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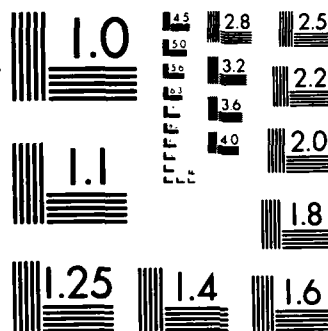
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ARTIFICIAL INTELLIGENCE DEVELOPMENTS RE:
DOD GATEWAY INFORMATION SYSTEM (DGIS)
AND
DEFENSE APPLIED INFORMATION TECHNOLOGY
CENTER (DAITC)

Allan D. Kuhn

February 1987

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DTIC AI Foundational Series No. 2

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- No. 1: Toward An Artificial Intelligence Environment for DTIC:
Staffing Qualification Criteria For AI Application Development.
Defense Technical Information Center, Feb 87, AD-A181 100.
- No. 2: Artificial Intelligence Developments Re:
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ARTIFICIAL INTELLIGENCE DEVELOPMENTS RE:
DOD GATEWAY INFORMATION SYSTEM (DGIS)
6
DEFENSE APPLIED INFORMATION TECHNOLOGY CENTER (DAITC)

SUMMARY

The artificial intelligence activities of the DGIS and DAITC are summarized. AI-like developments are discussed as precursors to true AI activity. The DGIS is presented as a low-level AI-like system, which attempts to mimic human responses. The DAITC is now being established as an information technology resource for DoD. The missions of the individual DAITC laboratories are described. These laboratories will study applications of AI, high density storage, interconnectivity, video laser disk, and human factors. The overall objective of implementing AI applications will be to make the human-machine interface more human-like.

KEYWORDS: artificial intelligence, Defense Technical Information Center, DTIC, DoD Gateway Information System, DGIS, Defense Applied Information Technology Center, DAITC, information technology, human factors, interfaces

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ARTIFICIAL INTELLIGENCE DEVELOPMENTS RE:
DOD GATEWAY INFORMATION SYSTEM (DGIS)
6
DEFENSE APPLIED INFORMATION TECHNOLOGY CENTER (DAITC)

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Office of Information Systems and Technology
Defense Technical Information Center, Alexandria, VA.

February 1987

INTRODUCTION

DTIC has several initiatives in artificial intelligence (AI) and AI-like activities. These initiatives are associated with the DoD Gateway Information System (DGIS) and the Defense Applied Information Research Center (DAITC), at the Mark Center, Alexandria, VA. As these initiatives develop, it is our experience that AI-like technology precedes pure AI, and then begins to blend with it. AI-like applications have already been incorporated in the DGIS.

DGIS itself a low-level AI-like system, in that it operates on an integrated BSD UNIX and INGRES based software called the Intelligent Gateway Processor (IGP). IGP, developed by the Department of Energy's Lawrence Livermore National Laboratory (LLNL) Technology Information System (TIS), provides the system user a box of tools to abstract information from local and remote databases, and reformat and transfer that information. In essence, the IGP gives the user capabilities to transform data into a form that the user deems useful, i.e., "...the way I want it." The IGP, then, to an extent lets the user handle information in one's own, or a somewhat human manner.

Thus, the categories AI and AI-like. The goal of incorporating both AI and AI-like technology is to give electronic machine systems the appearance of having human responses.

DEFENSE GATEWAY INFORMATION SYSTEM (DGIS)

