Network Working Group
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CBI Networking Activity at MITRE

This RFC is in response to Tom O'Sullivan's probe for comments on Computer Based Instruction. MITRE is currently doing some preliminary work in the area,at the present time limited to use of CAI-related network resources.

The most expedient way for me to respond is by attaching excerpts taken from a recent status report prepared for internal MITRE use, intended for staff not generally familiar with the ARPANET. Comments directed at specific items in Tom's attachment will follow in a future RFC.

We welcome comments on our activities and would like to participate in any CBI dialogs that take place.

STATUS OF IR&D TASK 9780
ARPA NETWORK STUDIES AND EXPERIMENTS

1.0 OBJECTIVES

MITRE/Washington became a node in the ARPA computer network in September 1971 when a Terminal Interface Message Processor (TIP) was installed. Since that time MITRE's use of the network has largely been supported by IR&D funds. The objectives of the IR&D Network Studies are:

(a) to promote the use of the network resources in an operational mode within MITRE to increase the computer capabilities available for supporting sponsor's work;

(b) to use the ARPANET itself as a research tool for conducting computer networking experiments; and

(c) to demonstrate the use of ARPANET resources to extend the capabilities of existing systems.

Specifically, the proposed objectives are:

(1) to select ARPANET resources that can be used to support identified MITRE projects and to demonstrate how these resources can be used;

(2) to use the ARPANET as a research tool to conduct data sharing experiments to study techniques for data handling on a computer network; and

(3) to demonstrate the feasibility of using remote resources on the ARPANET to augment the capabilities of the TICCIT* system.

*The principle use of the TICCIT (Time-Shared Interactive Computer Controlled Information Television) system has been for Computer Assisted Instruction (CAI). A TICCIT/CAI system is currently being developed by MITRE under a National Science Foundation (NSF) grant.

2.0 APPROACH

The IR&D Network Studies and Experiments project requires software development on selected ARPANET Host computers and extensive exercising of network resources. The approach taken to fulfill the project objectives involves effort in three areas.

Task area I is designed to build up ARPANET usage by MITRE. Task II involves conducting data sharing experiments on the network utilizing software being built by MITRE at several network sites. Task III is intended to demonstrate the use of CAI-related network resources to augment the TICCIT/CAI system.

The specific activities involved in each task area are discussed below.

2.3 Task III - Demonstrate Extensions to TICCIT System Capabilities That Are Possibly by Drawing on ARPANET Resources

The structure of the ARPANET is such that it is technically possible to combine resources on the network to form a "distributed system." A first step in this direction would be to use network resources to augment a special-purpose system connected at one of the nodes. The special-purpose system would serve as the vertex of the distributed system, dynamically drawing on network resources to perform specific functions.

The TICCIT/CAI system is a good candidate for demonstrating the feasibility of the concept of a distributed system. However, rather than initially connecting TICCIT to the network, resources on the network will first be used to demonstrate how they could augment the capabilities of TICCIT

Task III is organized as three subtasks to demonstrate that the range of curriculum material can be extended, to demonstrate that the TICCIT/CAI system can be supplemented with specialized CAI systems that use AI techniques, and to demonstrate that TICCIT system resources and capabilities can be augmented by using computing and storage resources available on the network.

(a) Demonstrate that the range of curriculum material can be extended.

The range of curriculum material offered by the TICCIT/CAI system can be extended by using network resources. Two areas that were selected for the demonstration are mathematics and computer science.

The Culler-Fried On-Line Graphics-Oriented system available on the IBM 360/75 at the University of California at Santa Barbara (UCSB) was selected for use in mathematics courses. A collection of diverse systems and languages will be selected to demonstrate how they can be incorporated in a computer science curriculum.

The following tasks are necessary for demonstrating that the range of curriculum material can be extended:

* learn the use and structure of the Culler Fried system.

* use the Culler-Fried system over the network using an

IMLAC graphics display terminal.

* design sample courses for demonstration of the use of the Culler-Fried system in a mathematics curriculum.
* develop software to incorporate the use of the Culler-Fried system in the sample courses and demonstrate.
* prepare a sample computer science curriculum and demonstrate how the wide range of systems on the network can be utilized in a typical computer science curriculum.
* determine and document the technical specifications required for a TICCIT/CAI system interface.

(b) Demonstrate that the TICCIT/CAI system can be supplemented with specialized CAI systems that use AI techniques.

There are two network resources utilizing AI techniques that have been applied to computer assisted instruction tasks: SCHOLAR and LOGO. SCHOLAR is a mixed-initiative rather than a frame-oriented CAI system. LOGO is a LISP-based programming language designed to study whether notions and skills of formal reasoning and problem-solving can be taught. We will investigate if these systems can be used to supplement the TICCIT system and, if possible, will demonstrate their use.

The following tasks are required:

* investigate the use of SCHOLAR on the TENEX system at BBN over the network.
* investigate the use of LOGO and the "turtle" over the network from the PDP-10 at MIT/AI and/or from TENEX at BBN.
* demonstrate the use of the systems over the network.

* determine and document the requirements for an interface with the TICCIT system.

