Seminar of I. Vekua Institute
of Applied Mathematics
REPORTS, Vol. 34, 2008

ABOUT 1-STAGE VOICE MANAGED GEORGIAN INTELLECTUAL COMPUTER SYSTEM [1]

Pkhakadze K.,* Chichua G.,* Abzianidze L.,** Maskharashvili A.**

*I.Vekua Institute of Applied Mathematics
**Iv. Javakhishvili Tbilisi State University

Abstract. In the paper, 1-Stage Voice Managed Georgian Intellectual Computer System is described in detail and, also, here are described some new theoretical approaches, which we use in construction of the 1-Stage Voice Managed Georgian Intellectual Computer System and which are elaborated on the basis of the 1-Stage Logical Grammar of Georgian Language and, also, on the basis of those theoretical researches, which lead in our group for the aims to Construct 1-Stage Voice Recognition and Synthesizer Systems for Georgian.

Keywords and phrases: The voice managed Georgian intellectual computer system, the logical grammar of the Georgian language.

AMS subject classification (2000): 68T50; 68S05; 91F20; 68T10; 68T15; 03B65.

1. Introduction

In the paper, we will discuss the technological aim of subproject "Foundations of Logical Grammar of Georgian Language and its Methodological and Technological Applications" of TSU SPP "Free and Complete Programming Inclusion of a Computer in the Georgian Natural Language System".

Final aim of the TSU SPP is mathematical and mechanical foundations of GL&T. This means an elaboration of MTofGL&T and construction of basic Georgian ICS, which, in turn, is a computer softwared with the MTofGL&T.

Main scientific aim of the subproject is to systemize and to extend the MTofGL&T_1 to the 2-stage one. Main technological aim of the subproject is to construct the 1-stage Voice Managed Georgian Intellectual Computer System, shortly VMGeointel_1 system, which is planned as the first experimental step to free and complete programming inclusion of a computer in the GNL System.

More than fifty years open research processes go in order to create ICS. These processes aimed to construct such computers, which will be able to be used without any special programming knowledge. This assumes that users will have possibility to interact with them basing only on their native language knowledge.

Today, it is clear, that such type intellectual computers will play very wide and very crucial role in the future streaming world-wide cultural processes. This, in turn, makes clear, that if Georgian society is not able to construct such Georgian ICS, then it is very plausible that after 12-15 years Georgians will completely lose ability of taking part in the future world-wide cultural processes by means of GL. - The well known high

[1]This work was carried out with the aims of the State Priority Program "Free and Complete Inclusion of a Computer in the Georgian Natural Language System" (2003).

estimation of the TSU SPP together with mentioned is caused by that circumstance, that till nowadays GL is almost completely unstudied from the points of contemporary Mathematical Linguistics, without what any attempt to construct Georgian ICS of above underlined type is hopeless.

Main cause that GL is not studied from the point of contemporary ML is the late formation of mathematical logic in Georgia. Because of this Georgian logicians were not involved in the previous researches of GL. It makes clear why till today there does not exist even completely systematized partial mathematical grammar for GL, and, also, why there does not exist even completely systematized partial syntactic type parser system for it[2].

The local researches for creating MTofGL&T began only 10 years ago, and from this point there are still very serious problems in Georgia. The point is that being far from current researches in contemporary Mathematical Linguistics it is hard to recognize for the part of Georgian mathematicians that these researches are mathematical indeed. It is hard for them to understand what a crucial role plays discrete mathematics and mathematical logic in Chomsky's and Montague's linguistic researches. - Here mentioned and nothing else explains that in 2006 university reform rejected the studying process in Logic of NL and Mathematical Linguistics, which were founded in 2004-2006 years. Our appellate process brought us to the university view, which was announced on February 7, 2008, according to which high actuality of rejected studying process was confirmed one more time. - We hope, that in near future, once already founded studying process will return at TSU.

2. About VMGeointel_1 System and its Constituents

The VMGeointel_1 system is a systemic unit of its subsystems GVmanager_1, GWreader_1, GSlistener_1, GWLintel_1, GSLintel_1. GVmanager_1, GWreader_1, GSlistener_1, GWintel are basic subsystems of the VMGeointel_1 system. The GSLintel_1 is a produced subsystem of VMGeointel_1 system and it is constructed through integration of the basic subsystems of VMGeointel_1 system. Below there is given a general schematic description of VMGeointel_1 System:

VMGeointel_1 -
(1) - **GVManager_1**
(2) - **GWreader_1**
- **GWLdirectreader_1** (2.1)
- **GWLcorrectreader_1** (2.2)
- **GWLcorrector_1** (2.2.1)
- ***GWLabstractor_1*** *(2.2.1.1) = (4.1)*
- ***GWLsynthesizer_1*** *(2.2.1.2) = (4.2)*
- ***GWLchecker_1*** *(2.2.1.3) = (4.3)*
- ***GWLdirectreader _1*** *(2.2.2) = (2.1)*

(3) - **GSlistener_1**
- **GSLdirectlistener _1** (3.1)
- **GSLcorrectlistener_1** (3.2)
- ***GSLdirectlistener_1*** *(3.2.1) = (3.1)*
- ***GWLcorrector_1*** *(3.2.2) = (2.2.1)*

(4) - **GWLintel_1**

[2]The causes of non-existence of more complex type parser systems for GL are evident.

