The USL/DBMS NASA/RECON Working Paper Series contains a collection of reports representing results of activities being conducted by the Computer Science Department of the University of Southwestern Louisiana pursuant to the specifications of National Aeronautics and Space Administration Contract Number NASW-3846. The work on this contract is being performed jointly by the University of Southwestern Louisiana and Southern University.

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USL NASA/RECON PROJECT PRESENTATIONS

AT THE

1985 ACM COMPUTER SCIENCE CONFERENCE:

ABSTRACTS AND VISUALS

Frank Y. Chum
Suzy Gallagher
Martin Granier
Philip Hall
Dennis Moreau
Spiros Triantafyllopoulos

Center for Advanced Computer Studies
University of Southwestern Louisiana
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March 10, 1985
USL NASA/RECON PROJECT PRESENTATIONS
AT THE
1985 ACM COMPUTER SCIENCE CONFERENCE:
ABSTRACTS AND VISUALS

ABSTRACT

This Working Paper Series report comprises material presented by NASA/RECON research assistants at the 1985 ACM Computer Science Conference in New Orleans, Louisiana, March 12-14, 1985. Each entry includes both the abstract presented and the visuals used for the presentation.

The abstracts presented are:

1. "The Specification and Design of a Distributed Workstation" by Frank Y. Chum,
2. "An Innovative, Multidisciplinary Educational Program in Interactive Information Storage and Retrieval" by Suzy Gallagher,
3. "Critical Comparative Analysis of the Major Commercial IS&R Systems" by Martin Granier,
4. "Design Criteria for a PC-Based Common User Interface to Remote Information Systems" by Philip Hall,
5. "The Design of an Object-Oriented Graphics Interface" by Dennis Moreau, and
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I. THE SPECIFICATION AND DESIGN OF A DISTRIBUTED WORKSTATION

by

Frank Y. Chum
The Specifications and Design of a Distributed Workstation. FRANK CHUM University of Southwestern Louisiana- This project includes the development of a general system for transparent sharing and access of resources in a distributed IS&R environment. The proposed PC-based distributed workstation (PCDWS) prototype will give IS&R users an integrated PC-based workstation environment for transparent access and sharing of resources available from both local and remote facilities. The PCDWS will provide a robust personal computer workstation environment with a comprehensive set of tools as functional components to serve the users, as well as intercommunication and uploading/downloading protocols between workstations and remote mainframes as well as between workstations, thus providing access to multiple local and/or remote DBMS and IS&R systems.

* This work was supported in part by the National Aeronautics and Space Administration under NASA Contract Number NASW-3846.

ACM Computing Reviews
Category Number(s)

B.4.3, C.2.4, H.4.3

Keywords

- Distributed System
  Communications
  Information Search and Retrieval
  Network Operations
DISTRIBUTED WORKSTATION SUPPORT

FOR

INFORMATION STORAGE & RETRIEVAL SYSTEMS
GENERAL GOALS AND OBJECTIVES

*** Provide a mechanism for very wide distribution of the information storage and retrieval capabilities of NASA/RECON system.

*** Provide the potential performance improvement of performing selected functions local to the users.

*** Provide simulated information storage and retrieval system environments.

*** Provide state-of-the-art technology available to the NASA/RECON system.
- SPECIFIC R&D OBJECTIVES

*** Provide a robust personal computer workstation environment with a comprehensive set of tools as functional components to serve as a scientist's / engineer's R&D workbench.

*** Provide access to multiple DBMS and/or IS&R systems.

*** Provide distributed/networked workstation communication and uploading/downloading protocols between workstations and remote mainframes as well as between workstations.
RESEARCH & DEVELOPMENT METHODOLOGY

Phase I: Specifications

*** User Requirement Analysis

*** NASA/RECON Requirement Analysis

*** Distributed Workstation Functional Specifications

*** Evaluation of Candidate Workstation Systems

*** Selection of Candidate Systems

*** Model System and Network Architecture
Phase II: Design and Implementation

... Implementation Study and Design Specifications

... System Implementation

... Testing and Debugging

... Prototyping of Finished System
Phase III: Deployment

*** Development Deployment and Support Strategies

*** Operational Maintenance and Enhancement

*** Performance Measurement and Evaluation
II. AN INNOVATIVE, MULTIDISCIPLINARY EDUCATIONAL PROGRAM IN INTERACTIVE INFORMATION STORAGE AND RETRIEVAL

by

Suzy Gallagher
An Innovative, Multidisciplinary Educational Program in Interactive Information Storage and Retrieval
SUZY GALLAGHER University of Southwestern Louisiana-A description of the development of a set of transportable, college-level courses in the use of interactive, online IS&R systems, in particular the NASA/RECON system, is presented. The purpose of these courses is to educate science and engineering students in the effective use of automated scientific and technical IS&R systems. The presentation includes an overview of project objectives, management phases, and accomplishments to date. The methodology used for the course development is described and future plans, both long-term and short-term, are discussed.

