M Technology in a Computer and Information Systems or Computer Science Program

by William J. Harvey, Frederick G. Kohun, and Donald J. Caputo

There is a constant need in the M community for more M experts and enthusiasts. The February 1994 issue of *M Computing* dealt with this subject extensively. Offering regular college and university courses on or involving M Technology expands the acceptance of the technology and helps assure a pool of potential new employees for M user organizations. Here is a "roadmap" on how to include M instruction in higher education programs. We hope you can use these experiences and ideas to open discussion with a nearby college or university on including M Technology in the regular curriculum or at least in the continuing education program.

Although several major institutions of higher education use the M language to manage information in various medical projects, such as cancer research and in veterinary science, only a small number include it in computer and information systems (CIS) or computer science (CS) programs. The purpose here is to relate the experience with M Technology in the Computer and Information Systems curriculum at Robert Morris College and to give some pointers on establishing use of M Technology in regular computer instruction in colleges and universities.

Program at Robert Morris College

Robert Morris College (RMC) is a private business college with a suburban main campus and a downtown center in the Pittsburgh metropolitan area. Inclusion of M instruction in the Computer and Information Systems curriculum at the college benefits from a period of planning and development. M courses have been offered in the regular CIS program since 1990.

M (also called MUMPS) was envisioned as an alternative information systems technology that would enrich the education of CIS majors and majors in other business areas. For the advanced students, M Technology also conveniently supports multiuser and distributed-application development and testing, which students rarely encounter in non-M computing. Students learn operating systems and database concepts as they develop applications, since M Technology seamlessly combines all these features into its programming interface.

RMC has sought to achieve an integrated approach to M within the context of information systems: M is only one component of adaptation to change in technology and practice, and is seen as only one element in improving the educational experiences for RMC students. M is one of the tools we can use to deal with multimedia data management and object data management.

Our revised regular curriculum includes two courses that focus on M Technology: M Programming and Advanced M Information Processing. The original versions of each were added to the catalog in the late 1980s. M Programming was first taught in the Spring Semester 1990 and has been scheduled in both evening and day classes. Both courses have been offered on a regular basis since then (M Programming three times a year and Advanced M Information Processing one or two times per year; annual enrollment: about 55 to 60 for the former and about 20 for the latter.) There is some use of M and FileMan outside of these courses and in the graduate curriculum, especially in a course entitled Computer Applications and Information Systems. Some special student projects involve M.

An integrated multidisciplinary approach to combining multimedia with the M language is being developed with faculty from the CIS and Communications departments and RMC graduate students. The focus of this study is the utilization of a media control interface standard in the M language.

Evening courses held alternately on each campus have provided the most favorable response from students, due to the strong interest in M from individuals who are presently employed in full-time positions as computer professionals. They are either exploring an opportunity to change employment to an M-based corporation or have sensed the practical application of M to their present information systems.

RMC also provides custom M training courses on request. Organizations that have requested such courses include the Pennsylvania Department of Mental Health and the University of Pittsburgh Medical School Information Services Division.

Three faculty members normally teach M courses or use M Technology in teaching a course on health services management. An additional four full-time faculty members are knowledgeable about M Technology and its history. Thus students have access to technical viewpoints and comparisons regarding M in a variety of classes. All seven faculty members, along with information management assistants and interns, help support special programs, individual projects, and continuing education seminars.

RMC's M classes use Micronetics MSM-PC, and IBM MUMPS/VM through the campus-wide Novell network. MSM-PC can be downloaded to individual workstations and run from workstation hard disks while MUMPS/VM is accessed through a Novell gateway to the IBM 9370 system and Novell emulation of 3270 sessions. InterSystems' DT-STU and Micronetics' MSM-EXPLORER are available for students to set up M on home or dorm computer systems. (Contact either company or the M Technology Association for a free student version.)

The RMC libraries maintain a full M and FileMan collection at both sites. A special M collection is being built to support M-related research and includes items of technical and historical significance.

Through the RMC Institute for Information Management (IIM), a graduate assistantship and a number of internships are available to support specialized M-related projects. The IIM attracts a number of M research and development projects in which students participate.