- **GWLabstractor_1** (4.1)
- **GWLsynthesizer_1** (4.2)
  - **GWLwordsynthesizer_1** (4.2.1)
  - **GWLsentencesynthesizer_1** (4.2.2)
  - **GWLtextsynthesizer_1** (4.2.3)
- **GWLchecker_1** (4.3)
  - **GWLwordchecker_1** (4.3.1)
  - **GWLsentencechecker_1** (4.3.2)
  - **GWLtextchecker_1** (4.3.3)
- **GWLanalyzer_1** (4.4)
  - **GWLwordanalyzer_1** (4.4.1)
  - **GWLsentenceanalyzer_1** (4.4.2)
  - **GWLtextanalyzer_1** (4.4.3)
- **GWL-GMLconnect_1** (4.5)
  - **GWLtoGMLreducer_1** (4.5.1)
    - ***GWLabstractor_1*** *(4.5.1.1) = (4.1)*
    - ***GWLchecker_1*** *(4.5.1.2) = (4.3)*
    - ***GWLanalyzer_1*** *(4.5.1.3) = (4.4)*
  - **GMLtoGWLproducer_1** (4.5.2)
    - ***GWLsynthesizer_1*** *(4.5.2.1) = (4.2)*
- **GWLthinker_1** (4.6)
  - **GWLreasoner_1** (4.6.1)
    - ***GWLtoGMLreducer_1*** *(4.6.1.1) = (4.5.1)*
    - **GMLreasoner_1** (4.6.1.2)
    - ***GMLtoGWLproducer_1*** *(4.6.1.3) = (4.5.2)*
  - **GWLtheoremprover_1** (4.6.2)
    - ***GWLtoGMLreducer_1*** *(4.6.2.1) = (4.5.1)*
    - **GMLtheoremprover_1** (4.6.2.2)
    - ***GMLtoGWLproducer_1*** *(4.6.2.3) = (4.5.2)*
  - **GWLtasksolver_1** (4.6.3)
    - ***GWLtoGMLreducer_1*** *(4.6.3.1) = (4.5.1)*
    - **GMLtasksolver_1** (4.6.3.2)
    - ***GMLtoGWLproducer_1*** *(4.6.3.3) = (4.5.2)*
  - **GWLreasoningchecker_1** (4.6.4)
    - ***GWLtoGMLreducer_1*** *(4.6.4.1) = (4.5.1)*
    - **GMLreasoningchecker_1** (4.6.4.2)
    - ***GMLtoGWLproducer_1*** *(4.6.4.3) = (4.5.2)*
- **GWLinteltranslator_1** (4.7)
  - **GWL-EngWLtranslator_1** (4.7.1)
    - ***GWLtoGMLreducer_1*** *(4.7.1.1) = (4.5.1)*
    - **GMLtoEngWLproducer_1** (4.7.1.2)
    - **EngWLtoGMLreducer_1** (4.7.1.3)
    - ***GMLtoGWLproducer_1*** *(4.7.1.4) = (4.5.2)*
  - **GWL-GerWLtranslator_1** (4.7.2)
    - ***GWLtoGMLreducer_1*** *(4.7.2.1) = (4.5.1)*
    - **GMLtoGerWLproducer_1** (4.7.2.2)
    - **GerWLtoGMLreducer_1** (4.7.2.3)
    - ***GMLtoGWLproducer_1*** *(4.7.2.4) = (4.5.2)*
  - **EngWL-GerWLtranslator_1** (4.7.3)
    - ***EngWLtoGMLreducer_1*** *(4.7.3.1) = (4.7.1.3)*
    - ***GerWLtoGMLreducer_1*** *(4.7.3.2) = (4.7.2.3)*
    - ***GMLtoEngWLproducer_1*** *(4.7.3.3) = (4.7.1.2)*
    - ***GMLtoGerWLproducer_1*** *(4.7.3.4) = (4.7.2.2)*

