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TRANSLATION OF THEOREM-PROVING TEXT IN $\mathcal{MTSR}$ TO NATURAL LANGUAGE TEXT

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Abstract. In the article is described translation of theorem-proving text from $\mathcal{MTSR}$language into natural language. As example, it is considered translation into English. Used method is valid for any language.

Keywords and phrases: $\mathcal{MTSR}$ theory, theorem-proving text, formal grammar, Bison program, parsing.

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1. Introduction. In the article is described translation of theorem-proving text from $\mathcal{MTSR}$ language into natural language. As example, it is considered translation into English. Used method is valid for any language. Source language's grammar is traduced into LR (1) grammar [1] and by the grammar is composed Bison program. Compilation of Bison program gives working program. Input of the program is theorem-proving text and output is its transfer into target language's text [2-3].

2. $\mathcal{TSR}$-Logic Language. The language of $\mathcal{TSR}$ logic consists of the following symbols:

1. Fundamental symbols:
   (a) Logical connectives: $\neg$(of the weight 1), $\wedge$, $\vee$, $\rightarrow$, $\leftrightarrow$ (each of the weight 2).
   (b) Logical operational sign $\mathcal{T}$ of the weight $(1, 1)$.
   (c) Substantive special substitution operator S of the weight $(1, 2)$.
   (d) Relational logico-special substitution operator R of the weight $(1, 2)$ and with the logicality indicator 2.
   (e) Object letters: $X_0, X_1, \ldots$ (1)
   (f) Predicate symbols $=$ and $\in$, each of the weight 2, and predicate letters: $P_0^n, Q_0^n, P_1^n, Q_1^n, \ldots$ (2)
   (g) Functional symbol $\supset$ that has the weight 2, and functional letters: $f_0^n, g_0^n, f_1^n, g_1^n, \ldots$ (3)
   (h) [and] (left and right brackets)
2. Signs, introduced by the definitions of the types I, II and II'.

Finite sequence of signs of $\mathcal{TSR}$ are called a *word* of $\mathcal{TSR}$ logic. The words $\mathcal{T}X_0, \mathcal{T}X_1, \ldots$ are the $\mathcal{TSR}$ logic operators with the weight 1. The words $SX_0, SX_1, \ldots$ and $RX_0, RX_1, \ldots$ are the $\mathcal{TSR}$ logic operators with the weight 2. Besides, the operators $SX_0, SX_1, \ldots$ are substantive partial quantifiers with the binding indicator 2, and the operators $RX_0, RX_1, \ldots$ are logico-special partial quantifiers with logicality and binding indicator 2.

The operator is called :

1) A logical relational if its operands are formulas, and results is formulae. For examples:$\neg, \bigvee, \forall x, \exists x \ldots$

2) A logical substantive if its operands are formulas, and results is term. For examples: $\mathcal{T}x, \varepsilon x, \ldots$

3) A special relational if its operands are terms, and results is formulae. For example: $< represent > x, \ldots$

4) A special substantive if its operands are terms and results is term. For examples: $+, \sin, Sx, \ldots$

5) A logico-special relational, if its operands are terms and results is formulae. For examples: $Rx, < root > x, \ldots$

6) A logico-special substantive if its operands are terms and results is term. For examples: $< subset > x, \ldots$

Formulas and *terms* of $\mathcal{TSR}$ logic are defined in following way:

1. Subject letters are simple terms.

2. If σ is an n-ary relational logical (resp. special) operator, then $\sigma A_1 \ldots A_n$ (resp. $\sigma T_1 \ldots T_n$) is either a formula or a term depending whether σ is relational or substantive.

3. Let $C_1, \ldots, C_n$ be a sequence of formulas. If σ is an n-ary logico-special operator whose logicality indicator is $(n_1, \ldots, n_k)$, and $C_{n_1}, \ldots, C_{n_k}$ is the maximal subsequence of the sequence $C_1, \ldots, C_n$ consisting of formulas only, then $\sigma C_1, \ldots, C_n$ is either a formula or a term depending whether σ is relational or substantive.