* This work was supported in part by the National Aeronautics and Space Administration under NASA Contract Number NASW-3846.

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Category number(s)
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H.3.0, K.3.2

List major key words in order of importance

Education
Information systems education
Online information services

- 13 -
An Innovative, Multidisciplinary Educational Program in Interactive Information Storage and Retrieval

An Abstract of Thesis Research
Presented to
The Association for Computing Machinery
Thirteenth Annual Computer Science Conference

by
Suzy Gallagher
University of Southwestern Louisiana

March 12, 1985
PROJECT OBJECTIVES

Set of Courses

Hands-on Usage

Science and Engineering Students

Transportable Courses
MANAGEMENT PHASES OF NASA CONTRACT

A. Needs Analysis
B. Course Development
C. Pilot Course Administration
D. Pilot Evaluation
E. Development of Distribution Plan
F. Implementation of Distribution Plan
G. Conduct of Regional Seminars
H. Conduct of On-Site Seminars
I. Coordination of Request Processing and Information Dissemination
J. Course State-of-the-Art Enhancements
K. Institutional Surveys and Evaluations
L. Graduated Student Surveys and Evaluations
M. Periodic Statistical Summary Reporting
OVERALL COURSE DEVELOPMENT DIAGRAM

Needs Analysis Survey --> Deliverables Development --> In-House Evaluation --> Final Product
COURSE DELIVERABLES DEVELOPMENT DIAGRAM

Outline

General References

Visuals

Lesson Plans

Handouts

Instructor Notes

Homework Assignments and Keys

Usage Assignments and Keys

Examinations and Keys
MAJOR CATEGORIES OF ACCOMPLISHMENTS

Project Control

Needs Analysis

Project Working Paper Series

Course Development Working Paper Series

PC R&D Working Paper Series

Other Research Support
Relationship Between PC R&D Goals
FUTURE OF THE NASA/RECON EDUCATION PROJECT

Short Term

Define Additional Course Configurations

Pilot Administration

Pilot Evaluation

Distribution Plan Development

Additional Systems

Additional Disciplines
DEVELOPMENT PLAN FOR THE SET OF 4 COURSES

1-2 Day Intensive Workshop

6 Week Mini Course

12 Week Full Quarter Course

18 Week Full Semester Course
FUTURE OF THE NASA/RECON EDUCATION PROJECT

Long Term

Distribution

Evaluation

Extensions

Enhancements

Non-Educational Institutions

Request and Information Processing

Result Reporting
CONCLUSIONS

End User Education

Co-ordinated Materials

Complete

Varied

Extensions

IS&R Systems

Disciplines

Enhancements

Improvements

Updates

Transportability
III. CRITICAL COMPARATIVE ANALYSIS OF THE MAJOR COMMERCIAL IS&R SYSTEMS

by

Martin Granier
Critical Comparative Analysis of the Major Commercial IS&R Systems. MARTIN GRANIER
University of Southwestern Louisiana- The number of online search services commercially
available to the public today has, in many
cases, complicated the search process for the
casual user. Faced with an increasing number
of systems, each one necessitating the mastery
of a different retrieval language and a
particular set of protocols, the user is left
confused and often unable to satisfactorily
complete his search. This study compares the
syntax, semantics and functions of the
different languages used by some of the
commercial IS&R systems available in the United
States today. It also leads to a proposal for
a common command language which would cover the
functions most needed during the retrieval
process.

* This work was supported in part by the
National Aeronautics and Space Administration
under NASA Contract Number NASW-3846.