As stated, the DGIS is a low-level AI-like system. It offers the IGP toolbox, and it does so in two manners. The first is a user interface menu system which organizes the toolbox, and through secondary and subsidiary menus steps the user through all the toolbox capabilities from beginning to end. The second manner allows the user to use the menu commands independently of each other, to speed up information processing. Thus, DGIS provides the user two levels of information handling, one casual and one knowledgeable. The figure following is the top menu, and shows the components of the DGIS toolbox.

```

0      WELCOME TO THE DoD GATEWAY INFORMATION SYSTEM

>>>>>>>INFORMATION TRANSFER MODULES
1      directory      DGIS Directory of Online Resources.
2      communicate    Connect to information resources and people.
3      process        Information product tailoring.

>>>>>>>INFORMATION UTILITIES
4      em             Electronic Mail.
5      files          File operations.

>>>>>>>SUPPORT INFORMATION
6      help           Description of features.
7      users          DGIS registered users.
8      info           DGIS news and information.
9      dtdlog         DGIS full text retrieval.

DGIS HOTLINE NUMBER: (703) 276-8182
or send questions via DGIS EM to 'dgishelp.'

Enter a menu number, a command, 'b' to backup, 't' for top, or 'e' to end.

```

Figure: Top Menu of the DGIS.

Currently, there are five major areas in DGIS concerned with AI-like and AI supported technology. These areas are:

Common Command Language (CCL)
PROLOG Initiative
Online Directory of Resources
Command Pattern Search System (COPS)
SearchMAESTRO

At this point, the PROLOG initiative involves the highest level of AI technology. Its incorporation into DGIS developments was precipitated by the CCL project, and its utility for further AI applications is foreseen. These future applications are included under the end section titled AI DEVELOPMENT THRUSTS. The current developments respond to the user in a manner that mimic human-like reactions, however, and in doing so, surpass rigid machine-demanded invocations and results.

>>> COMMON COMMAND LANGUAGE (CCL)

The DGIS CCL project began when it was realized that DGIS could take a user to a database, but once you were in it, you were on your own. This is fine if one searches a limited set of databases, and doesn't mind learning the individual command languages of that set. DGIS, however, in accessing a multiplicity of databases, provides the potential of creating a virtual domain of information resources for one's subject area. This means that a user can get information relevant to one's query from any number of relevant databases, from one to 10 to 20 and more. But generally users, including professional searchers, are not likely to learn the native command languages of an unlimited number of systems. This is especially true of endusers, whose jobs are to fulfill the missions of their offices, rather than take the extensive amount of time needed to learn native command languages of diverse databases.

DTIC, therefore, targetted several information systems of probable general interest to the DoD information community, and structured a DGIS CCL activity to develop a CCL in an incremental fashion. Basically, CCL is a standardized command language replacement for diverse native command languages, meaning that the user learns one command language to search diverse databases. DGIS CCL

follows the draft standard developed by the National Information Standards Organization (NISO) for the CCL command set.

The CCL activity is structured in a matrical fashion to develop in three basic phases and through three basic groups. Phase I concerns the programming of the standard commands. Phase II concerns cross-command invocation, i.e., allowing the user to use one's favorite native command language or even mixed language commands in any database. Phase III incorporates a common access approach, involving 4th generation language (4GL) capabilities and AI implementations.

Phase III is foreseen as merging DGIS system capabilities under a natural language umbrella system, and in doing so, creating an Expert DGIS. Such a merging would include the Directory of Resources, automatic connections to remote databases, natural language queries, multiple remote database results, and download file creations. Through the use of natural language, the user would initialize all these activities with the query and instruction invocation and not through a set of time-consuming sequential invocations.

Concurrent with these development phases is the incremental implementation of the command-invocation groups. We realized very early that we were NOT actually dealing with commands, but with functions, and that the standard commands were the function labels. We therefore established function groups. Group I concerns a selected set of the most used functions. Group II concerns the remaining functions generally common to systems. Group III involves database idiosyncratic functions. Additionally involved throughout CCL development is boolean logic and system features such as ordering, qualifying, sorting, etc.

The following table shows the general idea of CCL development. In that DGIS is a gateway to diverse databases, there is already a standard procedure for connecting (the automatic connect) and disconnecting. The NISO standard commands shown are the most common functions in searching databases. The representative native command languages show not only the criticality of correctly identifying the relation between DGIS CCL and the remote information system, but also the wide diversity of command languages even within the small example shown.