4. C is formula or term if and only if it is derived by the three rules above.

3. Translation from $\mathcal{TSR}$ Grammar into $LR(1)$ Grammar. Suppose $G = (N, \Sigma, P, S)$, where Σ is set of terminal symbols from $\mathcal{TSR}$, N is set of non-terminal symbols, S is starting symbol from N, P is set of rules corresponding to rules from $\mathcal{TSR}$ grammar:

<theorem-proving-text> ::=<theorem-statement><theorem-proving-with-comments>
<theorem-statement>::=<label>$M\mathcal{TSR}$<formula>
| <label>$M\mathcal{TSR}$<(sequence-formula>)<formula> | < label> (<formula1>
<complement-symbol><formula1>)<complement-symbol>$M\mathcal{TSR}$ <formula>
<formula1>::=$M\mathcal{TSR}$| <sequence-formula> | <formula>
<label>::=$((C|ID|I) < digits > |(ra|rb|rc|rd|re))$.
<digits1>::=<digit1><digits> | $< digit1 >$
<digits>::=<digit1> |0
<digit1>::=1|2|3|4|5|6|7|8|9
<sequence-formulae>::= <formula>, <sequence - formulae> | <formula>
<formula>::=<one-place-operator><formula> |
(<formula><two-place-operator><formula>)|
<atom>

<one-place-operator>::= $\emptyset$
<two-place-operator>::= $\acute{U}|\acute{\acute{U}}|$®| <<
<atom>::= $A < digits > |B < digits > |A|B$
<theorem-proving-with-comments>::= $\vdash \mathcal{MTSR}$, <sequence-members> $\dashv \mathcal{MTSR}$
<sequence-members>::= $\vdash \mathcal{MTSR}$—<sequence- formulae>—, <sequence-members>, $\dashv \mathcal{MTSR}$ |
<sequence-formula>——<formula>.., <sequence-members> |
<formula>.
<label>, <sequence-members> | <formula> ..| <formula>. <label>

The grammar is $LR(1)$ grammar.

4. Translation from $LR(1)$ Grammar into BISON Program. Grammar' rules from paragraph 3 we should add semantic rules to receive Bison's program file. Bison program has the following struqture:

%{
Prolog
} %
Bison Declaration
%%
input : /* Empty line */
input line
;
line: '\n'
| theorem_ proving_ text '\n' { printf ("\t %.10g\n", S1); }
;
theorem_ proving_ text : theorem_ statement theorem_ proving_ with_ comments { SS =S1 "." $2 ; } ;
theorem_ statement : label $\mathcal{MTSR}$ formula { SS =S1 ".' " " "." " " "." " $\mathcal{MTSR}$ " "." " " "." S3 ; }
| label $\mathcal{MTSR}$ (sequence_ formula) formula label (formula1 complement_ symbol formula1) complement_ symbol $\mathcal{MTSR}$ formula { SS = S1 "." "$\mathcal{MTSR}$" "." "{" "." S4 "." "}" "." S6 "." S7 "." "{" "." S9 "." S10 "." S11 "." "}" "." S13 "." " $\mathcal{MTSR}$ " "." S15 ; }
formula1:$\mathcal{MTSR}$ | sequence_ formula | formula
| label: ((C |ID | I)digits |(ra |rb |rc |rd | re)).
digits1: digit1 digits | digit1
digits: digit1 | 0
digit1: 1|2|3|4|5|6|7|8|9
sequence_ formulae:formula, sequence_ formulae | formula
formula: one_ place_ operator formula |
(formula two_ place_ operator formula)|
atom
one_ place_ operator :$\emptyset$
two_ place_ operator: Ú | Ú | ® | $\ll$
atom: A digits | B digits | A | B

theorem_proving_with_ comments: $\vdash \mathcal{MTSR}$, <sequence_ members $\dashv \mathcal{MTSR}$
sequence_ members: $\vdash \mathcal{MTSR}$ | sequence_ formulae |, sequence_ members,
$\dashv \mathcal{MTSR}$ |
sequence_ formula || formula .., sequence_ members | formula. label,
sequence_ members | formula ..| formula. label
%%
Epilogue

5. Getting Target Text. After translation of Bison program we receive working program. Running the program with input (theorem-proving text in $\mathcal{TSR}$) will give corresponding text in target language.

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