(5) - **GSLintel_1**

- ***GSlistener_1*** *(5.0) = (3)*
- **GSLabstractor_1** (5.1)
  - ***GWLabstractor_1*** *(5.1.1) = (4.1)*
- **GSLsynthesizer_1** (5.2))
  - ***GWLsynthesizer_1*** *(5.2.1) = (4.2)*
- **GSLchecker_1** (5.3))
  - ***GWLchecker_1*** *(5.3.1) = (4.3)*
- **GSLanalyzer_1** (5.4)
  - ***GWLanalyzer_1*** *(5.4.1) = (4.4)*
- **GSL-GMLconnector_1** (5.5)
  - **GSLtoGMLreducer_1** *(5.5.1) = (4.5)*
    - ***GWLtoGMLreducer_1*** *(5.5.1.1) = (4.5.1)*
  - **GMLtoGSLproducer_1** (5.5.2)
    - ***GMLtoGWLproducer_1*** *(5.5.1.1) = (4.5.2)*
- **GSLthinker_1** (5.6)
  - **GSLreasoner_1** (5.6.1)
    - ***GWLreasoner_1*** *(5.6.1.1) = (4.6.1)*
  - **GSLtheoremprover_1** (5.6.2)
    - **GWLtheoremprover_1** *(5.6.1.2) = (4.6.2)*
  - **GSLtasksolver_1** (5.6.3))
    - ***GWLtasksolver_1*** *(5.6.1.3) = (4.6.3)*
  - **GSLreasoningchecker_1** (5.6.4)
    - ***GWLreasoningchecker_1*** *(5.6.1.3) = (4.6.4)*
- **GSLinteltranslator_1** (5.7)
  - **GSL-EngWLtranslator_1** (5.7.1)
    - ***GWL-EngWLtranslator_1*** *(5.7.1.1) = (4.7.1)*
  - **GSL-GerWLtranslator_1** (5.7.2)
    - ***GWL-GerWLtranslator_1*** *(5.7.2.1) = (4.7.2)*
- ***GWreader_1*** *(5.8) = (2)*

*** above, the subsystems typed in italic are integrated in the described system from that system where they are typed as classical ones.**

2.1. About GVManager_1 system

GVManager_1 (i.e. 1-Stage Georgian Voice Manager) expands computer-user communication abilities. Namely, it allows a user to give the user-defined commands to the computer via Georgian spoken signal.

GVManager_1 consists of WithDP_GVManager_1 (i.e. GVManager_1 with DP), OutDP_GVManager_1 (i.e. GVManager_1 without DP) subsystems and DP switch. With the help of DP switch users have possibility to choose one of the modes from outDP and withDP modes.

GVManager_1 system being in the without DP mode, i.e. in OutDP_GVManager_1 mode accomplishes user's voice command instantly after hearing. Therewith, from the insurance point in this mode there are voice commands "abort" and "Un do" too. The GVManager_1 system being in with DP mode, i.e. in WithDP_GVManager_1 mode answers the voice commands given by user or in a written or in a voice form according to user's intention. After what user orders the system to accomplish the correctly understood command.

It is obvious that for a blind user voice dialog modes and for a deaf user written one are the modes without alternatives. Users having none of above mentioned disabilities

will use these modes according to their current necessity.

In order to build GVManager_1 system we base on voice recognizer system, which was elaborated in our group in 2004-2008 years. The system works based on the principle of "teaching" of written and spoken forms of basic lexical words. Its percentage of recognition of Georgian sentences and phrases built up with the lexicon consisting of 200-300 words is about 97%. It should abide that by selecting forms of GVManager_1 lexical words it is possible to improve its recognition percentage to the guaranteed (i.e. 100%) recognition.

It should be also taken into account that the system together with simple instruction how to use it gives the users the possibility to create their own lexicon of voice commands and to equip their computers with Georgian listening abilities.

2.2. About GWreader_1

GWreader_1, which consists of GWdirectreader_1 and GWcorectreader_1 subsystems, expands computer-user communication abilities. Namely, it allows user to get information from the computer via Georgian spoken signal.

GWcorectreader_1 consists of GWLcorrector_1 subsystem, in which, in turn, are integrated GWLabstractor_1, GWLsynthesizer_1 and GWLchecker_1 systems. These systems are elaborated as subsystems of GWLintel_1. In construction of GWdirectreader_1 we use methods of natural division of Georgian words and phrases in constituents.

The computer softwared by GWdirectreader_1 system will be equipped with non-semantic reading abilities: this means that the System will directly, i.e. literally reads the written text which is given to read. The computer softwared by GWcorectreader_1 system will be equipped with semantic reading abilities: This means that the System will read the written text after its correction from that type mistakes, which are possible to be corrected unambiguously.

