L.T.Kuzin: Research Program

Viacheslav Wolfengagen

Institute for Contemporary Education "JurInfoR-MSU",
Vorotnikovsky lane, 7, bld. 4
Moscow, 103006 Russia vew@jmsuice.msk.ru

Dedicated to the memory of Professor Lev Kuzin
on the occasion of his 70th Birthday

Abstract

Lev T. Kuzin (1928–1997) is one of the founders of modern cybernetics and information science in Russia. After getting his Doctor of Technical Sciences degree in the industrial research sphere he joined the Moscow Engineering Physical Institute at the time when there were a few specialists in cybernetics in Russia. A few years later he became a founder of Cybernetics department and a Chair of the section in Applied Problems for Cybernetics

in Moscow House for Scientific and Technical Knowledge Propagation. Almost the same time he became a project principal researcher (project *Data Bank* promoted by the Russian Academy of Sciences), and attracted the teams of researchers to apply the computational models to a field of data and knowledge bases, making the pioneering research in Artificial Intelligence.

He was awarded and honored the USSR State Prize for inspiring vision into the future of technical cybernetics and his invention and innovation of key technologies.

The last years he interested in the computational models of geometrical and algebraic nature and their applications in various branches of computer science and information technologies. In the recent years the interest in computation models based on object notion has grown tremendously stimulating an interest to Kuzin's ideas. This year of 50th Anniversary of Cybernetics and on the occasion of his 70th birthday on September 12, 1998 seems especially appropriate for discussing Kuzin's Research Program.

1 Introduction

The explanation to the term *research program of L.Kuzin* arose from the attempts to analyze the trends, directions and stages of his scientific activity. Kuzin did not used this expression in its own sense but often preferred some way of making the research and development work.

The obvious and simplest way is to declare that the general topic of his research was cybernetics and information science. Nevertheless, this explanation is not precise and exact. For better acceptance and understanding of his efforts, interests and activity it is important to pay attention to his basic aims and ap-

proaches. In case we forgot this general direction we have a chance to loose this understanding.

There has been some general way to understand and select out his research road. But there has been misunderstanding of his main aims and general research approach. One of the reasons for this is that many of his, especially early, tutorials, invited talks and keynote papers appeared in a few copies published in widely inaccessible paper collections or even with a limited access to copies. His ideas have changed with a time but the later ideas, as a rule, arose from the earlier preliminary contributions and projects. The evolution of his ideas with a convenience can be divided into four periods: 1) till early 60s, 2) from 1963 till 1975, 3) from 1975-1976 till 1983, and 4) after 1983-1986.

2 Period till early 60s

Kuzin earned M.S. in Radio-physics as an Engineering Mathematician from Gorky State University in 1951. For 15 years he worked as Senior Scientist and Principal Scientist at the military research institutes where he earned his Ph.D. degree and Doctor of Technical Sciences degree.

This ten years period he worked in military research institutions at the governmental tasks in a field of technical cybernetics. He characterized his position as the "fitter and faultfinder of 10 thousands electronic tubes". He acquired a good experience in developing, fitting and inculcating of the large complex technical systems. But he felt a discomfort with a gap between the theory and engineering practice. On the one hand a theory was extremely abstract, long distant from the practical needs. On the other hand the developers of the complex systems had no effective engineering methods because of their lack. In particular, the educational background of the specialists was insufficient for a success of the development, they had an extreme needs for good background knowledge in system analysis, operation research, and cybernetics. That is why the research and development efforts were often directed to a blind alley, when this became obvious they were canceled out and re-initiated from the starting point. During five years he worked as a principal investigator in a theory of large complex technical systems, and he observed a frequent change of the senior managers for their failed projects.

All of this inspired his decision to change his position, join an educational institute and start the academic activity to contribute to the educational programs for managers, developers of the complex technical systems with well balanced engineering and theoretical ground. This time he was invited to join the Moscow Engineering Physical Institute and found a new department. In establishing the educational

schedules he used his experience from Gorky State University, where due to the school of academician A. Andronov, his Professor, in 1946 the first in USSR technical radio-physics faculty aimed to educate the engineering mathematicians was established. A feature of this educational direction was the accommodation of existing methods and developing the new theoretical approaches to solving the real tasks arising during the development of a large complex technical system. The educational system has a lack of the clear written source books in cybernetics which were written at a good engineering level without a lost of mathematical generality, and Kuzin decided to start this new stage of his career.