DGIS	NISO	Diverse Databases
Automatic Connect	START	[Logon Routines]
	CHOOSE	DIALOG: b DROLS: @s[database name]@ ORBIT: [file name] NASA: b, bb BRS: change/ [database name]
	FIND	DIALOG: s, ss DROLS: @s[database name]@ ORBIT: [search term] NASA: s BRS: ..s
	DISPLAY	DIALOG: t DROLS: @dsr@ ORBIT: print NASA: d BRS: ..p
<ESC><CONT>d	STOP	DIALOG: logoff DROLS: @term@ ORBIT: stop NASA: signoff BRS: ..o

Table: Comparison of CCL and Native Command Language Examples.

DGIS CCL will become AI-like as its development progresses and expands. Incorporated in this feature already is the ability to toggle back and forth between CCL and the native command language, as an aid to the searcher to search the database directly if one feels that response is not quite what is wanted. The user may also employ any of the DGIS UNIX-based capabilities (shell-spawning) as needed, e.g., files manipulation, electronic mail, etc., while already having invoked the CCL shell.

The progressive development has also involved the exploration of AI application. PROLOG, further explained below, was recommended because of its inherent reversibility in handling information. This application satisfies the capability to employ a native command language in any of the information systems. It additionally provides the potential for incorporating a Command Language knowledge base system, as a search assistant to the user, and of course, natural language inclusion. The availability of the INGRES DBMS in the IGP provides the potential to explore and incorporate 4GL capabilities such as windows, query-by-form, etc., in the development and enhancement of a common access approach. Common access would make use of the CCL base, but which would be transparent to the user.

Once the DGIS CCL is up and running, an anticipated capability is being able to access and search a set of databases simultaneously with a single query rather than sequentially, thereby quickening the pace of information processing for the user. Also anticipated is the development of a CCL generator for adding on the command languages of remote systems as they are needed, including by the DGIS enduser.

>>> PROLOG INITIATIVE

As mentioned above, our exploration into PROLOG was precipitated by CCL development, during which it became apparent that there were certain processes that might be better accomplished with the incorporation of PROLOG. The problem was the substitution of a command for a remote system's programmed command, and the recognition of that substitution by our own system (DGIS). Our own system's recognition is necessary in order to not only get the wanted responses, but also to maintain the continuity of the command invocation sequence.

The elements of PROLOG that we judged advantageous to CCL needs, therefore, are:

1. Its reversibility. In determining object relationships, a program can be written establishing those relationships, with the inverse of relationship inherent in the program.
2. Its database capability. In that PROLOG has its own internal databases, this feature allows a PROLOG program to manipulate codes as relations that can be asserted or deleted. PROLOG incorporation in CCL includes extending to external databases, e.g., INGRES, to achieve the flexibility of storing knowledge in both PROLOG internal databases and traditional external databases. This allows including more powerful database technology in the program system for greater performance and easier use of DGIS by the enduser.

3. The separation of logic and control. A PROLOG program amalgamates rules and facts, basically making one also the other. Although they are governed by a default execution control, the control can be easily supplemented or replaced by more powerful meta-rules also coded in PROLOG.

4. The two powerful programming features of object language methodology: object inheritance and message passing. Both are easily implemented and embedded in PROLOG. Both features are elemental for the more graceful functioning of CCL.

>>> ONLINE DIRECTORY OF RESOURCES

The DGIS Online Directory of Resources is at the core of the DGIS. It presently consists of references to over 600 DoD and commercial databases of interest to the DoD R&D community, with an expectation of growing to over 3000. Its purpose is to serve as a tool for identifying, within the plethora of information resources, those databases appropriate to a subject query, accessing the identified databases, and interrogating them. A prototype has been implemented using the INGRES relational DBMS.

The directory is menu-driven, but also provides the options of using menu-driven mode or native mode. Although there are over two dozen searchable data elements, it is expected that the majority of casual or novice users will search by subject, database name, or database producer. Its subject-searchability is a key feature. Boolean logic is included. The use of menus solicit the query from the user.

It is planned to incorporate in the future a natural language interface. Eventually, the Directory and CCL are expected to closely interface, as AI and AI-like applications such as natural language and knowledge-base systems are developed. With these developments, the components of DGIS are expected to merge into the initial Expert DGIS.

