults to the empty string. If *parents* is omitted, it defaults to '(BaseCT). If *hyps* is omitted, it defaults to the empty list.

(definePath *slotname path*) [*Function*]
Given a slot name, *slotname*, and a path expression, *path* (*see* §1.3), generate the functions that will compute that path and its converse, and store them in the slot named *slotname*.

(definePrimaction *primactionfun vars* &body *forms*) [*Macro*]
Creates the primitive action function named *primactionfun*. *vars* should be a (possibly empty) list of slot names that get bound to the appropriate node sets. However, if any *var* is enclosed in parentheses, it gets bound to a member of the appropriate node set. *forms* syntax is just as it is for defun. Returns the function name, *primactionfun*.

(defineSlot *name* &key *type docstring posadjust negadjust min max path*) [*Macro*]

Defines the slot named *name*. *type* must be a semantic type. It defaults to Entity. *docstring* must be a string. It defaults to the empty string. *posadjust* must be either reduce (default), expand, or none. *negadjust* must be either reduce, expand (default), or none. *min* must be a positive integer. It defaults to 1. *max* must be either nil (default) or an integer equal to or greater than *min*. *path* must be either nil (default) or a path (*see* §1.3).

(defineTerm *term &optional (semtype 'Entity)*) [*Function*]
If *term* is not already a term in the SNePS knowledge base, it is added to the KB with the semantic type *semtype*, which defaults to Entity. If *term* is already a term in the KB with semantic type *currenttype*:

- if *currenttype* is a subtype of *semtype*, the type of *term* is left as is;
- if *semtype* is a subtype of *currenttype*, the semantic type of *term* is lowered to *semtype*;
- if *currenttype* and *semtype* have one greatest common subtype, the semantic type of *term* is changed to that type;

- if *currenttype* and *semtype* have several greatest common subtypes, the user is asked which one (s)he wants *term* to be, and *term*'s semantic type is changed to that type;
- otherwise, an error is generated.

The term is returned.

(defineType *newtype supers* &optional *docstring*) [*Macro*]
Defines *newtype* to be a SNePS semantic type, and a subtype of the types listed in the list *supers*. If *docstring* is given, it is set as the documentation string of the new type. Returns a string-message, either of success or what the problem was.

(defrule *rulename* &body rulebody) [*Macro*]
Defines a rule with the given name, and a body looking like

[*description-string*] [*lhs...* =>] *rhs...*

An *rhs* element can be any form, including (:subrule [*lhs...* =>] *rhs*), to be evaluated in the binding environment of the *lhs*. An *lhs* element can be

- a pattern;
- (:bind *variable value*);
- (:break);
- (:for *elt* in *list*) or any other loop for clause;
- (:unless *predicate*);
- (:when *predicate*).

Variables, symbols of the form ?*var*, may be bound by a pattern clause, a :bind clause, or a :for clause. If an unbound variable occurs in a pattern clause, it is bound by the function find, without any inference. A pattern clause containing no unbound variables is given to the askif function.

(demo &key file pause) [*Function*]
Echoes and evaluates the forms in the *file*. If *pause* is non-nil (the default is nil), will pause after echoing each form, but before evaluating it. If the *file* is omitted, a menu will be presented of available demos.

(describe-terms &rest *ftnames*) [*Macro*]
Prints a description of all the given terms.

(erase-term *term*) [*Function*]
Erases the *term* from the knowledge base completely. Returns the term if successful, nil if there are dependencies that prevent the term from being erased.

(find *exprpat*) [*Function*]
Returns two values: a set of instances of *exprpat* that are in the knowledge base; and a set of substitutions, which when applied to *exprpat* would give those instances. *exprpat* may be any wft with variables, symbols starting with a "?", in the place of any subterms.

`(find-term name)` [*Function*]
Returns the term named *name*, or `nil` if there isn't one. The name of an atomic term is a symbol, string, or number. The name of a molecular term is its wftname.