3 Period from 1963 to 1975

Lev Kuzin was awarded the USSR State Prize. Kuzin was honored for inspiring vision into the future of technical cybernetics and his invention and innovation of key technologies.

For nearly 35 years he worked permanently at Moscow Engineering Physical Institute where he founded the department initially named "Managing computing machines" and later renamed as "Cybernetics".

During the first two years he concentrated his efforts at the detailed preparations of the academic programs, plans and schedules in the new speciality to launch the long term activity for educating the engineering mathematicians.

He and his collaborators worked closely with industry, academia and governmental structures to promote a principal improvement of information infrastructure strongly oriented towards processing of the very large information bulks and later very large data bases and knowledge processing.

This was a stage in his career when he interested in interactive computing. He observed that in 60s and 70s automatic computing in Russia was mainly valued for data processing by the industrial communities. In 70s his interests moved permanently into the computer field, he paid a lot of attention of humans using computers interactively via CRT displays. After that he had become convinced that computers could make a difference between the humans way of thinking, everyday engineering reasoning and computational plans, so that he decided to contribute in handling the volumes of professional knowledge. He felt that this direction of research has a long range future and perspective and a lot of impacts towards a higher education.

4 Period of 1975–1983

In the 1973–1976 period he wrote a series of reports, in which he set out a conceptual framework about how to

organize the medium and environment where the humans could actually represent their knowledge. Later he was under an influence of ARPA whose leaders committed to the idea of establishing interactive computing with time-sharing.

By 1980 he was one of the principal investigators with a series of industrial projects and started working on a project on 'intelligent computing'. This time he was deeply interested in trying to recruit a vast community of people to start learning how to do the collaborative and multistage investigation of knowledge discovering and representation. He had some good teams of volunteers who started the partial research in a field. Often they worked days-and-nights to concentrate on fastest achievement even of the intermediate results and working software prototypes.

One of his proposals in 80s was to develop an extensible knowledge representation environment. His advice to the research community was to implement an enhanced OPS Information Technology, and a promising project was implemented by his collaborator Oleg Balovnev. This was the full scale OPS computational environment, the toolkit, information technology and corresponding particular applications were used for knowledge systems at the industrial enterprises giving rise to a fruitful research stream.

Nevertheless, in the first half of 70th most of the computing ideas moved more in the direction how to automate the industrial routine work with the huge databases than how to represent and discover the knowledge and establish the knowledge base which would be able to communicate with the databases. This period he launched several Ph.D. research topics to cover the problems of long-range future. He kept thinking about the humans with a high and deep professional training whose 'natural' knowledge could be transformed with the aid of knowledge engineers into a suitable computing schemata. He thought both of declarative and procedural approach trying to combine them into the uniform computational environment.

5   After 1983

He felt that the professional in all fields could boost the quality of their knowledge work using the knowledge representation engines. But for a long time it was the single focus of his efforts, because there were a lot of years when he kept trying to save and continue the most promising working projects which were already launched and running in industry.

During the time in the 70s till the mid-80s he accumulated his experience, knowledge and intuition in a field of information systems in general. He observed the most important projects in government, academy, various research fields, industry to understand the scale and rate of their changes with a time. In each of the branches the changes were with external/internal knowledge schemata and operations, the challenge was for interoperable information exchange using, possibly, the relational databases and meta-relational knowledge bases. He was influenced by the 5th Generation Computing Systems project and tried to select out the basic, but outstanding and challenging ideas.

He used his Ph.D. students research as a platform from which, using the prototype software systems, to launch the promising computational ideas into industry. He felt importance of collaborative efforts with different participating organizations to cooperate in order to explore the possible and actual ways in which the technical systems of artificial intelligence can be done.

Intermediately he and his collaborators ended up generating a concept that they called the "Intelligent Data Bank", or shortly, IDB. He described the real phenomenon of transactions between the counterparts of this poli-based information human-machine system. This time Kuzin and his team launched a series of conferences and symposia to broader discuss the aims, targets and results in this direction. His main idea was based on the effects of group of experts behavior when they act collaboratively and try to get familiar with their environment and to coordinate the common resources with a purposeful efforts and actions. Under these circumstances they must integrate their fuzzy and incomplete knowledge into the entire IDB.

From the mid-80s with a group of supporters he kept pitching the topics of the intermediate direction between the computer science and information technologies. In particular, he was interested in an idea to apply the categorical universe of discourse to the field of data models which erased in the late 70th – early 80th.

