

# **CSNePS USER'S MANUAL<sup>1</sup>**

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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 */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) (?).

```

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

binaryop  =  'if' | i ⚭ '=>' | 'v=>' ;

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

param2op  =  'andor' | 'thresh' ;

atomicwft =  atomicname | Lisp string | Lisp number ;

atomicname = Clojure symbol other than wfti ;

function  =  wft // other than reservedWord ;

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

argumentFunction = 'setof' ;

reservedWord = 'every' | 'some' | 'close' | '?' ⚭ 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 , ')'
      | '(' , 'domain-restrict' , '(' , path , wft , ')' , path , ')'
      | '(' , 'range-restrict' , path , '(' , path , wft , ')' , ')' ;

```



## Chapter 2

# Running CSNePS

CSNePS is implemented in the Clojure programming language, a recently developed dialect of lisp which runs (primarily) on the Java Virtual Machine.

### 2.1 Pre-Requisites

- **git** is a versioning system which will be required. Install it via your preferred package manager if you do not already have it.
- **Leiningen** (aka **lein**) is a dependency manager for Clojure projects. To install Leiningen, follow the directions at <https://github.com/technomancy/leiningen>.

### 2.2 Running CSNePS at the Command Line

The preferred method of running CSNePS at the command line is to use the REPL component of Leiningen.

1. At the command prompt, change directories to the CSNePS directory. This is the directory containing the `project.clj` file which Leiningen will use to load the project.
2. Type `lein repl` at the command prompt and hit enter. Any required dependencies will be downloaded, Clojure will load, and you will be presented a Clojure prompt, `csneps.core.snuser=>`, indicating that CSNePS has loaded and we are in the 'csneps.core.snuser' namespace.

### 2.3 Running the CSNePS GUI

The CSNePS GUI may be started with or without pre-loading CSNePS. If you choose to pre-load CSNePS you will also have access to the command prompt in your terminal window. This will not be available if you choose not to pre-load CSNePS.

#### 2.3.1 By Pre-Loading CSNePS

1. Follow the directions from Section [2.2](#).
2. Type `(startGUI)` from the prompt and press enter. This will load the CSNePS GUI.

### 2.3.2 Without Pre-Loading CSNePS

1. At the command prompt, change directories to the CSNePS directory. This is the directory containing the `project.clj` file which Leiningen will use to load the project.
2. Type `lein run` at the command prompt and hit enter. This will load CSNePS and its GUI.

## 2.4 Using Eclipse to Run CSNePS

Before getting started with Eclipse, be sure to check out the `Sneps3-Clojure` project, change directories to that project, and run `lein deps` to be sure the project and its dependencies are up to date.

In order to run and develop CSNePS in Eclipse, you will require a version of Eclipse which includes Java support. The version on the CSE servers seems somehow incompatible with CounterClockwise, so I recommend installing the latest version from <http://www.eclipse.org> in your home directory.

First we must install the CounterClockwise plugin, which lets us run Clojure apps from Eclipse.

1. Click the Help menu, then "Install New Software..."
2. In the "Work With:" field, enter <http://ccw.cgrand.net/updatesite/> and click the "Add..." button.
3. Enter "CounterClockwise" (or whatever text you like) in the "Name" field and click "OK".
4. Check the box next to "Clojure Programming" in the list that appears, and click the "Next" button.
5. In the dialogs that follow click Next, agree to the license agreement, and click Finish.
6. Agree to any warnings about unsigned content, and agree to restart Eclipse when installation has finished.

Now we will import our project.

1. Choose "Import..." from the File menu.
2. Choose "Existing Project or Workspace" under the "General" node in the tree shown.
3. With the "Select root directory" radio button selected, click browse and browse to the `SNePS3-Clojure` directory.
4. Click next and follow the dialogs until it is imported.

Now the project is imported into Eclipse and we can run it. In the project explorer on the left side of the workspace, expand the `SNePS3-Clojure` node and then the `src` node, right click on `core.clj`, and choose to run it as a Clojure Application. Once the repl loads, run `(loadsneps3)`.

## 2.5 Using Emacs to Run CSNePS

### 2.5.1 Configuring Emacs

There are multiple methods for configuring Emacs to run and edit Clojure code. The method described here is perhaps the easiest, but debatably not the best. We will use 'lein repl' as an inferior lisp, but also use SLIME. We will install clojure-mode to have proper syntax highlighting.

1. Either create a directory or change to a directory where you will keep Emacs plugins. We'll call it `/home/user/tools` here, but you can use whatever you like.

2. Clone SLIME to the current directory by executing:  
`git clone https://github.com/technomancy/slime.git`. Note this is a customized version of SLIME which plays nice with Clojure.
3. Clone clojure-mode to the current directory by executing:  
`git clone https://github.com/technomancy/clojure-mode.git`.
4. Update your `.emacs` file with the following:

```
;; A function to load Clojure using lein repl.
(defun run-clojure ()
  ;; Invoke Clojure with M-x run-clojure
  (interactive)
  (setq inferior-lisp-program "lein repl"
        inferior-lisp-load-command "(load \"%s\")\n"
        lisp-function-doc-command "(doc %s)\n"
        lisp-var-doc-command "(doc %s)\n")
  (slime))

;; Load and configure SLIME
(add-to-list 'load-path "/home/user/tools/slime")
(require 'slime)
(eval-after-load 'slime '(setq slime-protocol-version 'ignore))
(slime-setup '(slime-repl))

;; Load a major mode for editing Clojure code.
(add-to-list 'load-path "/home/user/tools/clojure-mode")
(require 'clojure-mode)
```

### 2.5.2 Loading and Running the Project in Emacs

1. Load Emacs and switch the current directory to the Sneps3-Clojure directory. This is the directory containing the `project.clj` file which will be used to load the project.
2. Execute the `run-clojure` function we defined in our `.emacs` file, `M-x run-clojure`. Any required dependencies will be downloaded, Clojure will load, and you will be presented a Clojure prompt, `core=>`, indicating we have started in the `'core'` namespace.
3. You may now load CSNePS by typing `(loadsneps3)` at the prompt and press enter.
4. CSNePS is now loaded, follow the directions presented and switch to the `snuser` namespace by typing `(in-ns 'snuser)` and pressing enter. CSNePS is now ready to be used.



## Chapter 3

# User Commands

`(allTerms )` [Function]

Returns a set of all the terms in the knowledge base.

`(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.

`(clearkb &optional (clearall nil))` [Function]

Reinitializes the SNePS knowledge base. If *clearall* is non-nil also reinitializes all slots, caseframes, and 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 *docstring* 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*.

(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.

(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.

(find exprpat) [Function]

Returns a list of vector pairs. In each pair, the first element is an instance of *exprpat* in the knowledge base, and the second is a substitution, which when applied to *exprpat* would give that instance. *exprpat* may be any wft with variables, symbols starting with a "?", in the place of any subterms.

(findTerm 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 wfname.

`(krnovice boolean)` [Function]

If set to `true` (the default value is `false`), 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.

`(listContexts )` [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.

`(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.

`*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.

`(showTypes )` [Function]

Graphically displays all the defined semantic types.

`(startGUI &rest terms)` [Macro]

Starts the CSNePS 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.

`(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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