A concentrated effort to form associations or partnerships with local corporations and institutions is a key element of a viable M program. In 1990, RMC knew of only a couple of organizations offering employment or cooperative education (co-op) experiences. Today, a significant number of M-related firms have been identified in the local area. One M-user concern alone has employed three RMC graduates and recently added another co-op student to its ranks. We work closely with firms looking at new M applications. Such companies may want to be reassured that there is a source of new employees to support the technology.

The favorable M job market has stimulated interest in courses focusing on M. RMC students have been able to compete successfully for good positions in western Pennsylvania and in other parts of the country. We realize that our students seeking entry-level M-related employment need to offer equal perspectives and capabilities in M and non-M information system technologies.

Adding M Technology to the Curriculum

Here are some ideas to help evaluate M's appropriateness for a curriculum.

First, determine if there is a need for M in the service area of the college or university. Washington, Florida, New York, Alaska, and West Virginia are examples of states in which an effort is underway to use M-based technology in some state health facilities.

Are there M users in your immediate area? M users are the best source of support, encouragement, technical advice, and jobs for your students. The most likely sites are Veterans Affairs (VA) Medical Centers (about 170 nationwide use M-based hospital systems and software). VA information systems staff in your area should be knowledgeable about other M users. Other typical sites include medical and chemical laboratories, blood banks, some banks (particularly trust departments), software companies that develop M-based applications, and certain international export-import firms. Other public health-care agencies use M, such as the Indian Health Service (more than 200 sites) and some state clinics.

A curriculum that focuses on health care or business seems the most suitable for computer-information systems courses. M can enrich computer-science programs in courses dealing with programming languages, data structures, databases, local area networks (LANs), distributed processing, and operating systems.

M has special benefits to offer. A particular strength of M Technology in the classroom lies in the multiuser experiences that can be supported. Most applications run on multiuser systems, but students across the country develop applications primarily in a single-user mode. Although college and university systems use LANs or centralized systems with inherent multiuser capability, most editing and debugging rely on the system only to transmit, upload, and download files or to gain access to a compiler. Students almost never have the opportunity for parallel group application development, multiuser practice with concurrency control, direct control of replication, and translation in distributed environments. Most important, students usually do not have the opportunity to have a multiuser test of their application with all the students in a class simultaneously logged onto one student's application.

Students read about concurrency, shared data, and distributed databases, yet rarely manage data in such as way as to gain direct experience with these properties of computing. The Data Processing Management Association's Model Curriculum for Information Systems calls for learning about multiuser systems in the following "knowledge clusters":

- DPMA Knowledge Cluster E: Systems Development (Course IS-7 specifies that students "will use systems design methodologies to develop multi-user system including using database.")
- DPMA Knowledge Cluster F: System Project (Target objectives specify that mastery of this topic "implies the ability to develop a multiuser information system with audit controls.")[1]

M Technology environments conveniently support group development and application testing. At Robert Morris College, students have developed multiuser applications such as banking systems, car rental systems, and hospital systems, in M programming courses. M thus helps us meet the requirements of the DPMA Model Curriculum.

The Job Market

A final reason for adding M to the curriculum is the marketability of skills in M. The M job market is national, with concentrations in some parts of the country. We receive constant inquiries, but of course there are two limitations to consider: Students must be willing to relocate for many of these positions, and not all the positions can be filled by an entry-level person. It pays to cultivate the local and regional job market, and to develop co-op positions and internships at M user sites relatively near the campus.

The M Technology Association operates the Job Referral Service. MTA members can use this service without additional charge.

Recruiting firms contact colleges and universities known to teach M. MTA, through the *MLink* newsletter and the *MSources* directory, publicizes institutions and companies teaching M.

You may be able to meet the needs of experienced data-processing personnel wishing to retrain and find a job requiring or preferring M.

Curriculum Approaches

Separate courses can be designed and/or M modules can be included in existing courses on interactive data management, databases, programming-language surveys, data structures, and operating systems.