He paid special attention to discuss applications of categories to the field of data modeling[1]. His early idea was to use some kind of untyped calculi and impose some weak restrictions to capture the intutitive reasons concerning the data models. This approach tends to taking in mind a family of *computation models* as the restrictions of the untyped combinatory logic or untyped λ-calculus.

During more than a decade he worked as a project principal researcher (project *Data Bank* promoted by the Russian Academy of Sciences during 70th – early 80th), he attracted the teams of researchers to apply the computational models to a field of data and knowledge bases. Having launched in Russia some research

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[1]See, for example, his books: L.T.Kuzin, *Foundations of Cybernetics*, Vol. 2, Moscow, Energija, 1979, and L.T.Kuzin, *Foundations of Cybernetics*, Vol. 1, Moscow, Energija, 1994, both printed in Russian.

projects in a field he discovered that the vital point of a general data model is to build an access to the computation environment. His proposal was to separate the *function* symbol and an *argument* symbol (when the functional expression is included within a query), then to generate access to the domain for argument and to the domain for function separately. The most of the difficulties at this way were observed and some of them were resolved.

Later the more neutral approach was established, roughly speaking, to deal with all the *both-syntax-and-semantic* entities as with the homogeneous *objects*. The objects are interlinked by the relations which correspond to the *scripts* (script-driven data model). This model was extended to capture more *dynamics*. Studying the transitions between the scripts he verified some pure categorical models (with the explicit notion of a *state* in a computation model).

Nevertheless, the *semantics* of the computation in a category was not yet covered. During the last period of his research he was interested in discovering more and more facts which fit in the mathematical ideas beyond a category theory. In his draft research schedule he had done some improvements concerning the feasibility of a categorical abstract machine to evaluate the queries.

6 Selected publications of Lev T.Kuzin

This is not a complete list of Kuzin's contributions, reports, papers, and books. A lot of his reports were published just as the very short theses in hardly available and accessed collections. A part of them were known in details as manuscripts. Another part was represented only as a collections of transparencies which he used during his regular reports at the monthly seminar "Artificial Intelligence" in Moscow House for Scientific and Technical Knowledge Propagation which existed more than a decade. Many of his papers were contributed with the collaborating co-authors. This list is compiled to reflect Kuzin's most promising ideas and challenges, and corresponds to the list of the event which he inspired or stimulated.

In addition, Kuzin was Editor-in-Chief of the periodical "Engineering matematical methods for physics and cybernetics" (Atomizdat, Moscow, Russia). His aims were to stimulate, step by step, the research activity and publications from an open position of Information Technologies. The main target was to launch the development of engineering mathematical methods based on the computer technologies in the various scientific fields. He applied efforts to select out and review the contributions in a field of cybernetics. This periodical has attracted the research communities and stimulated their activity in a manner and in an area of engineering mathematicians.

1961

[Кузин, 1961] Кузин Л.Т.
Расчет и проектирование дискретных систем управления.
Москва, Машгиз, 1961

1973

[Кузин, 1973] Кузин Л.Т.
Основы кибернетики. т. 1. Математические основы кибернетики.
Москва, Энергия, 1973

1977

[Кузин, 1977] Кузин Л.Т.
Интеллектуальные банки данных.
В сб.: Интеллектуальные банки информации, Сухуми, 23 сентября – 2 октября 1977. Тбилиси, 1977, с.3-5

[Кузин, Петров, 1977] Кузин Л.Т., Петров А.Е.
Тензорные методы проектирования ИБД.
В сб.: Интеллектуальные банки информации, Сухуми, 23 сентября – 2 октября 1977. Тбилиси, 1977, с.43-46

[Кузин, Храмов, 1977] Кузин Л.Т., Храмов А.А.
Вопросы использования метаязыков для программного обеспечения систем искусственного интеллекта.
Инженерно-математические методы в физике и кибернетике. Москва, Атомиздат, 1977, No 6, с. 39-43

1978

[Кузин, 1978] Кузин Л.Т.
Проблемы информационно-программного обеспечения систем искусственного интеллекта (СИИ).
В сб. Информационно- программное обеспечение систем искусственного интеллекта, Москва, МДНТП, 1978, с.5-8

[Кузин, Стрижевский, 1978] Кузин Л.Т., Стрижевский В.С.
Интеллектуальная система программирования в АСП.
Автоматизация проектирования, Москва, МДНТП, 1978, с.3-7

1979

[Кузин, 1979a] Кузин Л.Т.
Интеллектуальные банки данных (ИБД).
В кн.: Вопросы кибернетики, вып. 55. Интеллектуальные банки данных. (Под ред. Л.Т. Кузина), Москва, АН СССР, 1979, с.5-16

[Кузин, 1979b] Кузин Л.Т.
Информационно-программное обеспечение

интеллектуальных банков данных.