ACM Computing Reviews
Category number(s)
(January 1984 revision)
H.2.3, H.3.3, H.3.5, K.6.3

List major key words
in order of importance

Information Search and Retrieval
On-Line Information Services
Query languages
Software development
CRITICAL COMPARATIVE ANALYSIS
OF
THE MAJOR COMMERCIAL IS&R SYSTEMS

by

MARTIN GRANIER

Center for Advanced Computer Studies
- University of Southwestern Louisiana
  P.O. Box 44330
  Lafayette, Louisiana 70504

- 28 -
PROBLEMS FACING

USERS OF INFORMATION SERVICES

*** NUMEROUS AND VARIOUS SERVICES

*** SELECTING A SYSTEM

*** INTERROGATION LANGUAGES

AND SEARCH STRATEGIES VARY

*** DIFFICULT TO REMEMBER

MORE THAN A FEW COMMANDS

*** SAME DATABASES OFFERED

ON DIFFERENT SYSTEMS

*** SEARCH METHODS ON DIFFERENT SYSTEMS

*** LOGIN ACCESS

*** SEARCH QUERIES

*** DIFFERENT OUTPUT FORMAT
PROBLEMS FACING

USERS OF INFORMATION SERVICES (cont'd)

*** STORING OUTPUT

*** COMPARISON OF SEARCHES

*** SUPPORT

*** COMMUNICATIONS PROCEDURES

*** CASUAL USERS
   *** TIME CONSUMING
   *** EXPENSIVE
   *** FEAR OF USAGE

- 30 -
POSSIBLE SOLUTIONS

*** SEARCH SPECIALIST

*** USER INTERFACE

*** FRIENDLY GATEWAY

*** EDUCATING USERS

*** MULTIPLE LEVELS OF ACCESS

*** NATURAL LANGUAGE SEARCH

*** STANDARDIZATION: COMMON COMMAND LANGUAGE
THE ISSUES

*** COMPATIBILITY

*** LANGUAGE

*** SAME INFORMATION ON DIFFERENT DATABASES
THE GOALS

*** HELP THE CASUAL USER

*** GIVE A BETTER AND MORE COMPLETE COVERAGE OF SEARCH

*** COMPARISON OF COVERAGE, TIME AND PERFORMANCE

*** ACCESS MANY DATABASES

*** FACILITATE THE FORMATTING OF OUTPUTS
OUTLINE OF STUDY

... COLLECTION OF INFORMATION

... SELECTION OF SYSTEMS

... ANALYSIS OF AVAILABLE DATA

... PROPOSAL AND CRITICISM OF PROPOSED SET

... FIRST DRAFT OF COMMON COMMAND LANGUAGE

... APPLICABILITY TO EXISTING IS&R SYSTEMS

... POSSIBLE METHODS OF IMPLEMENTATION

... ANALYSIS OF RESULTS
COLLECTION OF INFORMATION

*** SELECT LITERATURE

*** SYSTEM USAGE

*** EXCHANGE WITH USERS

*** EXCHANGE WITH PROFESSIONAL SEARCHERS

*** EXCHANGE WITH SYSTEM DESIGNERS

*** USER MANUALS AND SYSTEM DOCUMENTATION
SELECTION OF SYSTEMS

*** "MAJOR" ONLINE VENDORS

*** AVAILABLE TO A WIDE USER COMMUNITY

*** COMMERCIAL NETWORKS

*** SEARCH LANGUAGE IN ENGLISH

AVAILABLE IN THE US

*** OFFERING A MINIMUM OF COMMERCIAL DATA BASES

*** AVAILABLE PUBLICATIONS

*** SELECTION OF COMMANDS

- 36 -
SYSTEM LIST

*** BRS

*** CAS-ONLINE

*** DIALOG

*** ISI

*** MEDLARS

*** ORBIT

*** PERGamon-INfolINE

*** QUESTEL

*** VU-TEXT
PROPOSAL AND CRITICISM OF
PROPOSED SET

*** ADVANTAGES OF CCL

*** DISADVANTAGES OF STANDARDS

*** DRAWBACKS OF CCL
ADVANTAGES OF CCL

*** DEGREE OF STANDARDIZATION BETWEEN SYSTEMS

*** WOULD BENEFIT:

   USERS
   PRODUCERS
   PROCESSORS

*** TECHNOLOGICAL ADVANCES
- DISADVANTAGES OF STANDARDS

*** COST OF COMPLYING

*** RIGIDITY

*** SPECIAL CASES

*** INVESTMENT

*** DOUBLE SET OF COMMANDS
MUST BE ACCEPTABLE

*** NECESSARY COMPROMISE

*** CONFLICTS MAY EXIST

*** PREVIOUS ATTEMPTS (CCL, ISO)
FIRST DRAFT OF

COMMON COMMAND LANGUAGE

**COMMON DEFINITION OF**

RETRIEVAL SYSTEM FUNCTIONS
- COMMANDS TO INCLUDE (Cont'd)