In M there is no artificial line in data structures between data in volatile memory and data in mass storage. The M tree-structured global array allows students to "think differently"

regarding persistent data. (MUMPS is included in the list of examples for handling persistence in the X3/SPARC/Final Report.)[2]

Both the data-access method of the standard M environment and the VA FileMan database management system offer interesting material for database courses. We have developed a bibliography on M data management, which we will send on request.

M-based FileMan database modules broaden the perspective of database students though the handling of interfile constraints, use of subfiles, data types with automated constraint specification, and active automated data-dictionary support.

M systems make it feasible for students to develop and test multiuser applications. As described earlier, few students today receive multiuser application development experience because they work at single-user workstations and test applications only in single-user mode. A hands-on approach also has substantial impact on group work experience. (See preceding comments on the DPMA Model Curriculum.)

Novice M students begin with an appreciation of the unique characteristics of the language and apply their learning in reality-based projects that capture all the global multiuser approaches to solving a problem. Typical of such projects are the development of an interactive airline flight reservation system and an inquiry-based hospital patient-care system.

In Computer Science, M supports the teaching of data structures by providing experience with tree data structures and their exploitation, with linked lists, and the relationship of global subscripted arrays to the underlying B-tree structures.

The standard M system architecture, as well as features of M implementations—such as distributed processing support, resources management, process synchronization, inter-process communication support—and the relationship of an M system (as a "guest") to a host operating system—such as UNIX, MS-DOS, VMS, or VM/ESA—can be explored in operating systems courses. The MS-DOS case is particularly interesting, since MS-DOS is typically regarded as a single-user operating system, while M systems running under MS-DOS typically offer multiuser access.

The M LOCK command implements a particular hierarchical locking algorithm described in database literature, and is therefore useful when instructing students on concurrency control. M LOCK can be used to show the difference between deadlock-proof locking and incremental locking, the properties of shared and exclusive locks, and multiple-granularity locking.

Interdisciplinary MIS approaches can be implemented: developing an application with special attention to auditing/control/quality issues, developing prototypes for marketing concepts.

M Instructional Configurations

Typical configurations are:

- Stand-alone PCs or IBM PS/2s with single-user M;
- Stand-alone Apple Macintosh systems with single-user M;
- Networked PCs or IBM PS/2s with downloading of M software to run on a single-user basis from individual hard disks;
- Multiuser system based on a PC or IBM PS/2 with terminals and a multiport serial board (Arnet Corporation markets such boards): sometimes surplus terminals are easily obtained for a campus computer center to establish such a system;
- UNIX, AIX, or Ultrix system (UNIX-based multiuser M system);
- Digital Equipment Corporation's Alpha (using VMS or OSF operating system);
- M server on a Novell or other network;
- PC or IBM PS/2-based distributed M (M network with two or more microcomputers);
- Networking of M on PCs or PS/2s with M on large systems; and
- Midrange or large multiuser system; some examples are IBM ES/9000, Digital Equipment Corporation's VAX, Data General. In some cases, M can be added easily to an existing IBM ES/9000 (using the VM/ESA operating system in either ESA or 370 mode) or Digital VAX (using the VMS or Ultrix operating system).

Some colleges are planning to use the M-based Veterans Affairs hospital system to support health-sciences technology programs, possibly in response to more state and other health-care agencies using M. Including M in the CIS curriculum may be facilitated if M is already supporting health-care programs or if a single installation can meet the needs of both instructional areas.

Database and Other Software to Run in M

- VA FileMan database management system;
- K_B SQL (or Micronetics' MSM-SQL, an M-based SQL); and

- InterSystems' Open M/SQL product, which includes an SQL facility and supports imbedded SQL programming.

Classroom Resources

M Systems' Vendors

Some of the vendors have special educational-support programs (licensing and maintenance at low cost for institutions; low-cost systems for student purchase). Here are some specific ones.