Всесоюзный научно-технический симпозиум "Диалоговые и фактографические системы информационного обслуживания", октябрь, 1979, Москва, 1979 с.96

[Кузин, 1979c] Кузин Л.Т.
Основы кибернетики. Т. 2. Основы кибернетических моделей.
Москва, Энергия, 1979

[Вольфенгаген, Кузин, Саркисян, 1979] Вольфенгаген В.Э., Кузин Л.Т, Саркисян В.И.
Реляционные методы проектирования банков данных.
Киев, Вища Школа, 1979

1980

[Кузин, 1980] Кузин Л.Т.
Состояние и перспективы исследований в области ИБД.
Тезисы докладов 2-го семинара "Интеллектуальные банки данных", п. Цахкадзор, Армянская ССР, 10-13 марта 1980, Ереван, 1980, с.3-4

1985

[Кузин, 1985] Кузин Л.Т.
Состояние и перспективы развития научно-технического направления "Искусственный интеллект".
Искусственный интеллект. Итоги и перспективы. Москва, МДНТП, 1985

1994

[Кузин, 1994] Кузин Л.Т.
Основы кибернетики. В двух томах. Том 1. Математические основы кибернетики.
Москва, Энергоатомиздат, 1994

7 Some of the prominent events stimulated, initiated and/or inspired by Lev Kuzin

This list includes some of the most important events which were inspired, stimulated and/or initiated by Lev T. Kuzin's and is not complete. The comments to his publications and contributions are shortly given because some of his works were never published as a complete papers, or were published in a minimal amount of copies. His most important publications are printed in Russian.

1963

He founded at Moscow Engineering Physical Institute the department No 22 "Controlling electronic computing machines" later renamed as "Cybernetics". A few time later he was awarded the USSR State Prize for contributing in technical cybernetics.

1971

SEMIOTICS METHODS FOR MANAGING THE LARGE SYSTEMS. Seminar at the Moscow House for Scientific and Technical Knowledge Propagation (MHSTKP)

1973

He analyzed the state of implementing and applications of Management Information Systems (MISs) in the USSR at the seminar with government representatives. He gave a system analysis of MIS in a scale of the big city like Moscow. This was aimed to effective using of computers and mathematical methods in industry and research institutions.

1974

ARTIFICIAL INTELLIGENCE. ADVANCES AND PERSPECTIVES. Seminar at the Moscow House for Scientific and Technical Knowledge Propagation (MHSTKP)

1976

He was one of the principal officers at the USSR conference MANAGEMENT INFORMATION SYSTEMS on May 10-13, Tbilisi, Georgia.

This was a forum for the scientists of the country. He had the invited talk on the problems of modeling for MIS. He summed up the results of applying the continuous mathematics under the new conditions in developing MISs. Kuzin paid attention to a strong necessity to use and establish the mathematical models of other types which previously were unknown because "... *the actual and existing industrial conditions need the frequent changes of criteria, the ranges of possible values for controlled parameters, and the functional structure and restrictions are changeable. The usual means from the general mathematical ware for computer do not give to the specialist from industry an ability to find out the controls which are optimal under the ad hoc industrial situation, without troublesome interference of the mathematicians and programmers*".

One of the possible solutions on his opinion were DBMSs. In particular, he had a serious interest to the relational databases, he inspired and personally assisted the research in this area. Usually he gave to the beginner in this field all the needed support helping to overcome both the principle scientific and purely practical difficulties.

At this event he moderated some round table discussions. Many of his listeners later became the serious researchers and high skilled specialist both in MIS software and in relational DBMS development and applications.

1977

THE 1-st USSR WORKSHOP ON INTELLIGENT DATA BANKS. He was a General Chair at the 1-st USSR workshop "Intelligent Data Banks", Sukhumi, Abkhazia.

In his tutorial Kuzin started up generating a concept of the Intelligent Data Bank (IDB). He determined this kind of information systems as "... *having an ability to generate or derive the new information which was not previously explicitly present, and having the following properties: interface via professionally restricted natural language, multi-user mode, self-learning via open dialog interface*".