>>> COMMAND PATTERN SEARCH SYSTEM (COPS)

COPS was conceived, designed and developed by one of the DGIS technical people to allow users to use truncated DGIS commands to speed up activity and decrease key-stroking. A command may be truncated at any length, down to a command entry that remains unique. For example, the system command 'communicate' may be entered as:

```
communicat
communic
commun
com
but not
co
which would be confused with the system commands
connect
count.
```

Additionally, COPS will tolerate faulty entries, and adjust the entry. For example, if one should accidentally enter 'delate', COPS will respond with:

"Do you mean 'delete'? (y/n)"

If one answers 'yes', the command is invoked. If 'no', one is retained at the last point of session activity, with the re-appearance of the menu prompt. This feature incorporates accommodation of human frailties.

>>> SEARCHMAESTRO

SearchMAESTRO (Menu Aided Easy Searching Through Relevant Options) is a knowledge gateway interface based on the EasyNet system, tailored for a

DoD-oriented service by Telebase Systems, Inc. SearchMAESTRO is a DTIC service, operated by DGIS. DoD endusers have the option of accessing SearchMAESTRO through the DGIS, or by dialling in directly.

The idea of SearchMAESTRO is to make available a common approach, user-friendly external interface for DoD endusers, to search diverse topic-relevant databases, including the DROLS Technical Reports (TR) database, for comprehensive information, in a coordinated, uniform manner. The DoD enduser, through SearchMAESTRO, has this common approach access to 800+ databases.

How SearchMAESTRO handles queries is, basically:

1. The enduser accesses SearchMAESTRO.
2. SearchMAESTRO asks how the enduser will pay for the service;
 - (a) If access is via DGIS, service will be paid for through an NTIS deposit account.
 - (b) If access is via direct dial, the DoD enduser will indicate payment by NTIS deposit account, or by charge card.
3. SearchMAESTRO then asks whether the user wishes to select a database for the query, or if SearchMAESTRO should direct the query to an appropriate database.
4. Through a series of sequential menus, SearchMAESTRO asks the enduser what the subject area of the query is, and finally, the actual query.
5. SearchMAESTRO takes the query; the enduser waits for the results. SearchMAESTRO comes back with the results of the database search, and through a series of menus, allows the enduser to determine the number of finds to be seen, and whether in citation form or abstract form.
6. Current SearchMAESTRO charge is \$7.20 for 10 citations or 500 lines of full text, \$2.00 for each citation abstract, regardless of database searched, plus telecommunication cost. An accommodation is to be made for DROLS access.

SearchMAESTRO is now in its advanced stage of development, and is hoped to be available in its finished form at the end of March (FY87 2nd Qtr). As it stands, SearchMAESTRO is highly functional. The OSD Defense Spares Initiatives Office (DSIO) is using it on a pilot project basis. SearchMAESTRO has been made available on the DGIS, and is also available by direct dial-in.

Refinements in process are as follows:

- a. There are still a number of DOD-oriented menus and information screens to be incorporated in the design.
- b. A combined DGIS/SearchMAESTRO charge plan has been developed and is in coordination in DTIC. \$28K has been placed with FEDLINK for use by an estimated 50 users for FY 87 as an interim payment measure.
- b. The SearchMAESTRO interface to DROLS has been developed and is available to DROLS-registered users. DROLS access remains secure by the user entry of the DROLS access user codes (unclassified, dial-in).
- c. Development as a DoD-oriented service has made surface the concept of clustering topical and mission-oriented relevant databases as needed by DoD offices. The first cluster is very basic: DROLS, NTIS, DOE-RECON, and NASA-RECON. This set appears as a menu option set for searching Federal R&D reports. More specific clusters will be determined by the mission information requirements of the individual DoD offices.

There now are several potential features that could enhance the system for DoD endusers.