... DATABASE
... DEFAULT <arguments>
... DISPLAY
... ERROR <message>
... FIELD <labels>
... LIMIT
... LOGIN
... LOGOUT
... NEWS
... REVIEW
... SHOW
DIFFERENCE BETWEEN LANGUAGES

*** COMMAND NAMES

*** COMMAND STRUCTURES

**** SEARCH MODE

**** COMMAND MODE

*** COMMAND FEATURES

*** COMMAND FORMATS
### COMPARATIVE STUDY

**COMMAND LANGUAGES FOR VARIOUS IS & R**

<table>
<thead>
<tr>
<th>BRS</th>
<th>DIALOG</th>
<th>ORBIT</th>
<th>QUESTEL</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>:</em></td>
<td>?</td>
<td>USER: display</td>
<td></td>
</tr>
<tr>
<td>root</td>
<td>expand</td>
<td>neighbor</td>
<td></td>
</tr>
<tr>
<td>and</td>
<td>and</td>
<td>and</td>
<td></td>
</tr>
<tr>
<td>or</td>
<td>or</td>
<td>or</td>
<td></td>
</tr>
<tr>
<td>not</td>
<td>not</td>
<td>not</td>
<td></td>
</tr>
<tr>
<td>adj with</td>
<td>(w)</td>
<td>(w) adj</td>
<td>adj sens</td>
</tr>
<tr>
<td>same and</td>
<td>(s)</td>
<td>(s) adj</td>
<td>nosens</td>
</tr>
<tr>
<td></td>
<td>(f)</td>
<td>(f) (r) and</td>
<td>dst</td>
</tr>
<tr>
<td>print</td>
<td>type</td>
<td>print offline</td>
<td>type print</td>
</tr>
<tr>
<td>printoff</td>
<td>print</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dialorder</td>
<td>order</td>
<td>..order</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(supplier)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>off</td>
<td>logoff</td>
<td>stop</td>
<td>logoff</td>
</tr>
<tr>
<td></td>
<td>logoff hold</td>
<td>stop yes</td>
<td>logoff hold</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIALOG</td>
<td>ORBIT</td>
<td>OTHERS</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>-------------</td>
<td>----------------</td>
<td></td>
</tr>
<tr>
<td>[logout/login]</td>
<td>[logout/login]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* FILE file no.</td>
<td>FILE file name</td>
<td>(*) number</td>
<td></td>
</tr>
<tr>
<td>EXPAND term</td>
<td>NEIGHBOR term</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SELECT topic</td>
<td>FIND topic</td>
<td>SEARCH</td>
<td></td>
</tr>
<tr>
<td>SELECT AU = name</td>
<td>FIND name (AU)</td>
<td>SEARCH</td>
<td></td>
</tr>
<tr>
<td>SELECT a (C) b</td>
<td>FIND a AND b</td>
<td>SEARCH</td>
<td></td>
</tr>
<tr>
<td>COMBINE m * n</td>
<td>m AND n</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMBINE m + n</td>
<td>m OR n</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TYPE x/2</td>
<td>PRINT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TYPE x/6</td>
<td>PRINT TI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRINT x/2</td>
<td>OUTPUT OFFLINE</td>
<td>MAIL, PRINTOFF</td>
<td></td>
</tr>
<tr>
<td>TYPE n/2</td>
<td>Sn/OUTPUT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>?NEWS</td>
<td>NEWS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOGOFF</td>
<td>STOP</td>
<td>DONE, QUIT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(all done?)</td>
<td>LOGOUT, FINISH</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>BYE, BYE-BYE</td>
<td></td>
</tr>
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</table>
FUTURE RESEARCH