In fact, this was a premier workshop in USSR in this direction which was aimed to disseminate the AI ideas all over the country. In particular, Professors G.G.Chogowadze, G.G.Gogichaishwili re-directed their collaborators in Tbilisi, Georgia, towards more close usage of the AI principles and approaches. They were among the founders of the Georgian national school of Artificial Intelligence.

1978a

COMPUTER AIDED DESIGN. He was a moderator and one of the General Chairs at the Moscow seminar "Computer Aided Design" at the Moscow House for Scientific and Technical Knowledge Propagation (MHSTKP).

Kuzin inspired this large scale seminar where many of the known specialists and the beginners in a field took part. A dominant trend was to discuss the results of finished and not-finished research projects and difficulties with the implementations and applications. Among them was a series of projects which were implemented by Kuzin's collaborators, this was an actual outcome of Kuzin's school.

In his tutorial he discussed a conceptual framework for the CAD system with the intelligent behavior, interface and other properties. This time he actively worked in this area and was a principal researcher in this branch. He sought for the opportunities to integrate the implementations of various logic means with the methods. This time he started to formulate the software design principles in terms of objects and scripts, he initiated and started the implementation of a tool kit based on event-driven doctrine.

He understood an importance to develop the general technology and discipline of programming, usage of the logical filters which would give more freedom to a usual or causal user. Most of his ideas were accepted by the USSR's specialists, they were used very naturally and in the most of the research and industrial communities.

This conceptual transparency of his tutorial, extremely natural in its origin, caused the wide dissemination, within the whole country, of the approaches and methods discovered by the collaborative groups of the researches, and first of all by Kuzin's school.

1978b

INFORMATION WARE AND SOFTWARE FOR SYSTEMS. He was a General Chair at the Moscow seminar INFORMATION WARE AND SOFTWARE FOR SYSTEMS at the Moscow House for Scientific and Technical Knowledge Propagation (MHSTKP)

He was not only the principal scientific leader but also a generator of the scientific ideas, moderator of the discussions and demonstrations of the implemented toolkits and applications. His tutorial was listened by some hundreds of humans, they occupied not only the seats in the Big Red Conference Hall, but all the adjacent rooms and halls where the radio translation was turned on.

During the tutorial duration there were no noise at all, this was an actual, highly accented interest to the topic. This was the best school of a live scientific investigation, later many of the beginners and Ph.D. students were influenced to work in this area. Kuzin analyzed the advances and perspectives in an area of the information systems which could be treated as the Artificial Intelligence Systems (AIS). He established the criteria and classification which are applicable to characterize AIS among the manifold of the Information Systems (IS), he analyzed the nature of difficulties attempting the practical Knowledge Representation. He did his tutorial in the engineering style, or using his own terminology, engineering mathematician, entirely in a constructive and even practical way, avoiding the troublesome details of the ontology.

According his tutorial, the future of a matter was extremely promising and scientifically interesting, and possible results of a work were significant. And all of this were in detailed and rigorous correspondence with the known facts and trends. He gave the proper engineering approximation of a rather complicated idea for the properties of a Knowledge Representation Language. He demonstrated his approach to develop the software and to evolve the Software Engineering, he pointed out what are the promising challenges in the world known research projects and what are the palliatives and followers of the ad hoc trends in development and fundamental research.

Kuzin highly estimated an elegance in the mathematical results, but did not like the unlimited usage of this elegance principle. Often he accepted and estimated the results of implementation, even without a rigorous mathematical background, which was based on the sound intuitive ground. But this was just a first stage, after which he, as a rule, inspired the mathematical verification up to establishing the computational

model.

1979a

Kuzin published, under his edition, the book of selected papers in AI-field reflecting the state-of-art in USSR. The title: Topics for Cybernetics. Intelligent Data Banks, vol.55, the USSR Academy of Sciences, Moscow, 1979. This was an extremely popular book which was mentioned among the specialists just as "TC-55" during half a decade. Kuzin selected out, reviewed and edited the papers, with an editing board, during almost half an year making his duties with a care.

This book gave insight and guidelines for both a theory and practice of Intelligent Data Banks and other advanced Information Systems which borrow the AI ideas. Kuzin formulated in depth the concept and notion of IDB which later were used and enriched by the hundreds of researches during the years. He accented that IDB is a kind of Cybernetics System which includes the range of bases: target base, knowledge base, data base, and, possibly some additional bases.