- a. The DTIC Administrator has expressed interest in interfacing the DROLS Work Unit Information System (WUIS). This could lead into doing the same for all major Federal current R&D report systems, and clustering them in the system design.
- b. EasyNet has developed two enhancements that should be made available relative not only as features in the interests of individual endusers, but also to the clustering concept. One is SCAN, for ascertaining volume of topical references or holdings in sets of databases. The

- other is TREND-TRACKING, for ascertaining in graphical form subject volume in a database across a defined period of years.
- c. EasyNet is gaining access to foreign databases, especially in Europe, as rapidly as possible.

The EasyNet development people have been extremely proficient and accommodating in the design and tailoring of SearchMAESTRO. They have already performed a number of tailored systems, including for the AT&T Bell Labs. in New Jersey, and for Western Union, which is called "InfoMaster"(c), and which has been advertized in newspapers and business magazines. SearchMAESTRO is being publicized through meetings, conferences, and by word of mouth. DTIC will create printed material to make it known as another DTIC service to the DoD community.

DEFENSE APPLIED INFORMATION TECHNOLOGY CENTER (DAITC)

At this point, the DAITC is in process of establishment as an information technology resource center for DoD. Its intended purpose is to create and maintain an environment to support the investigation of available information technologies. It is hoped then to develop and prototype information products and services for implementation within the DoD. Its planned program is to accelerate the introduction and use of new information technology in the Defense community by conducting a broad program of applied systems evaluation, prototype development, demonstration, and training.

The DAITC is to be composed of a number of laboratories to explore areas such as high density information systems, human factors, interoperability, and artificial intelligence. The labs are in various stages of formation, from initial to fairly well set up. Presently, they primarily provide demonstrations in their technology areas as a means to generate interest in forthcoming DAITC studies, evaluations, and applications. The labs already have, however, an amount of hardware and software that have AI application, and which will be used so eventually in the AI implementation merging of their respective technologies. These labs are:

>>> Artificial Intelligence Laboratory

This lab will research and evaluate artificial intelligence and decision support systems. Its initial thrust will be prototyping AI and DSS for OSD/Directorate of Computer and Office Automation Resources (DCOAR). The lab projects a hardware inventory that includes IBM/ATs, TI Explorer LX workstations, Xerox 1186 workstations, Sun Microsystems workstations, and Symbolics AI workstations. In addition to the AI-relevant software accompanying these systems, there will also be AI system building tools that will include Automated Reasoning Tool (ART), Knowledge Engineering Environment (KEE), Knowledge Engineering System (KES), Xerox Loops, et al.

>>> High Density Information Systems Laboratory

HDIS will explore optical memory and voice recognitions technology applications to information management. The lab already has several applications under development. One is a records management system on optical disk. A voice recognition system is being tested as a means to provide executive information retrieval and voice information entry or retrieval. Such a system can facilitate computer use by handicapped persons. Also being looked at is the high density storage of a 38 year historical case paper file of about one half million pages concerning the Defense Acquisition Regulation (DAR) System. Equipment projected for the lab., if not already in, includes Kurzweil Voicesystem and Voicewriter, Sun computers, word processing systems, optical disk systems, CD-ROM systems, etc.

>>> Interconnectivity and Interoperability Laboratory

At the moment, the status of this activity is nebulous. If no separate lab is formed, its activities will be performed in the other labs to varying degrees. The activity, however, is to deal with the functioning of the computer systems both within the DAITC and in communicating with external systems. A particular purpose is to overcome the "islands of automation" that have naturally grown and proliferated in the electronic systems explosion. Success in this area will help make the information universe a virtual database to the enduser.

>>> Technology Implementation and Human Factors Laboratory

This lab. will concern itself with human factors in the planning and implementation of automation efforts. The lab. will be staffed by management specialists and behavioral scientists, making use of the materials of the other labs. and of Automation Implementation Management Systems (AIMS) tools, developed by the contract organization running the lab. The objective will be to provide assistance in avoiding the problems that rise when inadequate attention is given to human needs in automation.