(c) Demonstrate that TICCIT system resources and capabilities can be augmented by using computing and storage resources available on the network.

It should be possible for the TICCIT/CAI system to substantially increase its capacity by using large data storage devices on the ARPANET for storing student records and curriculum and by using some Host computer to run complex statistical analysis programs to analyze and evaluate student progress and course content.

In order to demonstrate that such a scheme is possible, the following tasks are necessary:

* determine format and requirements for curriculum material and student records.
* develop a method to store and retrieve data on a demand basis.
* select a Host on the network and develop software for a demonstration.
* determine and document requirements for an interface with the TICCIT system.

3.0 PROGRESS OF WORK

In this section the progress of the work associated with each task is presented. Both achievements and problems encountered are discussed. The manpower expended thus far for each subtask is given in graphic form, together with a proposed schedule for completing the work.

3.3 Task III - Demonstrate Extensions to TICCIT System Capabilities That Are Possible by Drawing on ARPANET Resources

Many of the resources on the ARPANET were designed as stand alone systems not intended for use over the network nor for facile interfacing with other systems. Thus we have found that more work than initially was estimated is needed to use the selected CAI-related systems over the network. Therefore we plan to fulfill the goals of each subtask by demonstrating the use of selected resources over the network but will not attempt to interconnect the systems in any fashion during FY1972. A proposal to investigate the notion of a distributed CAI system using ARPANET resources is under preparation.

The status of our progress in using CAI-related resources over the network is presented below.

(a) Demonstrate that the range of curriculum material can be extended.

The Culler-Fried (C-F) On-Line Graphics-Oriented system at UCSB was selected to demonstrate its use in mathematics curriculum. The system has been used successfully in a variety of courses at UCSB, including chemistry, mathematics, and economics(30,31,32,33,35).

The Culler-Fried system’s normal mode of operation is with two keyboards and a Tektronics graphics display device. The keys on the second keyboard are "function" keys; for example, by pressing a single key the user can initiate complex actions such as displaying a plot of a convolution function(35). The system can also be used to provide online access to the 360/75 system to remotely control the execution of programs. The latter service is currently available on the network through TELNET. Access to the system was made possible by defining a mapping from ASCII characters (sent as the "network virtual terminal") to characters expected by the OLS. Thus it is often necessary to type a sequence of characters on a TTY-type device to invoke the action of a single function key. Under the current implementation, graphics output to the network is suppressed.

We plan to demonstrate the use of the C-F system on an IMLAC graphics device attached to our TIP. During the first phase of our implementation, we will not simulate the C-F function keyboard but will enter our graphics input using the procedures defined for use via TELNET. For output, UCSB agreed to provide a new output processor which will no longer suppress graphics output, but will map it into the remote graphics capabilities as provided by IMLAC (Figure 3). Such a system was implemented in early February but due to the character-oriented nature of the IMLAC device available to us, the resolution was unsatisfactory. We have now defined a low-level graphics protocol. UCSB has agreed to send graphics output to us using this protocol. We have had to program new processes for the IMLAC and are now debugging the new programs. Due to the limited core available on the particular IMLAC that we are using (4K 16 bit words) which limits the size of internal display lists, we will not be able to plot very complex graphs. However, the software being developed is general and can be moved to an IMLAC with larger core capacity. We currently send alphanumeric input from a TTY or 3300 and divert the graphics output to the IMLAC.

When we can access the Culler-Fried system for graphics output successfully via the network, we plan to modify the IMLAC programs to permit alpha input from the IMLAC keyboard. We also plan to investigate the possibility of attaching a function keyboard to the IMLAC. Lastly, we intend to investigate the use of TICCIT display devices with the TIP. A sample mathematics course will be designed to assist in demonstration of the CAI applications of the Culler-Fried system. We are currently studying the past uses of the system in a CAI mode.

We have not yet investigated computer science curriculums. We plan to get inputs from the ACM Committee on Computer Science Education(36,37) and to visit universities in the Washington area. This activity is scheduled to commence in April.

(b) Demonstrate that the TICCIT/CAI system can be supplemented with specialized CAI systems that use AI techniques.

The two network resources selected for demonstration are SCHOLAR and LOGO. Both systems are implemented in LISP and are currently available over the network on the TENEX system at BBN. A version of LOGO with a "display turtle" is available on the PDP-10 at MIT/AI, however, they do not yet have their NCP implemented and thus are not currently accessible over the network. There is also a version of LOGO on the TENEX system at SRI/AI. They also are not currently connected to the network and we have not investigated their version.

We used SCHOLAR over the network in January with a data base provided by BBN to review the knowledge of a student in the geography of South America(38,39).

The LOGO system at MIT/AI is perhaps the most impressive system for use in a demonstration due to the availability of a "display turtle". The system is currently being used remotely by the Bridge School in Lexington, Massachusetts. We visited the school and observed a class in session. We also attended an undergraduate class in Applied Math at MIT that was learning turtle geometry.