Kuzin concluded that the Cybernetics Systems of this kind need their own, newly established, mathematical foundations which, possibly, have no immediate predecessors and violate the traditional, e.g., continuous mathematics. He was interested in establishing a measure or unit of knowledge which give a sound basis for practical representation. He had a durable interest to the frames' research area which gave a ground to the frameworks based on scripts and situations selected out in the problem domains. One of his ideas was to iterate some simple structure to obtain the actual framework. He proposed to use the models for non-classical logics, but, possibly, had not yet enough intuition how to overcome the contradictions in the large bulk of information. In AI-field the research activity in this direction just started, the difficulties were hardly understood by the specialists, but no accepted constructive theoretical framework was established. Due to John McCarthy et. al the systems of non-monotonic reasoning with varying assumptions were established, so that some possibility to eliminate the contradictions did exist. But Kuzin preferred to find out some special algorithmic procedures or algebraic ground to re-solve and avoid the contradictions towards consistency of the represented information, instead of using and exploring the deductive problem solvers.

His principle paper on IDB inspired a great interest in Russia, its importance is acknowledged till the current years. It was conceptual in depth, enforcing the researchers to think over the range, scale and scope of the possible theory for Intelligent Systems, as well as over the limitations of the traditional Cybernetics and mathematical models, where they cancel out their working scope and the modern trends in cybernetics and Information Systems would affect.

Retrospectively speaking, many the researchers of 70s in AI-field took their own roads and tracks of investigations, which previously were hardly known, their theories met the scepticism from the orthodox mathematicians. The discussions, initiated at the conferences, had a lot of continuations in the voluminous publications of the academic periodicals.

Some of the TC-55 papers were invited, and Kuzin personally gave a lot of comments to the authors, improving the contents. He stressed, that each of these papers must contain the elements of foundations and guides to the future investigations. After the years passed, the Kuzin's strategical plan was succeeded, attracting both a lot of single volunteers and scientific groups. Almost all the young authors of the papers became the known specialists, in some cases founding their own scientific schools and directions of the research and development. Their origin have an easy recovering up to IDB book.

1979b

The USSR Scientific and Technical Symposium on Dialog and Factographic Systems for Information Services. This event was on October, 1979 in Ruza. Kuzin was invited by academician Germogen Pospelov from the USSR Academy of Sciences to organize the section. According the agreement, he got the duties of the principal coordinator for the main Artificial Intelligence stream, Knowledge Representation and Intelligent Data Banks. One of the main targets was to start up in the USSR the practical development and applications of the intelligent information systems, hence for Kuzin the organizing duties were dominant. And he succeeded in his efforts.

An atmosphere of this Symposium was stimulating, the participants could enjoy the golden autumn walking across the nearest forests. All the sessions started at 10:00 AM but Kuzin was in the habit to awake at 7:00 AM, so that all his assistants did the same. The working day of Kuzin's team started with a light running along the bank of the forest river, then sitting at the bench, they discussed the main topics of the current day session, brief outline of the reports and possibilities to organize the evening panels. It was a cool morning, the thoughts and proposals were generated distinctly, becoming in the years the valid directions of a scientific research.

Some of the evening panels were moderated while most of them were the natural continuations of the daytime sessions. The participants were attracted by Kuzin, his vision of the AI trends when he estimated and analyzed the topics. In the late evenings, when

the participants were tired, he moderated the Russian romance concerts singing solo "Shine, shine, my star", "I met you", and a lot of others. His strong and deep voice attracted the additional participants and soon the hotel hall became overfull. The singing was accompanied by the piano music, the other singers changed Kuzin or just the people listened to the classical music.

All of this was happened naturally, without preliminary planning, all the participants enjoyed the intelligent freedom. But in a time the concert again was changed by the multiple local discussions on how to build the Knowledge Systems. Kuzin at ease directed all the discussions simultaneously, sometimes changing the topic or taking his own initiative. These schools of contacts was stimulating for the researchers, especially for Ph.D. students.

With a short time the people created the research teams, exchanging the papers, reports and manuscripts between the teams. They were proud of belonging to Kuzin's school.

Kuzin's tutorial at the session gathered a lot of participants, the conference hall was full. He classified the numerous works and publications, using the qualitative evaluations, the characteristics of efficiency and throughput, generalized and concluded, and estimated the possible benefits and trends. He was confident that the Intelligent CAD systems should contain, besides the database and knowledge base, as a focal subsystem the target base. The most important was to evolve its structure and features, and to solve the most complicated task to establish, implement and release the mathematical model. His tutorial stimulated the research in the developing the target bases which was done by many research teams.