2.3. About GSlistener_1

GSlistener_1, which consists of GSLdirectlistener_1 and GSLcorectlistener_1 subsystems, expands as computer-user communication abilities as well as computer using abilities. Namely, it allows a user to give various different type information and user-defined command to the computer via Georgian spoken language, and, also, GSlistener_1 allows a user to use computer as automatic typewriter for GL.

GSLcorrectlistener_1 consists of GSLdirectlistener_1 and GWLcorrector_1, about which we have already mentioned. A computer softwared by GSLdirectlistener_1 system will be equipped with non-semantic listening abilities: This means that the computer will directly, i.e. literally type the spoken text which is given to listen. A computer softwared by GSLcorectlistener_1 system will be equipped with semantic listening abilities: This means that the computer will type the spoken text after its correction from those mistakes, which are possible to be corrected unambiguously.

For construction of GSdirectlistener_1 system we will use methods elaborated in our group through researches, which were pursued in recent years. Our approaches instead of Fourier's spectral analysis methods are based on the extended analysis method of

distances between nulls and use matrix computation. These methods were developed and experimentally confirmed by researches of our group. Unfortunately, there is no other experience of researches to construct Georgian speech recognition systems in Georgia.

In 2003, we had a computer system, which was able to recognize single words with 80% percentage of recognition. After, this system was improved using abovementioned more precise mathematical methods and as a result of this in 2007 it was created such computer system which was able to recognize discrete speech with 95% percentage of recognition in lexicon with 100-200 words.

By now there is planned to create such speech recognition system, which instead of the principle of learning of written and spoken forms of the words of dictionary, will be constructed using principle of internal listening of written forms of the words of dictionary. This means that the system will not be limited by users' voice. But, the system will be constructed in such way that it will be necessary to make very short pauses during speaking with it.

To construct GSLcorrectlistener_1 system we will use methods elaborated in our group through that researches, which are current for construction of GWLintel_1. At the first stage of our researches with the purpose of creating 'Georgian Computer Ear', we were using only phonetics date of the GSL, but now we plan to embed into the used methods the results, which were received in the confines of working on MTofGL&T_1. This means that we plane to construct "non-primitive, i.e. thinker computer ear", instead of already existing primitive "phonetic computer ear".

As conclusions it can be mentioned that the computer softwared by GSlistener_1 system will be equipped with limited listening ability: This means that the system will listen a text of GSL, which will be limited with dictionary including 100-200 words, and will give the listened text in written form. Through the selection of the forms of dictionary words it is available to increase the percentage of recognition from 90% to absolute recognition (i.e. to 100%). It should be also taken into account that the system together with simple instruction gives users the possibility to create their own lexicon of listened words and to use GSlistener_1 system as a faultless automatic typewriter in GSL, lexically limited by him.

2.4. About GWLintel_1 and GSLintel_1

GWLintel_1 consists of GWLabstractor_1, GWLsynthesizer_1, GWLchecker_1, GWL-analyzer_1, GWL-GMLconnector_1, GWLthinker_1, GWLinteltranslator_1 subsystems and it is the first ICS in the Core Part of GWL.

GSLintel_1 system, which is obtained by natural integration of GWLintel_1, GSlistener_1 and GWreader_1 systems, consists of GSlistener_1, GSLabstractor_1, GSLsynthesizer_1, GSLchecker_1, GSLanalyzer_1, GSL-GMLconnector_1, GSLthinker_1, GSLinteltranslator_1 and GWreader_1 subsystems is the first ICS in the Core Part of GSL.

Because of abovementioned relation between GWLintel_1 and GSLintel_1 systems, the intellectual abilities of GSlistener_1 system in CPofGSL are matched with analogous intellectual abilities of GWLintel_1 system in CPofGWL. Below, we will consider these two ICSs in parallel mode.