*** APPLICABILITY TO EXISTING IS&R SYSTEMS

*** POSSIBLE METHODS OF IMPLEMENTATION

*** ANALYSIS OF RESULTS
CONCLUSION

WITHOUT STANDARDS

*** NOT IN USERS INTEREST
*** ANARCHY
*** INHIBIT SEARCH
*** LOSS OF CUSTOMERS
*** LOSS OF REVENUES

WITH STANDARDS

*** ALL QUERIES ASKED IN ONE WAY
*** ABILITY TO SWITCH BETWEEN SYSTEMS
*** PRESERVE PARTICULARITIES OF SYSTEMS
*** NO CHANGE TO ORIGINAL DESIGN
*** INCREASES ACCESS TO ONLINE SYSTEMS
*** INCREASES USAGE OF ONLINE SYSTEMS
IV. DESIGN CRITERIA FOR A PC-BASED COMMON USER INTERFACE TO REMOTE INFORMATION SYSTEMS

by

Philip Hall
Design Criteria for a PC-Based Common User Interface to Remote Information Systems

PHILIP HALL  
University of Southwestern Louisiana- The problems associated with retrieval by casual users of information stored in remote IS&R systems and the possible utilization of personal computers to solve these problems are discussed. A standardized system which will allow the user to access information stored in many distinct systems through a single common interface is described. The intent of this system is to spare the user the necessity of learning multiple command languages in order to access multiple systems and also retain the full retrieval capabilities of each system. Several levels of interaction are provided to facilitate new user learning phase activity and allow the intermediate and advanced users to interact with the system with the minimum necessary prompting. The system is designed to maximize utilization of local processing and display capabilities and to provide built-in evaluation tools.

* This work was supported in part by the National Aeronautics and Space Administration under NASA Contract Number NASW-3846.

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H.1.2, H.3.3, H.3.5, K.8

Major Key Words:

User Interface Design
User/System Interaction
Information System Interfaces
Personal Computers
Online Information Services
USL NASA
Personal Computer
Research and
Development
PC-BASED COMMON INTERFACE
TO MULTIPLE REMOTE IS&R SYSTEMS
DEFINING THE CASUAL USER

*** 70% of User Population

*** Characteristics

*** No Desire to Memorize Command Languages
*** Infrequent Access to System
*** Limited Knowledge of Programming
*** Limited Knowledge of Command Languages
*** Extensive Knowledge of Subject Field
*** IS&R Access not REQUIRED By Job
*** Job Enhancement Thru IS&R Access
END-USER
MULTIPLE SYSTEM USAGE

INFORMATION

SYSTEM

INTERFACE

END USER
COMMON INTERFACE

INFORMATION

SYSTEM

INTERFACE

PC

MISI

END

USER
DESIGN GOALS

""" Ease of Access to Different Systems
  """ Handle Communications
  """ Facilitate Addition of New Systems
  """ Incorporate Changes to Existing Systems

""" Improve User/System Interaction
  """ One Interface to All Systems
  """ System Documentation
  """ Multilevel Design
  """ Facilitate Downloading
FUTURE ENHANCEMENTS

*** Expert System / AI Applications

*** Enhance User Queries

*** "Advice" to Users

*** "Find" System With Information
V. THE DESIGN OF AN OBJECT-ORIENTED GRAPHICS INTERFACE

by

Dennis Moreau
The Design of an Object Oriented Graphics Interface, DENNIS MOREAU University of Southwestern Louisiana. A description of an advanced graphics interface design that provides the applications developer with a very high level graphics environment is presented. The object oriented design is shown to be appropriate to achieving device and implementation independence. This approach is also shown to provide a flexible means of managing non-graphic information associated with graphic objects. Implementation, using standard graphics primitives, is proposed.

* This work was supported in part by the National Aeronautics and Space Administration under NASA Contract Number NASW-3846.

ACM Computing Reviews
Category Number(s)
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H.1.2, 1.3.2

List major keywords
in order of importance

Graphics Interface
Object oriented environment
An Object-oriented Graphics Interface

Objectives:

To provide an easy to use interface for graphics applications development.

To provide conceptually consistent structure for partitioning graphics functionality.

To provide an extensible environment for archiving graphics components and tailoring available functions.
Interface Evaluation

Test Applications

Interactive Presentation Development System
3-D Surface Construction and Display System
Dataflow Programming Workstation

Evaluation Parameters

Development Time
Application Port Complexity
Performance Degradation
VI. KNOWLEDGE-BASED INFORMATION RETRIEVAL:
TECHNIQUES AND APPLICATIONS

by

Spiros Triantafyllopoulos
Knowledge-Based Information Retrieval: Techniques and Applications - SPIROS TRIANTAFYLLOPOULOS University of Southwestern Louisiana

A collection of knowledge-based tools and techniques in support of information retrieval is presented. Applications such as natural language query systems, data integrity and consistency control, and intelligent interfaces to remote systems and DBMS front-ends, are discussed. Knowledge-based tools and techniques in support of such applications, including frame- and rule-based knowledge representation, knowledge acquisition and utilization, and intelligent dictionaries are presented. The presentation includes future research issues and extensions to existing applications and methods.