- Digital Equipment Corp.: VAX or Alpha (Digital Standard M or DSM may be available through a current educational program if your college already has installed a VAX for educational purposes).
- Greystone Technology: VAX.
- IBM: ES/9000 environments (IBM MUMPS/VM may be available through the IBM Consortium if your college or university is already a member).
- InterSystems: PCs and PS/2s and PC networks—InterSystems distributes an educational version of DataTree M (DT-STU) available free for educational use through the MTA (DT-STU includes the VA FileMan database system); also VAX and UNIX.
- MGlobal: PCs and PS/2s, PC networks, Macintoshes. Emphasis on multimedia capabilities in a new product.
- Micronetics Design Corp.: PCs and PS/2s, PC networks, VAX, UNIX—Micronetics offers an educational version of M (MSM-EXPLORER), including VA FileMan and MSM-SQL if requested (two-year educational licenses are available without charge from Micronetics).

A full list is available from MTA in the published list of M implementations in *MSources*.

Software Utilities for the M Environment

A number of companies market utilities for the M computing environment. Many have special licensing arrangements for educational institutions. Please contact the MTA, individual firms or advertisers in MTA publications, or the authors for information.

Textbooks and Instructional Materials

There are a number of texts, references, and video materials dealing with M. The two most widely used books are: Richard F. Walters, *ABCs of MUMPS: An Introduction for Novice and Intermediate Programmers* (Digital Press, 1989, reprinted 1994); and John Lewkowicz, *The Complete MUMPS: An Introduction and Reference Manual for the M Programming Language* (Prentice Hall, 1989). Both are available for purchase from MTA. MTA has several texts available on VA FileMan database management, as well.

Foreign language M texts are available for specialized training needs (in German, Dutch, Spanish, Portuguese, Chinese, and other languages).

Educational Systems, Inc., (ESI) markets computer-based tutorials on M, on the M-based VA FileMan database management system, and on the new standard M Windowing Application Programming Interface (MWAPI). A tutorial from the University of California at Davis is available through MTA. Paragon Training, Inc., has extensive teletraining materials available.

MTA distributes a reference book, *MSources*, listing its members and M user companies and organizations.

The most recently published ANSI M standard (ANSI/MDC X11.1 1990) is available from the MTA. There has been an ANSI M or MUMPS standard since 1977. A new M standard was approved for canvass in 1994.

Robert Morris College is developing its own text materials and demonstration software.

Reading *M Computing* is recommended. It is available with any individual or organizational membership in the M Technology Association.

M Technology Association

The M Technology Association of North America (MTA) is a source of periodicals, texts, and software. It conducts an annual meeting, supports M users' groups, and operates a job referral service.

Regional M Users' Groups

Local and regional M users' groups meet in many areas and may be of great help in developing a program.

A strong local users' group functions as a model clearinghouse for dissemination of new standards, discussion of current issues, and demonstrations of cutting-edge technologies. Students in attendance are introduced to the practical aspects of M development.

Other Colleges and Universities Teaching M

The following institutions include M Technology in the regular curriculum: Rochester Institute of Technology; Central

Methodist College (Missouri); and the University of California at Davis.

Several colleges and universities offer M continuing-education courses. Some information sharing has begun to take place. RMC cooperates with and assists other institutions teaching M.

Faculty Development

RMC extends an offer to work with interested colleges and universities on faculty development plans for acquiring M Technology.

Local M users may be helpful by permitting faculty to sit in on staff training sessions. This kind of experience is invaluable in gaining insight into M Technology and how it's used.

Several companies offer M and FileMan training programs.

Training workshops on M, FileMan, and other topics are available at the MTA Annual Meeting (June 13-17, 1994, in Reno). Faculty considering adding M to the curriculum are encouraged to attend these yearly events.

Conclusion

After completing M courses, students at Robert Morris College return to traditional information-processing technology with new insights and skills. They are strengthened and better able to meet the challenge of constant technological change because they become adept at meeting needs in different ways. At the same time, students gain specialized experience with M Technology that helps them enter the M job market.

Endnotes

1. *Information Systems: The DPMA Model Curriculum for a Four Year Undergraduate Degree* (Park Ridge, IL: Data Processing Management Association, 1991).
2. ANSI Accredited Standards Committee, *Object Data Management Reference Model* (X3, *Information Processing Systems*, Document Number OODB 89–01R8, 17 September 1991), 2–17.

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Rick Marshall has been on assignment. Focus on FileMan will return in the next issue.