2.4.1. GWLabstractor_1 (resp. GSLabstractor_1) system directly (resp. through using GSlistener_1 system) basing on the main lexicon of the Geointel_1 system, takes an expression of CPofGWL (CPofGSL) as input datum and gives its abstract form or forms as output result. A resulted abstract form is called as an abstract expression of CPofGWL (resp. CPofGSL).
2.4.2. GWLsynthesizer_1 (resp. GSLsynthesizer_1) system takes as input datum an abstract expression and written (resp. spoken) lingual data of CPofGWL (resp. CPofGSL) and directly (resp. through using GWreader_1 system) gives as output result a written (resp. spoken) lingual form, which is result of concretization of the input abstract expression by the output written (resp. spoken) lingual data.
2.4.3. GWLchecker_1 (resp. GSLchecker_1) system takes as input datum an expression of CPofGWL (resp. CPofGSL) and checks it directly (resp. through using GSlistener_1 system) or in non-dialog, i.e. in automatic, or in dialog, i.e. non-automatic mode and gives as output result the fully corrected form of the input expression. This checked expression is called as well-formed expression of CPofGWL (resp. CPofGSL).
2.4.4. GWLanalyzer_1 (resp. GSLanalyzer_1) system takes as input datum a well-formed expression of CPofGWL (resp. CPofGSL), mathematically analyses it on the base of main lexicon of the Geointel_1 system and gives as output result its complete bracketing form. This complete bracketing form is called as well-formed bracketing expression of CPofGML.
2.4.5. GWL-GMLconnector_1 (resp. GSL-GMLconnector_1) system realizes two-way connection between CPofGWL (resp. CPofGSL) and CPofGML. Namely, GWLtoGMLreducer_1 (resp. GSLtoGMLreducer_1) system, which is a subsystem of GWL-GMLconnector (resp. GSL-GMLconnector) system, takes as input datum a well-formed bracketing expression of CPofGML and gives as output result its semantically equivalent mathematical expression. This mathematical expression is called as well-wormed mathematical expression of CPofGML. GMLtoGWLproducer_1 (resp. GMLtoGSLproducer_1) works in vice versa, i.e. it takes as input datum a well-formed mathematical expression of CPofGML and gives as output result its semantically equivalent expression of CPofGWL (resp. CPofGSL).
2.4.6. GWLthinker_1 (resp. GSLthinker_1) system consists of GWLreasoner_1, GWLtheoremprover_1, GWLtasksolver_1, GWLreasoningchecker_1, (resp. GSLreasoner_1, GSLtheoremprover_1, GSLtasksolver_1, GSLreasoningchecker_1) subsystems. Below we will consider them very briefly:

2.4.6.1. GWLreasoner_1 (resp. GSLreasoner_1) system takes as input datum one or two declarative sentences of CPofGWL (resp. CPofGSL) and makes all possible general conclusions, which are implied with given sentences as premises in CPofGWL (resp. CPofGSL).

2.4.6.2. GWLtheoremprover_1 (resp. GSLtheoremprover_1) system takes as input datum a text of CPofGWL (resp. CPofGSL) and as output result gives its proof, or the system gives as output result a confirmation that it is unable to prove the given input, or the system gives as output results a confirmation that the given input is not a theorem of CPofGWL (resp. CPofGSL).

2.4.6.3. GWLtasksolver_1 (resp. GSLtasksolver_1) system takes as input datum a textually formed task only by means of CPofGWL (resp. CPofGSL) and it

gives as output result its solution, or a confirmation that the given task is unable to be solved uniquely, or a declaration that the system is unable to solve this task.

2.4.6.4. GWLreasoningchecker_1 (resp. GWLreasoningchecker_1) system takes as input datum a textually formed reasoning, which is formed only by means of CPofGWL (resp. CPofGSL) and it gives as output result a confirmation that the given input is a right (i.e. well-formed) reasoning, or declaration that the input is not a right (i.e. well-formed) reasoning and in this case the system gives report about the mistake, which was found in the false input "reasoning" and if this is possible, the system checks the input "reasoning" and as output result gives this already checked right, i.e. well-formed reasoning.

2.4.7. GWLinteltranslator_1 (resp. GSLinteltranslator_1) system consists of GWL-EngWLtranslator_1, GWL-GerWLtranslator_1, EngWL-GerWLtranslator_1 (resp. GSL-EngWLtranslator_1, GSL-GerWLtranslator_1) systems. Below we will consider them very briefly:

2.4.7.1. GWL-EngWLtranslator_1 (resp. GSL-EngWLtranslator_1) system takes as input datum a text of CPofGWL (CPofEngWL) (resp. CPofGSL (CPofEngWL)) and gives as output result the translation of input text in CPofEngWL (CPofGWL) (resp. CPofEngWL (CPofGSL)) using GML as mediator language.

2.4.7.2. GWL-GerWLtranslator_1 (resp. GSL-GerWLtranslator_1) system takes as input datum a text of CPofGWL (CPofGerWL) (resp. CPofGSL (CPofGerWL)) and gives as output result the translation of input text in CPofGerWL (CPofGWL) (resp. CPofGerWL (CPofGSL)) using GML as mediator language.

2.4.7.3. EngWL-GerWLtranslator_1 takes as input datum a text of CPofEngWL (CPofGerWL) and gives as output result its translation in CPofGerWL (CPofEngWL) using GML as mediator language.

3. About Ideological Bases of Our Technological Aims

To construct GVManager_1, GWreader_1, GSlistener_1, respectively GWLintel_1, GSLintel_1 subsystem of VMGeointel_1 system we use those theoretical results of our researches, which are described in details in [14-16], respectively in [1-13, 17-19].