*This work was partially supported by the National Aeronautics and Space Administration, under NASA Contract Number NASW-3846.

ACM Computing Reviews
Category Number(s)
(January 1984 revision)

H.2.3, H.3.3, I.2.1

Key words:

Knowledge-Based Systems
Information Systems
Software Tools and Techniques
Knowledge-Based Information Retrieval:

Techniques and Applications

by

Spiros Triantafyllopoulos

Center for Advanced Computer Studies
University of Southwestern Louisiana
Lafayette, LA. 70504
THE RETRIEVAL PROCESS

*** Task: Data or Information Retrieval

*** Available Solutions:

*** Application Programs
*** "Canned" Command Files
*** Menu Systems
*** Programming Languages
*** Query Languages

*** Oriented towards the Frequent User

*** Casual User has to Invest:

*** Time
*** Effort

*** Typically, too many Rules, Languages and Terms
THE RETRIEVAL PROCESS (Cont'd)

*** Specialized Software System Knowledge Required from the User's part

*** The Software System itself does not have any Knowledge of the Human's Process of Thought

*** The Result: Knowledge Gap between User and System

*** The Solution: Make a Part of the User's Knowledge available to the System
KNOWLEDGE ISSUES

Knowledge Representation

The encoding of domain-specific knowledge in a machine-readable and usable format

Knowledge Utilization

The use of knowledge by the DHMS to assist the user in the retrieval process

Knowledge Acquisition

The acquisition of knowledge at either

--- Program development time

--- Program initialization time

--- Program execution time
Frame-Based
All Knowledge about an entity in one "slot"

Rule-Based
Allowable Constructs specified by rules

Knowledge Storage and Retrieval

Typically, a Separate KBMS (Knowledge Base Management System) is used

This approach uses the Host DBMS/FMS for Knowledge Storage and Retrieval

Knowledge transformations needed

Frame-Based knowledge made to fit into table form (relationships)
--- Normalization
--- Redundancy Elimination
--- Storage Efficiency

Rule-Based knowledge also transformed to "fit" in table form
AN EXAMPLE OF KNOWLEDGE REPRESENTATION

NAME: salary
TYPE: noun
DATATYPE: numeric, real
RANGE: 0.00 to 99,999.99
PATTERN: \{ $ \} [ 0-9 ]*\{ .[ 0-9 ]* \}
USED BY: raise, pay, add, subtract
IS-A: object
APPLICABLE-TO: employee
OPERATORS: ge, le, gt, lt, eq, ne
UNIT: $, dollar, dollars
SYNONYMS: payment, paycheck, pay

Can be represented in relations as follows
**KNOWLEDGE REPRESENTATION (Cont'd)**

"""" Proposed Knowledge Representation """

### Noun Frame

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>datatype</th>
<th>max</th>
<th>min</th>
<th>pattern</th>
<th>unit</th>
</tr>
</thead>
</table>

### Synonyms Representation

<table>
<thead>
<tr>
<th>term</th>
<th>stands for</th>
</tr>
</thead>
</table>

### Verbs Representation

<table>
<thead>
<tr>
<th>verb</th>
<th>subject</th>
<th>object</th>
</tr>
</thead>
</table>

### Adjective Representation

<table>
<thead>
<tr>
<th>adjective</th>
<th>noun</th>
<th>implies</th>
</tr>
</thead>
</table>

### Dictionary Representation

<table>
<thead>
<tr>
<th>word</th>
<th>word type</th>
</tr>
</thead>
</table>

### Multiword Representation

<table>
<thead>
<tr>
<th>term</th>
<th>pattern id</th>
<th>rank</th>
</tr>
</thead>
</table>
In addition, the following knowledge is needed to process the user requests

Allowable Syntactical Constructs

--- Since it is fairly constant, syntax is "hardcoded" in pattern form

--- Verification of input pattern via matching with allowable patterns

Allowable Lexical Terms

--- Also stable, "hardcoded" in the program

--- Rules that transform different grammar forms in the ones known by the system (i.e., different tenses, singular/plural forms, etc.)
**KNOWLEDGE UTILIZATION**

Knowledge is abstracted as

- nouns
- verbs
- adjectives
- sequences of words (idioms, etc.)
- noicewords
- overall organization (DB schema)

With such abstraction, it is relatively simple to design and implement the knowledge processor for the restricted natural language.