Seymour Papert of MIT expects the MIT/AI PDP-10 to be up on the network by the middle of April(40). He has agreed to modify his system to interface with our IMLAC via the network using the low-level graphics protocol that we specified. He has developed many courses and games using LOGO(41,42,43,44,45) that provide sufficient material for use in demonstrating the system. A real turtle may be available in early summer to run from our TIP.

We have used the LOGO system at BBN via the network. Since the system is continually being modified, Dr. Feurzeig agreed to put a clean version on the RAND TENEX for our use. BBN’s LOGO does not currently have a display turtle, however, they are willing to implement one. Even without the display turtle, courseware that has been developed for teaching mathematics provides sufficient material for us to work from(46,47). A radio controlled turtle has been designed at BBN. It may be possible to obtain the specifications and have one built at MITRE to run from our TIP.

(c) Demonstrate that TICCIT system resources and capabilities can be augmented by using computing and storage resources available on the network.

Work has not begun on this subtask. However, much of the software developed for the data sharing experiments can be used to store and retrieve data on a demand basis.

We have received preliminary curriculum material from TICCIT personnel. We expect to interact with them to determine more specifically the format and requirements for curriculum material and student records.

REFERENCES

30. Ewig, C. S., Gerig, J. T., and Harris, D. P., "An Interactive On-Line Computing System and Its Use in Chemistry Education", Department of Chemistry, UCSB.

31. Howard, J. A., and Wood, R. C., "Computer Assisted Instruction in Engineering Using On-Line Computation", _Journal_of_Engineering_ _Education_.

32. Sullivan, J. J., "Computer Based Instruction in Economics: A Report on Facilities and Applications at UCSB", paper presented at a conference on Computers in Undergraduate Curricula, University of Iowa, Iowa City, Iowa, 1970.

33. Wood, R. C., and Bruch, J. C., Jr., "Teaching Complex Variable with an Interactive Computer System", article submitted for review and publication in _IEEE_Transactions_on_Education_, July 1970.

34. Wood, R. C., and Howard, J. A., "An Interactive Computer Class- room, _Educational_Research_and_Methods_Journal_, Vol. 2, No. 4, June 1970, pp. 29-31.

35. "UCSB On-Line System Manual", NIC #6502, September 1971.

36. "Curriculum 68", _Communications_of_the_ACM_. Vol. 11. No. 3. March 1968, pp. 151-197.

37. Teichroew, D., ed., "Education Related to the Use of Computers in Organizations", _Communications_of_the_ACM_, Vol. 14, No. 8, September 1971, pp. 573-588.

38. Carbonell, Jaime R., "AI in CAI: An Artificial Intelligence Approach to Computer-Assisted Instruction", _IEEE_Transactions_ _on_Man-Machine_Systems_, Vol. MMS-11, No. 4, December 1970, pp. 190-202.

39. Carbonell, Jaime R., "Mixed-Initiative Man-Computer Instructional Dialogues", BBN Report No. 1971, 31 May 1970.

40. Williams, R. W., "LOGO Manual", MIT/AI, Draft memo, 9 April 1971.

41. Papert, S., and Solomon, C., "Twenty Things To Do with a Computer", MIT Artificial Intelligence Laboratory internal report, June 1971.

42. Papert, S., "A Computer Laboratory for Elementary Schools", MIT/AI Memo No. 246, LOGO Memo No. 1, October 1971.

43. Papert, S., "Teaching Children Thinking", MIT/AI Memo No. 247,

LOGO Memo No. 2, October 1971.

44. Papert, S., "Teaching Children to be Mathematicians vs. Teaching About Mathematics", MIT/AI Memo No. 249, LOGO Memo No. 4, July 1971.

45. Papert, S., and Solomon, C., "NIM: A Game-Playing Program", MIT/AI Memo No. 254, LOGO Memo No. 5, January 1970.

46. INFORMATION PROCESSING MODELS AND COMPUTER AIDS FOR HUMAN PERFORMANCE

Final Report, Section 3: Feurzeig, W., and Lukas, G., "Programming Languages as a Tool for Cognitive Research", BBN Report No. 2187, 30 June 1971.

47. PROGRAMMING-LANGUAGES AS A CONCEPTUAL FRAMEWORK FOR TEACHING MATHEMATICS, BBN Report No. 2165, 30 June 1971.

Volume 1, Part 1: Feurzeig, W., Lukas, G., "An Introductory LOGO Teaching Sequence".

Part 2: Lukas, J. D., and Lukas, G., "LOGO Teaching Sequence on Logic".

Part 3: Feurzeig, W., Lukas, G., and Grant, R., "LOGO Reference Manual".

Volume 2, Part 1: Grant, P., Falflick, P., and Feurzeig, W., "LOGO Teaching Sequences on Numbers".

Part 2: Feurzeig, W., Lukas, G., and Grant, R., "LOGO Functions and Equations".

Volume 3, Part 1: Lukas, G., Falflick, P., and Feurzeig, W., "LOGO Strategy in Problem-Solving".

Part 2: Lukas, G., and Feurzeig, W., "LOGO Story Problems in Algebra".

Volume 4: Weiner, W. B., Morgan, C. R., and Feurzeig, W., "The LOGO Processor, A Guide for System Programmers".