Below, we will discuss only ideological bases of our technological aims: Our scientific ideology besides our theoretical results is mainly based on Prof. Sh. Pkhakadze's Notation Theory (NT) and on that general semantic program, which was elaborated by him on the basis of his NT [22-23].

In very general sense NT is a system of formally extending formal rules of formal theories and languages. We call a formal theory (language) without, respectively with possibility to be formally extended as formally non-developable, respectively developable theory (language). Herewith, Sh. Pkhakadze's NT, which is formed on the basis of described by him sufficiently general $\Im$ mathematical language ($\Im_{SGML}$) (sufficiently general $\Im$ mathematical Theory ($\Im_{SGMT}$)) gives us new understanding of $\Im$ Formally Developable Mathematical Languages ($\Im_{FDML}$) ($\Im$ Formally Developable Mathematical Theories ($\Im_{FDMT}$)).

Without any doubt, that formally developable theories and languages give us very fruitful new possibilities to construct non-simple intelligence systems. Moreover, above

underlined scientifically founded new understanding of formally developable theories and languages give us scientifically founded new understanding of intellectual abilities naturally existing in humans.

According to this new view we do not consider Frege's ML as artificial one and accordingly, we do not differ it with natural languages. Moreover, according to us any NL and Natural Thinking, respectively, are a result of step by step formal extensions of PML and PMT, which together with PMCs universally exist in all humans. - Here PMT is a $\Im_{FDMT}$ constructed on the bases of PMCs and PML, which, in turn, is a $\Im_{FDML}$.

This means, that according to our lingual ideology any NL, respectively Natural Thinking is a result of that step by step extensions of PML, respectively PMT, where, in any step of mentioned extensions, the extensions are realized according to extension rules of this NL, respectively Natural Thinking. - The truth of above stated general view for GL&T is already sufficiently proved by our recent researches, and this is one of the main result of our researches.

We differ from each other GWL and GWT, GSL and GST, and GTL and GTT. But, at the same time, on the base of abstract views we consider GWL (GWT) as a sub-language of GSL (sub-theory of GST), and GSL (GST) as a sub-language of GTL (sub-theory of GTT). This means that in abstract form any lingual element of GWL, respectively GSL is a lingual element of GSL, respectively GTL. The mentioned is written shortly as:

$$\{GWL\} \subset \{GSL\} \subset \{GTL\}$$

Where {GWL}, respectively {GSL}, respectively {GTL} is a set of all lingual elements of GWL, respectively GSL, respectively GTL. Now, we can define GML as follows:

$$\{GML\} = \{GTL\} \backslash \{GSL\} = \{GTL\} \backslash (\{GSL\} \cup \{GWL\})$$

Also, we have understood GMT as that sub-theory of GTT, which is obtained by restriction of it on the GML. Besides all above mentioned for us any lingual element of GWL, respectively GSL, in generally sense, is a Prof. Sh. Pkhakadze's contracted, i.e. abbreviated symbol, which is definable on the bases of GML, which, in turn, is a result of extension of PML.

We call GML (GMT), respectively GSL (GST), respectively GTL (GTT) as Georgian Subconscious Natural Language (Theory), respectively Georgian Conscious Natural Language (Theory), respectively Georgian Natural Language (Theory). Because GWL (GWT) in its abstract form is a sub-language of GSL (sub-theory of GST), sometime we consider it as Georgian Conscious Natural Language (Theory). But, at the same time, we have understood GWL as an old sufficiently, but not fully successful attempt to formalize GSL.

Now we are ready to declare our views on genesis of GNL (i.e. GTL) and GNT (i.e. GTT), and on the problems of construction of artificial intelligence and automatic translator systems for GL:

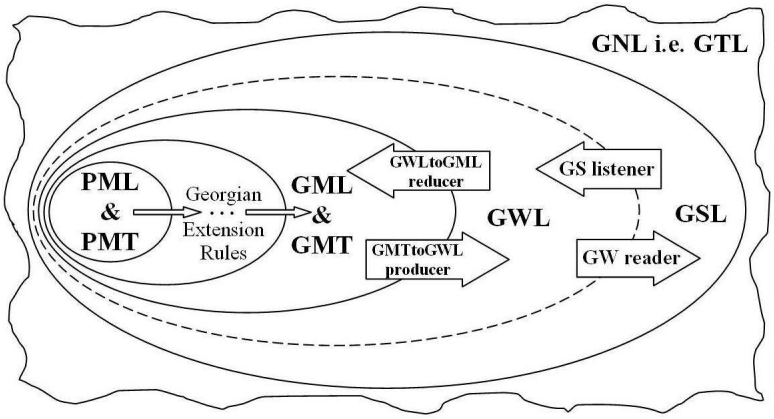

Fig.1.