At the panel discussions some speakers pointed out an interest for the knowledge representation units, the frames, comparing the authors and their approaches. There were a lot of criticism and sceptic attitude. Kuzin did not share this position, it seemed that he has an intuitive vision of the in-the-years perspective and long term trends. He usually was right when selecting out what to investigate, what has a perspective and what lost the rate and is a blind alley. In his research predictions he practically never was failed, this was known for other researchers, and as a consequence his Ph.D. students had a good orientation and a starting position to succeed in their own research. At this stage he even enforced the Ph.D. students to develop and implement the knowledge systems based on the distinct notion of frame. He highly estimated the results of a good experiment work which was compared with the same of the other authors. His strategy was to accumulate a range of working prototypes of the intelligent information systems with the aim to develop a full scale release for the industrial applications.

The same year (1979) he published his famous 2nd volume of "Foundations of Cybernetics" with a special subtitle "Models for Cybernetics". This book was written with a great inspiration and confidence in a good perspective for the Artificial Intelligence models during at least 10 years period.

In his book the most important and prominent models for knowledge based systems were selected out and classified. The readership level was as usually the engineering mathematician students, graduate and undergraduate. He applied special efforts to avoid the complicated formal derivations and used instead the trasparent intuitive reasons, the feasibility and qualitative measures, hints and explanations. He described and estimated the scopes of the models and the possible modifications to capture more meaning under the renewed conditions.

His approach attracted a lot of successors and inspired a series of scientific discussions.

1980

THE 2ND USSR WORKSHOP ON INTELLIGENT DATA BANKS. This Workshop was on March 10–13, 1980 in Tsakhadzor, Armenia. He was General Co-Chair sharing his duties with Dr. Ashot Hovanesyan, a director of Medical Information and Computing Center of Armenia. The efforts of joint organizing team to prepare this event, disseminate call for papers, book the conference hall took several months. Kuzin's position helped the organizers to overcome all the difficulties and involve a lot of scientists from various research institutions of the country.

This event was hosted by the team from Medical Information and Computing Center of Armenia. This was due to the attractiveness of the topics and the live interest of the specialists in Medical Cybernetics to develop and apply the intelligent information systems for the health care. The computer-aided working place for the physician was one of the nearest targets. The specialists in medical cybernetics were granted by the government to make a progress in this area. Most of them were highly interested to achieve the desired results, there was a stimulating and collaborative atmosphere.

The participants were located in the hotel at a nice mountain resort, they were vivid and highly collaborative. Among them were the known specialists with invited reports, researchers with different skill, Ph.D. students, specialists from the industry.

Kuzin always was in a center of events, nobody had a free time. The working day started early in the morning with the mountain skies and sliding down the nearest hills. The participants used this opportunity to establish the personal contacts which later generated the good research teams.

The regular sessions were started after lunch time and had a duration till the late evenings while the participants just were tired to continue the panels. A few late evenings were used for the on-fly concerts which were in a Grand Red Hall. The participants could enjoy the classical piano music and Armenian songs of the highly musically talented hosts. Kuzin changed them with the Russian romances.

The topic of his tutorial and moderated panels dealt with the augmentation of the concepts for an information system based on the Intelligent Data Bank. The ways of implementing the adequate data models were at a central position. He gave the feature analysis of the IDB projects and prototypes. Some of the implementations were based on the dialects of Frame Representation Language (FRL), in a few projects the ideas of Nick Roussoupolos to separate frames and relational database were used, others were the followers of deductive models. The team from Medical Information and Computing Center of Armenia implemented and applied to the practical tasks the IDB based on IMS, this was a balanced and successful implementation, in their reports the results of two years experience were discussed.

This was a highly stimulated event with the experience exchange, the relations between many of the institutions were established. This allowed later to share the job of collaborators for the project "Data Bank".

1981

THE 2ND USSR SCIENTIFIC AND TECHNICAL SYMPOSIUM ON DIALOG AND FACTOGRAPHIC SYSTEMS FOR INFORMATION WARE. This Symposium was held on April, 1981 in Suzdal, its aims and scopes were analogous to the 1st Symposium in 1979. Kuzin was a Chair of the Section on Knowledge Representation in Intelligent Systems. He decided to attract the contributions in an area of CAD, and especially in Advanced Programming Technology (APT). His aims were to discuss and analyze in depth the Intelligent Programming Systems and Intelligent CAD. More briefly, he concentrated the efforts on the target description generation for the system under development. His efforts at the 1st Symposium helped him to attract to this event the high quality submissions. Many of the researchers, under his influence, started to develop their frame-based software, dropping the initial system description down to the elementary units of knowledge representation. His school now had the branches with the research teams from Armenia, Baltic States, Georgia, the Ukraine. The new results were reported by the team from Armenia, they launched in the USSR the applied Intelligent Information Systems for Medical Cybernetics. Later the joint project was launched by the teams from Medical Information and Comput-

ing Center (MICC) of Armenia and from MICC of the Russian Federation.