>>> Video Laser Disc Applications Laboratory

The VLDAL is concerned about VLD technology in training, through interactive video courseware in the areas of project management, procurement management, and computer literacy. Initially, exploration in this technology will be aimed at solving OSD problems in these areas. The VLDAL will be involved with optimal configurations of video laser disk players, color monitors, scanners, keyboards, and laser printers. The integration of VLD technology with expert systems, decision support systems, and optical disk mass storage has strong potential in information technology applications.

As can be seen from above, there is tremendous potential for AI implementations through merging these technologies. For example, a possible implementation is applying an AI-based Expert System for logistics material information, stored on video disk. Video disk provides for text description of an item, its image display, specifications display, and even sound as a subsidiary description capability. The expert system would be used to search the disk. Disk copies could be distributed to all system users for local searching.

AI DEVELOPMENT THRUSTS

DGIS, to be maintained by DTIC, will be the computer system core of the DAITC. DGIS has two basic functions. One is aggregating information from remote databases and processing that information. The second is development of information processing capabilities for the DoD users. The DGIS development team envisions quite a number of highly potential AI applications for Expert DGIS information handling.

Such development thrusts include:

- Common Command Language Search Assistant (in development).
- Routine Generator Expert Systems.
- Information postprocessor systems.
- Thesaurii integration for expert searching.
- Diverse Database Query Expert System.

- Numeric Information Query and Processing System.
- Portable Natural Language Interface.
- Natural Language Interface to UNIX.

The purpose of these applications will be to make the human-machine interface more human-like, and more natural, rather than machine-like. In doing so, the system will act in a manner that simulates intelligence, i.e., makes educated, useful decisions. DGIS then becomes a gracefully operating system that, instead of acting intolerantly on strict machine-demanded action, responds with human-like tolerances to the benefit of the user.

ADDENDUM A

ARTIFICIAL INTELLIGENCE APPLICATION AREAS

The following is a concise listing of the general areas of AI studies and application. It is fairly comprehensive, although it may be incomplete.

- Computational Linguistics
- Knowledge Representation
- Expert System Technology
- AI Architecture
- Special AI Applications (education, CAI, environments)
- Learning and Acquisition (of knowledge)
- Theorem Proving/Logic Programming
- Common Sense Reasoning
- Distributed Problem Solving
- Cognitive Modelling
- Vision
- Robotics
- Neural Networking

Sources:

Nils J. Nilsson, Artificial Intelligence Center, SRI: "Artificial Intelligence Prepares for 2001." The AI Magazine, V4 N4 Winter 1983.

Roger C. Schank, Yale Univ.: "The Current State of AI: One Man's Opinion." The AI Magazine, V4 N4 Winter-Spring 1983.

ADDENDUM B

QUICK STUDY OF AI REPORT DOCUMENTATION IN DROLS AND OPEN LITERATURE

In response to a Command request: Provide a bibliography in artificial intelligence.

A quick study was made of report references to artificial intelligence in the literature. The study is broken down into two areas: one DoD research and developments as referenced in the DTIC Technical Reports (TR) Database in the Defense RDT&E On-Line System (DROLS), the other a compilation of reference statistics in the open literature obtained from searching a selected set of highly relevant databases.

••• DROPS RESULTS

A search was made of DROLS TRs, with the query being expanded to include expert systems and robotics. DROLS covers thirty years of DoD RDT&E. Excluded from this search is the origins of AI, language translation, particularly Russian-English.

U. S. A. 1910.

Total references	4016	
Unclassified:	2945	(Includes limited distribution)
Classified:	71	(Restricted, Confidential, and Secret)

An unclassified DROLS bibliography was compiled. It is in four volumes, is 1447 pages long, and is five inches thick.

TEMPERATURE RESULTS

For the open literature search a set of databases of high relevance was selected. Because many databases, including specialized information databases, exceed the reference abilities of IB and IR, and because of the expense and complexity involved in the generality of the query, it was decided to:

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The present authors have used a language, limit the search to current level, present only the first ten references and sample first ten citations per literature.

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TOTAL -> -> -> -> 27337

This study does not pretend to be totally comprehensive. What it does show is that there is a lot out there on "artificial intelligence," and that specificity is now needed in asking about AI developments and applications.

ADDENDUM C

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