1. According to our lingual ideology GNL (GNT), i.e. GTL (GTT) consists of GSL (GST), GWL (GWT) and GML (GMT), were GSL (GST) and GWL (GWT) are result of extension of GML (GMT), and GML (GMT) is a result of extension of PML (PMT). At the same time, the extensions are performed only by using Georgian Rules of Extension, which rules, in generally sense, coincide with contracted rules of NT (see figure 1).

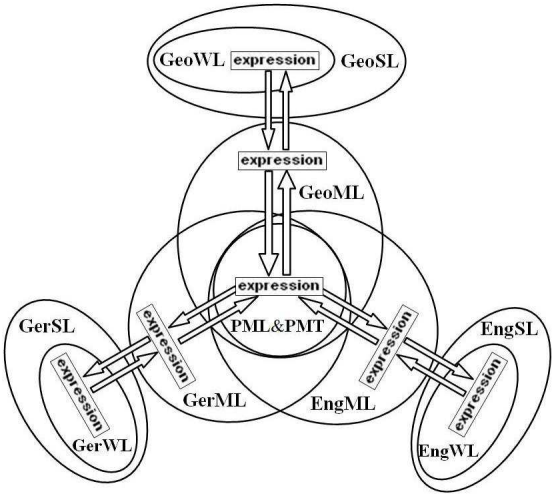

Fig.2.

2. According to our lingual ideology, which is based on above presented genesis and understanding of GNL, for some type intellectual elaboration of some type text of GWL, for example, to solve some textually given task, first of all, we reduce this text to its equivalent text (task) of GML, and only after this reducing we begin to elaborate (to solve) it in GML and through parallel producing the results of mentioned elaborating (solving) processes in GML we form the elaboration (solution) to elaborate (to solve) given text (task) in GWL (see figure 1). - Here is described our ideological bases for constructing GWLintel_1, which plays basic role in construction of GSLintel_1, which, in turn, for some type intellectual elaboration of some type text of GSL, first of all,

with the help of GSlistener_1 system, transforms the text into its equivalent text of GWL, and after elaboration of this transformed text by GWLintel_1 system it produces the final results of mentioned elaborating processes in GSL with using of GWreader_1. So the GSlistener_1 system form the intellectual elaboration to elaborate given text in GSL (see figure 1). - We must mention that, according to our ideological views, realization of two-way connection between GSL and GML (i.e. GTL) using GWL is not in accordance with these systems' relationship naturally existing in humans, but by now because of almost fully non-studding of GSL we are not ready to realize direct connection between GSL and GML (i.e. GTL).

3. Even today to construct automatic translator systems for certain languages is mainly used statistical methods of translation, instead of using strict translation methods based on the mediatory language. On the basis of our lingual ideology we think that the only way to solve completely the problem of automatic translation is to form and to use called by us as a Universally Agreed Mathematical Language (UAML) as a mediator language system between the NLs. In this case Two-way translation between two NLs will be available with the help of two-way translation between UAML and these certainly taken NLs and, at the same time, in this case any NL society will be independently responsible to provide this two-way translation connection of its native language with UAML. - Because of universality of mentioned aims, it is clear, that any specifics of any NL must be in the UAML only in their universally, i.e. mathematically understandable form. - In figure 2, there is pictured how we have constructed GWLinteltranslator_1 and GSLinteltranslator_1 systems, by which are realized two-way translation relation between Georgian, English and German languages according to above declared approach. But, here, GML is used as mediator language instead of UAML.

List of Abbreviations

A_1	- 1-stage A	GTL	- Georgian thinking language
AofB	- A of B	GTT	- Georgian thinking theory
CP	- Core part	GWL	- Georgian written language
DP	- Dialog possibility	GWT	- Georgian written theory
EngWL	- English written language	ICS	- Intellectual computer systems
EngWL	- English written language	ML	- Mathematical language
GerWL	- German written language	MT	- Mathematical theory
GL	- Georgian language	NL	- Natural language
GL&T	- Georgian language and thinking	NT	- Notation theory
GML	- Georgian mathematical language	PMC	- Primary mathematical concept
GMT	- Georgian mathematical theory	PML	- Primary mathematical language
GNL	- Georgian natural language	PMT	- Primary mathematical theory
GNT	- Georgian natural theory	SPP	- State priority program
GSL	- Georgian spoken language	TSU	- Tbilisi State University
GST	- Georgian spoken theory	UAML	- Universally agreed mathematical language

VMGeointel - Voice managed Georgian intellectual computer
$\Im_{SGML}$ - Sufficiently general $\Im$ mathematical language
$\Im_{FDML}$ - Formally developable $\Im$ mathematical language

REFERENCES

1. Pkhakadze K. About Syntactic Relation Between Words, GEU, Journal "Iveria",Paris, **VII-VIII** (2002-2003), 117-126 (in Georgian).