1982

THE 3RD WORKSHOP ON INTELLIGENT DATA BANKS. This workshop was in Georgia. He was a General Co-Chair sharing his duties with Profs. G.Chogowadze and G.Gogichaishwili from the Georgian Politechnical Institute in Tbilisi, Georgia. This was a joint forum where the Georgian school in Artificial Intelligence was widely presented. The topics were as follows: knowledge bases and their development, augmenting the relational databases with the intelligent access, interfaces, intelligent CAD, and various applications. Most of the Georgian research teams shared Kuzin's approach and worked in a close collaboration with Kuzin's school.

In his tutorial Kuzin paid attention to the computational environment of IDB and its properties. He proposed to organize on-fly the series of panel discussions and a round table to better coordinate the mutual research activity. He felt a good reason and opportunity to launch the concert projects which were aimed towards development the full scale prototypes of IDB. Some of them must use the various data models and knowledge representation schemata, while others used the specific problem orientation. The agreements between the institutions were achieved and in the nearest future the projects were launched. This was a great advance in the sphere of Artificial Intelligence in the USSR which strongly influenced the research activity in the country.

1983

THE COORDINATING WORKSHOP OF THE PROJECTS "DATA BANK" AND "SITUATION" ON FORMAL MODELS FOR DEVELOPING THE DATABASES AND DATA BANKS. This workshop was on October 25-27, 1983 in Uzhgorod. Kuzin was a Co-Chair as the principal investigator for the project "Data Bank". This event was addressed to further stimulating of the younger generation researchers. The reports were concentrated on the discussions and feature analysis and trends for developing the advanced data models.

1984a

THE 4TH WORKSHOP ON INTELLIGENT DATA BANKS. He was a General Co-Chair with Georgian partners the same way as at 3rd Workshop. This Workshop was in Terscol, Naltchik and was planned in 1982. Its aim was to estimate the results of joint projects in an area of IDB.

In his tutorial he analyzed the most advanced results of the research teams pointing out the success in applying the relational databases. The Georgian

teams accumulated a good experience developing the intelligent applications for the industry. One of the projects from the Russian team resulted in a toolkit as the extensible computation environment with the embedded knowledge base system and relational database system. The basic primitives were objects within the host programming system LISP, implemented by the system programmer Anatoly Panteleev. The features of implementation and applications were discussed at the evening panels.

Among the interesting theoretical issues on data models were the categorical model and tensor model. The research teams which worked in this directions believed in the promising results and demonstrated the embedding of the relational algebra into categorical or tensor framework. They were at the beginning stage with the experiments, only partial implementations were released.

As was happened, one of the main topics for this Workshop were the embedded systems.

1984b

THE INTERNATIONAL CONFERENCE ON DATABASES IN NETWORKS. This event was on February, 1984 in Moscow, hosted by the International Center for Scientific and Technical Information. One of the main topics was the AI methods for the New Information Technologies. He was an invited speaker and in his tutorial gave in depth analysis of the most prominent results in AI field and their fruitfulness for the Advanced Information Technologies.

1986

THE 1ST WORKSHOP ON INTELLIGENT ACCESS FOR DATA BANKS. This workshop on November 19-21, 1986 was in Dilijan, Armenia, with Kuzin as a General Co-Chair. Dr. Ashot Hovanesyan was both a General Co-Chair and Program Committee Chair and attracted a set of submissions reflecting the state-of-art in an area. Kuzin's school was presented by the numerous reports. All the relative research teams also joined this event. In fact, this was the 5th Joint Workshop on Intelligent Data Banks which continued the series of previous four workshops.

Kuzin's tutorial "Evolution, advances and trends in an area of intelligent access for data banks" later was disseminated in manuscript within the research community. One of his ideas was to use objects as data and knowledge units which are equipped with the attached procedures. Under this assumption the information system would be extensible. This time he worked at the extensible data models and gave their feature analysis in depth.

References

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