`*KRNovice*` [*Variable*]
If set to a non-`null` value (the default value is `nil`), slots and caseframes will automatically be created whenever a function symbol is used that is not already associated with a caseframe. The slots will be named `fn`, `arg1`, `arg2`, *etc.*, and both slots and caseframes will have their default parameters. This should only be used by novices, or for very quick tests, as the careful modeling required by defining types, slots, and caseframes might be ignored.

`(list-caseframes )` [*Function*]
Prints all the caseframes.

`(list-contexts )` [*Function*]
Prints a list of all the contexts.

`(list-slots )` [*Function*]
Prints a list of all the SNePS slots.

`(list-terms &key (asserted nil) (types nil))` [*Function*]
Prints a list of all the terms in the KB. If `asserted` is non-null, only asserted propositions will be printed; otherwise, all terms will be printed. If `:types` is non-null, the type of each term will also be printed.

`(listkb )` [*Function*]
Prints the current context and all propositions asserted in it.

`(noshowproofs )` [*Function*]
Turns off the effects of `showproofs`.

`(pathsfrom terms path)` [*Function*]
Returns the set of terms at the end of the given *path* (*see* §1.3) from *terms*, which must be a term, the name of a term, a list of terms or names of terms, or a set of terms.

`(perform actform)` [*Function*]
Performs the `Act` expressed by the form *actform*.

`*PRECISION*` [*Variable*]
A positive integer: a floating point number will be rounded to this number of decimal places before being converted to a term.

`(remove-from-context term ctx)` [*Function*]
Removes the provided *term* from the context *ctx*. The term will still be asserted in contexts it isn't removed from.

`(sameFrame newf oldf)` [*Function*]
Associates the same frame associated with the function symbol *oldf* with the symbol, or list of symbols, *newf*.

`(setCurrentContext ctx)` [*Function*]
If `ctx` is a context name, makes the context named `ctx` the current context. If `ctx` is a context, makes it the current context. Else raises an error.

`(showproofs &key (goals nil))` [*Function*]
Turns on printing of the proofs of derived terms.If `goals` is non-`nil`, a message is printed whenever: a goal or subgoal is issued; a goal or subgoal is found asserted in the knowledge base; a rule fires. If `goal` is `nil` (default) a message is printed only when a rule fires, thus printing a proof.

`(showTypes )` [*Function*]
Graphically displays all the defined semantic types.

`(startGUI &rest terms)` [*Macro*]
Starts the SNePS 3 GUI. Takes a variable number of `terms` to display on the graph. Each term is either found or defined using `defineTerm`. If no terms are given, the entire graph will be displayed.

`(unassert prop &optional (cntxt (currentContext)))` [*Function*]
Unasserts the proposition `prop` in the given context and all ancestor contexts. Currently there is no belief revision, so propositions derived using `prop` might still be asserted, and prop, itself, might be rederivable.

`(unbox term)` [*Function*]
If `term` is a number, return it; if `term`'s name looks like a number, return the number; else throw an error.

`(withInstances (variables of pattern &body forms)` [*Macro*]
For each asserted substitution instance of `pattern`, evaluates the forms in `forms`, with each variable in `variables` taking on the term appropriate for the instance. Question mark variables in `pattern` that are not in `variables` take on the values they should have gotten in an enclosing `withInstances`.
For example,

```
(withInstances (?x ?y) of (Isa ?x ?y)
   (format t "~s is an instance of ~s.~%" ?x ?y))
```

or

```
(withInstances (?x ?y) of (Isa ?x ?y)
   (format t "~s is an instance of ~s.~%" ?x ?y)
   (withInstances (?z) of (Ako ?y ?z)
      (format t "~s is an instance of ~s, and also of ~s.~%" ?x ?y ?z)
      (assert `(Isa ,?x ,?z))))
```

`(writeKBToTextFile file &optional headerfile)` [*Function*]
Writes the KB to the given text `file`, so that when that file is loaded, all the propositions asserted in the current KB will be asserted in the new KB. If the `headerfile` is included, a load of that file will be written before any of the asserts.

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