2. Pkhakadze K. (with co-author), About the Main Ideas of the Direct Formal-Logical Description of the Georgian Natural Language System through One Example, RS I.Vekua IAM, **29** (2003), 11-14.

3. Pkhakadze K. (with co-authors), About the Main Ideas of the Direct Formal-Logical Description of the Georgian Natural Language System Through the Examples, Proceedings of the V Tbilisi Symposium on Language, Logic and Computation, University of Amsterdam, 2003, 129-137.

4. Pkhakadze K. A fragment of the Georgian Natural Language System as a Set-Theoretic System, GEU, Journal "Iveria", Paris, **X-XI** (2003-2004), 104-116 (in Georgian).

5. Pkhakadze K. (with Co-Author), About Main Ideas of Direct Formal-Logical Description of the Georgian Language, Proceedings of I. Vekua IAM, **53** (2004), 33-40, Tbilisi.

6. Pkhakadze K. Pre-verbal Semantic Unit, Problem of Personal Signs, Integral and Non-Integral Verbal Semantics and Incomplete or First Semantic Classification of Georgian Verbs, Additional Course in Modern Mathematical Linguistics, Tbilisi, 2004 (2006), 72-152 (in Georgian);

7. Pkakadze K. (with co-authors), The Logical-linguistics Analysis of the Georgian Lingvo-logical System on the Base of the ϑ Notation Theory, The IV Congress of The Georgian Mathematics, 2005.

8. Pkhakadze K. (with Co-Author), On the Linguistic Relations and Logical Declension in Georgian, S-E Journal "Georgian Language and Logic", **1** (2005), 19-77 (in Georgian).

9. Pkhakadze K. (with co-author), General Quantifier-Predicative Analysis of the Georgian Language and First Experimental Version of the Logical Reasoner for Georgian, S-E Journal "Georgian Language and Logic", **2** (2005), 82-87 (in Georgian).

10. Pkhakadze K. with co-author, Georgian-German Translator and Syntaxes Type Synthesizer and Analyzer for Georgian, S-E Journal "Georgian Language and Logic", **2** (2005), 88-91 (in Georgian).

11. Chichua G. Computer Speech Recognition, V Conference of Arn. Chiqobava Institute of Linguistics on NLP, Tbilisi, 2005, 34-35.

12. Chichua G., Pkhakadze K. (with co-authors), Computer will be able to Produce Georgian Narration, V Conference of Arn. Chiqobava Linguistics on NLP, Tbilisi, 2007, 36-37.

13. Chichua G., Abzianidze L. The Speech Recognition and Synthesizing, V Conference of Arn. Chiqobava Institute of Linguistics on NLP, Tbilisi, 2007, 34-35.

14. Pkhakadze K. Abzianidze L., Maskharashvili A. (with co-authors), Fundamental Questions of the mathematical theory of the natural logic of the Georgian natural language system, V Conference on NLP of Arn. Chiqobava Institute of Linguistics, Tbilisi, 2007, 42-44.

15. Maskharashvili A. Mathematical Analysis of Some Complex Sentences, TSU Bachelor Thesis, research supervisor Dr. K. Pkhakadze, 2008 (in Georgian).

16. Abzianidze L. Georgian Simple Sentence Spellchecker Based on Mathematical Methods, TSU Bachelor Thesis, research supervisor Dr. K. Pkhakadze, 2008 (in Georgian).

17. Pkhakadze N. Contracting Symbols in the Georgian Language, TSU Bachelor Thesis, research supervisor Dr. K. Pkhakadze, 2008 (in Georgian).

18. Pkhakadze K., Maskharashvili A., Abzianidze L. (with co-authors), Some Aspects of the Mathematical Theory of the Georgian Language and Thinking, , VI Conference of Arn. Chiqobava Institute of Linguistics on NLP, Tbilisi, 2008, 22-24;

19. Pkhakadze Sh., Some Problems of Notation Theory, TSU, 1977 (in Russian).

20. Pkhakadze Sh., Bourbaki A.N. Type General Theory and the Properties of Contracting Symbols and Corresponding Contracted Forms, GMG, **6**, 2 (1999) Kluwer Academic/Plenum Publisher.

21. Jurafsky D., Martin J. Speech and Language Processing, Prentice-Hall, 2000.

22. Hausser R. Foundations of Computational Linguistics, Springer, 1999.

23. Partee B., Meulen A., Wall R. Mathematical Methods in Linguistics, Kluwer Academic Publishers, 1990.

24. Benthem J. Essays in Logical Semantics, D. Reidel Publishing Company, 1986.

Received: 6.06.2008; revised: 20.10.2008; accepted: 27.11.2008.