Abstraction hides all details of storage/retrieval.

Knowledge processor asks for knowledge from the DBMS-implemented KBMS.
Natural Language Processing

Utilizing Domain Vocabulary knowledge and "natural" language constructs

-- Lexical Analysis

-- NL Query Parsing

-- Syntactic Verification

-- Semantic Verification

-- Formal Query Generation

Formal Query Evaluation

-- Handling of Null Results

-- Query Simplification

-- Query Optimization

Other Usage

-- Format Selection

-- Full Report Generation
KNOWLEDGE UTILIZATION (Cont'd)

*** Knowledge Abstraction Facilitates

General System Design

*** Modularity

*** Granularity

*** Portability

*** Variety of Applications

*** Knowledge Utilization Modules

*** Require no special languages
   i.e., Prolog, Lisp, etc.

*** Require no special Environment

*** Require no special knowledge in
   the implementation phase

*** Use simple algorithms
KNOWLEDGE UTILIZATION (Cont'd)

LEXICAL ANALYSIS

Intelligent Dictionary Grammar Knowledge

PARSING PROCESSOR

Intelligent Dictionary Syntax Knowledge

SYNTAX VERIFIER

Syntax Knowledge

Schema Knowledge

SEMANTIC VERIFIER

Semantic Knowledge

Schema Knowledge

FORMAL QUERY GENERATION

Schema Knowledge

Formal Query Syntax Knowledge

Formal Query Semantic Knowledge

FORMAL QUERY EVALUATION

Formal Query Syntax Knowledge

Formal Query Semantic Knowledge

DBMS Specific Knowledge

QUERY POST PROCESSING

Output Device Knowledge

User Profile of Formats
KNOWLEDGE ACQUISITION

Knowledge is acquired at

System Design Time
--- Grammar Rules
--- Grammar Transformation Rules
--- Syntactic Patterns
--- Syntactic Rules

System Initialization Time
--- Schema-based Knowledge
--- Domain-specific Knowledge
--- Dictionary Initialization
--- Basic Knowledge needed for the system to become operational
--- Common Knowledge (applicable to a group of domains)
--- Transformation of Schema
**KNOWLEDGE ACQUISITION (Cont'd)**

--- At System Run Time

--- System can "learn" new entries

--- If a term is unknown, after all transformations, system asks

--- If application domain is expanded, system can learn the new terms

--- At System Maintenance Time

--- Updates to present Knowledge

--- Corrections to present Knowledge

--- New definitions/terms
Access problems have to be solved

Who has access to add knowledge

Who has access to modify knowledge

Who is responsible for initializing the KBS

How the system can be tailored for use at a Production environment

How the system can be maintained at such an environment
CONCLUSIONS

*** Advantages

*** Increased applicability

--- Knowledge about the application is not hardcoded in the system, but can be expanded/tailored

*** Increased system flexibility

--- No specific KBMS Needed

--- No specific DBMS Needed (Minimal code changes in the formal query generation module)

--- No specific environment

--- Modularization and abstraction
CONCLUSIONS (Cont'd)

*** Simpler system
--- Design time is reduced
--- Implementation time is reduced
--- No specific implementation

Knowledge needed

*** Disadvantages

*** Storage efficiency

More required due to normalization/transformations in relational form

*** Execution efficiency

Slower due to database accesses for knowledge retrieval
### Abstract

This Working Paper Series entry represents the abstracts and visuals associated with presentations delivered by six USL NASA/RECON research team members at the above named conference. The presentations highlight various aspects of NASA contract activities pursued by the participants as they relate to individual research projects. The titles of the six presentations are as follows:

2. "An Innovative, Multidisciplinary Educational Program in Interactive Information Storage and Retrieval,"
5. "The Design of an Object-Oriented Graphics Interface, and"

This report represents one of the 72 attachment reports to the University of Southwestern Louisiana's Final Report on NASA Grant NGT-19-010-900. Accordingly, appropriate care should be taken in using this report out of the context of the full Final Report.